BUILDING A BETTER WORLD

TWEED SHIRE COUNCIL

DEMAND MANAGEMENT STRATEGY

A1187200

DECEMBER 2009

REVISION SCHEDULE

REV. NO.	DATE	DESCRIPTION	PREPARED BY	REVIEWED BY	APPROVED BY
1.0	16/09/2009	Draft	T. Moore A. Binks	S. O'Brien	M. Bowman
1.1	21/12/2009	Final	T. Moore	External review by T. Mackney	M. Bowman

CONTENTS

TWEED SHIRE COUNCIL

DEMAND MANAGEMENT STRATEGY

FIGURES

TABLES

1. INTRODUCTION

1.1 BACKGROUND

With many parts of Australia in the grip of one of the worst droughts on record and considerable uncertainty about the impact of global warming on our traditional surface water supplies, there is an increasing focus on the many opportunities to conserve and use water efficiently and to use rainwater and recycled water as a substitute for traditional potable sources.

The preparation of a Water Supply Demand Management Strategy (DMS) is a key component of the Tweed Shire Council (TSC) Integrated Water Cycle Management (IWCM) Strategy and is required for compliance under the Department of Water and Energy Best Practice Management of Water Supply and Sewerage Guidelines (May 2007).

1.2 OBJECTIVES

The DMS has been delivered in two stages; Stage 1 (Interim Strategy) was adopted by Council on 27 January 2009 and focussed predominantly on the residential sector. This was followed by Stage 2 which focussed on the evaluation of water demand management measures for the non-residential sector.

This report describes the overall DMS, and presents the integration of the Stage 1 and Stage 2 demand management recommendations.

1.3 SCOPE

The scope for the DMS includes:

- A forecast of the long term demand to include the residential and non-residential demand management measures recommended in Stages 1 and 2 of the strategy;
- An implementation plan for the recommended measures, including program and cost estimates;
- A performance tracking and reporting plan;
- A summary of educational and promotional programs which will be required to facilitate the implementation of the recommended measures; and
- Information regarding funding opportunities available from the State and Commonwealth Governments.

2. WATER DEMAND ANALYSIS AND BASELINE FORECAST

This section outlines the methodology and results of the analysis of historic demand and applies the outcomes to the development of a baseline demand forecast. This forecast identifies the water supply that would be required under a 'do nothing' scenario.

2.1 POPULATION FORECASTS

An assessment of historic population and future growth was undertaken as part of the Stage 1 study of residential water demand. This included an assessment of major development areas for the Tweed Shire, encompassing Bilambil Heights, Cobaki Lakes, Kings Forest, Teranora and West Kingscliff. Shire population projections were provided by Tweed Shire Council for 2001, 2011, 2021, 2031 and 2041, and from these projections a serviced population was derived. Projections were commenced as of 2006, for which a review of occupancy and number of residential accounts was used to verify data. Residential population projections are summarised in Table 2-1 and Figure 2-1.

Table 2-1: Serviced (Water) Residential Population Projection for TSC

ESTIMATED POPULATION	2006	2011	2021	2031	2036	2041
Existing Serviced Population	73,185	71,966	69,018	66,044	64,854	64,854
Projected Infill Population	0	6,951	16,402	22,435	25,896	28,461
Major Development Areas						
Bilambil Heights	*0*	*0*	*2,934*	*5,609*	*6,881*	*6,881*
Cobaki Lakes	*0*	*0*	*4,454*	*8,525*	*10,464*	*10,464*
Kings Forest	*0*	*0*	*4,640*	*8,880*	*10,900*	*10,900*
Terranora Area A	*0*	*0*	*1,300*	*2,498*	*3,071*	*3,071*
West Kingscliff	*0*	*0*	*1,158*	*2,197*	*2,687*	*2,687*
Total of Major Development Areas	0	0	14,486	27,709	34,003	34,003
Greenfield outside Major Areas	0	6,182	19,540	27,301	32,295	36,395
Tweed Shire Total	**73,185**	**85,099**	**119,446**	**143,488**	**157,048**	**163,714**

Note: Population is estimated to more than double in the next 30 years, of this growth 66,000 will be housed in Greenfield areas, providing a significant opportunity for the implementation of measures such as rainwater tanks and efficient fixtures and fittings.

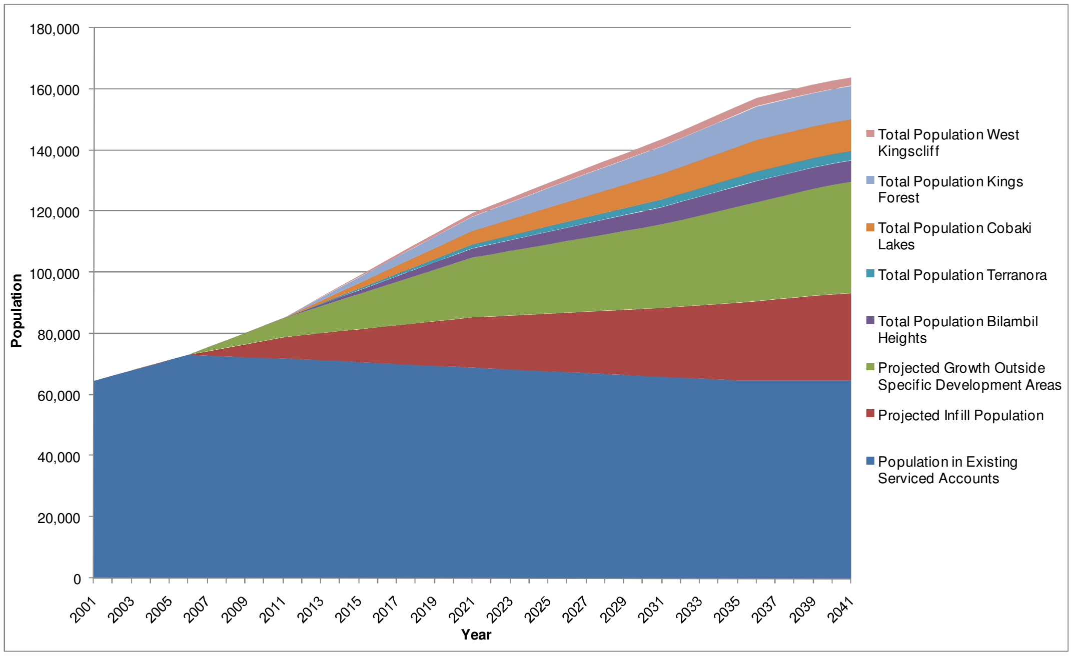


Figure 2-1: TSC Population Projections

At the time of investigation no information regarding future non-residential developments in the Shire was available. Assumptions were made and agreed upon with TSC for account growth in the non-residential sector, for forecasting purposes. Stage 1 of the strategy considered four non-residential sectors: commercial, industrial, public and rural. A more detailed analysis of water use data in Stage 2 of the strategy resulted in a revision of these into six sectors, to allow for more refined analysis of sectoral usage.

Non-residential account projections as revised in the Stage 2 report are summarised in Table 2-2.

Table 2-2: Serviced (Water) Non-Residential Account Projection for TSC

SECTOR	NUMBER OF ACCOUNTS							ADOPTED GROWTH RATE
	2008	2013	2018	2023	2028	2033	2038	
Bulk Sales	103	121	143	165	177	193	207	As per population growth
Commercial	830	975	1,151	1,330	1,429	1,558	1,672	
Industrial	152	160	168	178	185	195	205	1% per annum
Public Uses	422	496	585	676	727	792	850	As per population growth
Rural	13	13	13	13	13	13	13	0%
Sewer	162	190	225	260	279	304	326	As per population growth
TOTAL	**1,682**	**1,955**	**2,284**	**2,623**	**2,811**	**3,055**	**3,273**	

A description of each of the non-residential sectors is as follows:

- **Commercial**: Commercial is the general category for businesses. Water use is dominated by staff and / or customer water use. It includes businesses such as caravan parks, restaurants and cafes, shopping centres, hotels/motels, clubs and office buildings. This sector does not include multi-family residences or agriculture.
- **Industrial**: Industrial usage comprises customers who are primarily manufacturers or processors of materials. This sector includes TSC water treatment and land fill facilities.
- **Public Use**: Public usage encompasses customers dedicated to public service, including aged care facilities, hospitals, schools, government buildings and TSC operated sports grounds, parks and gardens. Please note, Institutional accounts are included in the Pubic sector.
- **Rural**: Agriculture and farming.
- **Bulk Sales**: Water sold directly to customers from metered standpipes.
- **Sewage**: Water used in sewage treatment and sewage pump stations.

A summary of total water demand by each of these sectors is provided in Figure 2-2. Commercial water use represents 60% of the non-residential water consumption in TSC, followed by Public Use (19%) and Industrial (13%).

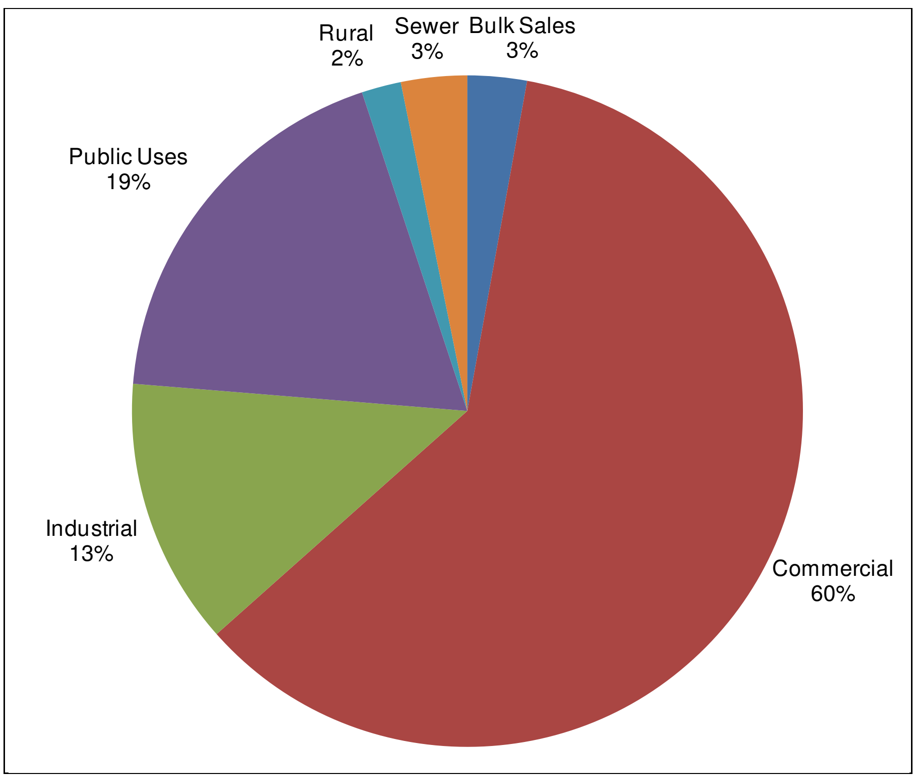


Figure 2-2: Non-residential Water Use by Sector (2007/08)

2.1.1 NRW

The volume of Non-Revenue Water (NRW) was determined as the difference between total water production (treated water from the Bray Park Water Treatment Plant) and total water consumption (as measured at customer meters). For initial assessment purposes NRW is expressed as a percentage of the total production volume.

Table 2-3 outlines the derivation of the percentage of NRW. Fluctuations of NRW percentages can be related to major construction work and water infrastructure commissioning using un-metered water. For the purposes of the DMS a baseline NRW level of 13% of the total production was adopted for future demand modelling and assessment.

Table 2-3: Summary of NRW Assessment

DEMAND COMPONENT	2001/2	2002/3	2003/4	2004/5	2005/6
Annual Production (ML/a)	10,449	8,773	9,461	9,917	9,428
Annual Consumption (ML/a)	8,699	7,576	7,785	8,567	8,142
Non-Revenue Water	16.7%	13.6%	17.7%	13.6%	13.6%

2.2 BASELINE DEMAND FORECAST

The MWH “Decision Support System” (DSS) was used to develop a detailed demand forecast. The DSS is an end use model, designed for assessing baseline water demand forecasts as well as for evaluating various demand management, water use efficiency or source substitution (e.g. rainwater tanks or recycled water) measures.

Detailed descriptions of the forecasting methodology, water use trends, adopted end use breakdowns and results of the demand analysis can be found in the Stage 1 report. Baseline demand forecast results are summarised in Figure 2-3. The baseline demand forecast showing the breakdown in residential, non-residential and NRW use is shown in Figure 2-4 and Table 2-4.

Please note:

- Since the original forecast was determined in 2006 the overall demand has continued to decrease despite continued population growth and the removal of climate influences.
- The Baseline Forecast is based on current and future predicted market share of fixtures **without** the impact of WELS or BASIX.
- A detailed assessment of non-residential water demand was undertaken in the Stage 2 study, as such the non-residential demand projections above vary slightly from those stated in the Stage 1 report. This has resulted in a decrease in total projected water demand for the Shire. However, this decrease is minimal (approximately 2% of total demand) and does not affect the outcomes or recommendations of the Stage 1 strategy report.

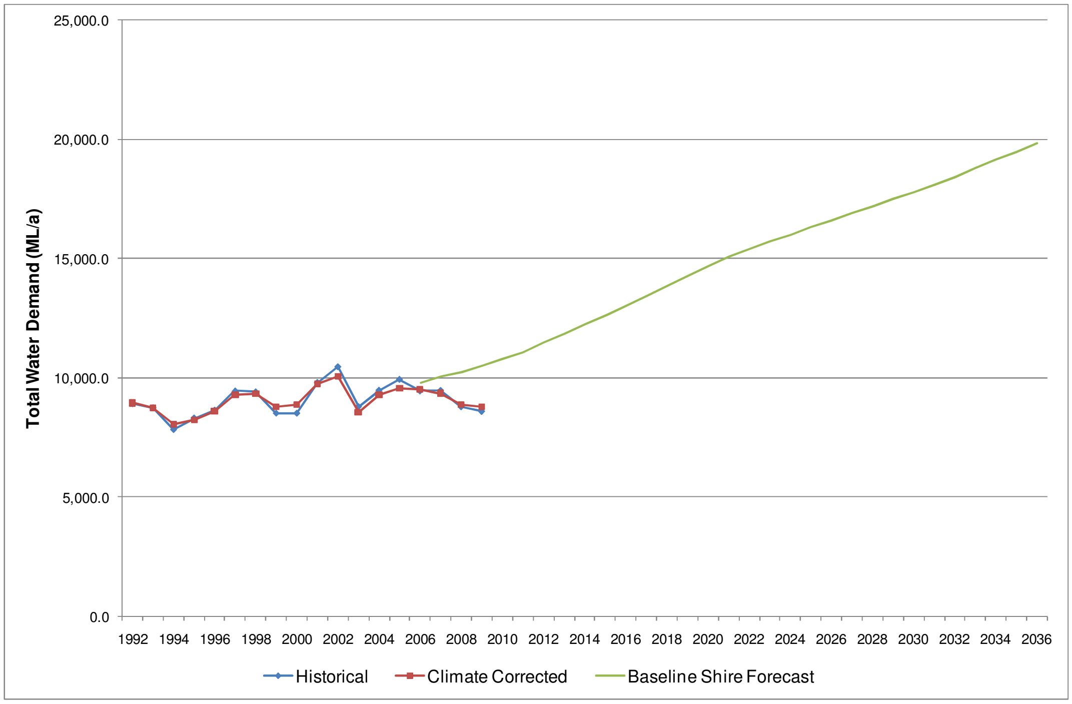


Figure 2-3: Tweed Shire Council Total Annual Baseline Demand Forecast

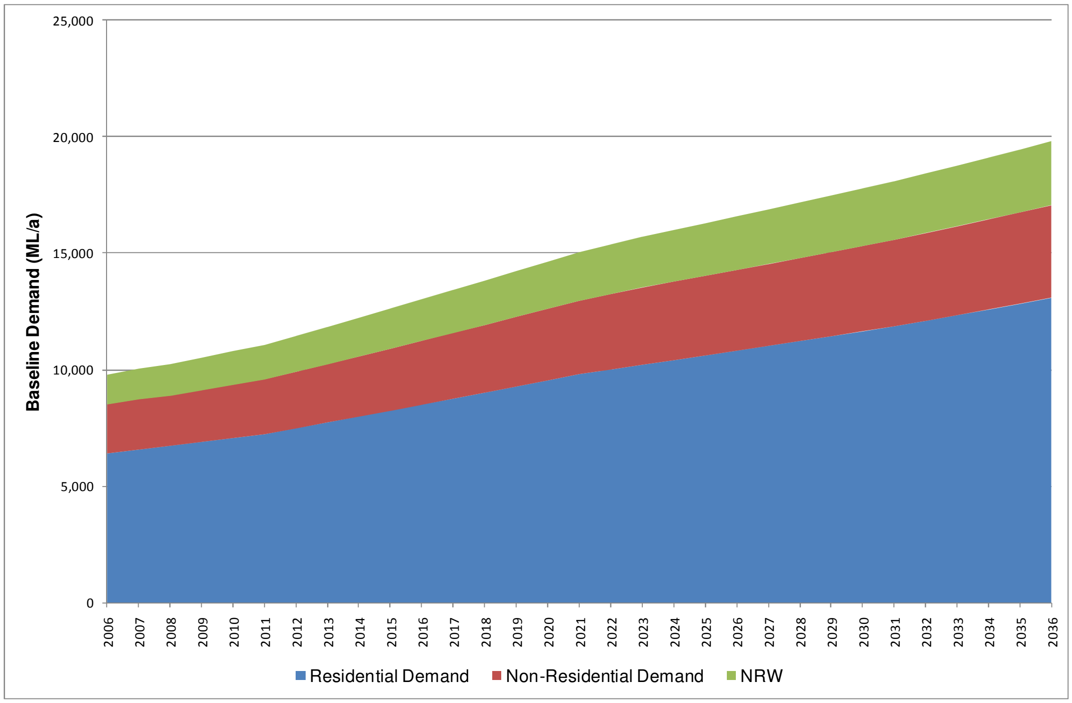


Figure 2-4: TSC Total Annual Baseline Demand Forecast by Sector

Table 2-4: TSC Total Annual Baseline Demand Forecast

	TOTAL ANNUAL WATER DEMAND (ML/YR)						
	2006	2011	2016	2021	2026	2031	2036
Residential Demand	6,416	7,238	8,511	9,821	10,829	11,870	13,103
Non-Residential Demand*	2,113	2,364	2,741	3,154	3,460	3,708	3,967
Non-Revenue Water (NRW)	1,274	1,482	1,784	2,080	2,292	2,499	2,735
Total Demand	**9,804**	**11,084**	**13,036**	**15,055**	**16,581**	**18,077**	**19,804**

*The non-residential demand has decreased compared to the Stage 1 baseline as a result of a detailed analysis of non-residential demands undertaken during the Stage 2 DMS.

The baseline demand per capita based on total production is shown in Table 2-5.

Table 2-5: TSC Total per Capita Baseline Demand Forecast

	PER PERSON WATER DEMAND (L/PERSON/DAY)						
	2006	2011	2016	2021	2026	2031	2036
Total Demand per Capita (includes NRW)	367	310	288	276	269	264	259

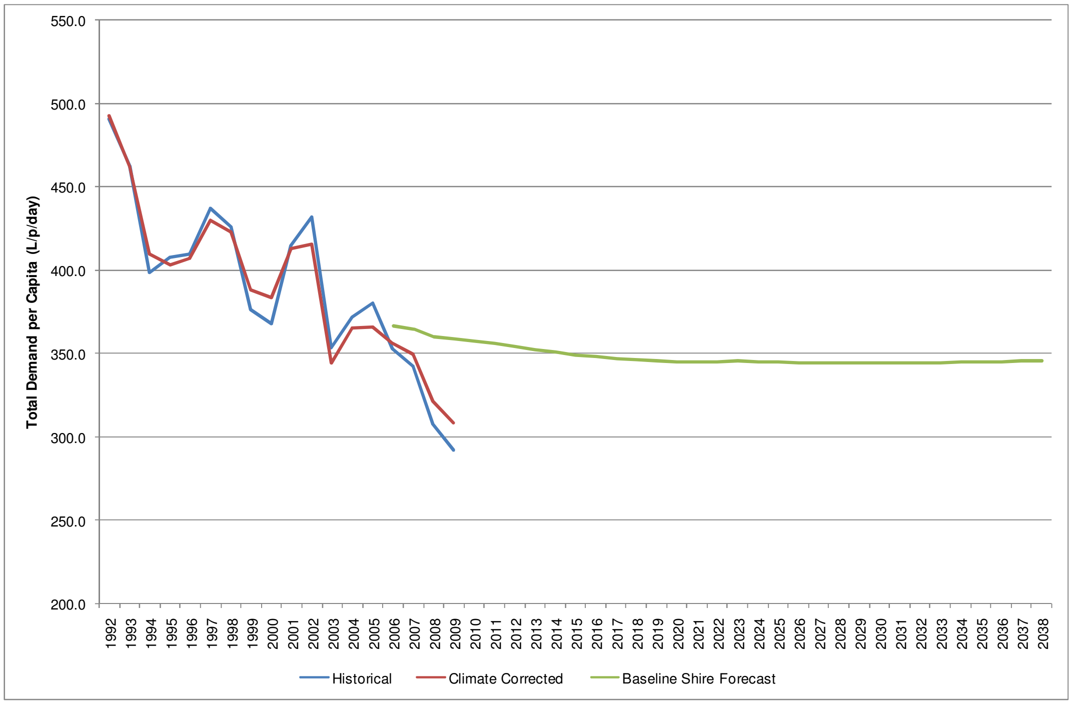


Figure 2-5: TSC Total per Capita Baseline Demand Forecast

3. ASSESSMENT OF OPTIONS

3.1 APPROACH TO OPTIONS ASSESSMENT

The development of integrated water cycle scenarios for assessment as part of this study was based on techniques as required by the Department of Water and Energy (2007) and included stakeholder input and the Triple Bottom Line (TBL) principles. A long list of measures was initially screened and possible measures shortlisted for more detailed evaluation. Detailed evaluation involved an analysis of the cost effectiveness of water conservation initiatives followed by assessment of the impact of various combinations, or scenarios, comprising source substitution such as recycled water and rainwater use.

The water supply, recycled water and related infrastructure required for each scenario was assessed together with the financial, social and environmental impacts using the same TBL assessment process. An overview of the process adopted for the study is summarised in Figure 3-1.

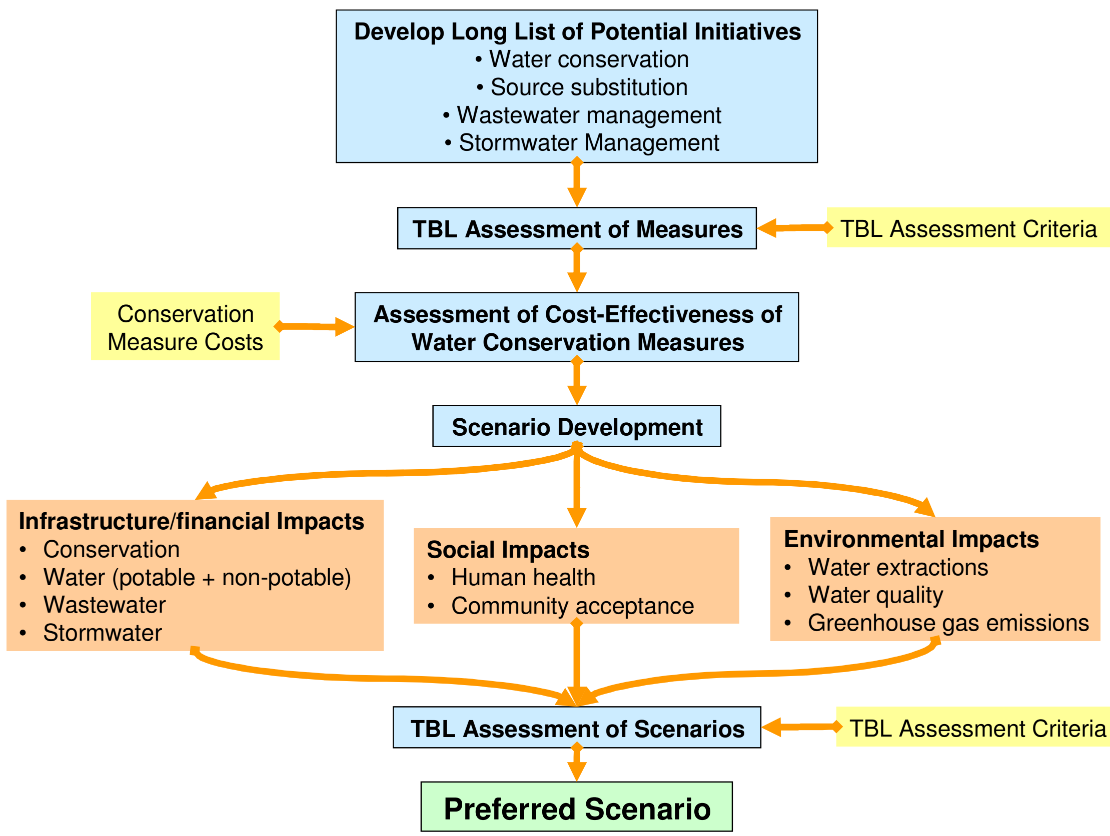


Figure 3-1: Integrated Urban Water Cycle Management (IUWCM) Planning Process

3.2 OPTIONS ASSESSMENT

Demand scenarios comprising a range of water efficiency measures, source substitution and water loss management were developed in conjunction with representatives of the Tweed Shire Council. Greenfield development and whole of Council scenarios were assessed separately, and are outlined below.

3.2.1 OPTIONS DEVELOPMENT - GREENFIELD

Five demand scenarios were considered for the major greenfield development areas of Cobaki Lakes, Bilambil Heights, Terranora Area A, West Kingscliff and Kings Forest. The scenarios reviewed were:

- Greenfield Development Scenario 1 – Implementation of BASIX including a 5,000 L rainwater tank connected to external uses, toilet flushing and cold water to the washing machine;
- Greenfield Development Scenario 2 – BASIX (without rainwater tanks) together with recycled water for external use and toilet flushing;
- Greenfield Development Scenario 3 – BASIX with a 5,000 L rainwater tank for internal uses and recycled water for external uses;
- Greenfield Development Scenario 4 – Indirect Potable Reuse combined with rainwater tanks to further lower the reliance on dam sources; and
- Greenfield Development Scenario 5 – A fourth pipe system that would collect and treat greywater and blackwater separately for recycling of greywater to households and blackwater to open space.

For all scenarios the use of Reduced Infiltration Gravity Sewers (RIGS) was included to increase the efficiency of collecting sewage. This had the effect of reducing the overall sizes and costs of the sewerage system through reduced wet weather flows.

A detailed assessment of the infrastructure and demand impacts was undertaken for Scenarios 1 to 4. Detailed consideration of water cycle issues and options, impacts on infrastructure, environmental impacts, and trunk system, customer and council costs were all taken into account. Scenario 5 was not considered in detail due to the number of operational issues and higher capital and on-going costs associated with such a system.

Outcomes of the assessment are reported in detail in the Stage 1 strategy report. These outcomes were used to perform a triple bottom line assessment to guide the recommendation of a preferred option for Greenfield development area demand management. The recommended approach for Greenfield development in TSC is as follows:

- Greenfield Development Scenario 1 (implementation of BASIX including a 5,000 L rainwater tank connected to external uses, toilet flushing and cold water to the washing machine) be adopted for the Cobaki Lakes, Bilambil Heights, Terranora and Kings Forest developments. This scenario was selected as it demonstrated the lowest costs to community, best return on investment, modest environmental impacts and expected broad community acceptance in comparison to Scenarios 2 and 3.

- For West Kingscliff (Greenfield), recycled water be made available if there is a sufficient level of end use in the industrial land uses. This was recommended due to its proximity to the sewage treatment plant rendering the cost of return flows to the area low.

3.2.2 OPTIONS DEVELOPMENT – WHOLE OF COUNCIL

In addition to the major greenfield development assessment, four future demand scenarios were developed and reviewed for the whole of the Tweed Shire, including existing (Brownfield) areas. This assessment adopted the recommended scenario from the Greenfield assessment (Greenfield Scenario 1 - BASIX including a 5,000 L rainwater tank connected to external uses, toilet flushing and cold water to the washing machine) for all new development in the shire. The scenarios reviewed were:

3.2.2.1 SCENARIO 1 – BASIX / WELS PROGRAM

Scenario 1 reflects the current legislative requirements for new residential developments in NSW according to the Building Sustainable Index (BASIX) and the national Water Efficiency Labelling and Standards (WELS) scheme. This scenario mandates the installation of water efficient fixtures as discussed above, including a 5 kL rainwater tank.

The WELS program was introduced in 2005 by the Federal Government to encourage the purchase and installation of water efficient appliances and fixtures. This scenario enhances the market share of water efficient showerheads, washing machines and dishwashers.

3.2.2.2 SCENARIO 2 – BASIX/WELS PROGRAM AND LEAKAGE MANAGEMENT

Scenario 2 extends Scenario 1 to include a Loss Management Strategy with an aim to reduce the current losses to below 10% by 2010. The Stage 1 report discusses Tweed Shire's current approach to water loss management in accordance to their Water Loss Management Program (WLMP) and investigates the Active Leakage Management options that have been assessed in this scenario, such as the implementation of District Metering Areas (DMAs) and Pressure Management Areas (PMAs) to monitor and reduce losses.

3.2.2.3 SCENARIO 3 – SELECTED DEMAND MANAGEMENT OPTIONS

Scenario 3 is a further extension of Scenario 2 but including a suite of demand management initiatives, such as residential retrofits, rebates for water efficient fixtures and a residential audit program, designed to develop long term reductions in water use.

An assessment of the water savings and annualised costs of the individual measures described above was undertaken and the results are provided in Table 3-1.

Table 3-1 Individual Measures - Water Savings and Annualised Cost

MEASURE DESCRIPTION	ANNUAL POTABLE WATER SAVINGS (ML/A)			ANNUALISED COST ($/KL)
	2016	2036	AVG.	
BASIX Fixtures and WELS	219	532	290	$0.02
BASIX - Internal/External Rainwater Tank (5 kL)	827	2,611	1,277	$4.42
Inclining Block Tariff	33	60	36	$0.04
Residential Education Program	76	73	70	$0.88
Landscape Use Efficiency Awards	62	71	57	$1.17
Residential Rebate Program - Showerheads	29	10	20	$0.51
Residential Rebate Program - Washing Machines	16	4	11	$14.23
Residential Rebate Program - Rainwater Tanks	91	104	85	$4.64
Pressure and Leakage Management Program	532	813	556	$0.94
Residential Retrofit	77	65	68	$1.34
Total	**1,900**	**3,993**	**2,328**	

Based on the results of the above assessment the majority of the proposed demand management measures assessed are likely to be cost effective. The exceptions were the rebate programs for rainwater tanks and washing machines, which were not included in the program.

3.2.2.4 SCENARIO 4 – FULL SUITE OF DEMAND MANAGEMENT OPTIONS WITH ENHANCED NON-RESIDENTIAL EFFICIENCIES

Scenario 4 utilises the demand management options developed for Scenario 3, and originally included an estimated 10% reduction in demand for all existing and new non residential accounts to be achieved by 2010. A full assessment of non-residential demand management opportunities was subsequently undertaken in the Stage 2 report. The outcomes of the Stage 2 report were then used to fully inform the costs and savings associated with Scenario 4.

3.2.3 OPTIONS ASSESSMENT - NON-RESIDENTIAL

In order to identify large water consuming sub-sectors within the non-residential sector, customer sectorisation was performed by analysing TSC billing databases in conjunction with land use classification information. Following this, customers were ranked by water use in order to establish the focus for the development of demand management program. Based upon these results, further analysis was undertaken to establish common end-uses across the high water consuming sub-sectors.

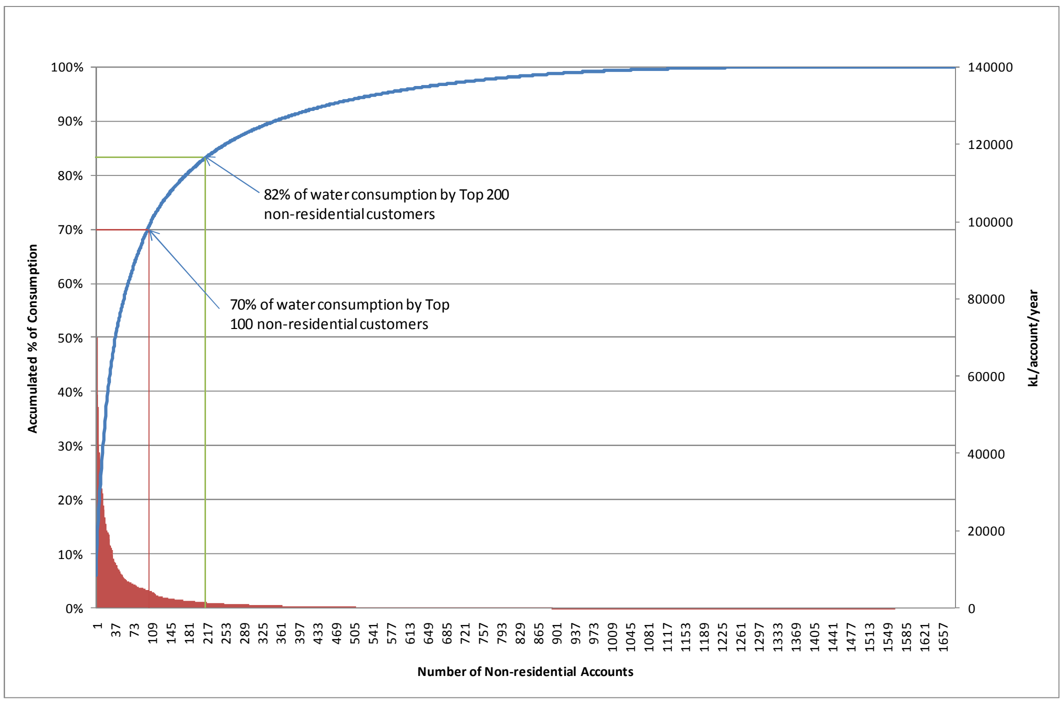


Figure 3-2: TSC Non-residential Customers Ranked by Water Use (all accounts)

As shown in Figure 3-2, it was found that the top 5% of customers (top 100) are responsible for 70% of the total non-residential demand. The significance of this is highlighted by the fact that the next 100 users (top 100-200 ranked users) consume only 12% of the total non-residential demand. The 200 to 300 ranked customers consume only 6% of the total non-residential demand, which further illustrates the diminishing returns. This demonstrates that to maximise water savings any demand management measures should focus predominantly on the top 100 users.

Based on an assessment of water demand and account usage a range of sub-sectors were identified for targeting in programs, summarised in Table 3-2.

Table 3-2: Summary of Targeted Non-Residential Sub-Sectors

SUB-SECTOR	CUSTOMER TYPE	% NON-RES USE	TOTAL ACCOUNTS	ACCOUNTS IN TOP 100	AVERAGE ACCOUNT USE IN TOP 100 (ML/YEAR)
Com	Caravan Parks	15.0%	25	20	15.5
Com	Clubs inc Sports Clubs	11.2%	26	9	24.8
Public	TSC Open Space Irrigation	8.9%	216	12	10.2
Com	Shopping Centres	4.8%	6	7	15.6
Pub	Aged Care	4.8%	18	10	8.8
Com	Mobile home park	3.9%	3	3	27.8
Ind/Sewer	TSC Facilities	4.2%	9	4	20.8
Ind	Industry	12.3%	151	9	25.8
Pub	Hospital	1.5%	2	2	16.7

To identify global opportunities for demand management in the non-residential sector, a review of successful water conservation measures in NSW, interstate, nationally and internationally was undertaken. The review revealed both common attributes and innovative approaches to non-residential demand management. A comprehensive list of 40 potential demand management measures was then compiled, based upon the review of sectoral water use and major users, end uses identified to have high savings potentials, and the review of successful water conservation programs.

A qualitative assessment was undertaken of the long list of measures for the sector based on a triple bottom line multi-criteria assessment. The assessment reduced the number of measures which were then considered in detail based on their water savings and costs from both a customer and council perspective. For each measure an annualised costs and cost-benefit from the TSC perspective was then calculated. Based on this assessment the preferred measures (i.e. those with a cost-benefit > 1) where recommended for implementation by TSC. The cost-effectiveness and annual average water savings for each of the preferred measures are shown below in Table 3-3.

Table 3-3: Cost Effectiveness and Water Savings for the Recommended Non-residential Program (2008-2036)

SECTOR	COUNCIL NPV ($)	CUSTOMER NPV ($)	TOTAL NPV ($)	AVERAGE ANNUAL POTABLE SAVINGS (ML/YEAR)	ANNUALISED COST ($/KL)
Major Users Audit	$199,520	$88,834	$288,354	198	$0.12
Commercial Business Water Audit Program	$187,864	$66,119	$253,983	87	$0.24
Aged Care Audit	$60,524	$27,319	$87,843	30	$0.24
TSC Open Space Irrigation Audit	$82,855	$0	$82,855	24	$0.28
Waterwise Non-residential Education	$93,933	$10,779	$104,712	28	$0.30
Training Landscape Managers	$5,088	$14,147	$19,235	2	$0.75
Non-res Efficient Fittings Regulation and Management	$109,385	$765,559	$874,944	113	$0.64
Total	$739,170	$972,756	$1,711,926	483	$0.29

4. REVISED DEMAND FORECAST

4.1 MANAGED DEMAND FORECAST

The preparation of the DMS has adopted a staged approach. As such there has been a time lapse between the preparation Stage 1 DMS and the Stage 2 DMS. For the Stage 1 DMS, the cost and water saving analysis was conducted between 2006 and 2036, whereas the Stage 2 assessment used the most recent data from 2008 as the basis, running until 2036. Overall, this has minimal impact of the assessment of each of the scenarios because:

- The time step is small compared to the overall length of the program; and
- All measures assessed in Stage 1 (with the exception of BASIX) were assumed to commence in 2008, this is clearly visible in Figure 4-1.

Table 4-1 provided a summary of which demand management measures are included in each Scenario. Scenarios 1, 2 and 3 remain unchanged from Stage 1 as they focused specifically on residential water use. Scenario 4, however, has been revised to include the savings and costs from the implementation of the preferred non-residential measures.

Table 4-1: Measures Included in each Scenario

	SCENARIO			
SECTOR	1	2	3	4
Residential				
BASIX Fixtures and WELS	✓	✓	✓	✓
BASIX - Internal/External Rainwater Tank (5kL)	✓	✓	✓	✓
Inclining Block Tariff			✓	✓
Residential Education Program			✓	✓
Landscape Use Efficiency Awards			✓	✓
Residential Rebate Program - Showerheads			✓	✓
Residential Retrofit			✓	✓
NRW				
Pressure and Leakage Management Program		✓	✓	✓
Non-residential				
Major Users Audit				✓
Commercial Business Water Audit Program				✓
Aged Care Audit				✓
TSC Open Space Irrigation Audit				✓
Waterwise Non-residential Education				✓
Training Landscape Managers				✓
Non-res Efficient Fittings Regulation and Management				✓

A summary of the future water demand management outcomes for Tweed Shire, based on the assessment of demand for each scenario is provided in the following figures and tables. The assessment indicated that on an annual basis the following savings can be achieved in 2036:

- Scenario 1 will save approximately 16% over the baseline.
- Scenario 2 will save approximately 20% over the baseline.
- Scenario 3 will save approximately 21% over the baseline.
- Scenario 4 will save approximately 25% over the baseline.

Table 4-2: TSC Total Annual Demand Forecast

	2006	2011	2016	2021	2026	2031	2036
Baseline Forecast	9,804	11,084	13,036	15,055	16,581	18,077	19,804
Scenario 1 – BASIX / WELS	9,804	10,471	11,987	13,395	14,457	15,479	16,653
Scenario 2 - BASIX /WELS and Loss Management Program	9,804	10,028	11,449	12,767	13,765	14,725	15,827
Scenario 3 – Scenario 2 plus Active Demand Management Options	9,804	9,845	11,182	12,508	13,511	14,474	15,577
Scenario 4 – Scenario 3 plus Non Residential Demand Management	9,804	9,649	10,788	15,055	12,950	13,839	14,859

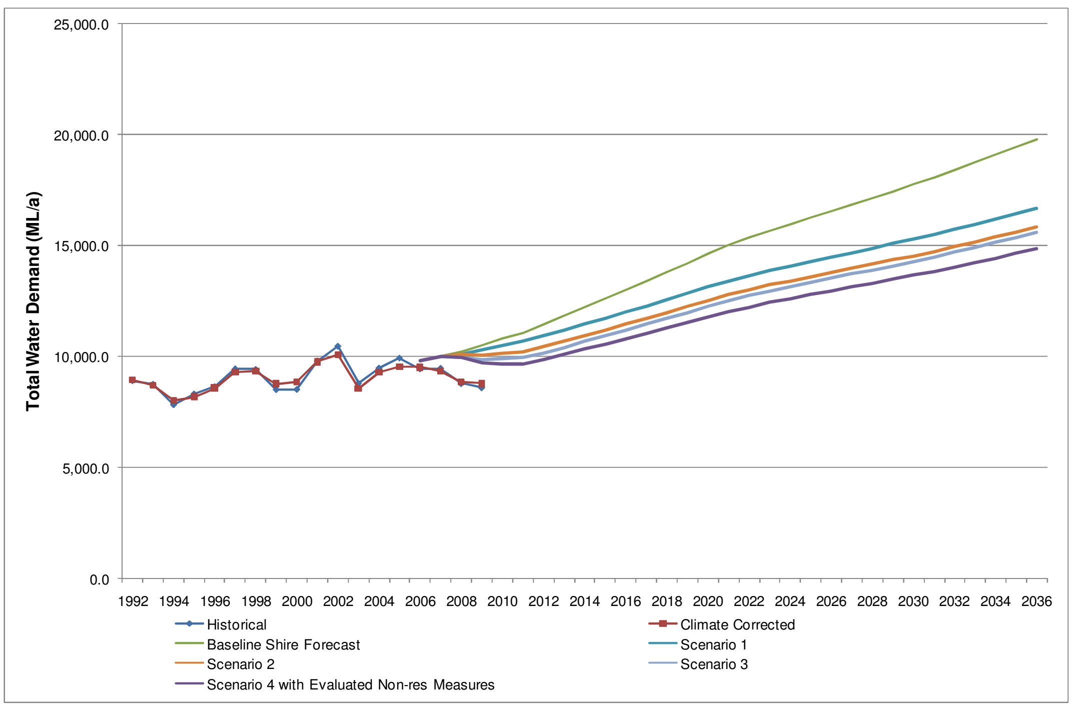
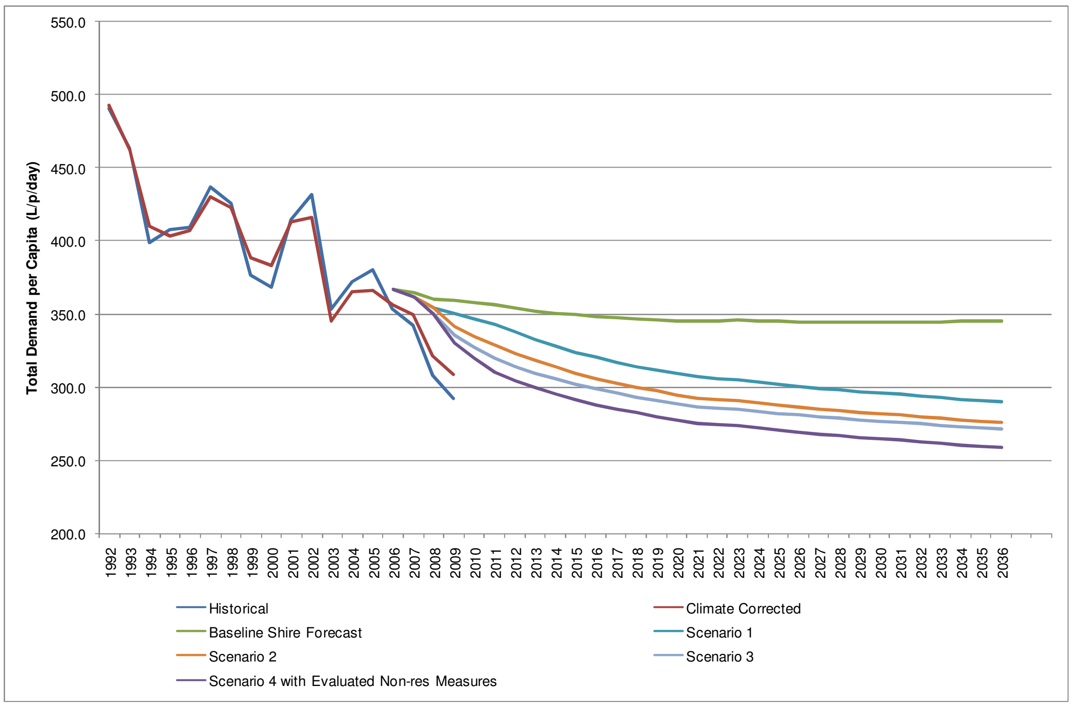


Figure 4-1: TSC Total Annual Managed Demand Forecast

Table 4-3: TSC per Capita Demand Forecast

	2006	2011	2016	2021	2026	2031	2036
Baseline Forecast	367	357	348	345	345	345	345
Scenario 1 – BASIX / WELS	367	343	320	307	301	295	290
Scenario 2 - BASIX /WELS and Loss Management Program	367	329	306	293	286	281	276
Scenario 3 – Scenario 2 plus Active Demand Management Options	367	320	299	287	281	276	272
Scenario 4 – Scenario 3 plus Non Residential Demand Management	367	310	288	276	269	264	259

Figure 4-2: TSC per Capita Managed Demand Forecast



4.2 EVALUATION OF SCENARIOS

An overall cost assessment was undertaken for each of the four scenarios. A summary of the assessment is provided in the tables below. The total NPV contained costs for the following elements:

- Council Capital Costs – assumed to be capital costs of works to council.
- Customer Capital Costs – assumed to be the costs related to provision of rainwater tanks and other fixtures and fittings.
- Council Operational Costs – assumed to be the on-going cost of maintaining programs and for compliance testing and inspections.
- Customer Operational Costs – assumed to be the costs of operating a rainwater tank as well as the benefits of lower energy costs from hot water savings.

Please note: The non-residential measures in Scenario 4 were assessed between 2008 and 2036. All other measures were assessed between 2006 and 2036.

Table 4-4: Individual Demand Measurement Results – Scenario 1

SECTOR	COUNCIL NPV ($)	CUSTOMER NPV ($)	TOTAL NPV ($)	AVERAGE ANNUAL POTABLE SAVINGS (ML/YEAR)	ANNUALISED COST ($/KL)
Residential					
BASIX Fixtures and WELS	$0	$72,120	$72,120	290	$0.02
BASIX - Internal/External Rainwater Tank (5kL)	$1,947,303	$68,100,351	$70,047,654	1,277	$4.42
Total	**$1,947,303**	**$68,172,471**	**$70,119,774**	**1,568**	**$3.60**

Table 4-5: Individual Demand Measurement Results – Scenario 2

SECTOR	COUNCIL NPV ($)	CUSTOMER NPV ($)	TOTAL NPV ($)	AVERAGE ANNUAL POTABLE SAVINGS (ML/YEAR)	ANNUALISED COST ($/KL)
Residential					
BASIX Fixtures and WELS	$0	$72,120	$72,120	290	$0.02
BASIX - Internal/External Rainwater Tank (5kL)	$1,947,303	$68,100,351	$70,047,654	1,277	$4.42
NRW					
Pressure and Leakage Management Program	$6,456,261	$0	$6,456,261	556	$0.94
Total	**$8,403,564**	**$68,172,471**	**$76,576,035**	**2,124**	**$2.91**

Table 4-6: Individual Demand Measurement Results – Scenario 3

SECTOR	COUNCIL NPV ($)	CUSTOMER NPV ($)	TOTAL NPV ($)	AVERAGE ANNUAL POTABLE SAVINGS (ML/YEAR)	ANNUALISED COST ($/KL)
Residential					
BASIX Fixtures and WELS	$0	$72,120	$72,120	290	$0.02
BASIX - Internal/External Rainwater Tank (5kL)	$1,947,303	$68,100,351	$70,047,654	1,277	$4.42
Inclining Block Tariff	$17,469	$0	$17,469	36	$0.04
Residential Education Program	$759,923	$0	$759,923	70	$0.88
Landscape Use Efficiency Awards	$141,128	$679,807	$820,935	57	$1.17
Residential Rebate Program - Showerheads	$71,846	$53,154	$125,000	20	$0.51
Residential Retrofit	$963,009	$156,408	$1,119,416	68	$1.34
NRW					
Pressure and Leakage Management Program	$6,456,261	$0	$6,456,261	556	$0.94
Total	**$10,356,939**	**$69,061,839**	**$79,418,777**	**2,373**	**$2.69**

TABLE 4-7: INDIVIDUAL DEMAND MEASUREMENT RESULTS – SCENARIO 4

SECTOR	COUNCIL NPV ($)	CUSTOMER NPV ($)	TOTAL NPV ($)	AVERAGE ANNUAL POTABLE SAVINGS (ML/YEAR)	ANNUALISED COST ($/KL)
Residential					
BASIX Fixtures and WELS	$0	$72,120	$72,120	290	$0.02
BASIX - Internal/External Rainwater Tank (5kL)	$1,947,303	$68,100,351	$70,047,654	1,277	$4.42
Inclining Block Tariff	$17,469	$0	$17,469	36	$0.04
Residential Education Program	$759,923	$0	$759,923	70	$0.88
Landscape Use Efficiency Awards	$141,128	$679,807	$820,935	57	$1.17
Residential Rebate Program - Showerheads	$71,846	$53,154	$125,000	20	$0.51
Residential Retrofit	$963,009	$156,408	$1,119,416	68	$1.34
NRW					
Pressure and Leakage Management Program	$6,456,261	$0	$6,456,261	556	$0.94
Non-residential*					
Major Users Audit	$199,520	$88,834	$288,354	198	$0.12
Commercial Business Water Audit Program	$187,864	$66,119	$253,983	87	$0.24
Aged Care Audit	$60,524	$27,319	$87,843	30	$0.24
TSC Open Space Irrigation Audit	$82,855	$0	$82,855	24	$0.28
Waterwise Non-residential Education	$93,933	$10,779	$104,712	28	$0.30
Training Landscape Managers	$5,088	$14,147	$19,235	2	$0.75
Non-res Efficient Fittings Regulation and Management	$109,385	$765,559	$874,944	113	$0.64
Total	**$11,096,109**	**$70,034,595**	**$81,130,704**	**2,856**	**$2.29**

Based on the assessment of the individual measures, the following observations have been made:

- The majority of savings are due to the installation of rainwater tanks in new residential developments. The savings are pronounced due to the expected high growth in the shire and the high yield of the rainwater tanks based on modelling undertaken by MWH. The cost to TSC associated with this measure is for compliance testing and education.

- The requirement for water efficient fixtures in new developments under BASIX and the influence of WELS also result in major potable water savings in the Shire. These measures are already regulated and have no direct cost implications for TSC.

- The pressure and leakage management program results in major savings for the shire; however, it has a reasonably high annualised cost of just under $1 per kL. The majority of this cost is required upfront in the implementation of District Metering Areas (DMAs) and Pressure Management Areas (PMAs).

- For the non-residential sector, the most significant savings come from the major user and commercial auditing programs, the requirement for water efficient fittings in all new developments and the requirement for a water management plan for all new high users.

4.3 RECOMMENDED DEMAND MANAGEMENT PROGRAM

Based on the evaluation of scenarios it is evident that the preferred option is Scenario 4, comprising the implementation of BASIX with 5,000 L rainwater tanks, the implementation of a pressure and leakage management program, the implementation of demand management measures for both the residential and non-residential sectors. The major reasons for the selection of this scenario are the following:

- Scenario 4 has the highest savings potential at the lowest cost per kL saved to the community as a whole. This cost is however higher than the marginal cost of potable water due mainly to the overall cost of rainwater tanks.
- The majority of the capital cost and on-going costs are the responsibility of the householder. Council will need a management plan including regular inspections to ensure that health and water quality aspects are addressed through regular maintenance.
- From an environmental perspective Scenario 4 is the best performer, with reductions in river extractions due to the additional reductions in demand.
- Scenario 4 would have broad community acceptance as it involves all sectors of the community and council contributing to achieve a water reduction target.
- Scenario 4 includes cost-effective water savings targeting non-residential users.

5. IMPLEMENTATION OF DEMAND MANAGEMENT STRATEGY

5.1 INTRODUCTION

To facilitate action required to achieve these savings, detailed advice on strategy implementation has been compiled including an implementation program and recommendations for tracking and reporting strategy performance. Budgeting and staffing considerations have also been addressed.

A description of educational and promotional measures required for strategy facilitation has been provided in Section 5.5 of this report. A review of funding opportunities offered by the State and Commonwealth governments was also undertaken to identify financial support available to assist in strategy implementation, and is described in Section 6.

5.2 IMPLEMENTATION PLAN

The recommended Demand Management Strategy represents a significant long-term commitment by TSC to reduce water consumption in the Shire. As such, it is important that TSC proceeds in a planned and careful manner. It is not practical to commence all programs in the first year. Program implementation should be staged as new staff are appointed and become capable of conducting programs and liaising with customers. The expansion of the program should be paced with the growing capabilities of staff, the success of initial implementation, the increasing understanding of the public and increases in the availability of funding.

Scenario 4 was chosen on the basis on the whole of life (NPV) values shown in Table 5-1 presents the actual costs to TSC of Scenario 4 for the first 10 years of the program. These costs are based on an indicative staging of each of the measures. The full annual budgeting requirements until 2036 are provided in Appendix A. First year costs include considerations of funding required for program setup and implementation, with following years taking into account continued operating and administration costs. Please note, the costs are presented in real terms based on current (2009) costs – they have not been time adjusted.

Costs for pressure and leakage management are high due to the costs associated with establishing pressure and district management areas. Cost for this measure has been distributed over 4 years.

There is a significant decrease in costs after 2013 when the pressure and leakage management program has been established and the residential retrofit program ceases.

Table 5-1: Scenario 4 Staged Annual Budgeting Requirements

MEASURE	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Residential Education Program	$61,002	$61,002	$54,934	$55,193	$54,984	$64,353	$64,480	$64,608	$66,549	$66,124
Waterwise Non-residential Education	$25,000	$4,328	$4,445	$4,561	$4,727	$4,892	$5,057	$5,221	$5,385	$5,549
Pressure and Leakage Management Program	$688,212	$688,212	$688,212	$688,212	$302,920	$309,691	$316,359	$326,194	$336,002	$345,781
Residential Rebate Program - Showerheads	$32,943	$18,791	$18,791	$18,791						
Residential Retrofit	$311,454	$301,451	$301,448	$301,445						
BASIX - Internal/External Rainwater Tank (5kL)	$11,918	$23,849	$35,891	$48,057	$60,123	$76,651	$93,239	$109,889	$127,504	$144,891
Landscape Use Efficiency Awards		$100,892	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Major Users Audit		$50,000	$42,873	$22,476	$22,470	$7,843	$7,837	$7,830	$7,809	$7,807
TSC Open Space Irrigation Audit		$15,000	$25,400	$25,400	$4,531	$2,181	$2,175	$2,169	$2,152	$2,150
Aged Care Audit			$15,000	$11,700	$12,918	$2,101	$2,376	$2,373	$2,371	$2,364
Commercial Business Water Audit Program			$55,000	$35,600	$14,836	$14,198	$14,219	$9,771	$6,642	$6,691
Training Landscape Managers			$5,000	$10	$10	$10	$10	$15	$15	$15
Internal Fittings Regulation and Management			$45,000	$4,829	$4,840	$4,808	$5,819	$5,811	$5,803	$5,780
Inclining Block Tariff			$20,000							
Total Estimated Budget Requirement	**$1,130,529**	**$1,263,525**	**$1,316,994**	**$1,221,272**	**$487,359**	**$491,728**	**$516,571**	**$538,881**	**$565,233**	**$592,152**

5.3 STAFFING REQUIREMENTS

To effectively implement the DMS, approximately three full-time staff members would be required. However, staffing levels would need to be refined after detailed program design, including considering program consolidation and economies of scale which might reduce total staffing needs. The following positions are suggested:

- WEP Coordinator;
- WEP Public Information Officer; and
- WEP Program Technician.

As training programs for water conservation staff do not currently exist, it is expected that the new staff would train on the job. The capabilities required of staff fulfilling these key positions are described below:

- *WEP Coordinator*

  An engineer or management specialist with a water background and an ability to supervise people, communicate with upper management, prepare budgets, supervise contractors, be the principal program spokesperson and advocate, manage an advisory committee, spend some time organising the public education program as well as designing other programs and the evaluation process.

- *WEP Public Information Officer*

  A professional person capable of creating public educational material, including press releases, brochures, contests, booths, and other promotional material needed, and of supervising a school education program.

- *WEP Water Technician*

  Responsible for organising water audits and implementing programs including the hiring and supervision of part-time personnel or contractors for the residential and non-residential water audit programs. The technician should be knowledgeable about water fixtures, appliances and conservation devices, and have spreadsheet capability to undertake the program evaluation, data collection and manipulation.

To maximise the success of the project these staff should commence at an early stage, particularly the program coordinator and information officer.

5.4 PERFORMANCE TRACKING AND REPORTING

In tracking the performance of the demand management strategy, TSC should focus on specific quantitative assessment of water reduction. This approach will enable TSC to adjust the program to ensure that the overall demand is achieving the ultimate long-term reduction goals envisioned by the program. Many of the recommended measures are regulated (such as BASIX and WELS) and cannot be monitored directly; however, the success of the strategy as a whole can be monitored, and provides an indication of the success of many of these individual measures. It is important that the impacts of climate correction of data is undertaken to understand the trends in demand.

Recommended key performance indicators (KPIs) for demand reduction in the Tweed Shire are outlined in Table 5-2 below for the first five years of the strategy. KPIs beyond 2013 have not been developed as performance will be increasingly dependent upon the success of the earlier stages of the strategy. Longer term goals should be developed once feedback on initial demand reductions has been received and evaluated.

Table 5-2: Tweed Shire Council Demand Reduction KPIs

TARGET SECTOR	KPIS	2009	2010	2011	2012	2013
Residential	Per Capita Residential Demand (L/capita/d)	220	215	210	205	200
Non Revenue Water	% of production	10%				
Whole of Shire	Per Capita Total Demand (L/capita/d)	330	320	310	305	300
Whole of Shire	Overall percentage reduction	8%	11%	13%	14%	15%

Reduction targets for the non-residential sector were considered inappropriate considering the diversity of non-residential water use across, and even within, the different sub-sectors.

Additional KPIs may be considered for individual measures. For major water users, TSC should adopt the approach of water efficiency plans with individual performance targets to achieve water efficiency. Recommendations for tracking the performance of majors users programs and other specific measures are listed in Table 5-3.

Table 5-3: Specific Measure Performance Tracking

MEASURE	TRACKING
Non-Residential Major User Audits	Non-residential accounts targeted in the major users water audits (i.e. accounts consuming >20ML/year) should have their performance tracked through water efficiency plans with individual performance targets. Account users should be required to report progress towards these targets back to TSC periodically (at least annually).
Non-Residential Commercial Business (Top 100) Audits	Accounts targeted through the commercial business water audits (caravan parks, clubs and shopping centres) should have their performance tracked through water efficiency plans with individual performance targets. Account users should be required to report progress towards these targets back to the Council periodically (at least annually).
Residential Audit Programs	Residential audit programs can be monitored for success through participation rates (% of accounts participating). Demand trends for those participating in the program against non-participants can also be analysed through the TSC customer billing system.
Residential Showerhead Rebates	The success of the residential showerhead rebates can be monitored by tracking TSC expenditure on rebate claims.

5.5 EDUCATION AND PROMOTION

Several educational and promotional programs will be required to support the implementation of the DMS. In addition to measures grounded in public relations and communications, such as waterwise education programs and awards programs, further educational and promotional opportunities exist to maximise program savings.

5.5.1 RECOMMENDED MEASURE EDUCATION

Measures recommended in the Demand Management Strategy (see Section 2) that are underpinned by education measures are outlined below:

- *Waterwise Residential Education*

Residential education campaigns can focus on specific habits that commonly waste water (eg. tap running while cleaning teeth, shaving etc), and/or information on future supply shortages and the need for demand reductions. TSC has already developed materials for Waterwise education including a water use calculator and information regarding Waterwise showers, which can be accessed via their website. These materials should be further developed and actively promoted throughout the community.

- *Waterwise Non-Residential Education*

TSC should develop a general education package with information about the Waterwise program for non-residential users, promoting water efficiency and solutions. This may include specifically targeted programs for typical high water users such as caravan parks, shopping centres, aged care facilities and clubs, targeting end uses with high potentials for savings. These materials should then be actively promoted.

- *Rainwater Tank Education*

In order to support estimated rainwater tank yields (approximately 80 kL/year), community education and rainwater tank inspections should be introduced. It is recommended that education be developed focussing on correct use and maintenance of rainwater tanks. This should also support the regular program of inspections.

5.5.2 RECOMMENDED MEASURE PROMOTION

The success of the demand management strategy rests largely upon the ability of the TSC to convince the customer that water conservation is important enough to make it a priority. Supporting public relations exercises can raise awareness and interest in Council efforts towards demand management, increasing community support for the strategy and encouraging a ‘conservation ethic’. Voluntary commitment by consumers is critical in achieving water conservation targets, and consumers must be convinced that changed use habits are both essential and in their and the community’s interests.

Several of the recommended measures will require promotion in order to reach targeted users and to maximise participation rates. These include:

- Landscape use efficiency awards:
- Residential showerhead rebates;
- Residential retrofits; and
- Residential high water user audits.

Council should ensure that awards gain public attention, in order to encourage other customers to think about and employ water savings. Increased public attention can also raise interest in the awards program as customers understand the marketing value of such awards when widely accepted by the community. Similarly, rebate, retrofit and audit programs all require promotion to ensure customers are aware of the existence of, and benefits available through, such programs.

In addition to promotion required to support individual recommended measures, a broader promotions strategy should also be employed to engage public interest in the strategy as a whole. Tips and tactics for promotion of the demand management strategy are outlined below.

- *Strategy Awareness Campaign*

A start up campaign should be launched to raise awareness with the commencement of the strategy, with efforts and costs phasing down to a maintained public awareness level. Positive public relations provide non-monetary incentives to customers through popularity; commendation in newspapers, local radio or TV, special awards luncheons and/or breakfasts all support program uptake. Examples of supporting activities include:

- Theatrical productions;
- Poster contests, T-shirt design contests;
- Web page for the program;
- Speakers to employee and community groups; and
- Presentations and tours with hands-on demonstrations.

- *Liaison with Key Stakeholders*

  TSC may choose to organise workshops through the NSW Department of Commerce as well as other industry and commercial representatives to form relationships and disseminate key information regarding conservation programs to target sectors. Networking with facility management and industry-specific associations (such as the Hotel Motel and Accommodation Association NSW, the Australian Hotels Association, etc) can aid the spread of information and increase the popularity of programs.

- *School-based Education Campaigns*

  School-based campaigns are best placed to achieve long-term results in eliminating wasteful water use habits, and have a flow-on effect through the community as students carry lessons home to their families. Waterwise NSW has resources available to support education programs, with a WaterWise media team available to prepare media releases, advertisements, and publications to promote water conservation. They also offer ‘Wet WaterWise’ interactive displays and guest appearances by character ‘Whizzy the Water Drop’.

- *Council Promotion of Federal and State Programs*

  The promotion and dissemination of key information regarding State and Federal conservation programs can encourage strategy support, by demonstrating that water conservation is a priority for the wider Australian community as well as for TSC. State and Federal programs should be promoted to key stakeholders and target sectors to complement the TSC DMS.

- *Implementation of Non-residential Measures*

The key considerations in achieving sustainable water savings in the non-residential water savings are:

- Customer relationships are important to ensure acceptance of recommendations;
- Support for water conservation measures at the management level of businesses is essential;
- The implementation strategy must fit the company’s decision making process; and
- Follow up communication with the business is required to assess the implementation of water audit recommendations.

Marketing and promotion of non-residential programs should therefore include the following concepts:

- Conservation messages must reach the management level.
- Cost savings are the primary focus bearing in mind that water costs are a low priority in most businesses.

- Recognise that most conservation technology is complex and expensive.
- Employees control many end uses and must be included in the process through education.
- Specific uses of water in a business will dictate the appropriate conservation actions.
- TSC must embrace three tenets in promoting water conservation:
    - Credibility – of the authority representative (must have some technical; knowledge)
    - Reliability – what is promised must be delivered; and
    - Confidentiality – of water use and proprietary information must be respected.
- Progress is only possible once the customer trusts and respects the authority's representative.

6. FUNDING OPPORTUNITIES

The State and Commonwealth Governments have instituted a number of funding programs to support demand management measures. TSC may be able to take advantage of funding available through one or more of the programs outlined in Table 6-1.

Table 6-1: Funding Opportunities

AGENCY	FUNDING OPPORTUNITY
NEW SOUTH WALES STATE GOVERNMENT DEPT. OF ENVIRONMENT AND CLIMATE CHANGE (DECC)	GREEN BUSINESS PROGRAM DECC's Green Business Program has allocated $30 million over 5 years to fund projects saving water and energy in business operations in NSW. Activities which are eligible for funding under the Program include, but are not limited to: • Education and technology trial activities which increase the adoption of efficient technologies and practices; • Projects which improve the efficiency of buildings, appliances and industrial processes; • Projects which reduce peak electricity demand; and • Projects which reduce the demand for electricity or water supplied from electricity or water supply networks, eg cogeneration, fuel switching, water recycling, stormwater harvesting.
	PUBLIC FACILITIES PROGRAM The DECC Public Facilities Program has allocated $30 million over five years for water and energy conservation projects (including retrofits) in facilities in NSW which are open to, and frequently accessed by, the public. This includes schools, community buildings, sporting facilities, museums and art galleries. Two funding streams are offered: • Demonstration stream – funding for projects which demonstrate how water and energy savings work in practice in public or educational facilities which are open to, and frequently accessed by, the public; and • Community Savers stream – funding of up to $40,000 for not-for-profit community organisation to undertake simple, low-cost water and energy saving upgrades in the facilities they use.

<table>
<tr><th>AGENCY</th><th>FUNDING OPPORTUNITY</th></tr>
<tr><td></td><td>GOVERNMENT ENERGY AND WATER EFFICIENCY INVESTMENT PROGRAM (GEEIP)

The GEEIP was established under the NSW Treasury Loan Fund to help agencies fund projects, implemented by the agencies themselves, aimed at water and energy conservation. Funding is provided through the NSW Treasury Loan Fund, which provides $40 million a year through GEEIP or Performance Contracts (for larger projects).
To be eligible for the program agencies must satisfy the following requirements:

• The agencies must be budget-dependent;

• The project must not be part of the agency's forward capital program;

• The internal rate of return (IRR) of the project must be greater than or equal to 12% and at least 75% of the project's gross benefits must be savings from improved water and energy efficiency;

• The maximum loan term is seven years (with repayments every six months);

• The project must be independently verified.

Projects satisfying these criteria are eligible for the full capital cost and any associated costs for water and energy efficiency upgrades.</td></tr>
<tr><td>AUSTRALIAN GOVERNMENT DEPARTMENT OF ENVIRONMENT, WATER, HERITAGE AND THE ARTS (DEWHA)</td><td>NATIONAL RAINWATER AND GREYWATER INITIATIVE

As part of the $12.9 billion Water for the Future plan, the Australian Government is delivering the $250 million National Rainwater and Greywater Initiative. The Initiative offers households up to $500 towards a new rainwater tank or greywater system which is purchased after 30th January 2009. Rebates are available for either:

• The purchase and installation of a new rainwater tank which is connected for internal reuse of the water for toilet and/or laundry use; or

• The purchase and installation of a permanent greywater treatment system.

The owner of an existing home that is a principal place of residence where an eligible rainwater tank or greywater system has been installed may apply for a rebate. Commonwealth, state, territory or local government authorities are not eligible for the rebate.
An application for the Australian Government rebate program will not be affected by any rebates offered by other governments (including state, territory and local governments).</td></tr>
</table>

AGENCY	FUNDING OPPORTUNITY
	NATIONAL RAINWATER AND GREYWATER INITIATIVE : SURF LIFE SAVING CLUBS The Australian Government is offering grants of up to $10,000 (excluding GST) for Australian surf life saving clubs undertaking any of the following activities, provided they are for use by the surf life saving club on premises owned, leased or permanently occupied by the club: • Installation of new rainwater tanks that are connected to the club premises. It is a requirement of tank installation that the tank be plumbed into the club premises for toilet flushing and/or laundry use. Clubs can claim for plumbing, guttering, down pipes, pumps etc provided these are for the new tank. • Water efficient or water saving devices such as water efficient taps, toilets, urinals and showers. It is a requirement that showers and urinals have a minimum WELS three star rating and that toilet and taps have a minimum WELS four star rating. • Other water efficiency or water saving measures recommended by a water audit, such as smart meters. It is a requirement that activities proposed under this category be supported by a water efficiency audit. Applications will be accepted from 1st October 2008 until 31st January 2010, subject to the availability of funds.

7. RECOMMENDATIONS

Based on the assessment of options in the Stage 1 and 2 reports it is recommended that:

1. Greenfield Development Scenario 1 be adopted for the Cobaki Lakes, Bilambil Heights, Terranora and Kings Forest developments. This will include the adoption of BASIX with 5,000 L rainwater tanks (minimum of 160 m^2 roof area) connected to external uses, toilet flushing and cold water to washing machines. In addition new dwellings will have dual flush toilets as well as 3 star showerheads and taps.
2. For West Kingscliff, recycled water be made available to future industrial land use areas where demand is identified.
3. Scenario 4 be adopted for the whole of Tweed Shire, with a key focus on developing an extensive active leakage control and pressure management program.
4. Rainwater tank education programs be developed, focused on the correct use and maintenance including a regular program of inspections.
5. The inclining block tariff structure be maintained and enhanced to provide a price signal for high users.
6. The recommended non-residential demand management program be adopted:
    a. TSC develop an auditing program targeting the major users (>20 ML/year). Following the marketing and successful implementation of this program it is recommended that that the balance of the caravan parks, shopping centres, clubs and aged care facilities within the top 100 be targeted. Auditing programs should include the requirement to conduct a leakage assessment using data-loggers.
    b. The auditing of major water using parks and gardens should be undertaken and reinforced by training for TSC parks and gardens staff. Ideally, this should be complemented by the development of Open Space Irrigation Guidelines which would govern how parks and gardens and sports grounds within TSC are irrigated and managed in the future.
    c. TSC consider the introduction of regulations to control non-residential internal fitting and fixtures including taps, showers, toilets and possibly urinals. This should be complemented by the requirement for any new major user (e.g. 5 ML/year) to complete a water management plan at the DA stage. The Plan may include the provision that customers must use of an alternative water source e.g. rainwater, stormwater, recycled water etc, for non-potable water uses on-site.
    d. A non-residential education program be developed targeting the key sub-sectors identified. This could involve the preparation of fact sheets targeting water use efficiency within each of the targeted sectors e.g. caravan parks, clubs. There is significant amount of resources available on the internet relating to these sectors, including guidelines and check lists, which can be adapted and used by TSC as part of the education program.
    e. As part of the overall communications strategy, council liaise with key state government departments regarding the implementation of water efficiency programs (i.e. audits, retrofits) for state government buildings, such as hospitals and schools. It is also recommended that TSC organise workshops with Chamber of Commerce as well as other industry and commercial representatives to form relationships and disseminate key information regarding conservation programs to target sectors.
7. An on-going communication and education program be developed as part of the preferred program to ensure that savings are maintained in future.
8. The recommended performance tracking plan be adopted which will enable TSC to adjust the program to ensure that the overall demand is achieving the ultimate long-term reduction goals envisioned by the program.

APPENDIX A

DEMAND MANAGEMENT PROGRAM (SCENARIO 4) LONG TERM BUDGET

MEASURE	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Waterwise Residential Education	$61,002	$61,002	$54,934	$55,193	$54,984	$64,353	$64,480	$64,608	$66,549	$66,124
Waterwise Non-Residential Education	$25,000	$4,328	$4,445	$4,561	$4,727	$4,892	$5,057	$5,221	$5,385	$5,549
Pressure and Leakage Management	$688,212	$688,212	$688,212	$688,212	$302,920	$309,691	$316,359	$326,194	$336,002	$345,781
Residential Showerhead Rebates	$32,943	$18,791	$18,791	$18,791	-	-	-	-	-	-
Residential Retrofits	$311,454	$301,451	$301,448	$301,445	-	-	-	-	-	-
BASIX Rainwater Tank	$11,918	$23,849	$35,891	$48,057	$60,123	$76,651	$93,239	$109,889	$127,504	$144,891
Landscape Use Efficiency Awards		$100,892	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Non-Residential Major Users Audits		$50,000	$42,873	$22,476	$22,470	$7,843	$7,837	$7,830	$7,809	$7,807
TSC Open Space Audits		$15,000	$25,400	$25,400	$4,531	$2,181	$2,175	$2,169	$2,152	$2,150
Aged Care Audits			$15,000	$11,700	$12,918	$2,101	$2,376	$2,373	$2,371	$2,364
Non-Residential Commercial Business Audits			$55,000	$35,600	$14,836	$14,198	$14,219	$9,771	$6,642	$6,691
Train Landscape Managers			$5,000	$10	$10	$10	$10	$15	$15	$15
Non-Residential Fixture Regulation			$45,000	$4,829	$4,840	$4,808	$5,819	$5,811	$5,803	$5,780
Inclining Block Tariff			$20,000	-	-	-	-	-	-	-
Total Estimated Budget Requirement	**$1,130,529**	**$1,263,525**	**$1,316,994**	**$1,221,272**	**$487,359**	**$491,728**	**$516,571**	**$538,881**	**$565,233**	**$592,152**

MEASURE	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Residential Education Program	$66,063	$66,284	$66,507	$66,734	$66,965	$58,283	$58,434	$58,587	$58,742	$58,900
Waterwise Non-residential Education	$5,712	$5,874	$6,036	$6,197	$6,317	$6,436	$6,555	$6,673	$6,791	$6,908
Pressure and Leakage Management Program	$355,483	$365,175	$374,831	$384,452	$394,037	$403,586	$413,100	$420,032	$426,929	$433,790
Residential Rebate Program - Showerheads	-	-	-	-	-	-	-	-	-	-
Residential Retrofit	-	-	-	-	-	-	-	-	-	-
BASIX - Internal/External Rainwater Tank (5kL)	$162,250	$179,713	$197,283	$214,962	$232,751	$246,406	$260,133	$273,933	$287,808	$301,758
Landscape Use Efficiency Awards	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Major Users Audit	$7,798	$7,789	$7,780	$7,771	$7,762	$7,049	$7,040	$7,031	$7,021	$7,012
TSC Open Space Irrigation Audit	$2,143	$2,135	$2,127	$2,120	$2,112	$1,550	$1,543	$1,535	$1,527	$1,519
Aged Care Audit	$2,363	$2,360	$2,357	$2,354	$2,351	$2,348	$2,123	$2,119	$2,116	$2,113
Commercial Business Water Audit Program	$6,741	$6,793	$6,846	$6,901	$6,958	$7,016	$7,076	$7,138	$7,202	$7,267
Training Landscape Managers	$15	$15	$15	$0	$0	$0	$0	$0	$0	$0
Internal Fittings Regulation and Management	$5,777	$5,767	$5,757	$5,746	$5,736	$5,726	$4,896	$4,886	$4,875	$4,865
Inclining Block Tariff	-	-	-	-	-	-	-	-	-	-
Total Estimated Budget Requirement	**$619,345**	**$646,905**	**$674,541**	**$702,238**	**$729,989**	**$743,401**	**$765,900**	**$786,935**	**$808,012**	**$829,133**

MEASURE	2030	2031	2032	2033	2034	2035	2036	TOTAL COST (2006-2036)	NPV ($)*
Residential Education Program	$59,060	$59,223	$59,388	$59,556	$59,727	$63,712	$63,927	**$1,663,322**	**$759,923**
Waterwise Non-residential Education	$7,025	$7,141	$7,256	$7,371	$7,503	$7,634	$7,765	**$184,359**	**$93,933**
Pressure and Leakage Management Program	$440,615	$447,405	$454,159	$460,877	$467,560	$474,207	$480,818	**$11,886,850**	**$6,456,261**
Residential Rebate Program - Showerheads	-	-	-	-	-	-	-	**$89,316**	**$71,846**
Residential Retrofit	-	-	-	-	-	-	-	**$1,215,797**	**$963,009**
BASIX - Internal/External Rainwater Tank (5kL)	$315,784	$329,889	$344,072	$358,336	$372,681	$388,924	$405,270	**$5,603,966**	**$1,947,303**
Landscape Use Efficiency Awards	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	**$225,892**	**$141,128**
Major Users Audit	$7,003	$6,994	$6,985	$6,976	$6,967	$7,249	$7,240	**$300,414**	**$199,520**
TSC Open Space Irrigation Audit	$1,511	$1,503	$1,496	$1,488	$1,480	$1,702	$1,694	**$110,342**	**$82,855**
Aged Care Audit	$2,110	$2,107	$2,104	$2,101	$2,097	$2,094	$2,183	**$88,607**	**$60,524**
Commercial Business Water Audit Program	$7,335	$7,404	$7,476	$7,550	$7,626	$7,704	$7,784	**$279,773**	**$187,864**
Training Landscape Managers	$0	$0	$0	$0	$0	$0	$0	**$5,130**	**$5,088**
Internal Fittings Regulation and Management	$4,854	$4,844	$4,833	$4,823	$4,812	$4,802	$5,131	**$170,821**	**$109,385**
Inclining Block Tariff	-	-	-	-	-	-	-	**$20,000**	**$17,469**
Total Estimated Budget Requirement	**$850,298**	**$871,510**	**$892,769**	**$914,077**	**$935,452**	**$963,028**	**$986,812**	**$21,844,589**	**$11,096,109**

*The NPV presented is the Council NPV from Table 4-7. Because the measures in the recommended program have been staged in order to level resources over the first few years of the program the NPV from the above table does not correspond with the NPV presented in Table 4-7.

TWEED SHIRE COUNCIL

DEMAND MANGEMENT STRATEGY - STAGE 1

QUALITY ASSURANCE STATEMENT

PROJECT MANAGER: **Wayne Middleton**	**REVIEWED BY:** **Shane O'Brien**
PREPARED BY: **Steffi Senkpiel / Anjila Finan**	**APPROVED FOR ISSUE BY:**

REVISION SCHEDULE

REV. NO.	DATE	DESCRIPTION	PREPARED BY	REVIEWED BY	APPROVED BY
1	28/9/07	Sections on Brownfield measures added	SS / HL / GG	SOB	WM
2	14/12/07	Final report amendments	SS	SOB	WM
Final 1	8/02/08	Minor amendment to Executive Summary	SOB	WM	WM
3	16/11/09	Revised total demand forecast	TM	Ex review by T. Mackney	MB

SYDNEY
Level 2, 39-41 Chandos St, St Leonards, NSW 2065
p +61 2 9493 9700 f +61 2 9493 9799

MELBOURNE
Level 15, 150 Lonsdale St, Melbourne, VIC 3000
p +61 3 9666 1333 f +61 3 9663 1410

BRISBANE
Level 1, 601 Coronation Drive, Toowong, QLD 4066
p +61 7 3510 7300 f +61 7 3510 7350

GOLD COAST
Suite 4, 60 Nerang St, Nerang, QLD 4211
p +61 7 5596 9600 f +61 7 5578 4295

PINE RIVERS
Unit 27, 27-29 South Pine Road, Brendale, QLD 4500
p +61 7 3817 8500 f +61 7 3817 8555

PERTH
Level 7, 178 St Georges Terrace, Perth, WA 6000
p +61 8 9211 1400 f +61 8 9211 1411

SUNSHINE COAST
Level 1, 16 Ocean Street, Maroochydore, QLD 4558
p +61 7 5430 4200 f +61 7 5430 4222

CONTENTS

TWEED SHIRE COUNCIL

DEMAND MANGEMENT STRATEGY - STAGE 1

FIGURES

TABLES

APPENDICES

M. POTABLE WATER INFRASTRUCTURE PLAN

N. SEWER INFRASTRUCTURE PLANS

O. RECYCLED WATER INFRASTRUCTURE PLAN

P. REVIEW OF OPTIONS FOR COBAKI LAKES

EXECUTIVE SUMMARY

OBJECTIVES OF REPORT

Based on assessment undertaken as part of the Integrated Water Cycle Management Concept Plan, Tweed Shire Council (TSC) is facing a range of issues related to water. Specifically these issues relate to:

- The ability of existing surface water sources to adequately service future population, due to high population growth rates, recent reduction in the safe yield and the possibility of a reduced entitlement to water in the future under water sharing arrangements.
- A need to review and refine understanding of supply security and the potential impacts of environmental flow rules being applied at Bray Park Weir, together with the assessment of supply enhancement options such as raising Clarrie Hall Dam and constructing Byrrill Creek Dam.
- The need to have efficient water usage supported by effective demand side management, as well as diversification of water sources through the possible reuse of reclaimed effluent and stormwater.
- The need for consistency in the water supply business planning tools of the organisation (i.e. consistency between the directions and outcomes of the TSC Integrated Water Cycle Management (IWCM) Strategy 2006 and supporting instruments such as a Demand Management Strategy (DMS)).
- The need for compliance with the Department of Water and Energy (DWE) best practice requirements.

In recognition of the need to take action, TSC has decided to prepare a DMS (a recommendation of the TSC IWCM Concept Strategy) in two parts: an Interim (Stage 1) DMS and a Final (Stage 2) DMS. Ultimately, TSC aims to have an effective strategy to manage and monitor demand which is consistent with the organisation's overall water supply business directions and compliant with the DWE *Best Practice Management Guidelines (May 2004).*

The interim DMS focuses on the main water consuming customer category – the residential section, which consumed 60% of the total potable water supplied by TSC in 2004/05 (DWE, 2006). With respect to the new developments, namely Cobaki Lakes, Kings Forest, Bilambil Heights, Terranora (Area E), and West Kingscliff, the interim DMS considers the potential of source substitution of the potable supply through the capture of rainwater and the reuse of treated sewage effluent.

POPULATION AND BASELINE DEMAND FORECAST

An assessment of the historic population and future growth was undertaken as part of the study. Population assessment indicated the following:

- The current population of the Tweed Shire that is served by the Bray Park Water Treatment Plant is estimated to be 73,185.

- Population served by Brays Park WTP is expected to grow to 157,048 by 2036, mostly due to the development of large greenfield areas and the redevelopment and infill development of the Tweed Heads area.
- Occupancy rates are expected to fall between 2006 and 2036. For single family residences the rate will fall from 2.8 to 2.5 persons/dwelling, and for multi family dwellings from 1.95 to 1.7 persons/dwelling.

A detailed assessment of the water production and billing data was undertaken to identify demand trends in per capita and sectoral demand. The assessment included the climate correction of data to assist in the understanding of demand drivers and underlying trends. Results indicated that:

- The average per capita usage (including all metered use and non-revenue water) in TSC is 370 L/person/day, which is a fall from pre-drought (2002) demands. Since restrictions were lifted residential demand has increased.
- Average use for 2004/5 was 231 kL/residential property/annum, which was higher than most northern NSW coastal centres and the NSW average, however many of these centers have been under drought restrictions.
- Non-revenue water is currently estimated to be around 13% of the total water produced. The Infrastructure Leakage Index is relatively high at 2.3 for the Bray Park system. For systems with this level of loss, it is recommended that an active leakage reduction program be implemented.
- The Baseline demand forecast for the shire, taking account of the natural replacement rate for fittings and fixtures, indicates that the demand in 2036 will be 20,280 ML/annum.

GREENFIELD DEVELOPMENT OPTIONS

Five future demand scenarios were considered for the major greenfield development areas of Cobaki Lakes, Bilambil Heights, Terranora Area A, West Kingscliff and Kings Forest. The scenarios reviewed were:

- Scenario 1 – Implementation of BASIX including a 5,000 L rainwater tank connected to external uses, toilet flushing and cold water to the washing machine.
- Scenario 2 – BASIX together with recycled water for external use and toilet flushing.
- Scenario 3 – BASIX with a 5,000 L rainwater tank for internal uses and recycled water for external uses.
- Scenario 4 – Indirect Potable Reuse combined with rainwater tanks to further lower the reliance on dam sources.
- Scenario 5 – A 4th pipe system that would collect and treat greywater and blackwater separately for recycling of greywater to households and blackwater to open space.

For all scenarios the use of Reduced Infiltration Gravity Sewers (RIGS) was considered to increase the efficiency of collecting sewage. This had this effect of reducing the overall sizes and costs of the system through reduced wet weather flows.

A detailed assessment of the infrastructure and demand impacts was undertaken for Scenarios 1 to 4. Scenario 5 was not considered in detail due to the number of operational issues and higher capital and on-going costs associated with such a system.

The results of the assessment for the major *greenfield* development areas can be summarised as follows:

- Rainwater tanks would need to be 5,000 L and would save around 80 kL/a for the average household.
- Reduction of potable water use was determined to be approximately 36%, 42% and 61% for Scenarios 1, 2 and 3 respectively for all greenfield developments except West Kingscliff, where development is likely to be industrial.
- Significant savings in infrastructure will accrue from the introduction of smart sewers aimed at the reduction of infiltration and inflow.
- Scenario 1 has the lowest cost to the community. The majority of the capital cost and on-going cost for this scenario are the responsibility of the householder as a result of the legislative requirement to achieve savings under the BASIX program.
- Scenario 1 has the best return on investment with savings of 34 to 38% of the baseline demand forecasts. This scenario also has the lowest cost per kilolitre of savings.
- The cost of the recycled water scenarios (Scenario 2 and 3) is significantly higher than Scenario 1 due to the high cost of providing a third pipe network and establishing membrane treatment.
- From an environmental perspective Scenarios 2 and 3 reduce return effluent flows to the waterways by more than 10%. Scenario 1 will have a modest impact on urban water quality through the reduction of pollutants to waterways.
- The assessment of Scenario 4, involving Indirect Potable Reuse through pumping recycled water to the Clarrie Hall Dam, indicated that by 2036 a total volume of 28 ML/d or 10,220 ML/a could be provided. However the total cost of implementing the scheme would be in excess of $184m.

Additional work reviewing the options for a stand alone recycled water scheme at Cobaki Lakes indicated that the scheme would not be cost beneficial. However if a dual reticulation scheme were to be constructed it would be more cost effective to construct a the treatment facilities at the development rather than to opt for a centralised facility at the Banora Point STP. This option should be further pursued if the developer proposes a third pipe approach for Cobaki Lakes.

WHOLE OF COUNCIL OPTIONS

In addition to the major greenfield development assessment, four future demand scenarios were developed and reviewed for the whole of the Tweed Shire, focussing predominantly on existing (Brownfield) areas. This assessment adopted the recommended scenario from the Greenfield assessment (Greenfield Scenario 1 - BASIX including a 5,000 L rainwater tank connected to external uses, toilet flushing and cold water to the washing machine) for all future development within the shire. The scenarios reviewed were:

- Scenario 1 – BASIX with a Rainwater Tank serving external, cold water for washing machines and toilets combined with the WELS Program.

- Scenario 2 – BASIX with a Rainwater Tank serving external, cold water for washing machines and toilets combined with the WELS Program and a Loss Management Program.
- Scenario 3 – Selected Demand Management Options including a range of measures to reduce water demand in the residential sector.
- Scenario 4 – Enhanced Demand Management Options including Scenario 3 measures plus estimated non-residential sector measures.

The results of the assessment for the whole of shire are summarised as follows:

- Rainwater tanks would need to be 5,000 L in size and would save around 80 kL/a for the average household if connected to toilets, cold water to the washing machine and to external taps.
- Reduction of potable water use was determined to be approximately 16 %, 20%, 21% and 23% for Scenarios 1, 2, 3 and 4.
- Scenario 3 has the highest savings potential at the lowest cost per kL saved to the community as a whole. This cost is however higher than the marginal cost of potable water due mainly to the overall cost of rainwater tanks. Scenario 4 includes water savings from a non-residential program that has not been evaluated, but is expected to result in savings of around 10% at a similar cost to the residential program. These predicted savings will be quantified in the Stage 2 report targeting non-residential demand.
- The majority of the capital cost and on-going costs are the responsibility of the householder. Council will need a management plan including regular inspections to ensure that health and water quality aspects are addressed through regular maintenance.
- From an environmental perspective Scenario 4 is the best performer, with reductions in river extractions due to the additional reductions in demand.
- Scenario 4 would have broad community acceptance as it involves all sectors of the community and council contributing to achieve a water reduction target.

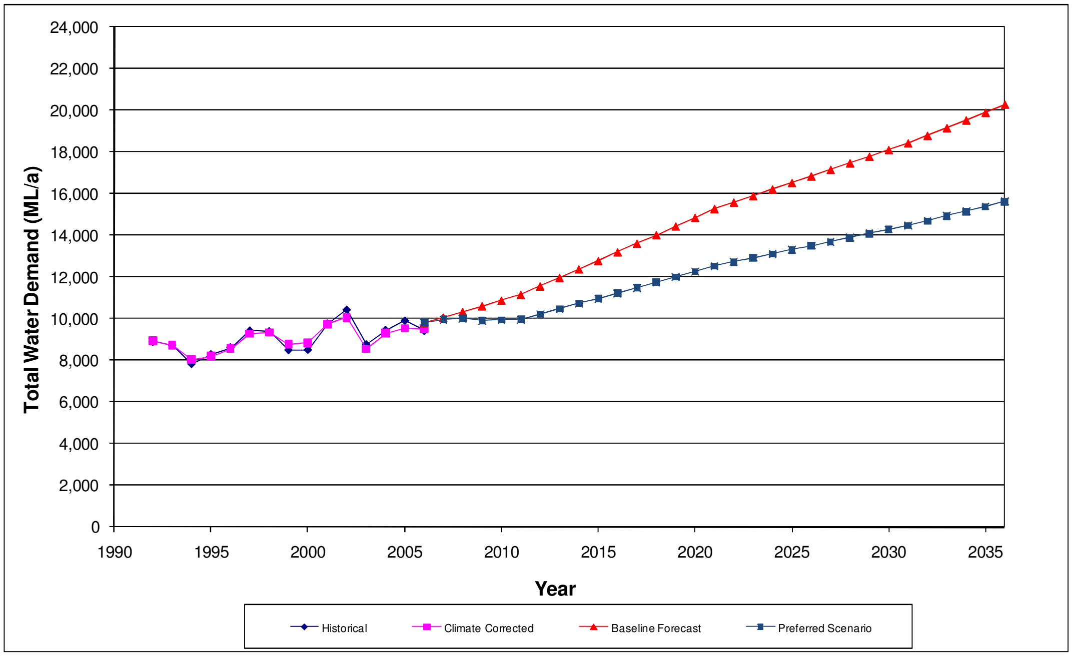
PREFERRED APPROACH

A Triple Bottom Line assessment was undertaken for all scenarios investigated in this report. The assessment indicated that the preferred strategy is to implement the following:

- Greenfield Development Scenario 1 for the major development areas of including the adoption of BASIX with 5,000 L rainwater tanks (minimum of 160 m^2 roof area) connected to external uses, toilet flushing and cold water to washing machines. In addition, new dwellings will have dual flush toilets as well as 3 star showerheads and taps.
- Scenario 4 be adopted for the whole of council with a key focus on developing an extensive active leakage control and pressure management program. This scenario includes an interim allowance of 10% demand reduction for non-residential development.

Figure E1 summarises the forecast baseline (excluding BASIX) and preferred option forecast to 2036.

Figure E1 Forecast Water Demand for the Preferred Demand Management Strategy



RECOMMENDATIONS

Based on the assessment of options in this report it is recommended that:

1. Greenfield Development Scenario 1 be adopted for the Cobaki Lakes, Bilambil Heights, Terranora and Kings Forest developments. This will include the adoption of BASIX with 5,000 L rainwater tanks (minimum of 160 m^2 roof area) connected to external uses, toilet flushing and cold water to washing machines. In addition new dwellings will have dual flush toilets as well as 3 star showerheads and taps.
2. For West Kingscliff, recycled water be made available to future industrial land use areas where demand is identified.
3. Scenario 4 be adopted for the whole of Tweed Shire with a key focus on developing an extensive active leakage control and pressure management program for the existing network.
4. In addition to the legislated WELS and BASIX programs and the Loss Management Program, the following measures were determined to be cost-effective and, hence, recommended for implementation as part of Scenario 4:
    a. Residential showerhead rebate program;
    b. Residential education program;
    c. Landscape use efficiency awards; and
    d. Residential retrofit program (to be run over 4 years)

5. Rainwater tank education programs be developed, focused on the correct use and maintenance including a regular program of inspections.
6. An on-going communication and education program be developed as part of the preferred program to ensure that savings are maintained in future.
7. The inclining block tariff structure be maintained and enhanced to provide a price signal for high users.
8. Options for a non-residential demand management program be considered further.
9. A review be undertaken of the potable water design standards based on the demand assessment undertaken in this report. A regular assessment should then be undertaken to review the adopted design standards.

1. INTRODUCTION

With many parts of Australia in the grip of one of the worst droughts on record and considerable uncertainty about the impact of global warming on our traditional surface water supplies, there is an increasing focus on the many opportunities to conserve and use water efficiently and to use rainwater and recycled water as a substitute for traditional potable sources.

Tweed Shire Council (TSC) is facing many of these same issues. Specifically:

- The ability of existing surface water sources to adequately service future population. This issue is driven by a number of factors including ongoing high population growth rates, a recent reduction in the estimate of safe yield, and the possibility of a reduced entitlement to water in the future under water sharing arrangements.
- The availability of alternative sources, such as groundwater, limited to emergency drought response only.
- A need to review and refine current estimates of system yields and supply security, including assessing the potential impacts of environmental flow rules being applied at Bray Park Weir and determining increased yields from supply enhancement options such as raising Clarrie Hall Dam and constructing Byrrill Creek Dam.
- The need to have a robust and effective water supply supported by effective demand-side management and diversification of water sources through the reuse of reclaimed effluent and stormwater.
- The need to demonstrate to the community paying for the scheme augmentation, the effectiveness and efficiency of the management of the system by TSC.
- The need for consistency in the water supply business planning tools of the organisation (i.e. consistency between the directions and outcomes of the TSC Integrated Water Cycle Management (IWCM) Strategy 2006 and supporting instruments such as a DMS).
- The need for compliance with the Department of Water and Energy (DWE) best practice requirements.

In recognition of the need to take action as quickly as possible, TSC has decided to prepare its DMS (a recommendation of the TSC IWCM Strategy) in two stages: Stage 1 will focus on the residential water use while Stage 2 will focus on non-residential water use. Ultimately, TSC aims to have an effective strategy to manage and monitor demand which is consistent with the organisation's overall water supply business directions and compliant with the DWE *Best Practice Management Guidelines (May 2004).*

1.1 OBJECTIVES

The overall study will be delivered in two stages. The Stage 1 DMS focuses on the residential sector, which consumed 60% of the total potable water supplied by TSC in 2004/05 (DWE, 2006). This sector has been the focus of most of the demand management initiatives by governmental regulations and initiatives (i.e. BASIX and WELS). The Stage 1 DMS considers the effectiveness of these regulated initiatives along with other potential demand management measures.

The first part of the Stage 1 report includes the identification and assessment of additional measures for residential demand management. With respect to the new developments, namely Cobaki Lakes, Kings Forest, Bilambil Heights, Terranora (Area E), and West Kingscliff, the Stage 1 DMS considers the potential of source substitution of the potable supply through the capture of rainwater and the reuse of treated sewage effluent.

The Stage 2 report will focus on the evaluation of demand management opportunities in the non-residential sector.

This report outlines a comprehensive analysis and forecasting framework based on the expertise of MWH in demand management.

1.2 SCOPE OF WORK

The DMS follows the scope outlined in MWH's proposal to TSC in January 2007 with a major emphasis on the new growth areas of Bilambil Heights, Cobaki Lakes, Kings Forest, West Kingscliff and Terranora. It also focuses on existing brownfield sites and potential savings that can be achieved by implementing leakage reduction and other demand management measures.

Summarised the following steps have been undertaken to deliver Stage 1:

- Data collection, review and compilation of information provided by TSC.
- Forecast of population considering previous studies and latest land use, settlement and demographic data.
- Assessment of TSC water demand performance considering water consumption and losses and comparison to average state-wide performances of similar sized utilities and characteristics.
- Assessment of climate corrected historical production and demands to provide baseline input data for the demand analysis.
- Determination of baseline demand for overall Shire and for each of the individual growth areas.
- Identification, costing and assessment of source substitution options for new residential dwellings in growth areas, such as rainwater, recycled water, on-site greywater re-use and indirect potable re-use.
- Cost-benefit assessment of residential demand management measures, including examinations of regulatory and policy instrument such as BASIX, WELS and education programs for individual and combined growth areas.
- Identification of potential deferral or avoidance of future infrastructure augmentation by implementing water efficient measures in new growth areas.
- Preparation of a Stage 1 Demand Management Strategy, including an estimate of potential reductions in non-residential demand.

2. METHODOLOGY

2.1 THE INTEGRATED APPROACH

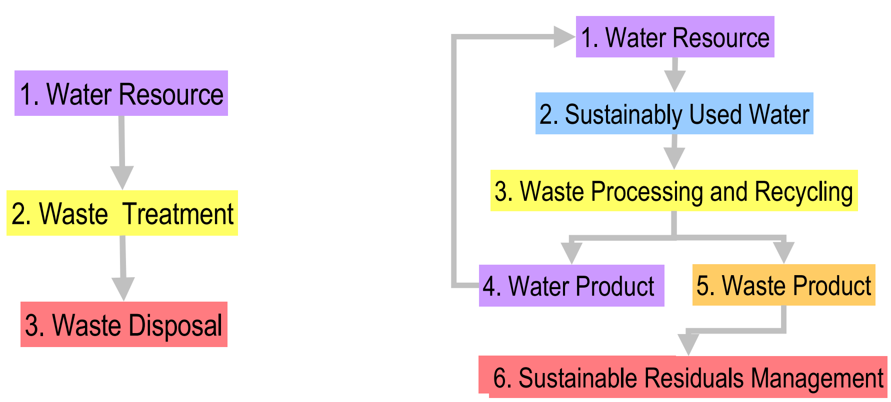
The management of catchments, water supply, wastewater and urban stormwater has traditionally been undertaken in a piecemeal manner. With pressures on water resulting from urban development it was recognised by DWE that the water cycle requires to be considered in an integrated manner. Integrated water management provides a framework to examine urban water supply, wastewater and stormwater management in a whole of catchment, triple bottom line context.

Conventional water cycle management (refer to Figure 2-1) where each element of the water cycle is treated sequentially, has provided us many important benefits. It has provided secure sources of clean water for drinking and use in industry and commerce, as well as treating our waste streams to minimise the impacts on the environment. With population growth and expansion of the urban footprint we are increasingly becoming aware that conventional water system management fails to take account of the interactions between the elements of the water cycle. The current system generally uses water only once, or not at all in the case of stormwater running off impervious surfaces.

Considering all water sources and uses in a single, integrated framework creates opportunities for increasing the efficiency of water use and improving management of the water cycle. By examining integrated options for management of the water cycle, we maximise the opportunity of discovering new ways of doing things as well as making ourselves aware of the interactions and synergies in all parts of water cycle management.

Figure 2-1 Integrated System Management (Source DWE, 2003)

Conventional System Management | **Integrated System Management**



Conventional System Management:

- Sequential management of individual water system components
- Limited consideration of 'big picture' and resource utilisation impacts

Leads to unsustainable outcomes

Integrated System Management:

- Integrated management of all water system components
- Full consideration of 'big picture' and resource management impacts (including triple bottom line)

Leads to more sustainable outcomes

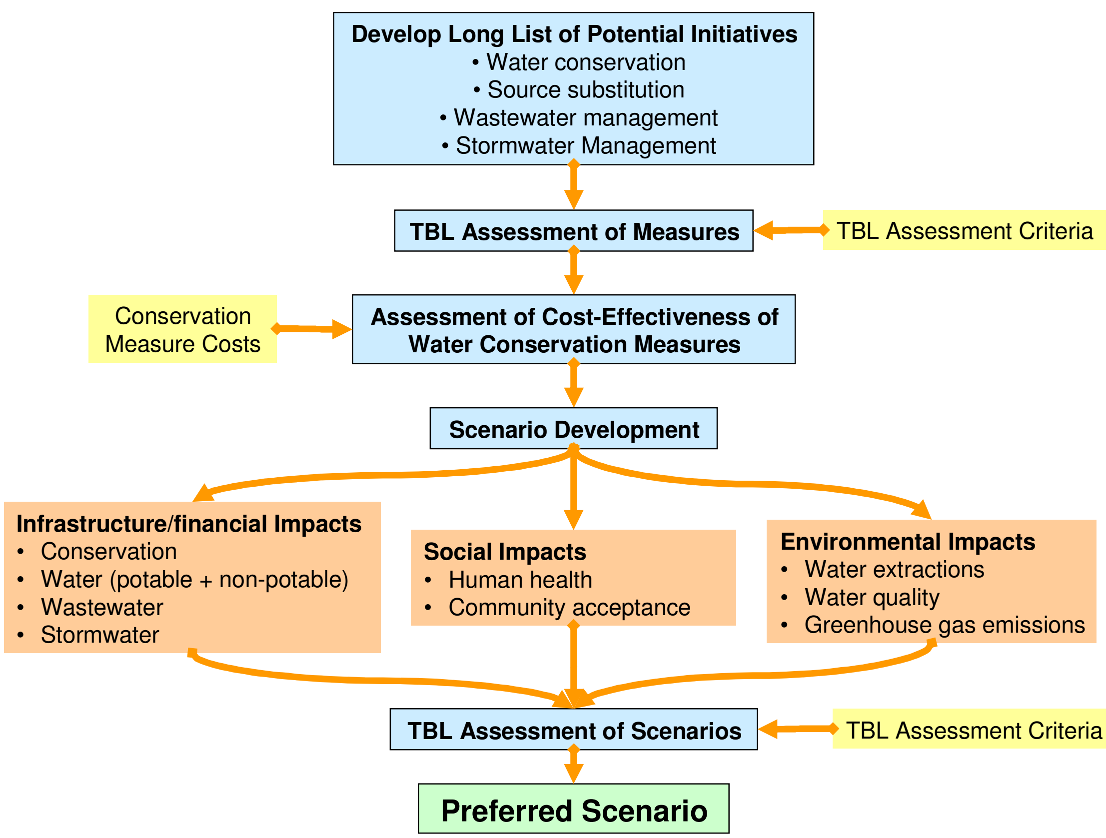
It is also becoming apparent that the current and increasing levels of natural resource use, including water and land uses, are not sustainable. The integrated approach to water management will seek to balance the competing demands on the available resources in Tweed Shire and develop a strategy that will ensure a sustainable water future.

2.2 METHODOLOGY OVERVIEW

The development of integrated water cycle scenarios for assessment as part of this study was based on techniques as required by the Department of Water and included stakeholder input and the Triple Bottom Line (TBL) principles. A long list of measures was initially screened and possible measures shortlisted for more detailed evaluation. Detailed evaluation involved an analysis of the cost effectiveness of water conservation initiatives followed by assessment of the impact of various combinations, or scenarios, comprising source substitution such as recycled water and rainwater use.

The water supply, recycled water and related infrastructure required for each scenario was assessed together with the financial, social and environmental impacts using the same TBL assessment process. An overview of the IUWCM process adopted for the project is summarised in Figure 2-2.

Figure 2-2 Integrated Urban Water Cycle Management (IUWCM) Planning Process



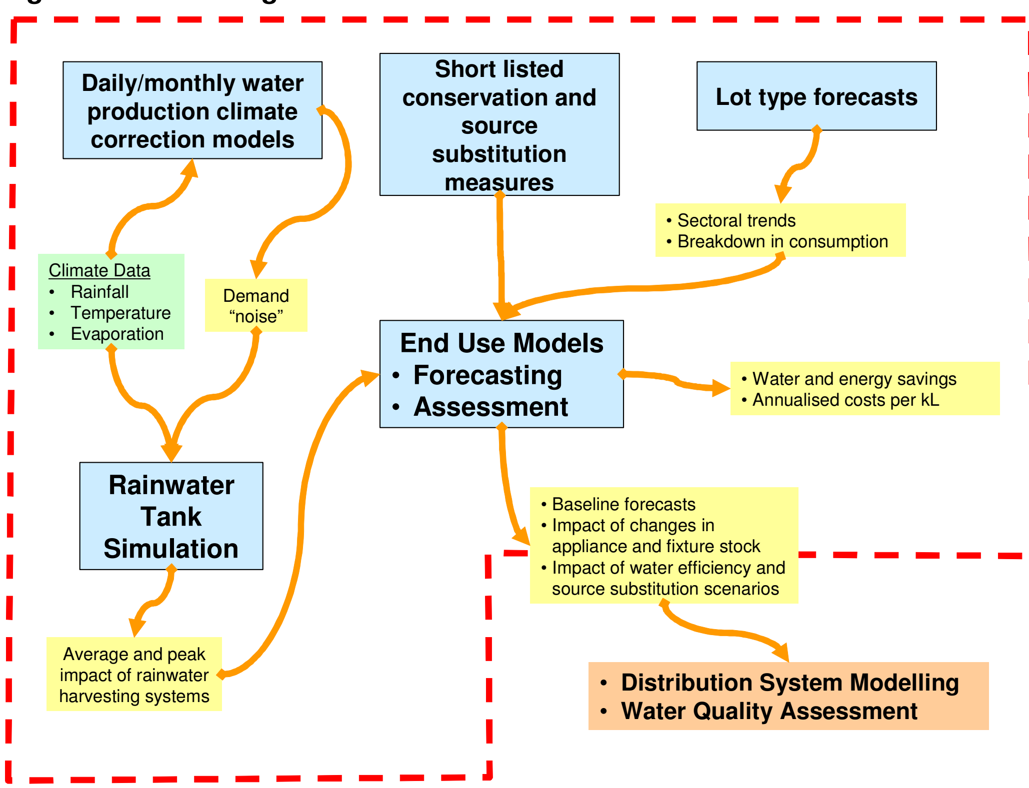
2.3 MODELLING TOOLS

The development of the Demand Management Strategy for Tweed Shire necessitates the use of a number of simulation and forecasting models as shown in Figure 2-3. The approach used for the assessment of options is reliant on a detailed End Use Model supported by various demand assessment tools. MWH's end use model (Decision Support System or DSS) is used to assess the impact of different water conservation and source substitution measures of future water end uses as well as determining the economic feasibility using a benefit cost analysis approach. The DSS is a more advanced version of the DWE's analysis software, however has the same assessment approach and software engine.

The End Use model is supported by the following demand assessment and analysis tools:

- Historic per Capita Water Demand Model. This model includes climate correction of total system production using a per capita approach to remove the influence of population growth. The underlying trends in demand can then be identified.
- Sectoral Demand Model. Assessment of actual consumption per account is important to understand the trends in usage for the various types of customer in the shire. Trends are climate corrected to provide an understanding of the demand drivers.
- Rainwater Tank Yield Model. A simulation model used to assess the impact of rainwater tanks, which was used to evaluate the reliability and yield of various tank sizes.

Figure 2-3 Modelling and Assessment Framework



3. TWEED SHIRE OVERVIEW AND ISSUES

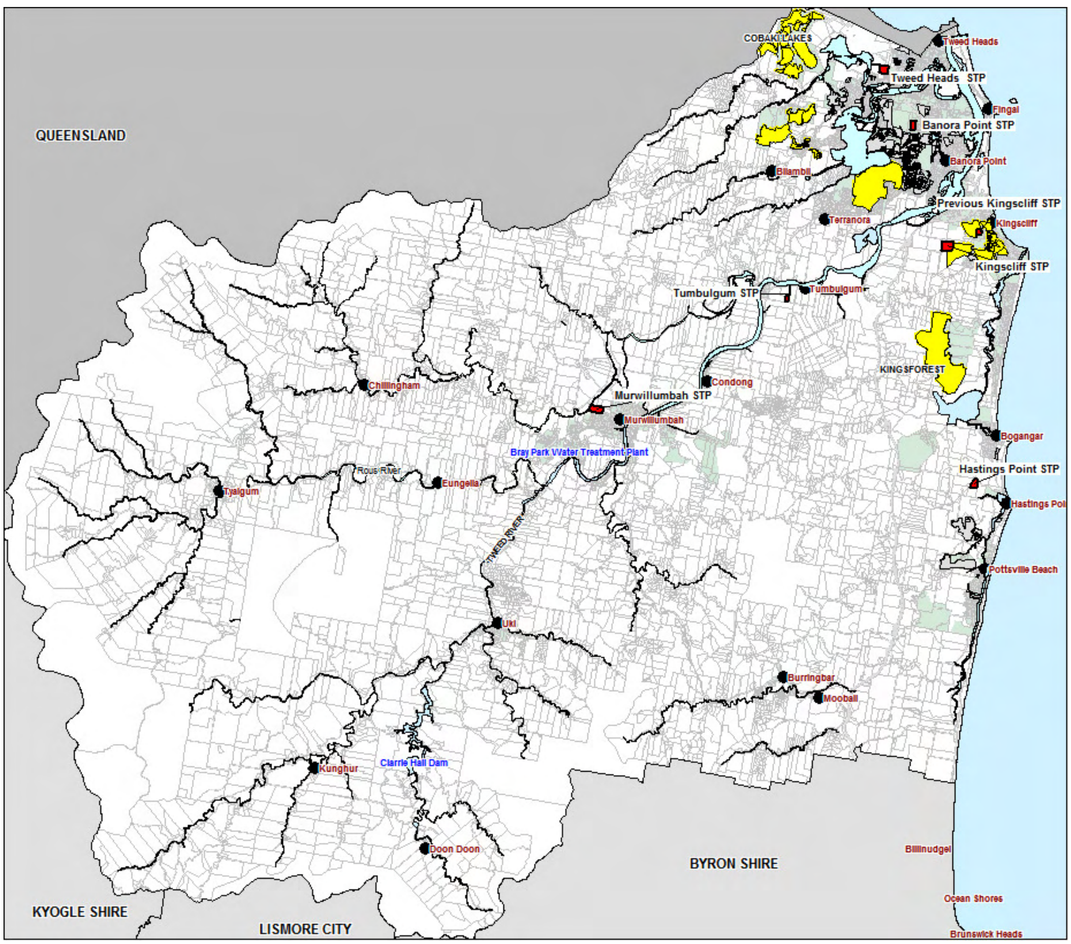
3.1 STUDY AREA

The area of study is shown in Figure 3-1. Tweed Shire is located on the far north coast of New South Wales and is characterised by mountain ranges to the north, west and south dropping to coastal plateau to the east with major floodplain areas in the central catchment.

The shire covers an area of 1,340 km^2, the majority of which (1,080 km^2) comprises the Tweed River catchment with the remaining area draining to 3 relatively small coastal estuaries: Cudgen Creek, Cudgera Creek and Mooball Creek (260km^2).

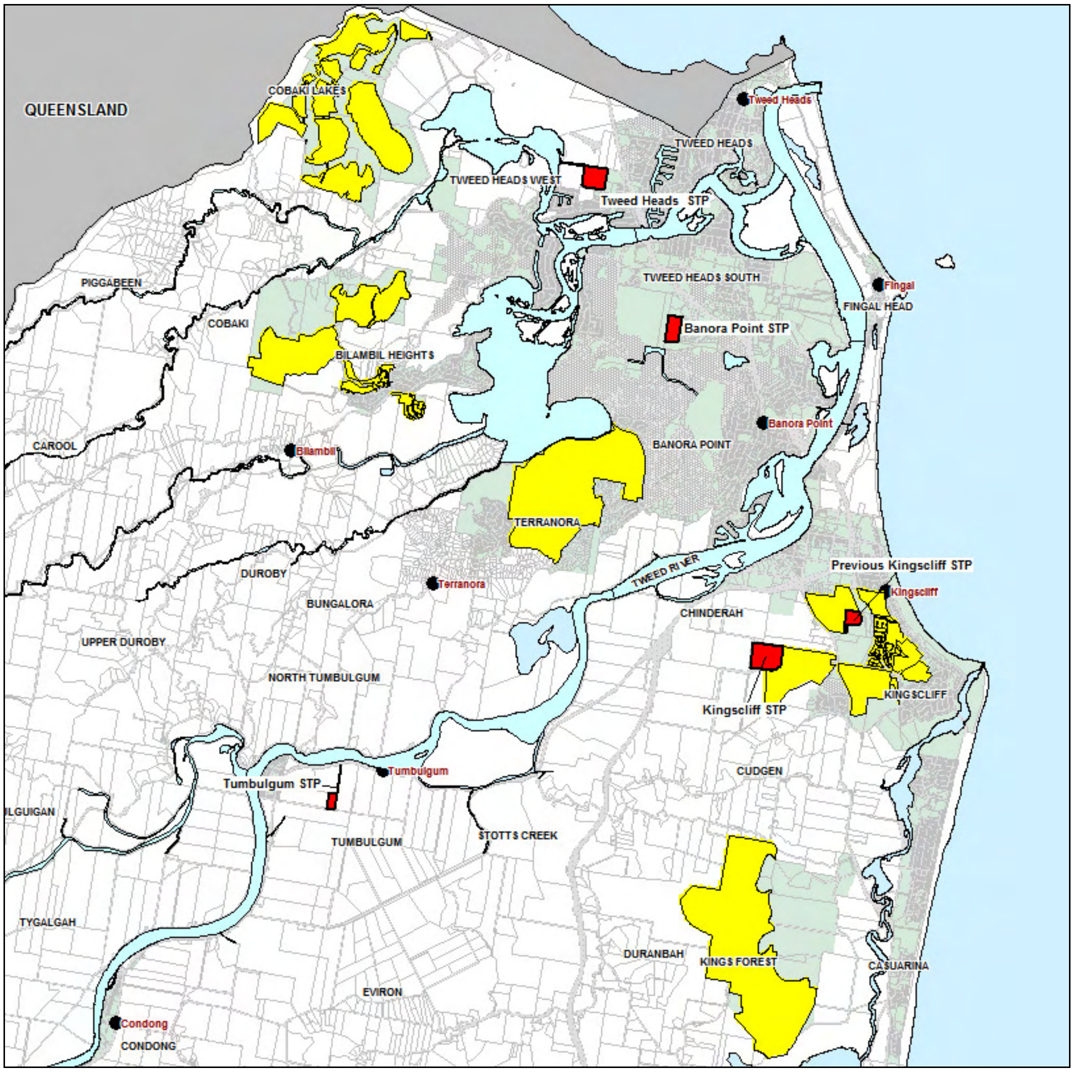
The study is focussed on the urban areas supplied by the Clarrie Hall Dam and Bray Park Water Treatment Plant water supply system. The small systems serving the villages of Uki and Tyalgum are not specifically addressed in the study, however it is anticipated that any demand management programs recommended for the shire would include customers in these areas.

Figure 3-1 Tweed Shire Study Area



Within the shire future development is concentrated in the areas of Cobaki Lakes, Kings Forest, West Kingscliff, Terranora and Bilambil Heights. These areas are to be developed as essentially mixed residential and non-residential developments between 2012 and 2036 and are shown in the following Figure 3-2.

Figure 3-2 New Growth Areas

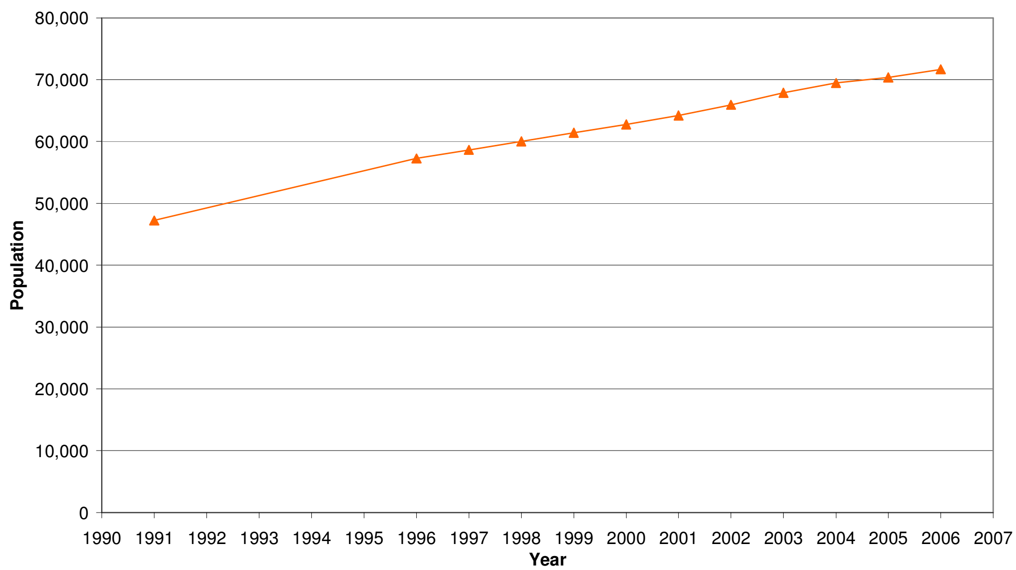


3.2 POPULATION ASSESSMENT

3.2.1 HISTORIC POPULATION GROWTH

The figure below highlights the historic population and annual growth rates of Tweed Shire. According to information provided by TSC the estimated serviced population in 2006 was 73,185 persons. Although the annual growth rates have reduced from above 3.5% to below 2% over the past 15 years, future annual growth is expected to be of the order of 2% to 4%.

Figure 3-3 Historic Population and Growth Profile



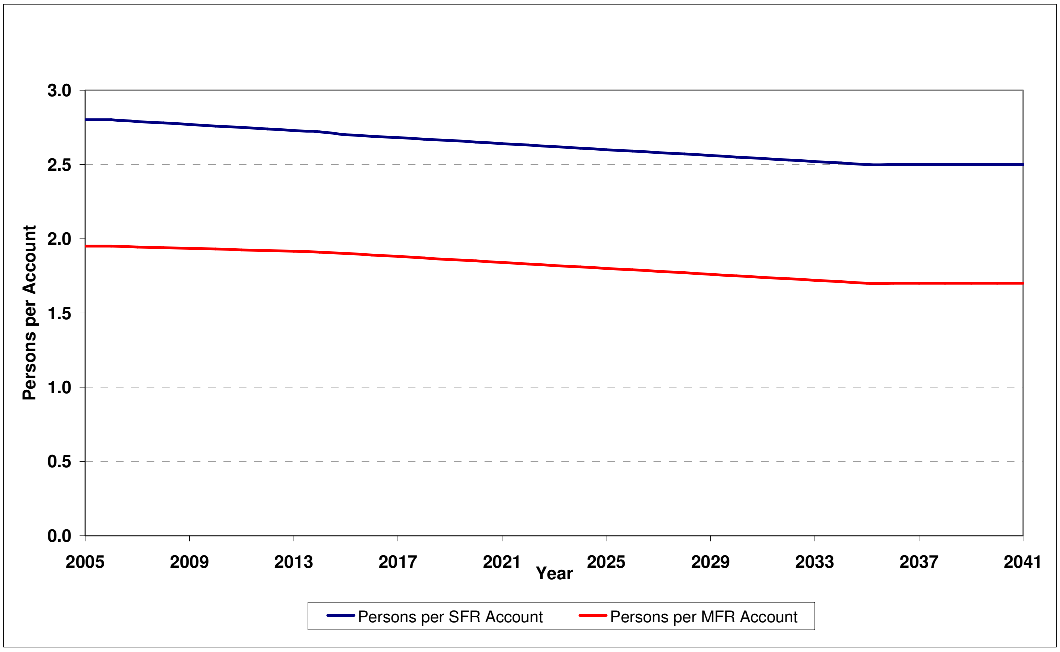
3.2.2 OCCUPANCY RATE

Initial occupancy rates (or persons per account) estimates were obtained from the Australian Bureau of Statistics (ABS) 2001 Census data. The 2001 occupancy rate for flats and units (referred to in this report as Multi-Family Residential or MFR) was found to be1.9 persons per dwelling. The actual rate for detached dwellings (referred to in this report as Single-Family Residential or SFR) was identified as 2.7 persons per dwelling.

During determination of the 2006 population calculations using the number of accounts and the assumed occupancy rates it was found necessary to adjust the persons per dwelling. The final applied occupancy rates for MFR and SFR for 2006 are 1.95 and 2.8 respectively.

In line with current trends in many parts of Australia, the occupancy rates for SFR and MFR dwellings are likely to reduce in future. Initially the adopted occupancy rates assumed a reduction in 0.1 persons per dwelling every 10 years for both MFR and SFR dwellings. The rate for MFR was subsequently reduced to 0.05 persons per dwelling for the period up to 2015. This was in order to account for the higher number of unit dwellings with lower occupancy, being built during this period. Figure 3-4 shows the adopted persons per account rates over time. The adopted average occupancy rates for 2036 were 2.5 for SFR and 1.7 for MFR.

Figure 3-4 Adopted Occupancy Rates for MFR and SFR Dwellings



3.2.3 MAJOR DEVELOPMENT AREA PROJECTIONS

Details of proposed development in the five identified Major Development Areas were provided by the individual developers and developer's engineers and planners. Table 3-1 summarises the number of dwellings in each of the major development areas for the residential sector.

Using the dwelling numbers supplied for each of the major development areas, populations were estimated using the occupancy rates adopted for the balance of the shire. At ultimate development the total residential population of these areas will be 34,003 persons.

Table 3-1 Summary of Dwellings and Population in Major Development Areas

Development Area	Single Family Residential	Multi Family Residential	Estimated Population at 2041
Bilambil Heights*	1,704	1,542	6,881
Cobaki Lakes**	2,880	1,920	10,464
Kings Forest**	3,000	2,000	10,900
Terranora***	1,108	177	3,071
West Kingscliff****	216	1,263	2,687
Totals	**8,908**	**6,902**	**34,003**

Source: * Stuart Brogan, ML Design
**Franz Van den Brink, Leda Pty Ltd
***PB LAS Draft Report – December 2003, Appendix G
****Darren Gibson, Gales Holdings

3.2.4 SHIRE POPULATION PROJECTIONS

Population projections by locality at ten yearly intervals were provided by Tweed Shire Council for 2001, 2011, 2021, 2031 and 2041. From these projections a serviced population was derived. Projections were commenced in 2006, for which a review of occupancy and number of residential accounts was used to verify the data.

Projections for the major development areas utilised the ultimate populations as outlined in Section 3.2.3. It was assumed that the development would commence in 2012 and continue linearly to 2036. For new greenfield areas outside the major development areas, it was assumed that the proportion of SFR and MFR population would be 60% and 40% respectively. For new infill areas this population split was altered to 20% SFR and 80% MFR.

The serviced population projections for each locality were allocated to the following categories:

- Existing Serviced Areas – areas served with water supply
- Infill Development – development and redevelopment of existing lots in areas such as Tweed Heads
- Major Greenfield Development Areas – large consolidated development areas, namely Cobaki Lakes, Kings Forest, West Kingscliff, Terranora and Bilambil Heights
- Greenfield Outside Major Areas – minor greenfield development outside the main growth areas.

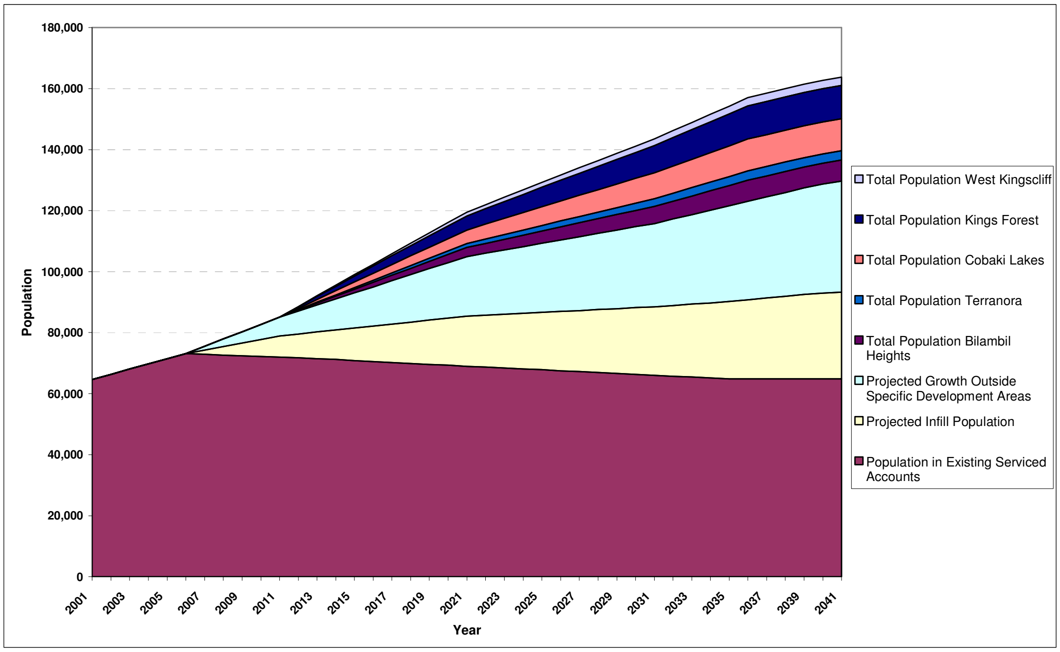
Guidance was obtained from TSC planners in order to determine the proportion of future population in each locality that should be allocated to greenfield or infill development. The results of this allocation are shown in Appendix A.

A summary of the estimated population growth for the shire to 2041 is provided in Table 3-2 and Figure 3-5. A comparison was undertaken to ensure that the adopted population was realistic and not excessively high.

Table 3-2 Serviced (Water) Population Projection for Tweed Shire

Estimated Population	2006	2011	2021	2031	2036	2041 (Ultimate)
Existing Serviced Population	73,185	71,966	69,018	66,044	64,854	64,854
Projected Infill Population	0	6,951	16,402	22,435	25,896	28,461
Major Development Areas						
Bilambil Heights	0	0	2,934	5,609	6,881	6,881
Cobaki Lakes	0	0	4,454	8,525	10,464	10,464
Kings Forest	0	0	4,640	8,880	10,900	10,900
Terranora Area A	0	0	1,300	2,498	3,071	3,071
West Kingscliff	0	0	1,158	2,197	2,687	2,687
Total of Major Development Areas	0	0	14,486	27,709	34,003	34,003
Greenfield outside Major Areas	0	6,182	19,540	27,301	32,295	36,395
Tweed Shire Total	**73,185**	**85,099**	**119,446**	**143,488**	**157,048**	**163,714**

Figure 3-5 Tweed Shire Growth Summary



3.2.5 NON-RESIDENTIAL DEVELOPMENT

At the time of investigation no information regarding future non-residential developments in the Shire was available. Therefore the following assumptions for Shire-wide growth were agreed with TSC:

- Commercial Sector – Growth proportional to residential population growth
- Industrial Sector – Assumed growth rate of 1% each year, which is similar to historic growth. Growth will in future be limited by the available land.
- Public Sector – Growth proportional to residential population growth.
- Rural Sector – No growth assumed.

These assumptions were applied to the overall forecasts outlined in Section 4 of this report. These assumptions will be quantified in the Stage 2 report targeting non-residential demand.

3.2.5.1 NON-RESIDENTIAL DEVELOPMENTS IN GROWTH AREAS

Estimated areas of non-residential development within the major development areas were obtained from the developers and are summarised in Table 3-3. Non-residential development was distributed to four sectors - commercial, industrial, public and open space irrigation. Where no data was provided by the developer an estimate was made based on similar developments.

Table 3-3 Adopted Non-Residential Development Area (ha)

Development Area	Commercial (ha)	Industrial (ha)	Public (ha)	Open Space Irrigation (ha)
Bilambil Heights	4.5	0.0	8.6	25.0
Cobaki Lakes	3.0	0.0	6.3	15.8
Kings Forest	3.0	0.0	6.3	15.8
Terranora	1.0	0.0	16.2	16.0
West Kingscliff	8.1	9.0	4.3	9.7

Conversion factors as outlined in Table 3-4 were applied to determine the number of equivalent persons (EP) for each sector.

Table 3-4 Applied Non-Residential EP Conversion Figures

Non-residential Sector	Adopted Density (EP/ha)
Commercial	30
Industrial	15
Public	30
Open Space Irrigation	5

Table 3-5 outlines the final determined EP figures of the identified non-residential sectors for the new growth areas.

Table 3-5 Estimated Number of Non-residential EP for Major Development Areas

Development Area	Commercial	Industrial	Public	Open Space	Total EP
Bilambil Heights	135	0	129	128	392
Cobaki Lakes	90	0	94	174	358
Kings Forest	90	0	94	174	358
Terranora	30	0	243	82	355
West Kingscliff	242	135	65	49	490

3.3 WATER CYCLE ISSUES

3.3.1 STORMWATER AND WATER QUALITY

Key initial water quality related observations in relation to Tweed Shire are as follows:

- Stormwater monitoring has been carried out in high priority drains in Tweed Shire since 1997, and has highlighted high pollutant loads in stormwater which has a significant effect on receiving waters.
- There is currently limited treatment of urban stormwater runoff in Tweed Shire, resulting in a nutrient and sediment load being discharged to the Shire's catchments. The effect of this is most notable in the coastal estuaries particularly the Lower Tweed Estuary where stormwater flows account for 70-90% of the variation in quality.

- The Stormwater Management Plan (TSC, 2000) has identified the areas of Cudgen Creek, Cobaki Lakes and Cudgera Creek to be under increasing pressure from future development

In regard to existing water quality in the region, based on information presented in the Tweed Integrated Water Cycle Management Context Study and Strategy Report (TSC, 2006) the following comments can be made:

- Water quality in the Tweed Estuary is generally poor with high concentrations of nutrients, suspended sediments and faecal coliforms. Water quality objectives for concentrations of faecal coliforms, total nitrogen and total phosphorus are generally exceed in the lower, mid and upper Tweed Estuary.
- The poor water quality in the Tweed catchment is a general reflection of the anthropogenic activities in the catchment:
  - The Upper Tweed catchment is characterised by elevated levels of nutrients and suspended solids as a result of poor management of agricultural and modified rural runoff containing fertilisers and animal waste;
  - The Mid to Upper catchment and Rous River are impacted by wastewater discharges and agricultural runoff;
  - The Mid Estuary is impacted by wastewater discharges; and
  - The Lower to Mid Estuary is heavily impacted by urban runoff processes;
  - Water quality at the mouth of the Estuary is generally good as it is well flushed by tidal sea waters.
- Water quality processes are dominated by point source loading during the dry months (e.g. wastewater discharges) and diffuse loads from the whole catchment during wet periods (e.g. rural and urban runoff). This leads to a strong seasonal variation with a water quality dropping significantly during wet periods.
- Cudgen, Cudgera and Mooball Estuaries are effected by similar issues as described for the Tweed catchment in addition the following issues;
  - Cudgen Creek - Reported erosion and transport of topsoil from vegetable growing areas;
  - Cudgera Creek – A significant factor is the impact of wet season pollution events on the lower estuary;
  - Mooball Creek – Acid flows from acid sulphate soils disturbance and increasing recreational use.

3.3.2 SUMMARY OF ISSUES

Poor water quality in the Upper, Mid and Lower Tweed catchment is a general reflection of the anthropogenic activities in the catchment. In general these can be characterised by agricultural runoff in the Upper and Mid catchment, wastewater discharges in the Mid catchment and urban runoff in the Lower catchment.

Cudgen, Cudgera and Mooball Estuaries are effected by similar issues as described for the Tweed catchment with topsoil erosion and increasing recreational use being particular issues in these catchments.

3.4 WATER SUPPLY AND WASTEWATER SYSTEMS

The following sections outline the current water supply and sewage systems of the areas assessed in this study. The information has been adopted from the Tweed IWCM Context Study & Strategy Report (March 2006) and from correspondence with TSC.

3.4.1 WATER SUPPLY

The major water supply system of Tweed Shire is Pray Park, which is supplied from Clarrie Hall Dam via Bray Park Weir (Tweed River). It serves the areas of Murwillumbah, Tweed Heads, the two smaller villages of Mooball and Burringbar and the coastal areas from Kingscliff to Pottsville.

With 60 km^2 Clarrie Hall Dam is the major water supply catchment for the area. It has an estimated storage capacity of 15,000 ML with a secure yield of 11,600 ML/annum. The storage of Bray Park Weir is limited to 840 ML.

Water is treated at Pray Park Water Treatment Plant (WTP) with a current maximum capacity of 55 ML/d. Augmentation is underway to increase the capacity to 100 ML/d, to cater for population growth and to increase the reliability of the treatment process.

Potable water from the treatment plant is stored at two reservoirs located at Hospital Hill in Murwillumbah before distributed via three main DN600 trunk mains to the northern, central and southern parts of the area. The central and northern trunk mains follow the Tweed River and supply the areas of Tweed Heads, Kingscliff and Bilambil. The southern trunk main delivers water to Duranbah Reservoir from where it is distributes to the southern areas, between Kings Beach and Pottsville and to the inland areas of Mooball and Burringbar.

An overview of the water supply system proposed to serve the new development areas are provided in section 5.4.1

In addition to Bray Park two smaller independent treatment systems supply the areas of Uki and Tyalgum. The Uki water supply system caters for approximately 350 EP with a total annual production of 55 ML/annum. Raw water for Uki WTP is pumped from Tweed River. For Tyalgum raw water is extracted from Tyalgum Creek. Tyalgum WTP produces approximately 32 ML/annum supplying around 250 EP. Both water supply systems are independent from Bray Park. Their assessment has been excluded from this demand study.

3.4.2 WASTEWATER

In total 98% of urban population or 80% of the shire population is connected to a centralised sewage system, with the exception of several smaller villages (including Burringbar and Mooball), which are currently not serviced. The total capacity of the Tweed Shire sewage system is 29 ML/day and corresponds to 122,300 EP at 240 L/EP/day. The combined dry weather flow (at 2006) has been estimated at 21.6 ML/day. Further, there are approximately 4000 local and rural onsite wastewater treatment systems.

The area is serviced by five major wastewater treatment plants:

- Banora Point STP – This plant is the largest sewage treatment plant in the region currently catering for estimated sewer flows of 62,500 EP from Tweed Heads and surrounding suburbs. Future augmentations are proposed to treat additional flows from Tweeds Heads STP (to be decommissioned in late 2007) and from the new growth areas of Bilambil Heights, Cobaki Lakes and Terranora. Depending on future water demand measures the final serviced population is estimated at 80,000 to 125,000 EP. The plant discharges to the Terranora Inlet.

- Tweed Heads STP – The plant is currently serving 12,000 EP in the area of Tweed Heads and is proposed to be decommissioned in late 2007. All sewage flows of this area will then be forwarded to Banora Point STP for treatment.

- Kingscliff STP – The plant is proposed to be replaced in the near future to cater for increased EP figures while maintaining better effluent qualities according to EPA criteria. Kingscliff STP currently serves approximate 14,000 EP. Additional flow contributions are expected by new developments in the West Kingscliff area and Kings Forest. Stage 1 of the new treatment plant is expected to be completed in December 2007. The final capacity will be increased to serve a population of up to 25,000 EP.

- Hastings Point STP – The treatment plant is currently being augmented with opportunities for effluent re-use identified for a nearby turf farm and irrigation of local sporting fields. The STP serves an equivalent population of 16,000 EP.

- Murwillumbah STP – The recently in 2001 upgraded sewage treatment plant is servicing the township of Murwillumbah with an estimated population of 16,000 EP. The majority of the produced effluent is recycled through use in the Condong sugar mill with any excess effluent being discharged into the Rous River. The reuse scheme has a 20 year life with a further 20 year option. Further reuse opportunities such as the golf course, racecourse and open space irrigation for new developments are being investigated.

Besides the five major sewage treatment plants, the villages of Uki, Tumbulgum and Tyalgum are serviced by their own individual treatment systems. Their capacities are estimated at 600 EP, 700 EP and 500 EP, respectively. For all three plants effluent re-use opportunities such as irrigation have been identified.

4. WATER DEMAND ANALYSIS AND BASELINE FORECAST

4.1 OVERVIEW

To assess water savings for various demand management initiatives and scenarios, it is necessary to understand current water demand as well as the drivers of demand in the shire. This section outlines the methodology and results of the analysis of historic demand and applies the outcomes to the development of a baseline demand forecast. This forecast identifies the water supply that would be required under a ‘do nothing’ scenario.

4.2 HISTORIC DEMAND ASSESSMENT

The aim of the water demand analysis is to utilise data held by Tweed Shire Council to assess:

- the factors influencing water demand, and
- to provide a detailed understanding on the factors that have influenced water demand in the past and the implications for forecasts of future demands.

The historic demand analysis includes the following assessments:

- Climate correction of historical water production records.
- Estimation of the amount of water used in each customer sector
- Estimation of the current level of non-revenue water.

It is noted that the climate correction of historic data does not provide a climate change impacts assessment. However the climate responses can be used to assess the impacts of climate change. This was not part of the terms of reference for this project.

4.2.1 TOTAL WATER PRODUCTION TRENDS

The analysis of historic water production utilised a climate correction water production trend tracking model to analyse historic trends in order to understand the underlying drivers and timing of trend changes.

The key outputs from this process are an indication of the recent trends in gross water production per capita, highlighting the impact of operational changes such as pricing and water restrictions. The water production data, when compared with water consumption, provides input to recent trends in Non Revenue Water (NRW).

Figure 4-1 shows the calibration of the water production model for Tweed Shire. The model was calibrated for a period from mid 2004 and mid 2006. Based on the residual demand (difference between the modelled and observed demand) the per capita demand has shifted significantly since the early 1990’s. This shift cannot be explained by climate alone.

The climate corrected demand is shown in Figure 4-2. The underlying trend indicates that water production per capita has a twelve month climate corrected rolling average of 370 L/capita/day. The trend has fluctuated and declined over the 1990s and again since the drought in 2002/3, but appears to have stabilised at current levels. As a result of this trend tracking, it appears that the most recent demand data available is an appropriate starting point for forecasting.

Figure 4-1 Water Production Model for Tweed Shire

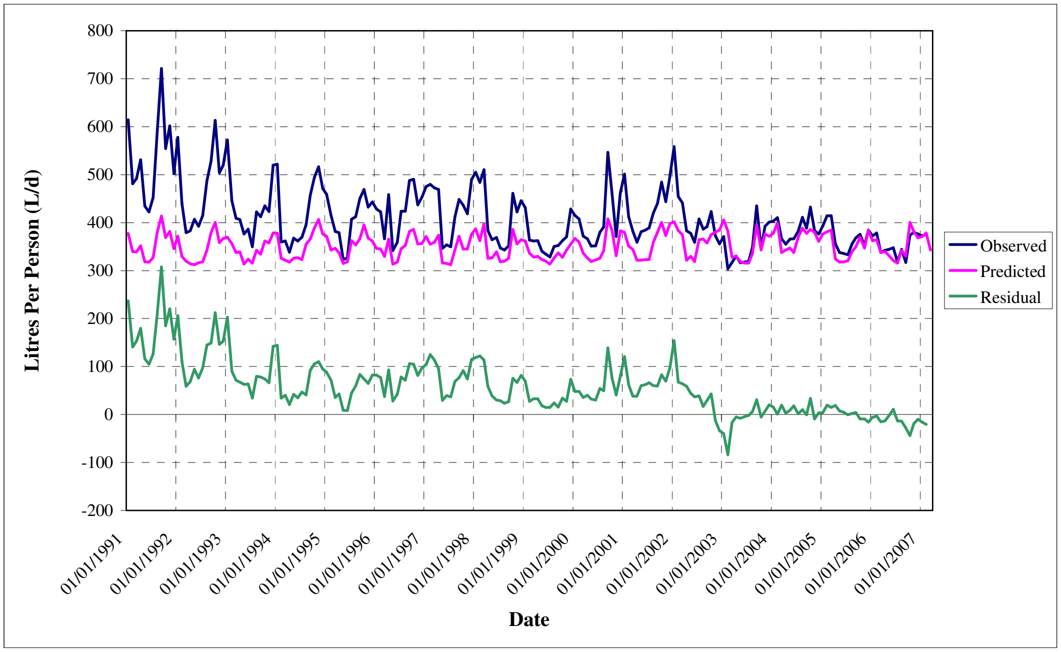
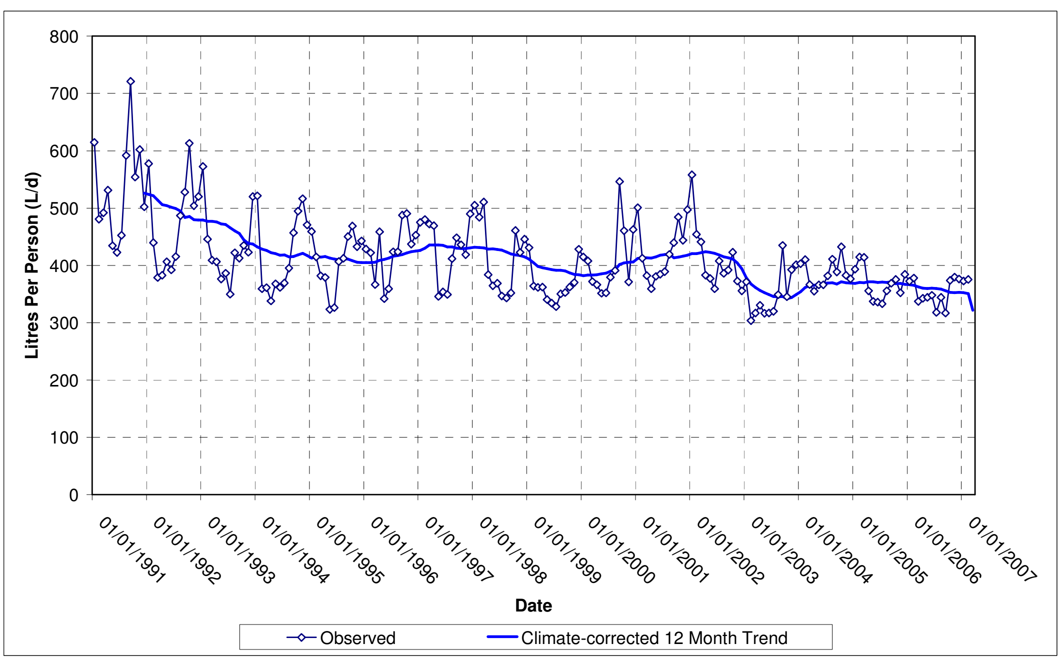


Figure 4-2 Climate Corrected Historic Demand



4.2.2 SECTORAL WATER CONSUMPTION TRENDS

In order to analyse the customer water consumption (i.e. water drawn from the network by customers through customer meters) in the various customer sectors, information from the Tweed Shire water billing system was extracted and analysed. Annual billing data including the total consumption and number of accounts in each customer sector was used. This data was rolled up into groups of land use codes (LUC). A summary of the number of accounts, total consumption and average consumption per account for the period 2001/2 to 2005/6 is provided in Table 4-1, Table 4-2 and Table 4-3 respectively.

It is noted that some of the billing data could not be allocated to a particular land use and therefore was not included in this assessment. This data was however included in the assessment of NRW.

Table 4-1 Number of Accounts Served per Sector

Sector	Abbreviation	Number of Accounts				
		2001/2	2002/3	2003/4	2004/5	2005/6
Single Family Residential	SFR	16,381	16,319	16,708	17,328	15,977
Multi-Family Residential	MFR	1,819	2,196	2,229	1,888	2,104
Bulk Sales	BS	1,652	827	774	195	1,896
Commercial	COM	798	939	914	922	887
Industrial	IND	0	32	24	50	128
Public Uses	PUB	465	305	312	212	280
Rural	RUR	230	232	238	232	212

Table 4-2 Annual Consumption (ML/annum) per Sector

Sector	Abbreviation	Total Consumption (ML/a)				
		2001/2	2002/3	2003/4	2004/5	2005/6
Single Family Residential	SFR	4,626	3,767	3,942	4,304	3,938
Multi-Family Residential	MFR	1,495	1,411	1,508	1,545	1,476
Bulk Sales	BS	87	96	71	75	46
Commercial	COM	1,692	1,724	1,576	1,548	1,157
Industrial	IND	0	40	104	67	27
Public Uses	PUB	625	394	459	421	334
Rural	RUR	175	145	168	170	191

Table 4-3 Average Account Consumption (L/day) by Sector

Sector	Abbreviation	Average Consumption per Account (L/day)				
		2001/2	2002/3	2003/4	2004/5	2005/6
Single Family Residential	SFR	774	632	646	717	767
Multi-Family Residential	MFR	2,251	1,760	1,853	2,362	2,182
Bulk Sales	BS	144	317	252	1,104	76
Commercial	COM	5,808	5,031	4,724	4,848	4,060
Industrial	IND	0	3,450	11,917	3,864	658
Public Uses	PUB	3,681	3,536	4,027	5,729	3,708
Rural	RUR	2,090	1,713	1,932	2,122	2,798

Further assessment was undertaken for the residential sectors to assess the current average per person usage to be used as a basis for baseline forecasting. The average daily residential consumption per person was determined based on the billing information stated above and the estimated persons per account (2.8 for SFR and 1.9 for MFR respectively). The results are shown in Table 4-4 and Figure 4-3.

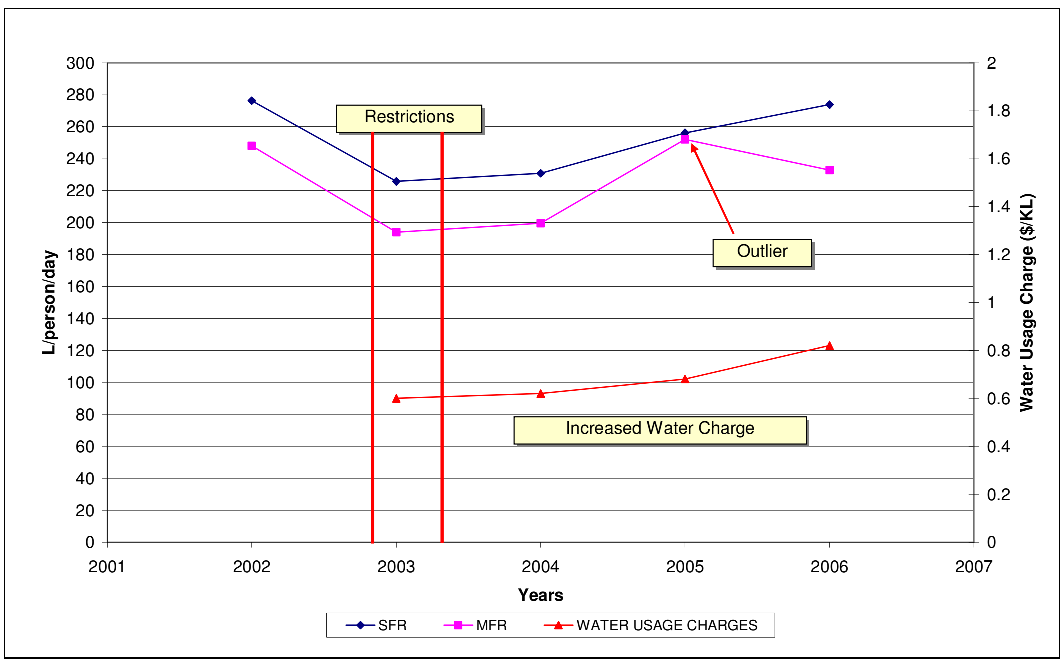
Within the assessment of the historic consumption further information including introduction of new water charges and drought restrictions were considered. The impact of these measures on residential consumption is also shown in Figure 4-3. Details about historical drought restrictions and increased water user charges can be found in Appendix B.

During the assessment it was found that the MFR consumption for 2005 was unusual high compared to previous usage. It was concluded that this figure was not representative and the data was excluded from the assessment.

Table 4-4 Average Daily Residential Consumption per Person (L/day)

Sector	Abbreviation	Daily Consumption (L/person/day)				
		2001/2	2002/3	2003/4	2004/5	2005/6
Single Family Residential	SFR	276	226	231	256	274
Multi-Family Residential	MFR	248	194	200	252	233

Figure 4-3 Historic Average Daily Water Consumption per Person



When reviewing the climate corrected production data, a downwards trend is evident since 2004. However the residential demand was slightly higher in 2006. This would normally have been explained through the climate correction of the billing record, that is the higher demand is related to climate and therefore the underlying trend is lower than the actual demand. For forecasting the baseline demand it was therefore it was decide to adopt a sectoral account demand of the average demand for the past three years.

The adopted per account consumptions are shown in Table 4-5.

Table 4-5 Adopted Average Daily Consumption per Account (L/day)

Sector	Abbreviation	Adopted Account Usage (L/day)
Single Family Residential	SFR	710
Multi-Family Residential	MFR	411
Bulk Sales	BS	197
Commercial	COM	4,060
Industrial	IND	3,657
Public Uses	PUB	4,136
Rural	RUR	2,131

4.2.3 WATER CONSUMPTION COMPARISON TO STATEWIDE PERFORMANCE

Information regarding statewide utility performance indicators was obtained from the Tables 3 and 4 of the DWE Water Supply and Sewerage Benchmark Report 2004/05. Table 4-6 outlines the average annual residential consumption for NSW and six coastal water service providers similar to Tweed Shire. For comparison, the sectoral consumption analysis results outlined in this report has been converted into annual residential consumption taking account of both single family residential and multi-family residential dwellings.

Table 4-6 Comparison of TSC Average Residential Demand to other NSW Centres

Area	Residential Consumption (kL/property/annum)			
	2001/2	2002/3	2003/4	2004/5
NSW (Average)	**240**	**220**	**215**	**200**
Byron Shire Council	-	-	-	214
Ballina City Council	-	-	-	220
Lismore City Council	-	-	-	179
Coffs Harbour City Council	-	-	-	186
Port Macquarie-Hastings	-	-	-	186
Mid Coast Water	-	-	-	204
Tweed Shire Council (based on analysis in this report)	**244**	**193**	**197**	**231**

According to the statewide figures there is a current downward trend in residential consumption. This is likely to be related to drought restrictions imposed during 2004/5, particularly in Sydney. In comparison the residential consumption for Tweed Shire has rebounded to 231 in 2004/5 following a lower consumption due to drought conditions of previous years. The 2004/5 is lower than pre-drought consumption in 2001/2. This leads to the conclusion that increased residential water awareness and elevated water charges have an effect on water usage.

4.2.4 NON-REVENUE WATER (NRW)

4.2.4.1 HISTORIC LEVEL OF NRW

The volume of Non-Revenue Water (NRW) was determined as the difference between total water production (treated water from the Bray Park Water Treatment Plant) and total water consumption (as measured at customer meters). For initial assessment purposes NRW is expressed as a percentage of the total production volume.

Table 4-7 outlines the derivation of the percentage of NRW. Fluctuations of NRW percentages can be related to major construction work and water infrastructure commissioning using un-metered water. For the purposes of this report a baseline NRW level of 13% of the total production was adopted for future demand modelling and assessment.

Table 4-7 Summary of NRW Assessment

Demand Component	2001/2	2002/3	2003/4	2004/5	2005/6
Annual Production (ML/a)	10,449	8,773	9,461	9,917	9,428
Annual Consumption (ML/a)	8,699	7,576	7,785	8,567	8,142
Non-Revenue Water	16.7%	13.6%	17.7%	13.6%	13.6%

4.2.4.2 KEY PERFORMANCE INDICATORS

A report was undertaken by Tweed Shire to assess the level of NRW and determine the Annual Key Performance Indicators (KPI) for the water supply network. The report indicates that the current performance of the system can be summarised in the following KPIs of 2005/2006:

- Percentage of NRW: 13.3% (level of service is 15%)
- Annual NRW per person: 17 kL/annum
- Estimated leakage: 600 ML/annum
- Estimated percentage of leakage: 6.4%
- Number of pipeline breaks failures: 29 / annum
- Number of pipeline breaks and failures per 100 km of mains: 4.4 / annum (level of service is 10).

The indicators show that the current water supply system satisfies the relevant targets of the 2006 Levels of Service.

4.2.4.3 INFRASTRUCTURE LEAKAGE INDEX (ILI)

The Infrastructure Leakage Index or ILI, developed by the World Bank Institute (WBI), can be used to provide a guide to the performance of water supply system losses. ILI is the ratio of the Current Annual Real Losses (CARL) and Unavoidable Annual Real Losses (URAL). Based on the ILI evaluation, the following network parameters and assumptions were adopted to calculate the ILI for the Bray Park water supply system for 2005/2006:

- Total pipeline length: 654 km
- Average operating pressure: 60 m
- Number of service connections: 29,459
- CARL = (18 x total pipeline length + 0.8 x no. of service connections) x average operating pressure = 2.12 ML/day
- URAL: 4.78 ML/day

Therefore, the ILI for Bray Park water supply system is about 2.3 and falls into Band B of the WBI grading system. Based on the WBI target matrix, the following actions are recommended:

- Investigate pressure management options, speed and quality of repairs
- Introduce / improve active leakage control
- Check the economic intervention frequency
- Identify options for improved maintenance
- Assess economic leakage level
- Review break frequencies and asset management policy.

4.3 BASELINE DEMAND FORECAST

4.3.1 OVERVIEW

As discussed in the previous sections, the first phase of the demand analysis was a historical examination of past and present trends in water usage. The outcome of this assessment is a starting point for reviewing the trends in water usage. Based on this analysis, the per account and per capita demands are adopted for use in future water needs forecasting.

For the Tweed Shire Demand Management strategy, the MWH “Decision Support System” (DSS) has been used to develop the detailed demand forecast. The DSS is an end use model, designed for assessing baseline water demand forecasts as well as evaluating various demand management, water use efficiency or source substitution (e.g. rain water tanks or recycled water) measures.

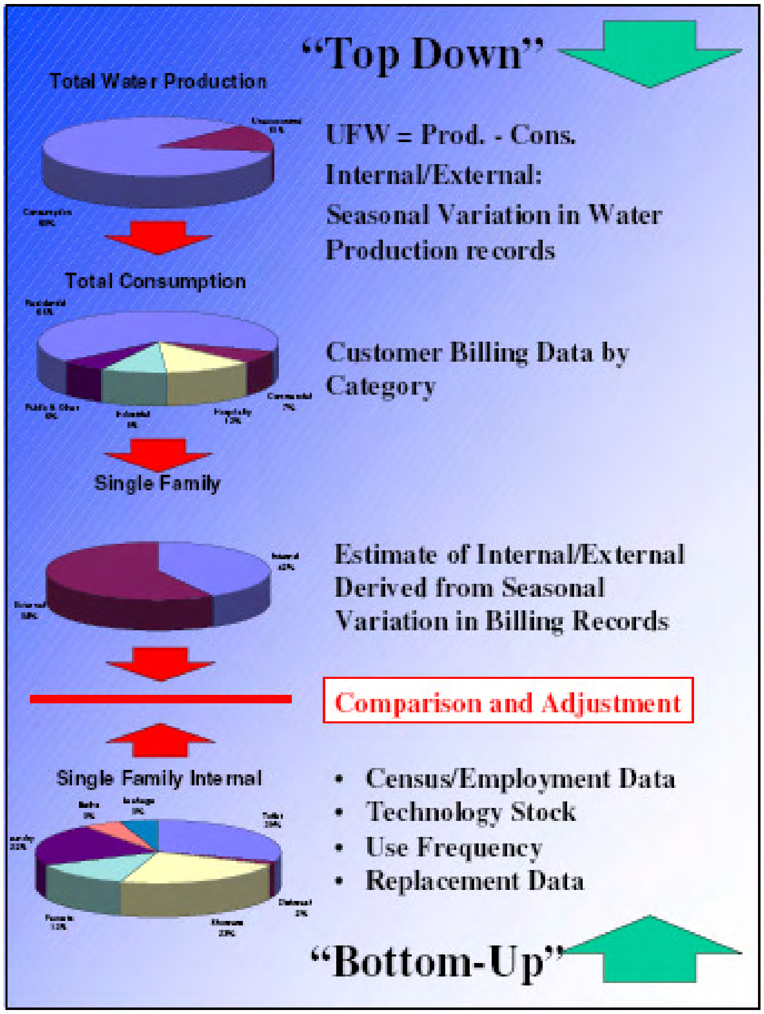
4.3.2 CALCULATION METHODOLOGY

The DSS end use model utilises ‘top down’ and ‘bottom up’ approaches to define a current demand breakdown as shown in Figure 4-4. In the ‘top down’ the internal water use is derived from both the water production model and sectoral consumption trend models. The default internal / external split for the Bottom Up used is based on examination of the production record for minimum demand periods as well as available end use studies completed in Australia (for example, the Perth “Domestic Water Use Study” and the more recent Yarra Valley End Use Study). Sewer gauging studies are also used to provide data on residential internal use.

The calibration process undertaken to ensure accuracy of the initial demand end use breakdown (existing development) is as follows:

- Entry of typical end use breakdown of internal and external uses in existing residential accounts
- Entry of the starting point per account daily demands
- Entry of population forecasts across the different sectors and people per account forecasts
- Review and adjustment of the external and internal split given the residential consumption and the number of people per account
- Definition of the non revenue water percentage
- Determination of a ‘bottom up’ total water production value by summing the consumption and the NRW
- Comparison of the ‘bottom up’ water production figure with the ‘top down’ observed and climate corrected water production obtained from the historic trend tracking. Adjustment of parameters is then undertaken where necessary.

Figure 4-4 Calibration Process for the Decision Support System



New dwellings incorporated into the forecast are assumed to have reduced internal water consumption, as a result of the use of more efficient water use fixtures. In particular it is assumed that all new dwellings will have dual flush toilets. The reduction in internal usage is generally is approximately 22 litres per person per day.

4.3.3 ADOPTED END USE BREAKDOWN

End use forecasting is an emerging field which relies on many small assumptions to build up a big picture. As such, a review of recent end use studies was conducted in order to determine a set of 'best available' end use assumptions for the project.

The applicability of the data gained in any end use study must be considered by examining the following factors:

- Location of study region
- Length of study period

- Demographic and socio-economic nature of study region
- Climate of study region
- Technique used for data collection (e.g. Phone survey, data logging)
- Sample size
- Confidence intervals (if available).

The end-use studies which have been considered as part of this study are:

- Perth *Domestic Water Use Study*, Western Australia, 1998-2001, Water Corporation Western Australia
- 2003/2004 Yarra Valley Water End Use Studies
  - 2003 Appliance Stock and Usage Patterns Survey
  - 2004 Residential End Use Measurement Study.
- American Water Works Association (AWWA), “Residential End Uses of Water Study” (USA)

The most recent end use study is from Yarra Valley Water (YVW). This study is also noteworthy due to its sound methodological approach. One limitation with the study was a relatively small sample size (100 houses in measurement stage of study, compared to 244 single and multi residential households measured in Perth). The other limiting factor was that the measurement stage focused entirely on single family dwellings and hence covered a relatively higher than average household size. Results from this study have been the major influence on values chosen in this study, but data has been modified where necessary.

The YVW study identified and quantified the link between household size and per capita water use. The results clearly showed decreasing per capita use with increasing household size. The results of the study resulted in an average per capita internal use of 169 L/person/day, based on an average household size of 3.1 persons. When this is factored to reflect an average household size across the YVW customer base it equates to 178 L/person/day. This correlates well with sewer flow gauging studies undertaken in Australia.

For both the Perth and YVW studies, the study period coincided with a period of drought and low level water restrictions. Although indoor use is less influenced by climate and water restrictions than outdoor, surveys have shown that people may also modify their indoor use during periods of restrictions, although this usually occurs for the later stages of restrictions rather than for the more outdoor and voluntary levels. However, the results of both studies may represent a lower than average indoor use total.

A second factor which will play a part in any study of end use is the problem of participants being a 'self selecting sample'. This means that the way participant's use water is not representative of how people use water on average, because they are already more water conscious than average and hence use less water than average. This was evident in the evaluation of the 'Every Drop Counts Residential Retrofit Program" (Beatty, K. et al 2005). The participant group in this program used consistently less water than the control group before the retrofits occurred in all four billing quarters. This difference was in the order of 5%.

Given the two factors above, the overall average per person indoor consumption figure used in the study has been set higher than the figure derived from YVW (unless specific consumption data suggests otherwise). A number of factors used to build up the total indoor use per person vary significantly from those estimated in YVW. These main differences are:

- *Shower frequency.* The measurement stage of YVW recorded an average frequency of use of 0.85 showers per person per day (in a sample size of 100). The survey stage recorded 1.0 showers per person per day (in a sample size of 840). A figure of 1.0 has been used in the is study as the lower figure from the YVW study is likely to be significantly influenced by the disproportionate number of children under twelve in the houses in the YVW measurement stage.
- *Toilet usage.* The measurement stage of YVW recorded and average of 4.2 flushes per person per day. It is likely that this was influenced by the higher household size of this group (more likelihood of young children and parents being present in the house during full day). The YVW report suggests that a figure of 3.8 flushes per person per day would be reasonable when extrapolating to their entire customer base. Given that Tweed Shire household size lies somewhere between these two figures, a figure of 4.0 flushes per person per day was adopted.
- *Existing proportion of water efficient appliances.* ABS survey information for NSW has been considered to establish the current baseline residential fixture profile for Tweed Shire. Appliance ownership figures for dishwashers, washing machines and toilets show that there is a natural tendency for more water efficient fixtures and appliances to increase in popularity (George Wilkenfeld and Associates, 2003). This trend towards increasing appliance efficiency is anticipated to continue into the future and will result in changes in household water use per account.

Estimated baseline figures for each fixture type are shown in Table 4-8. It is noted that figures for new residential reflect the current market share of fixtures without the additional impact by WELS and legislative requirements under the BASIX program. WELS and BASIX will further increase the uptake of water efficient fixtures and appliances, particularly showerheads and washing machines. Additional savings by these initiatives are discussed in Section 5.

Table 4-8 Baseline Fixture Market Share 2006/7

Fixture		Flow Rate (L/min)	Time of Usage (min)	Frequency of Use (Uses/person/day)	Total Volume (L/person/day)
Shower	Existing	10.1	7.0	1	71
	New	9.4	7.0	1	66
Toilet	Existing	7.2	-	4	29
	New	3.8	-	4	15
Washing Machine	Existing	144.7	-	0.33	48
	New	114	-	0.33	38
Tap	Existing	-	-	-	27
	New	-	-	-	27
Dishwasher	Existing	-	-	-	2.7
	New	-	-	-	2.7

Figure 4-5, Figure 4-6 and Figure 4-7 show the adopted ownership projections for single family residential dwellings for showerheads, toilets and washing machines respectively. The relationships outlined in these figures are termed Fixture Models and are used to predict future water use as the more efficient fixtures replace existing stock.

Figure 4-5 Projected Installed Shower Stock – Baseline Case (existing and new SFR)

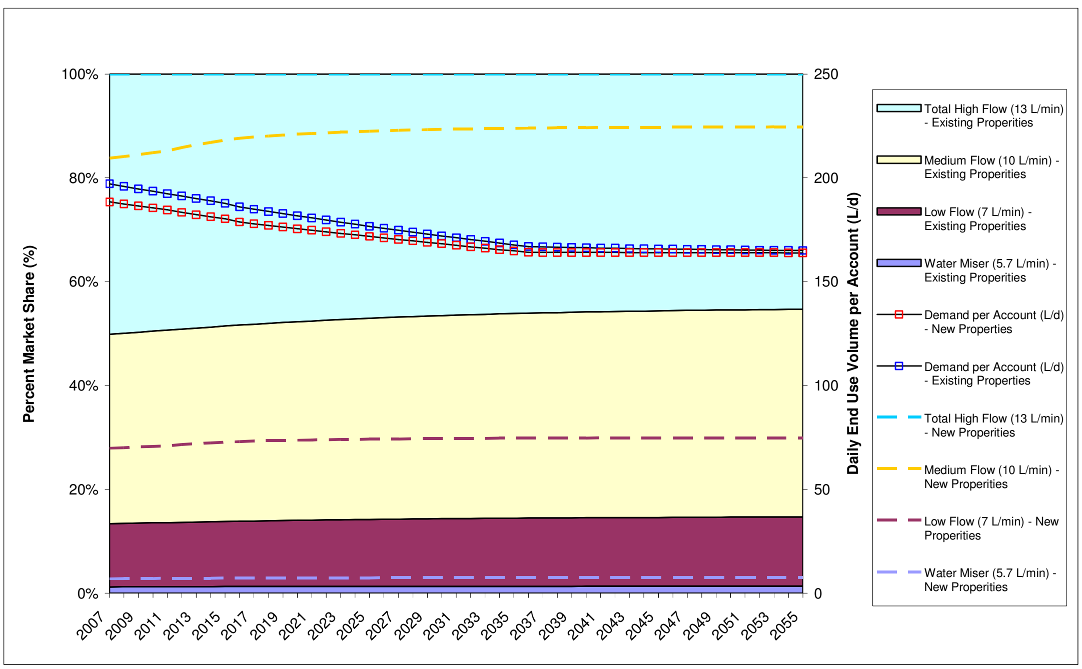


Figure 4-6 Projected Installed Toilet Stock – Baseline Case (existing and new SFR)

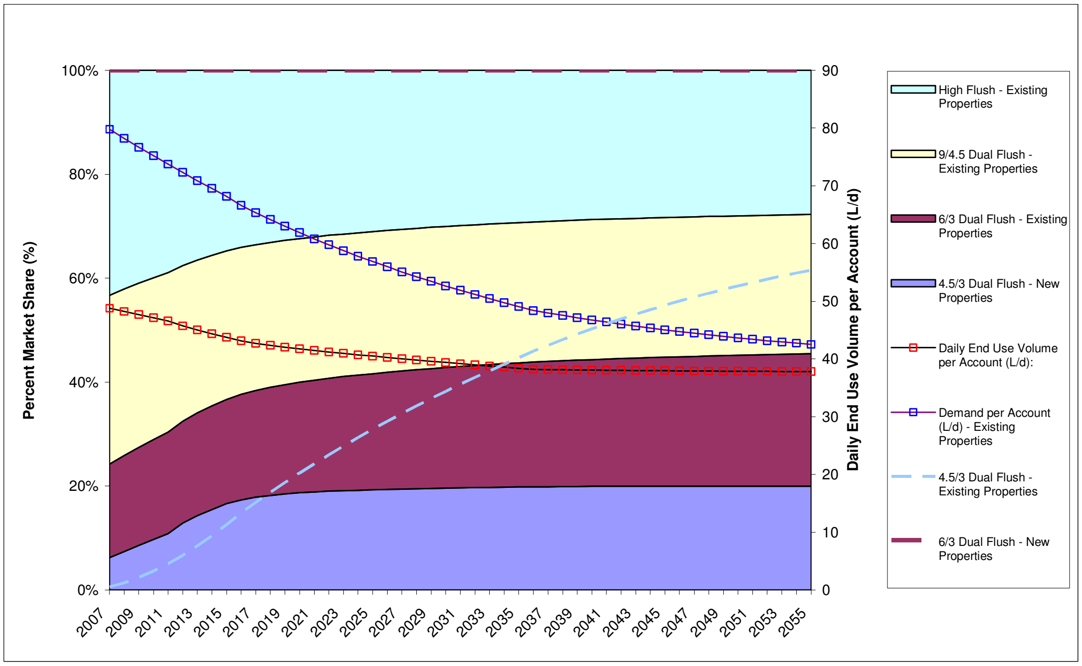
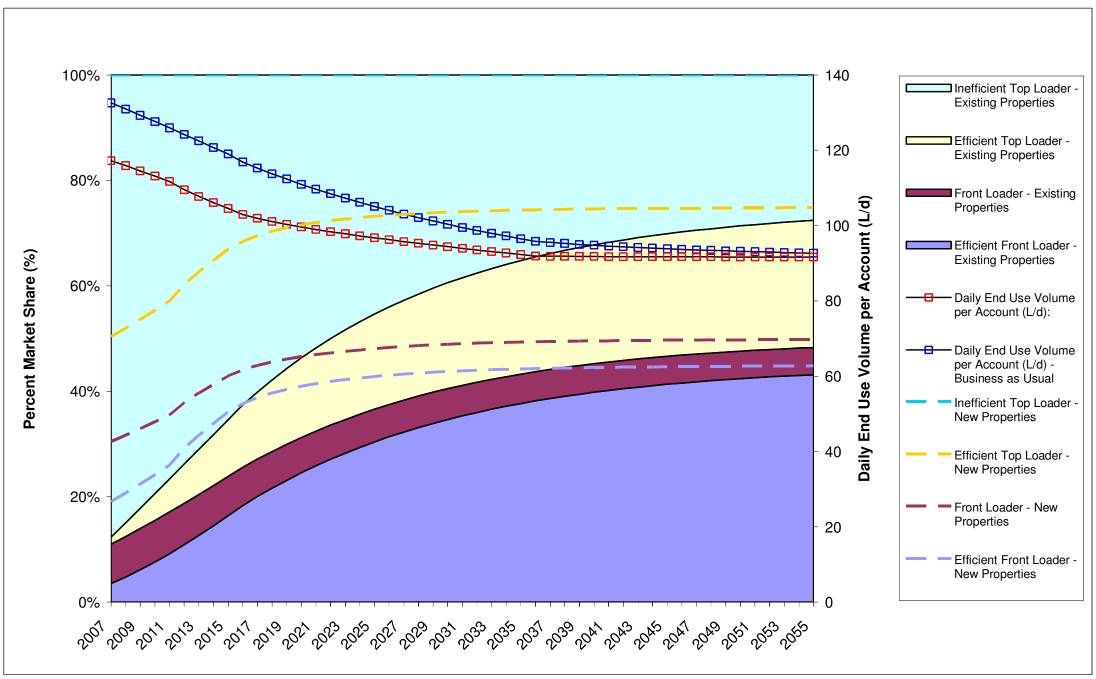


Figure 4-7 Projected Installed Washing Machine Stock – Baseline Case (existing / new SFR)



The adopted end use breakdown for the various sectors is shown in Table 4-9. Figure 4-8 and Figure 4-9 summarise the end use breakdown for an existing single family residential household based on 2.8 persons per account.

Table 4-9 Sectoral End Use Breakdown for 2007

Customer Sector	Internal Breakdown (Total 100%)							Total Usage	
	Toilet	Shower	Laundry	Bath	D/washer	Taps	Leakage	Internal	External
Existing SFR / MFR	15%	36%	24%	1%	1%	14%	2%	77%	23%
New SFR / MFR	10%	38%	24%	2%	2%	15%	9%	75%	25%
Commercial	Each non-residential sector has specific end uses, e.g. Industrial Process, Tourist Kitchen Spray, and Public Toilets							80%	20%
Industrial								80%	20%
Public								80%	20%
Bulk Sales								20%	80%

Figure 4-8 Existing Single Family Internal / External Use

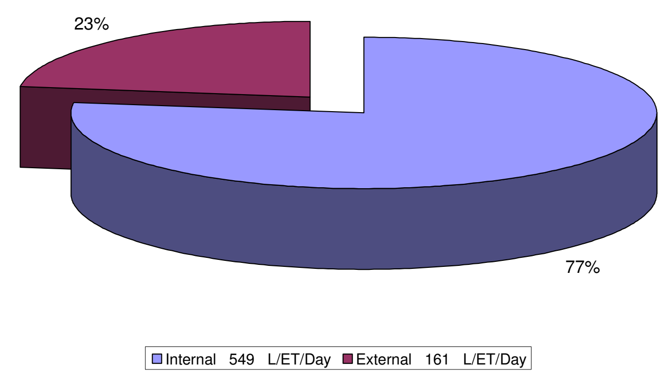
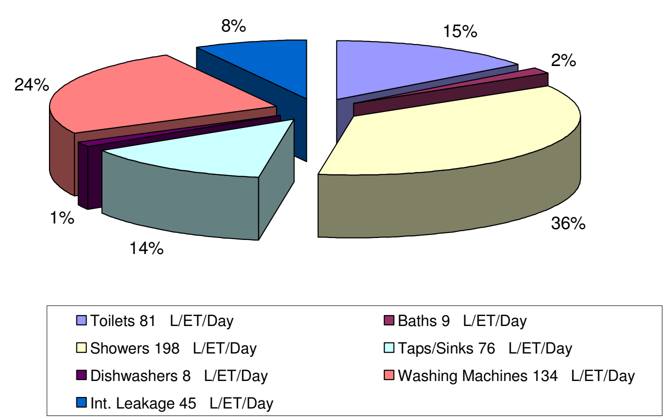


Figure 4-9 Existing Single Family Internal End Use



4.3.4 CURRENT WATER DEMAND SUMMARY

Figure 4-10 shows both the volume of water metered and the Non Revenue Water. As discussed in 4.2.4 the non-revenue percentage of the total water production has been assumed to continue its current trend of 13% if additional measures are not put in place.

Figure 4-10 Current Total Water Use

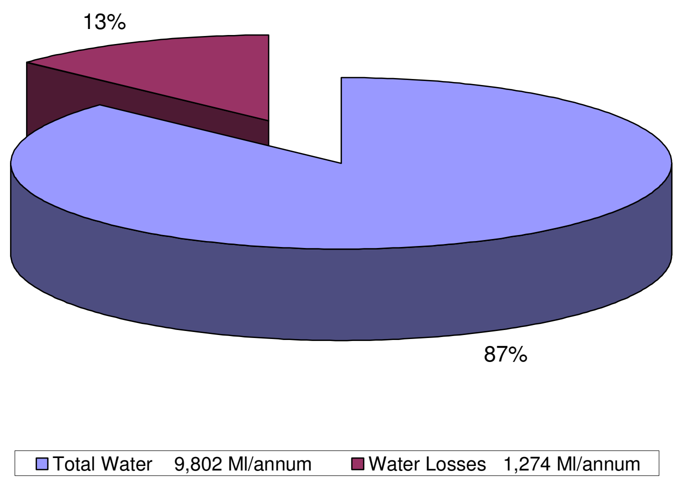
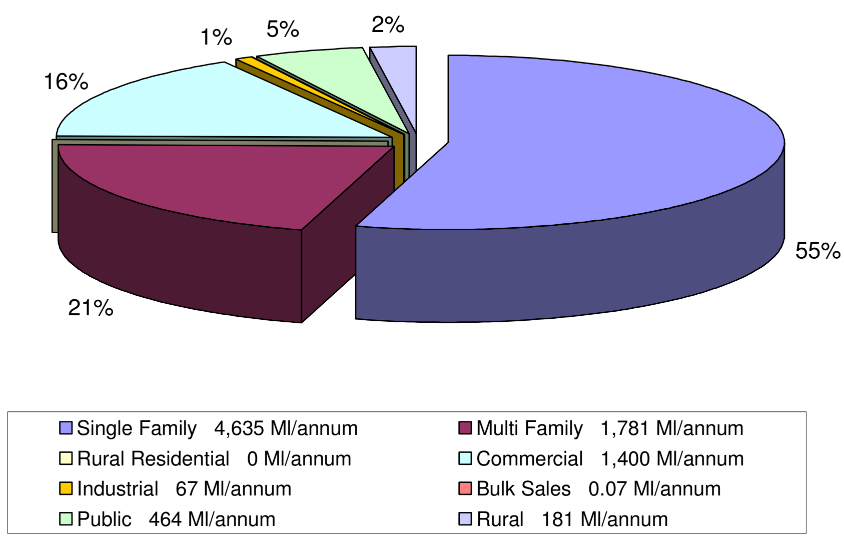


Figure 4-11 outlines the estimated sectoral consumption breakdown for the main supply areas of the shire. These figures are based on billing data analysis.

Figure 4-11 Total Sectoral Water Consumption Breakdown



4.3.5 FORECASTING ASSUMPTIONS

There are numerous assumptions and processes used within the end use model to provide an estimate of future water use. The key underlying processes can be divided into two groups: those which drive the demand per capita up; and those that drive the demand per capita down.

The two key processes which drive the overall demand per capita ***up*** are as follows:

- Household size or dwelling occupancy trends; the end use model reflects a decreasing household size
- Increased discretionary usage in new dwellings; the end use model adopts an increase of 0.8% per annum. Discretionary usage is defined as usage not controlled by fixtures, and includes external use, and the increased use of dishwashers, baths, spas or pools.

The main process that drives the overall demand per capita ***down*** is 'natural' conservation which results from the replacement of inefficient fixtures and fittings over time. This process is built into fixture models.

These key assumptions are summarised, in conjunction with other demand drivers in Table 4-10.

Table 4-10 Impact of Demand Drivers on Future Demand

Driver	Sensitivity	Adopted Action	Impact on Demand		
			Overall Residential	Overall Non-Residential	Overall Per Capita Demand
Population and Dwellings Growth	High	Increase (based on projections)	Increase	No change	No change
Non-residential Account Growth	Medium	Maintain current use	No change	No Change	No Change
Household Size	High	Decrease, results in increased account formation	Increase	No change	Increase
Housing Mix (SFR/MFR)	Medium	Increase proportion of Multi-Family Residential in Greenfield and Infill areas	Decrease	No change	Decrease
Residential Lot Size	Not modelled specifically although overlaps with housing mix assumptions.				
Market share of efficient fixtures	High	Increase	Decrease	No change	Decrease
Real household income	No change specifically modelled, but overlaps with lifestyle drivers				
Lifestyle	Medium	Increase discretionary use (baths, dishwashers, external)	Increase	Increase	Increase
Climate change	Low	Increased temperature, decreased rainfall	Potential increase	Potential increase	Potential increase

4.3.6 BASELINE FORECAST

Table 4-11and Figure 4-12 and Figure 4-13 provide a summary of the baseline forecast for Tweed Shire to the ultimate development in the year 2041. It noted that the Baseline Forecast is based on current and future predicted market share of fixtures **without** the impact of WELS or BASIX.

Table 4-11 Baseline Water Demand Forecast (Bray Park System)

Forecast	Baseline Water Demand Forecast							
	Unit	2006	2011	2016	2021	2026	2031	2036
Residential Demand	ML/a	6,416	7,238	8,511	9,821	10,829	11,870	13,103
Non-Residential Demand	ML/a	2,113	2,440	2,912	3,377	3,719	4,057	4,443
Non-Revenue Water (NRW)	ML/a	1,274	1,482	1,784	2,080	2,292	2,499	2,735
Total Annual Demand	ML/a	9,804	11,160	13,207	15,278	16,840	18,425	20,280
Per Capita Demand	L/Capita/day	367	359	353	350	350	352	354

Figure 4-12 – Total Annual Baseline Demand (Bray Park System)

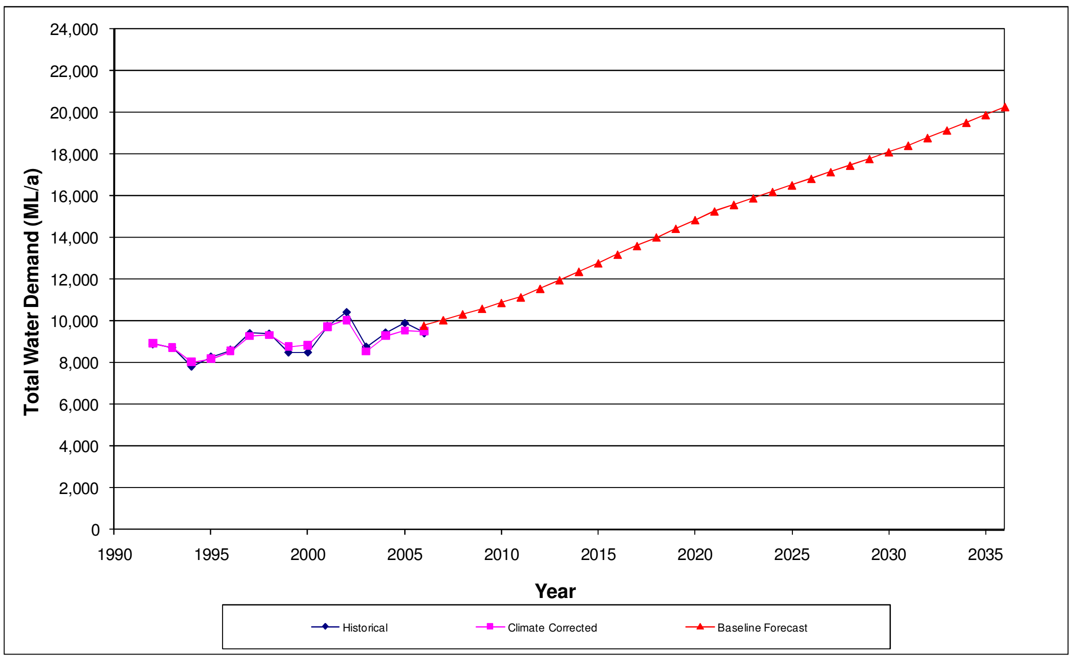
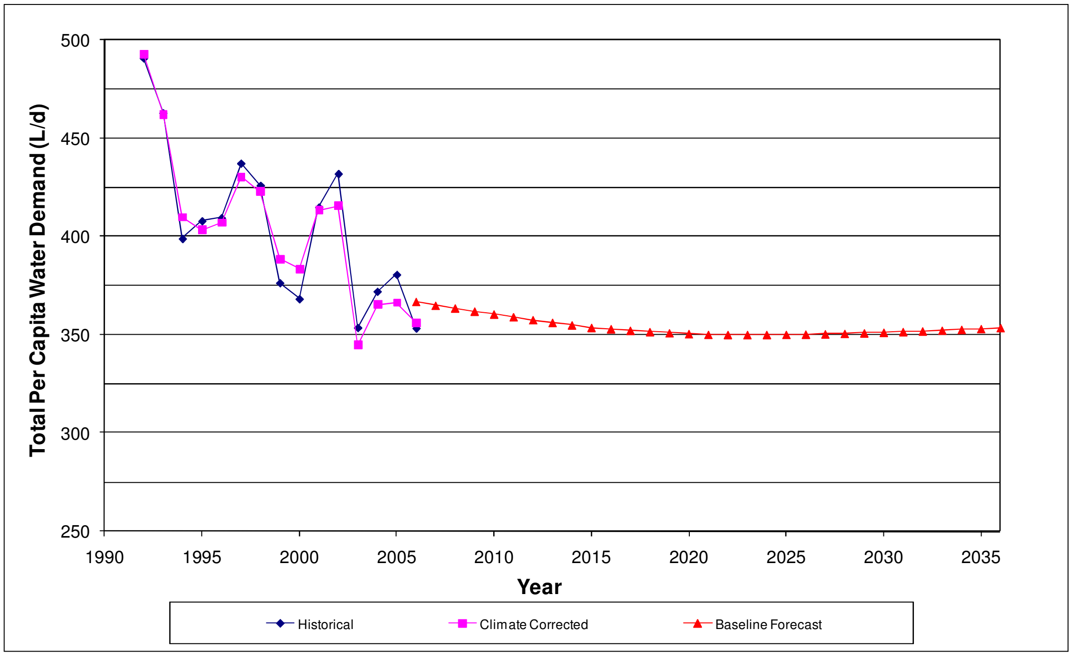


Figure 4-13 - Baseline Per Capita Demand Forecast (Bray Park System)



5. ASSESSMENT OF SCENARIOS IN GREENFIELD DEVELOPMENT AREAS

5.1 OVERVIEW

A specific assessment was undertaken to identify and analyse the costs and benefits of implementing demand management measures in the future growth areas of Cobaki Lakes, Bilambil Heights, Terranora Area E, West Kingscliff and Kings Forest. This section of the report outlines the development of the integrated scenarios, the assessment of the revised water forecasts and the costs and benefits of the options.

5.2 OUTLINE OF SCENARIOS

5.2.1 SUMMARY

Five scenarios, comprising a range of water efficiency measures, source substitution and water loss management were developed in conjunction with representatives of the Tweed Shire Council. The scenarios are defined as follows:

- Baseline – assumes that demand increases as per historic trends. The replacement of fittings and fixtures with more efficient units is assumed to occur at an unassisted rate through repairs and refurbishment.
- Scenario 1 – BASIX with Rainwater Tanks serving external, cold water for washing machine and toilets
- Scenario 2 – BASIX with Dual Reticulation serving external and toilets.
- Scenario 3 – BASIX with both Dual Reticulation (external and toilets) and Rainwater Tanks (serving cold water to washing machine and showers)
- Scenario 4 – BASIX with Rainwater Tanks (serving external and toilets) and Indirect Potable Reuse. This combination will increase the level of source substitution and reduce the reliance on the current dam supply.
- Scenario 5 – BASIX with 4th Pipe Network (separated greywater collection and reuse, and blackwater collection and disposal) as proposed by Leda for development of Cobaki Lakes and Kings Forest.

Each of the above scenarios reflects the current legislative requirements for new residential developments in New South Wales (NSW) according to the Building Sustainable Index (BASIX). All scenarios consider the installation of water efficient fixtures including showerheads, taps and dual flush toilets. According to BASIX these fixtures were considered to be 3 Stars or higher. Furthermore, a minimum of one source substitution option has been applied.

Besides the water savings generated through BASIX, additional savings from residential and non-residential education programs and the national water efficiency labelling and standards (WELS) scheme have been considered.

Table 5-1 summarises the general components of the adopted scenarios together with key assumptions.

Table 5-1 Overview of Demand Management Measures for Greenfield Development Areas

PROGRAM	TARGET SECTOR	TAKE UP RATE	WATER SAVINGS
WELS PROGRAM			
WATER EFFICIENT WASHING MACHINES	ALL NEW SINGLE AND MULTI-FAMILY RESIDENTIAL DWELLINGS	INCREASED SALE OF EFFICIENT WASHING MACHINES BY 7%	30% SAVINGS OF ORIGINAL HOUSEHOLD WASHING MACHINE DEMAND
WATER EFFICIENT DISHWASHERS		INCREASED SALE OF EFFICIENT DISHWASHERS BY 2%	20% SAVINGS OF ORIGINAL DISHWASHER DEMAND
EDUCATION			
BEHAVIOURAL CHANGES AND AWARENESS	ALL NEW SINGLE AND MULTI-FAMILY RESIDENTIAL DWELLINGS	100% OF RESIDENTIAL ACCOUNTS	1% SAVINGS FOR ALL INTERNAL END USES AND 2% OF EXTERNAL END USES
NON-RESIDENTIAL TRAINING OF LANDSCAPE MANAGERS AND WORKERS	NEW COMMERCIAL, PUBLIC AND OPEN SPACE IRRIGATION	80% OF IDENTIFIED ACCOUNTS	10% OF EXTERNAL AND INTERNAL IRRIGATION DEMAND
BASIX EFFICIENT FIXTURE REQUIREMENTS			
WATER EFFICIENT TAPS (MINIMUM 3 STAR)	ALL NEW SINGLE AND MULTI-FAMILY RESIDENTIAL DWELLINGS	100% OF NEW RESIDENTIAL ACCOUNTS	20% SAVINGS OF CURRENT DEMAND FOR TAPS AND SINKS
WATER EFFICIENT SHOWER HEADS (MINIMUM 3 STAR)		100% OF NEW RESIDENTIAL ACCOUNTS	15% SAVINGS OF CURRENT SHOWER DEMAND
WATER EFFICIENT DUAL FLUSH TOILET (MINIMUM 3 STAR)		100% OF NEW RESIDENTIAL ACCOUNTS	40% SAVINGS CURRENT EXISTING TOILET DEMAND
BASIX SOURCE SUBSTITUTION (RAINWATER TANKS OR RECYCLED WATER) –THIS APPLICATION IS SITE AND SCENARIO SPECIFIC. SEPARATE ANALYSIS HAS BEEN UNDERTAKEN. REFER TO SECTIONS 5.2.2 TO 5.2.6			
NON-RESIDENTIAL SAVINGS PROGRAM			
WATER EFFICIENT NON-RESIDENTIAL FIXTURES AND MANAGEMENT PROGRAM	ALL NEW NON-RESIDENTIAL ACCOUNTS	100% OF NON-RESIDENTIAL ACCOUNTS	20% SAVINGS OF ORIGINAL INTERNAL AND EXTERNAL DEMAND
LOSS MANAGEMENT PROGRAM			
LEAKAGE DETECTION AND PRESSURE REDUCTION PROGRAM	NON REVENUE WATER	THREE YEARS TO ACHIEVE SAVINGS	REDUCTION OF NRW FROM 13 TO 10% OF PRODUCTION

5.2.2 SCENARIO 1 – BASIX WITH 5KL RAINWATER TANK

Scenario 1 reflects the most common application of BASIX as defined through the DWE survey of development activity since the commencement of the regulation. Based on a state wide survey, the most widely adopted BASIX action includes a 5,000 L rainwater tank connected to external uses, toilets and cold water to the washing machine. The average connected roof area was 160 m^2 (80% of the average 200m^2).

Assessment of the required tank size for TSC is provided in Section 5.3.1. It was found that the most appropriate tank size for the Tweed Shire was 5,000L for a residential detached dwelling.

Table 5-2 Scenario 1 Source Substitution Components

SOURCE SUBSTITUTION	TARGET SECTOR	TAKE UP RATE	WATER SAVINGS
5 KL RAINWATER TANK (CONNECTED TO 160M^2 ROOF AREA)	SINGLE FAMILY AND MUL FAMILY RESIDENTIAL ACCOUNTS CONNECTED TO EXTERNAL, TOILET AND COLD WATER LAUNDRY	100% OF ALL NEW ACCOUNTS	DAILY AVERAGE YIELD OF TANK IS 231 L/DAY FOR SINGLE RESIDENTIAL DWELLINGS (AVERAGE 66% WATER SAVINGS)

5.2.3 SCENARIO 2 – BASIX WITH DUAL RETICULATION

Scenario 2 involves the use of the BASIX demand management measures plus the provision of dual reticulation as a further potential source substitution option. Scenario 2 assesses potential savings to be made by connecting a third pipe system to all external end-uses and toilets.

Table 5-3 Source Substitution – Scenario 2

Source Substitution	Target Sector	Take up Rate	Water Savings
Dual Reticulation	Single Family and Multi Family residential accounts Connected to external and toilet	100% of all new accounts	100% potable water savings of external and toilet demand

5.2.4 SCENARIO 3 – BASIX WITH DUAL RETICULATION AND RAINWATER TANK

Scenario 3 involves the use of the BASIX demand management measures plus the provision of dual reticulation and the use of a rainwater tank to optimise the potable substitution within the dwelling. Table 5-4 summarises the application of Scenario 3 to proposed residential development.

Table 5-4 Source Substitution – Scenario 3

Source Substitution	Target Sector	Take up Rate	Water Savings
Dual Reticulation	Single Family and Multi Family residential accounts Connected to external and toilet	100% of all new accounts	100% potable water savings of external and toilet demand
5 kL Rainwater Tank – connected to 160m^2 roof area[1]	Single Family and Multi Family residential accounts Connected to cold water washing machine and showers	100% of all new accounts	Daily average RWT yield – 192 L/day for single residential dwellings – on average 67% water savings of connected end-uses

[1] Note – 160m^2 roof area referring to single residential dwellings. Connected roof area for Multi-residential dwellings determined on per person per account basis.

5.2.5 SCENARIO 4 – BASIX WITH RAINWATER TANK AND INDIRECT POTABLE REUSE

Scenario 4 examines the option of Indirect Potable Reuse in conjunction with water efficient fixtures and mandatory rainwater tanks connected to external and toilet use for new residential developments. The potable water demand can be expected to be the same as determined in Scenario 1. The indirect potable reuse yield has been determined as the 75%ile of dry weather flows entering Banora Point and Kingscliff STPs in 2041. Further details about the methodology of this analysis are provided in Section 5.4.4. Table 5-5 summarises the application of Scenario 4 to proposed residential development.

Table 5-5 Source Substitution – Scenario 4

SOURCE SUBSTITUTION	TARGET SECTOR	TAKE UP RATE	WATER SAVINGS
5 KL RAINWATER TANK (CONNECTED TO 160M^2 ROOF AREA)	SINGLE FAMILY AND MULTI FAMILY RESIDENTIAL ACCOUNTS CONNECTED TO EXTERNAL, TOILET AND COLD WATER LAUNDRY	100% OF ALL NEW ACCOUNTS	DAILY AVERAGE YIELD OF TANK IS 231 L/DAY FOR SINGLE RESIDENTIAL DWELLINGS (AVERAGE 66% WATER SAVINGS)
INDIRECT POTABLE REUSE	ALL OF WATER BRAY PARK SCHEME	100% OF EXISTING AND FUTURE DEVELOPMENT	REFER TO SECTION 5.4.4

5.2.6 SCENARIO 5 – BASIX WITH 4TH PIPE NETWORK

The '4th Pipe' reticulation concept consists of two classes of water being separately collected from each property:

- Greywater (from other uses such as baths, showers, hand basins and laundry)
- Black water (from toilets, kitchen sinks and dishwashers).

Table 5-5 summarises the application of Scenario 5 to proposed residential development.

Table 5-6 Source Substitution – Scenario 5

Source Substitution	Target Sector	Take up Rate	Water Savings
Dual Reticulation – treated greywater	Single Family and Multi Family residential accounts Connected to external and toilet	100% of all new accounts	100% potable water savings of external demand
Open Space Irrigation – treated blackwater	Open Space areas such as golf course, parks, gardens and median strips	As required to dispose of treated blackwater and excess effluent from greywater treatment	Depends on the end use (not known at this stage)

The recycled greywater would be returned from a treatment plant to the property and used for garden use and toilet flushing.

There are three options available for treatment of the recycled grey water, these are:

- On-site treatment for each property
- Cluster treatment for a small group of properties
- Regional treatment at a central location, most likely a new STP close to the development.

This option was assessed through both a literature search and consideration of the construction, operations and maintenance aspects of the system. Discussion of related issues is provided below:

- The benefit of a 4 pipe greywater reuse system is proposed by the development to be greater public acceptability as no water is reused inside the house. Based on surveys undertaken as part of the development of the Pimpama Coomera project the public acceptance of highly treated recycled water is very high. No problems are anticipated in acceptance where comprehensive education occurs.
- There is a reduction in sewage loading allowing for lower capital and operational costs for blackwater transport. However due to change in loading and reduced flow in sewers, it is believed that sewer slopes will need to be steeper than for traditional systems and additional costs will result. In addition there will be a requirement to have two collection pipes thus increasing the capital cost, maintenance cost and the future replacement burden on the council.
- If the scheme is implemented extensively it would result in a more concentrated blackwater effluent going to the STP, which could impact on the ability of the STP to treat the effluent to the required standard.
- There is potential for septicity of the greywater to occur if allowed to stand untreated for a time as short as a few hours. This may lead to difficulty in consistent treatment.
- Effective operation relies on householder education and ‘buy-in’ so that there is an awareness of what can and cannot be discharged to the system (i.e. detergent type).
- The scheme requires more management than a traditional system (i.e. disinfection system needs regular maintenance, which particularly in the decentralised options can be a significant cost).
- There is potential in some instances for decentralised grey water treatment to reduce the total lifecycle costs as compared to centralised treatment for all wastewater given the reduction in capital and transportation costs.
- Given the potential for septicity and the need for regular maintenance there are potential health risks associated with treatment especially if treatment is on a household level and the householder does not understand or take responsibility for the treatment system.

Based on an initial review, it is believed that the considerable disadvantages, relating to operations risk and high initial and on-going cost, significantly outweigh the perceived advantage of public acceptance of this scenario. This option was not assessed further in the detailed assessment of options, but was included for the overall qualitative Triple Bottom Line Assessment undertaken in Section 7 of this report.

5.2.7 RELATED WATER CYCLE ISSUES AND OPTIONS

The aim of the following section is to provide background information on additional integrated water cycle options not mentioned above, including the reduction of wet weather flows by the installation of smart sewers and the harvesting and use of recycled water via sewer mining.

5.2.7.1 SMART SEWERS / LOW PRESSURE SEWERS / VACUUM SEWERS

Smart Sewers

Reduced Infiltration Gravity Sewerage (RIGS) Systems as the name suggests, are sewer systems designed to reduce infiltration of stormwater and groundwater inflows into the sewer system and therefore reduce Wet Weather Flows (WWF). This reduction is estimated to be in the region of 40-50% of WWF, which can be especially advantageous in areas where stormwater infiltration is high (WWFs have been observed with flows in excess of 10 x ADWF in some catchments).

Essentially, RIGS systems are a ‘smart’ way of using the available technology in sewer design hence, the alternative epithet of ‘Smart Sewers’. A reduction in infiltration is achieved through a combination of the following:

- Use of flexible polyethylene (PE) pipes and fittings which allow the introduction of bends in the system in both the vertical and horizontal plane. This reduces the need for maintenance holes, a major point of entry for water.
- The assumption of sole use of CCTV apparatus for inspection activities and jet-rodding for clearing blockages (i.e. no allowance for man entry) further reduces the need for maintenance holes.
- Access is provided using water tight maintenance structures in place of manholes.
- Fusion wielding of pipe joints; this not only reduces infiltration at the joints it reduces the possibility of tree root infiltration and hence damage to sewers.

A summary of key findings based on a review of RIGS systems found that:

- RIGS systems can offer a savings in capital costs through fewer maintenance access points due to the reduction in maintenance access and smaller pipe requirements due to the decrease in WWFs.
- They can offer a reduction in pumping and treatment costs, due to the lower dry weather and wet weather flows.
- They can offer a reduction in maintenance costs, due to fusion welded joints reducing the likelihood of tree root ingress.
- RIGS can be applied to both trench and trenchless installations using directional drilling.

Low Pressure Sewers

On a household level pressure sewer systems involve waste draining by gravity to a pump. Flows are then discharged to the transport main using the collective pressure generated by the pumps in the property pumping units. The pump also contains a grinder which reduces solids to a slurry to minimises the possibility of pipe blockages. Typically these systems are used where conventional sewers become expensive or impractical due to site conditions.

A summary of key findings based on a review by MWH of pressure sewer systems found that pressure sewers:

- May be the more economic option in areas with a largely rocky sub-surface as they only require shallow, narrow trenches, compared with the wider, deeper trenches needed by conventional sewers.
- Are suitable for areas with a higher groundwater table as de-watering may not be necessary due to the shallow depths.
- May be the more economic option in areas where properties are widely spread where conventional gravity sewers would need deeper trench depths and more lift stations.
- May be the more economic option in areas of flat topography due to the depth of conventional sewers construction.
- Reduce infiltration problems as pipes are pressurized and therefore sealed. This does not however reduce inflow from illegal connections and therefore high wet weather flows can occur.
- Have been used widely across the world including Australia and well designed pressure systems have been proved relatively easy to maintain.
- In some cases, pressure sewers and other alternative systems have been use inappropriately incurring additional expense unnecessarily.
- Each installation causes significant disturbance and inconvenience to the household, therefore a considerable amount of time is required for public relations.
- Need to use a backup generator in areas where prolonged power outages occur.

Vacuum Sewers

In locations of flat topography and high water table, such as many areas of the Tweed Shire coastal plain, conventional gravity sewerage systems may not be the most suitable option. Gravity systems require a certain pipe gradient to maintain flows which results in the need for deep excavations and/or numerous lifting stations. Installation costs can be high especially so in the case of a high water table as installation can be slow and difficult.

A summary of key findings based on a literature review by MWH of Vacuum Sewer systems found that:

- Conditions that favour the selection of vacuum sewer systems include unstable soils, flat topography, high water table and rocky sub-surface.
- The vacuum system is sealed and soil contamination is controlled, therefore suitable for environmentally sensitive sites, such as deltas or river shores.
- One central vacuum station is required as opposed to a number of rising stations. However, topography is a limiting factor in the location of a vacuum station, as the vacuum produced by the vacuum pumps is only able to lift about 4.5 - 6m.
- Construction cost savings may come at the expense of higher operation and maintenance costs when compared to a conventional sewer. Savings of up to 20% have been quoted however; the relatively small cost savings achieved make this option cost affective only in situations where a conventional sewer system is difficult or expensive to install.

- The major risk with this system is the vacuum valve failing in a closed position, this can result in wastewater backing-up the gravity drains and flooding into the property, this risk is exacerbated where raw sewerage is being transported without the intervention of a septic tank system.

There is limited data available in Australia where vacuum systems have generally only been used in small scale specialist situations. However, in both Europe and the US vacuum sewers have been installed with some success in situations where conventional gravity sewers would be costly. Examples of developments where vacuum sewer systems have been implemented in Australia are as follows:

- The coastal town of Minnamurra, New South Wales, where a vacuum sewage system was chosen due to flat topography, high water table, and environmentally sensitive surroundings;
- The Sanctuary Lakes development in South Australia where a vacuum system was chosen due to a high water table with clay fill soil in a highly saline location;
- Couran Cove Eco Resort, South Stradbroke Island where flat topography and environmentally sensitive surroundings resulted in this option being chosen.

Given the low lying nature and high water table of the Tweed Shire coastal plain the cost of implementing a conventional sewerage system may be prohibitive. This, in combination with the environmentally sensitive nature of some of the development areas, may make a vacuum sewerage system appropriate.

5.2.7.2 SEWER MINING

Sewer mining is the process of tapping directly into a sewer (either before or after a sewage treatment plant) and extracting wastewater for treatment and reuse as recycled water. Some sewer mining by-products may be returned into the sewerage system (sydneywater.com.au).

While the use of treated effluent for source substitution option is not a new concept, sewer mining is considered as a more decentralised / localised option for accessing recycled water. In cases where areas identified for potential recycled water supply schemes are found to be economically impractical (e.g. due to distance from a sewerage treatment plant), sewer mining may provide more feasible opportunities.

Potential uses for sewer mining applications include small scale residential areas (typically greenfield), irrigation, industrial use and fire fighting. A summary of key issues related to sewer is as follows:

- The average cost of fitting a third pipe system to a single dwelling is estimated as $2,000, which excludes trunk infrastructure.
- Recycled water is a possible application for outdoor and toilet flushing end uses.
- The application of recycled water in a residential dwelling for outdoor and toilet end uses is estimated to provide potable water savings between 30 to 50%.
- General industry has the potential to use large amount of recycled water.
- The issue of use of recycled water for urban fire fighting water supply is currently being resolved in Queensland and is critical to allowing potential downsizing the potable water supply system and the associated financial benefits.

Proponents of sewer mining schemes typically undertake preliminary discussions with referral and approval authorities, gain initial development approval, and then construction approval. Local councils approve the installation, operation and maintenance of privately operated recycled water schemes and the use of recycled water. Local government needs to seek the approval of the relevant Minister if Council itself is the proponent.

Benefits of sewer mining include a reduction on potable water sources and a reduction in the effluent discharged to receiving environments. When considering costs of sewer mining projects, the opportunity costs related to the alternative use of potable water made available as a result of recycling should also be considered.

5.2.7.3 OPEN SPACE IRRIGATION WITH RECYLED WATER

In the previous concept study “Tweed Shire Council - Recycled Water Opportunities” (February 2006) MWH outlined various options and costs for recycled water supply from several sewage treatment plants within Tweed Shire. These included the assessment of existing potential recycled water sites, i.e. memorial gardens, parks, sporting fields, private golf courses, a turf farm and plant nursery. The key driver for this concept study was the NSW EPA endorsement of the TSC Recycled Water Strategy.

Summarised, the progressive implementation of recycled water will have clear environmental benefits including reduction in nutrient loads and other pollutants currently discharged to the Tweed River. Future effluent water quality licence requirements set by the EPA for discharges to Tweed River may depend on the extent of recycled water achieved and the resultant reduction in pollutant loads on the river.

Although the demand for open space irrigation for the new growth areas has been included in the future potable demand assessment, it can be envisaged that this part of the future demand will be substituted to comply with the TSC Recycled Water Strategy.

It can be expected that in the event of introducing dual reticulation (Scenario 2 and 3) to the new growth areas, the installed third pipe system will be sufficiently designed to cover the additional demand for open space irrigation in the new growth areas.

Recycled Water (treated effluent)

Recycled water for use in open space irrigation is the most common source of potable water substitution. Using recycled water for irrigation has associated with it a number of considerations. As the source of treated effluent is relative constant throughout the year and not subject to seasonality, the issues with supply are not as significant as for other sources. Consequently, the need for storages is reduced to reflect the inflow of effluent, the treatment capacity and demand for the water source. Further advantages include a reduction in the detrimental impacts of wastewater discharges on the receiving environment and conservation of potable water supplies.

Although recycled water is commonly used on open spaces such as golf courses, open space irrigation of residential developments is subject to greater controls due to the increased risk of human contact. Recycled water is required to be of Class A+ quality and to meet stringent requirements to ensure that risk to human health is minimized. To that end, developments that intend to use recycled water as a water source for irrigation need to undertake a risk assessment / management approach to ensure that public health is not compromised. This may include subsurface or underground irrigation, which eliminates the chance of direct contact with people and also results in efficiency gains as it reduces water loss due to evaporation and surface runoff.

Stormwater

The use of stormwater for large scale irrigation is not common in urban areas. Reasons for this are primarily due to the cost of the storage (in terms of capital outlay, maintenance and space required) that would be required to store adequate supplies to meet annual demand. The uncertainty of supply is also a major factor that would make stormwater an unlikely source for open space irrigation.

Greywater

Greywater reuse is regarded as an alternative substitution option within the residential sector. Similar to Scenario 5, it is very unlikely that greywater will prove to be a likely source of potable water substitution for open space irrigation due to the infrastructure and treatment costs involved and the need to separate water sources from those that would normally be treated for recycling (i.e. including black water). On lot greywater use is also problematic due to public health concerns of the rapid water quality deterioration on storage. Although some systems do exist the cost of storage and treatment on site are prohibitive.

5.2.7.4 ADOPTED APPROACH

Based on considerations of options outlined above, the following actions were progressed as part of the report:

- Stormwater and greywater recycling were not pursued as no extensive applications were identified. Stormwater recycling opportunities should be investigated on a site by site basis. Greywater reuse will not likely progress at any rate until more practical and cost effective systems are available.
- Sewer mining may be viable for local area irrigation use, however the economic viability is questionable. This option was not taken forward as part of the assessment.
- Reduced infiltration gravity sewers (RIGS) or “smart” sewers are being implemented in a number of areas such as Brisbane and the Gold Coast. In an area of high rainfall such as TSC it is logical to adopt the principle of low infiltration sewers to reduce peak wet weather flows. It was agreed to include smart sewers in all scenarios. The benefits include a reduction in the capital and operating cost of sewer, rising main and pumping stations. These cost reductions can offset the higher cost of other options such as the construction of recycled water systems.

5.3 REVISED DEMAND FORECASTS

This section outlines the resultant managed potable water needs forecasts for all scenarios. The forecasts discussed in this report cover a number of different parameters:

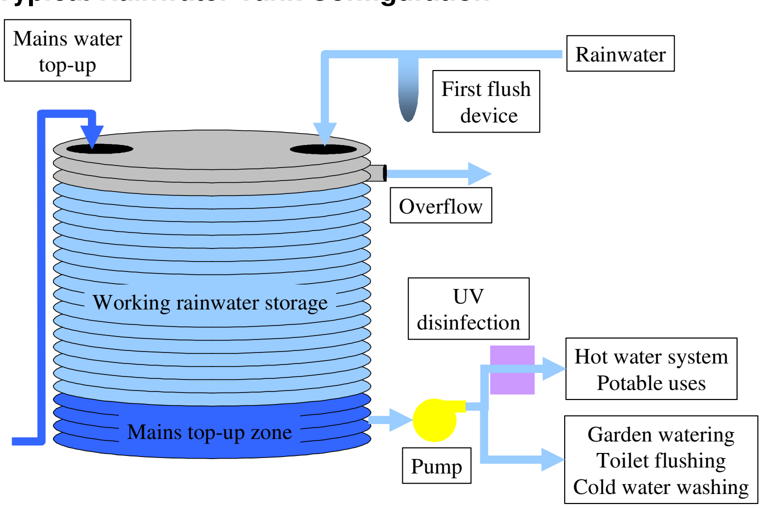
- Total annual water demand for water resources needs.
- Per capita demands which are useful to give an overview of the changes in unit demand, e.g. increasing components of non-residential demand.
- A usage per SFR account forecast which can be used as a forecast for a 'per Equivalent Tenement' (ET) demand in system planning.
- A usage per person in a SFR account forecast which can be used as a forecast for a 'per Equivalent Person' (EP) demand in system planning.
- The reduction in annual greenhouse gas emissions for the individual measures components as part of the environmental assessment.
- The Net Present Value (NPV) of the forecast expenditure and annual costs for the individual demand measurement components of each scenario.
- A demand profile for each scenario to determine annual and average water savings.

The combined results of the scenario assessment for the five growth areas is summarised in this section. Individual demand forecasts and assessments have been undertaken for each of the future growth areas. Detailed information of these outcomes are given in Appendices G, H, I, J and K.

5.3.1 RAINWATER TANK PERFORMANCE

Rainwater tanks are an acceptable solution to most householders in Australia. The tanks can provide water for end uses such as toilet flushing, garden watering, bathroom use, hot water and cold water to the laundry. It is important to model the performance of the rainwater tanks to enable the balance of the scenario assessments to be undertaken. These systems would have a top-up feed from the potable distribution system as shown in Figure 5-1.

Figure 5-1 Typical Rainwater Tank Configuration



A hydrological assessment of the impact of rainwater harvesting systems on water demands was undertaken utilising a probabilistic rainwater harvesting simulation. The simulation generates a large number of virtual dwellings, each with random occupancy patterns with seasonal water use determined by climate and a random element. The analysis assumed the following:

- Area of roof connected – 160 m^2
- End uses assumed - outdoor use, toilet flushing and cold water to washing machine
- End use was assumed as per Table 4-9 adjusted for the assumed greenfield development water fittings and fixtures.

Results of the assessment are outlined in Appendix L. Assessment indicated that the yield from a 5 kL rainwater tank would be approximately 260 L/dwelling/day for Single Family Residential dwellings. This yield was compared with detailed PURRS analysis results for the Gold Coast. Based on this comparison (and the fact that the average connected roof area expected in Gold Coast development was 100 m^2) the yield for the TSC developments was reduced to 231 L/dwelling/day for SFR.

5.3.2 FUTURE WATER DEMAND FORECASTS

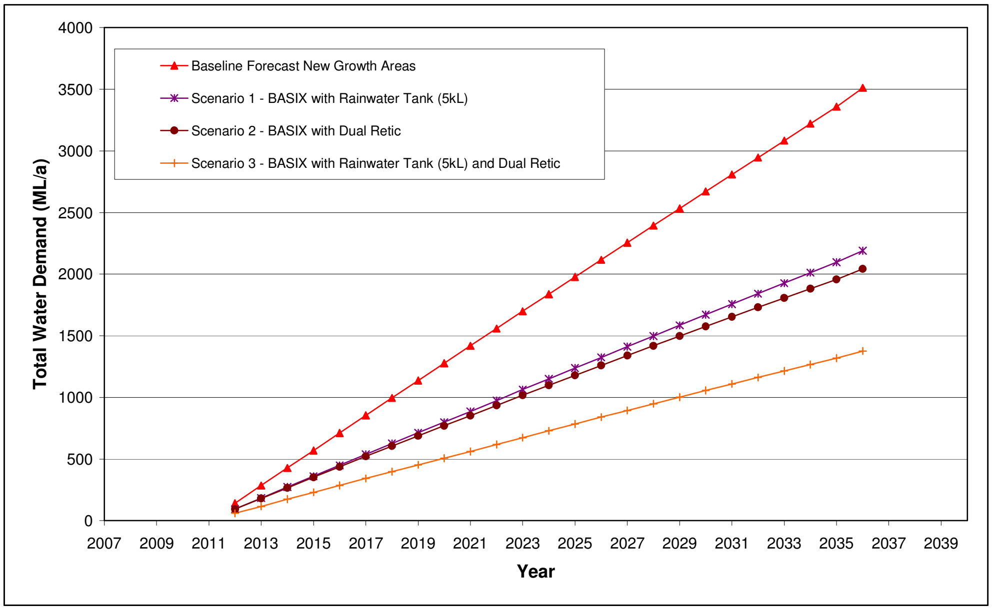
5.3.2.1 ANNUAL FORECAST

Table 5-7 and Figure 5-2 outline the combined annual demand forecast results for the five growth areas. The demand addresses the total water production including all sectoral consumption and water losses, which are forecast at the targeted level of 10%.

Table 5-7 Total Annual Demand Forecast (ML/annum) – Greenfield Development Areas

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast	142	712	1418	2,116	2,808	3,511
Scenario 1 - BASIX with Rainwater Tank	94	450	886	13,25	1,756	2,190
Scenario 2 - BASIX with Dual Reticulation	93	438	852	1,260	1,654	2,043
Scenario 3 - BASIX with Dual Reticulation and Rainwater Tank	59	287	561	840	1,109	1,377

Figure 5-2 Total Annual Water Demand Forecast – Greenfield Development Areas



5.3.2.2 PER CAPITA DEMAND

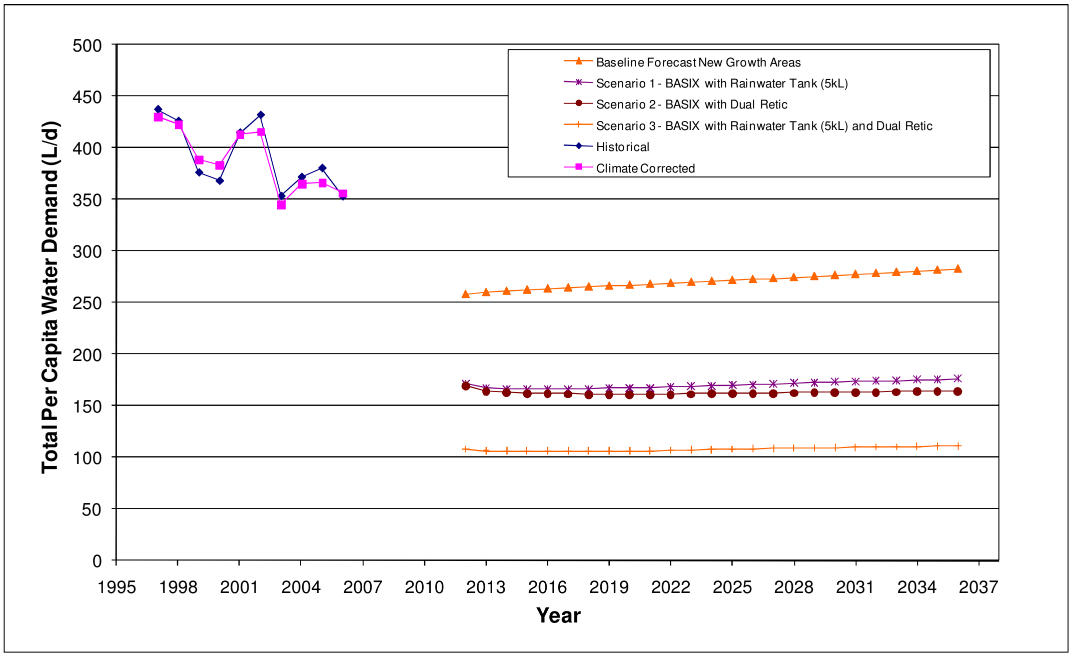
Table 5-8 summarises the per capita demand derived from the total demand of the future growth areas. It has to be mentioned that per capita demand will vary for each of the areas, since it is related to the sectoral structure of each area (e.g. proportions of SFR, MFR and non-residential accounts). For individual per capita demands please refer to Appendices G, H, I, J and K.

Table 5-8 Total per Capita Demand (L/Capita/Day) – Greenfield Development Areas

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast	258	264	268	273	277	283
Scenario 1 - BASIX with Rainwater Tank	172	166	167	171	174	176
Scenario 2 - BASIX with Dual Reticulation	170	162	161	162	163	164
Scenario 3 - BASIX with Dual Reticulation and Rainwater Tank	108	106	106	108	110	111

Table 5-8 and Figure 5-3 show that significant reductions in per capita demand can be expected by combining water efficient demand measures. The gradual increase in the per capita demand over time is related to an increase in discretionary use in the new residential growth areas. The effect of discretionary use is explained in Section 4.3.5.

Figure 5-3 Per Capita Demand Forecast – Greenfield Development Areas



5.3.2.3 SINGLE FAMILY RESIDENTIAL DEMAND

Table 5-9 and Table 5-10 show the demand per person and per account respectively for SFR households between 2012 and 2036 for the new developments. The SFR results are used as a measure of the average demand per EP and ET. The corresponding details for MFR development and for overall residential demand per person refer to further details in Appendix F.

Table 5-9 SFR Demand per Person or EP (L/person/Day) - Greenfield Development Areas

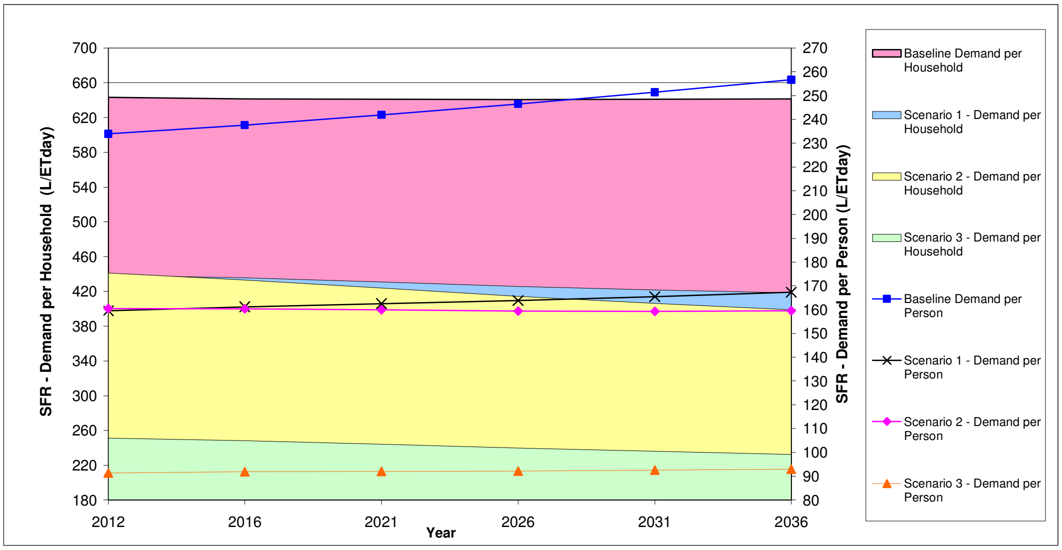
Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast	234	238	242	246	251	257
Scenario 1 - BASIX with Rainwater Tank	160	161	163	164	165	167
Scenario 2 - BASIX with Dual Reticulation	160	160	160	160	160	160
Scenario 3 - BASIX with Dual Reticulation and Rainwater Tank	91	92	92	92	93	93

Table 5-10 - SFR Demand per Account or ET (L/ET/Day) - Greenfield Development Areas

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast	643	642	641	641	641	641
Scenario 1 - BASIX with Rainwater Tank	439	435	431	426	422	418
Scenario 2 - BASIX with Dual Reticulation	441	433	424	414	406	399
Scenario 3 - BASIX with Dual Reticulation and Rainwater Tank	251	248	244	240	236	232

Figure 5-4 summarises the results shown in the previous tables. It can be seen that as the demand per person increases into the future the demand per household decreases slightly. This is a function of decreasing household sizes into the future.

Figure 5-4 Demand Forecast – Single-Family Residential Dwellings - Greenfield Development Areas



5.3.3 FORECAST DEMAND AND SAVINGS FOR INDIVIDUAL DEVELOPMENT AREAS

Table 5-11 outlines the water forecasts and benefits in terms of annual water saved over the baseline demand of each scenario.

Table 5-11 Forecast Demand Savings for Greenfield Development Scenarios

Greenfield Development	Scenario	Average Demand @ 2036 (ML/annum)	Average Savings @ 2036 (ML/annum)	Savings over Baseline Demand
Cobaki Lakes	Baseline	1,054	0	0%
	Scenario 1	669	386	37%
	Scenario 2	615	440	42%
	Scenario 3	407	647	61%
Bilambil Heights	Baseline	705	0	0%
	Scenario 1	440	265	38%
	Scenario 2	412	293	42%
	Scenario 3	279	426	60%
Terranora Area A	Baseline	373	0	0%
	Scenario 1	246	127	34%
	Scenario 2	200	173	46%
	Scenario 3	135	238	64%
West Kingscliff	Baseline	286	0	0%
	Scenario 1	260	26	9%
	Scenario 2	182	104	36%
	Scenario 3	137	149	52%

Greenfield Development	Scenario	Average Demand @ 2036 (ML/annum)	Average Savings @ 2036 (ML/annum)	Savings over Baseline Demand
Kings Forest	Baseline	1,096	0	0%
	Scenario 1	677	420	38%
	Scenario 2	639	457	42%
	Scenario 3	424	673	61%
Totals	**Baseline**	**3,514**	**0**	**0%**
	Scenario 1	**2,292**	**1,222**	**35%**
	Scenario 2	**2,048**	**1,466**	**42%**
	Scenario 3	**1,382**	**2,132**	**61%**

Figure 5-5, Figure 5-6 and Figure 5-7 show a breakdown of the potential water savings under Scenarios 1, 2 and 3 respectively from 2012 to 2036. In addition a breakdown of the residual water consumption is provided for each case.

Figure 5-5 – Demand Projections and Water Savings – Scenario 1 (Greenfield Developments)

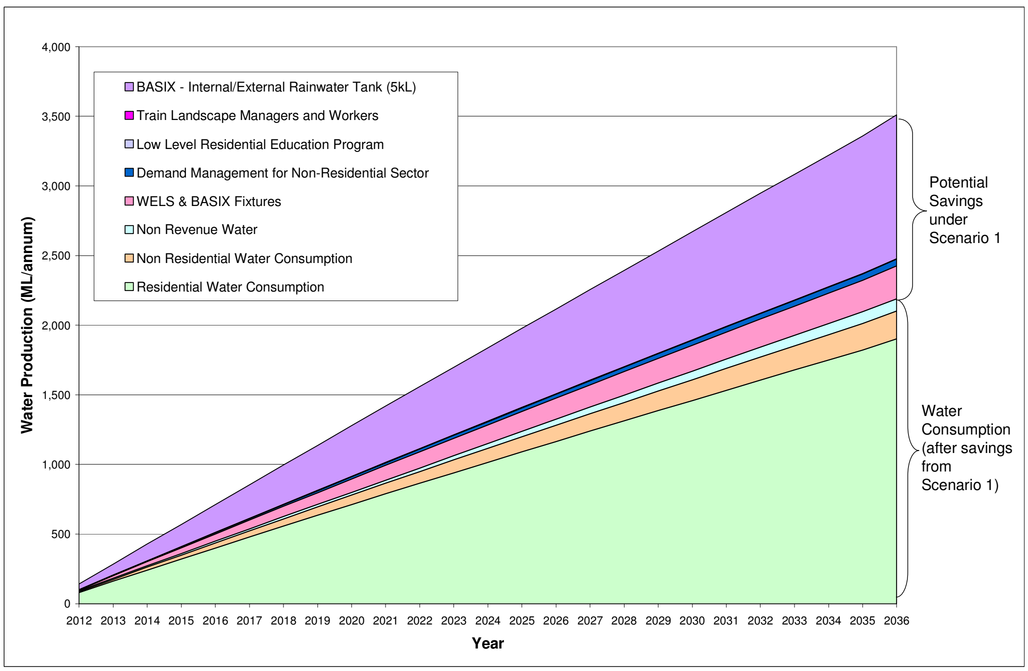


Figure 5-6 Demand Projections and Water Savings – Scenario 2 (Greenfield Developments)

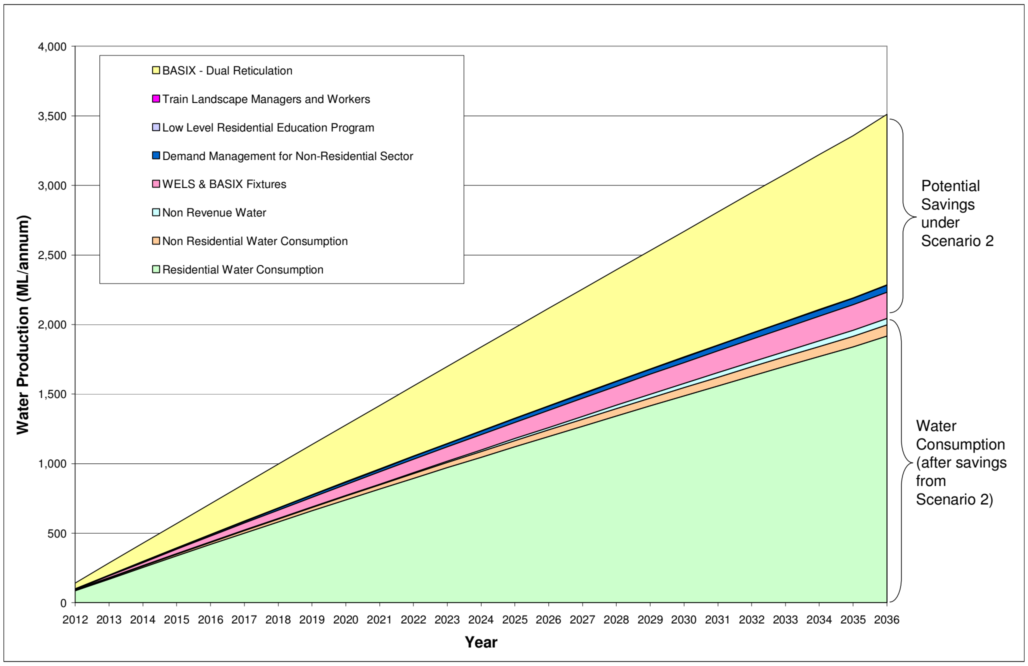
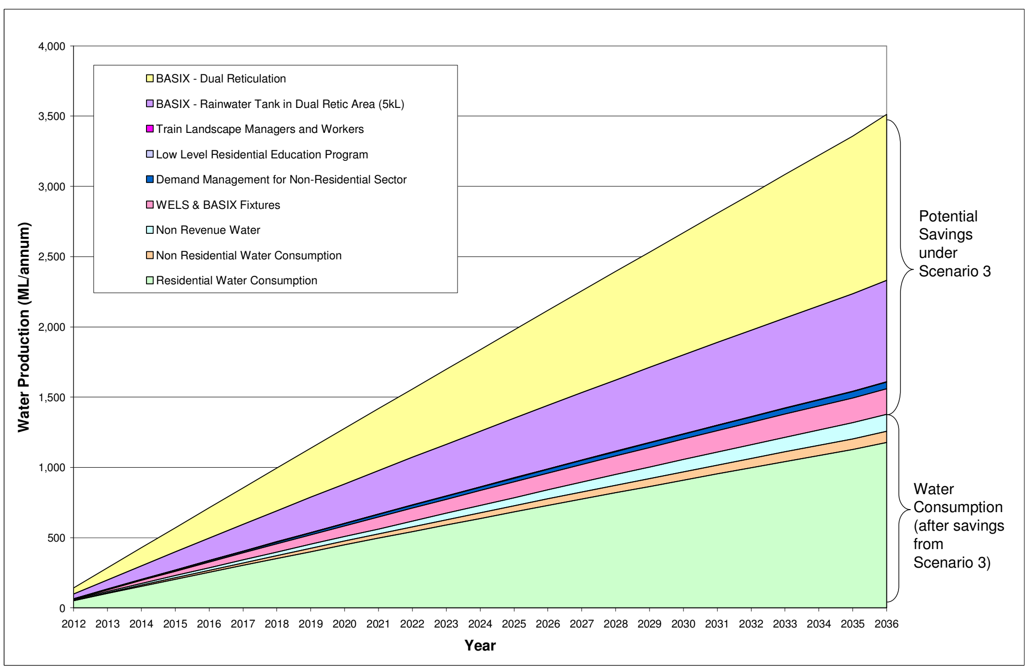


Figure 5-7 Demand Projections and Water Savings – Scenario 3 (Greenfield Developments)



5.3.4 FORECASTING RISKS AND UNCERTAINTIES

The following issues are identified as risks to the realisation of the managed water forecasts. Issues are listed in order from perceived highest to lowest risk.

- The accuracy of the population projections and growth rate used.
- The assumed uptake or penetration rates of the non-mandatory WM opportunities.
- The projected ongoing shrinking of household size continues as forecast.
- The accuracy of non-residential demand forecasts based on area and assumed growth rate. Coupled with this is the ability to maximise opportunities for non-residential source substitution.
- The modelled understanding of market share of water efficient fixtures and fittings along with the end use breakdown of demand across different customer sectors.

5.4 IMPACT ON INFRASTRUCTURE

5.4.1 POTABLE WATER SYSTEM

5.4.1.1 OVERVIEW

Generally it is anticipated that future augmentations can be downsized or avoided based on the reduced demands of the demand management scenarios. The asset needs for the Baseline, Scenario 1 (with BASIX) and Scenario 3 (with BASIX and dual reticulation) were analysed to determine where savings could be achieved compared to the water supply capital works program from 2008 to 2036.

Rainwater tank scenarios were not assessed as it is assumed that tanks will not be available during periods of peak system demand, that is, tanks will not reduce the peak water demand. Although this assumption may be conservative for many normal demand years it is considered to be a prudent approach to system planning.

5.4.1.2 APPROACH

As it was not possible as part of the project scope to undertake network modelling of the revised demands, a desktop analysis was used to assess the impact on the trunk system. The approach to this assessment adopted the following key assumptions:

- The existing infrastructure is assumed to be capable of catering for the 2007 demands.
- Only growth in Cobaki Lakes, Bilambil Heights, Terranora, West Kingscliff, Kings Forest and infill development of Tweed heads area were considered as contributing to future system augmentation.
- Average day demands of Baseline, Scenario 1 and Scenario 3 were evaluated using the DSS as described in previous sections.
- Rainwater tanks were considered not to available during peak demand conditions.
- A peak day factor of 1.89 was adopted. It was assumed that the peak demand factor was constant for all scenarios.
- System leakage of 13% was included for the baseline and 10% for other scenarios.
- Infrastructure is sized to cater for the peak day demand at 2036.
- A total of 50% of future Bilambil Heights growth is assumed to be served by Mcallisters Reservoir No.4, Country Club Reservoir (No.2).

- A total of 50% of future Kings Forest and 100% of other growth will be served by the augmentation between South Tumbulgum to Tweed River Crossing.
- A total of 100% of the future Cobaki Lakes and 20% of the Tweed Heads infill growth will be served by Walmsleys Road Reservoirs No. 2 and No.3.

5.4.1.3 POTABLE WATER DEMAND

Table 5-12 shows the calculated average and peak day demand for each demand management scenario. By comparing the existing design standard and the calculated Baseline average day demand, it is noted that the current demand is approximately 34% higher than the actual demand. For this study the adjusted or current Baseline was used for the purposes of comparing options. It is also noted that the Baseline (current) average daily demand includes a network factor of safety of 10% to account for uncertainty when sizing potable water infrastructure.

Table 5-12 Adopted Potable Peak Day Demand

Scenario	Average Day Demand (L/EP/day)	Peak Day Demand (L/EP/day)
Existing Design Standard	450	850
Baseline (current)	297	562
Scenario 1	274	517
Scenario 2	172	324
Scenario 3	172	324

A summary of the peak day demands for the greenfield development areas is given in Table 5-13.

Table 5-13 Peak Day Potable Demands for Greenfield Development Areas

Greenfield Development Area	Scenario	Potable Peak Day Demand (ML/day)
Cobaki Lakes	Baseline (current)	5.49
	Scenario 1	5.09
	Scenario 2 and 3	3.18
Bilambil Heights	Baseline (current)	3.67
	Scenario 1	3.39
	Scenario 2 and 3	2.13
Terranora Area A	Baseline (current)	1.94
	Scenario 1	1.78
	Scenario 2 and 3	1.04
West Kingscliff	Baseline (current)	1.49
	Scenario 1	1.35
	Scenario 2 and 3	0.94
Kings Forest	Baseline (current)	5.71
	Scenario 1	5.30
	Scenario 2 and 3	3.31
Total Peak Day Demand	**Baseline (current)**	**18.30**
	Scenario 1	**16.91**
	Scenario 2 and 3	**10.60**

5.4.1.4 IMPACT ON TRUNK WATER MAIN AUGMENTATIONS

Augmentations outlined in the Water Conveyance Study (GHD 1999) were identified for possible downsizing as part of the assessment of scenarios. Figure 6.1 of this study was used as the basis for the identification of assets that were likely to be impacted. A marked up version of Figure 6.1, which was used as the major reference for this work is included in Appendix M.

Due to the reduction in baseline demand over the current design standard, it was first necessary to amend the sizing of the proposed infrastructure so that a more accurate level of savings could be assessed. The revised sizes are provided in Table 5-14.

In total, 20 scheduled water main augmentations were selected for the downsizing assessment as listed in Table 5-14. The highlighted items can not be resized because they are not directly impacted by five identified greenfield developments or by the Tweed Heads infill development.

Table 5-14 Revised Sizes of Scheduled Water Main Augmentations

Scheduled Water Main Augmentation	Length (m)	Original Diameter (mm)	Baseline Diameter (mm)	Scenario 1 Diameter (mm)	Scenarios 2/3 Diameter (mm)
Kings Forest Duplication	4,000	600	375	300	300
Civic Centre To Condong	3,757	750	600	600	500
South Tumbulgum to Tweed River Crossing	1,600	750	600	500	450
Tumbulgum - Tweed River Crossing	300	600	500	500	450
North Tumbulgum - River Crossing To WPS 9	1,700	600	500	500	450
WPS 9 to WPS 12	2,500	600	500	500	450
WPS 12 To Duroby Crk	1,300	500	500	500	450
Duroby Crk To Marana St Reservoir	4,600	450	450	375	375
Lloyd St to Razorback 450 mm	2,700	300	300	300	300
Kennedy Drive Bypass To Boyds Bay Bridge	1,500	300	300	300	300
Kyogle Rd Tree St Nth to cane drain St 2	1,500	250	250	250	250
To Country Club Reservoir	1,700	250	250	200	200
Coast Rd To Koala Beach 2 Reservoir	1,800	300	300	300	300
Walmsley Res to Piggabeen Rd	1,700	450	375	300	300
Reserve Creek Rd	570	300	300	300	300
North Arm Road Duplication St 1	1,000	250	250	250	250
North Arm Road Duplication St 2	950	250	250	250	250
Simpson Drive to Mcallisters 4 Reservoir	400	450	250	200	200
WPS 32 McAllister Reservoir Booster to Bilambil Height High Level	2,300	300	200	200	150
Cobaki Lakes Intake Pump to Cobaki Lakes	4,405	450	300	300	250

5.4.1.5 IMPACTS ON RESERVOIR AUGMENTATIONS

Eight scheduled reservoir augmentations were selected for downsizing assessment as listed in Table 5-15. The items highlighted in yellow were not resized because they are not directly impacted by five identified greenfield development and Tweed Heads infill development.

Table 5-15 Revised Sizes of Scheduled Reservoir Augmentation

Scheduled Reservoir Augmentation	Original (ML)	Baseline (ML)	Scenario 1 (ML)	Scenarios 2/3 (ML)
Country Club Reservoir No 2	3	1.5	1.5	1
Duranbah Reservoir No 3	7.5	7	6	4
Koala Beach Reservoir No 2 & 3	10	10	10	10
Mcallisters Reservoir No 4	5	3	2.5	2
North Tumbulgum Reservoir No 2	5	5	5	5
Walmsleys Road Reservoir No 2 and 3	15 (7.5x2)	15 (7.5x2)	15 (7.5x2)	15 (7.5x2)
Bilambil Heights High Level Reservoir	3	1.5	1.5	1
Cobaki Lakes Reservoirs	12	7	6	4

5.4.1.6 IMPACTS ON WATER PUMPING STATION AUGMENTATIONS

Four scheduled pumping stations augmentations were impacted by the reduced demands resulting from the scenarios. A summary of the revised augmentations is provided in Table 5-16.

Table 5-16 Summary of Revised Pumping Station Augmentations

Scheduled Pumping Station Augmentation	Original	Baseline	Scenario 1	Scenarios 2/3
WPS 2 Durroon Ave Bray Park	2 x (650 kW, 465 L/s@85m)	650 kW, 465 L/s@86m	650 kW, 465 L/s@86m	650 kW, 465 L/s@85m
WPS 9 North Tumbulgum	2 x (360 kW, 350 L/s@67m)	2 x (380 kW, 370 L/s@67m)	2 x (370 kW, 360 L/s@67m)	2 x (350 kW, 340 L/s@67m)
WPS 19 Cudgera Ave Koala Beach	10 kW, 25 L/s@25m	10 kW, 25 L/s@25m	10 kW, 25 L/s@25m	10 kW, 25 L/s@25m
WPS 24 Tumbulgum Booster Ps	2 x (70 kW, 190 L/s@25m)	2 x (70 kW, 190 L/s@25m)	2 x (70 KW, 190 L/s@25m)	2 x (70 kW, 190 L/s@25m)
WPS 32 McAllister Reservoir Booster	-	30 kW, 25 L/s@75m	30 kW, 22 L/s@75m	20 kW, 15 L/s@75m
New Cobaki Lakes Intake Pump	20 kW, 120 L/s@20m	20 kW, 75 L/s@20m	20 kW, 65 L/s@20m	10 kW, 42 L/s@20m

5.4.1.7 COST ASSESSMENT

The assessment of capital costs was undertaken assuming the following:

- Costs of trunk infrastructure were derived based on the 2006 unit rates provided by TSC.
- The cost to the developer to provide baseline reticulation was adopted as $2,800 per lot based on assessment of similar developments. This cost reduced to $1, 880 per lot for areas with dual reticulation.

Operation and maintenance costs were considered for the treatment plants and distribution assets are estimated in accordance with the following assumptions:

- Electricity cost of $0.12 / kWh
- Average day demand was assumed for calculation of operation costs
- Operation of the Bray Park WTP was assumed to be $20 / ML.

An NPV analysis was undertaken with a discount rate of 7%. It is noted that all capital works expenditure was assumed to be scheduled to occur between 2012 and 2014. The cost assessment results are summarised in Table 5-17.

Table 5-17 Summary of Costs for Potable Water Provision

Greenfield Development	Scenario	Trunk Capital Cost	Opex Cost / annum at 2036	Reticulation Cost	Net Present Value of Costs
Cobaki Lakes	Baseline	$11,218,209	$126,646	$10,022,400	$11,478,720
	Scenario 1	$10,427,347	$81,225	$10,022,400	$10,795,686
	Scenario 2	$8,531,504	$73,274	$6,497,280	$8,258,593
	Scenario 3	$8,531,504	$48,580	$6,497,280	$8,168,536
Bilambil Heights	Baseline	$10,699,118	$35,815	$6,283,140	$9,491,756
	Scenario 1	$10,127,402	$27,394	$6,283,140	$9,081,556
	Scenario 2	$8,618,784	$22,311	$4,073,208	$7,275,322
	Scenario 3	$8,618,784	$15,067	$4,073,208	$7,248,983
Terranora	Baseline	$1,894,018	$35,815	$3,367,190	$2,581,443
	Scenario 1	$1,795,730	$27,394	$3,367,190	$2,487,189
	Scenario 2	$1,256,928	$22,311	$2,182,868	$1,691,906
	Scenario 3	$1,256,928	$15,067	$2,182,868	$1,665,566
West Kingscliff	Baseline	$631,650	$34,621	$1,725,210	$1,154,191
	Scenario 1	$578,004	$22,819	$1,725,210	$1,077,312
	Scenario 2	$490,184	$22,026	$1,118,412	$802,386
	Scenario 3	$490,184	$16,629	$1,118,412	$782,533
Kings Forest	Baseline	$7,064,517	$109,081	$10,440,000	$8,794,273
	Scenario 1	$5,788,407	$67,308	$10,440,000	$7,799,998
	Scenario 2	$5,024,446	$63,619	$6,768,000	$5,979,859
	Scenario 3	$5,024,446	$42,154	$6,768,000	$5,901,579
Total Greenfield	**Baseline**	**$31,507,512**	**$341,978**	**$31,837,940**	**$33,500,383**
	Scenario 1	**$28,716,890**	**$226,140**	**$31,837,940**	**$31,241,741**
	Scenario 2	**$23,921,846**	**$203,541**	**$20,639,768**	**$24,008,066**
	Scenario 3	**$23,921,846**	**$137,497**	**$20,639,768**	**$23,767,197**

5.4.2 SEWERAGE SYSTEM

5.4.2.1 OVERVIEW

For both the baseline and demand managed scenarios, sewer loadings were determined for the growth areas based on calculation of the average dry weather flow from the DSS end use model. It is noted that wastewater estimates are identical under all the demand management scenarios, as the measures identified do not influence the amount of water returned to the sewer, over and above BASIX measures which is also included in the baseline estimates.

5.4.2.2 APPROACH

The sewer infrastructure needed to service the greenfield areas was separately evaluated for the following groups of development:

- areas treated at the Banora Point STP - Terranora (Area E), Cobaki Lakes and Bilambil Heights
- areas treated at the Kingscliff STP – Kings Forest development was assessed. An evaluation was not carried out for the Kingscliff area as, due to the relatively small size of the development, there are negligible opportunities for demand savings. In addition, TSC have indicated that limited infrastructure upgrades are needed to manage the additional loading from this area due to existing capacity in the system.

To estimate the cost savings of the implementing demand management scenarios, an assessment was undertaken for the following options:

- Baseline Conventional - sewer loading determined under baseline demand, with conventional reticulation within the developments (revised population and demand estimates mean that this assessment differs from the current TSC development plan).
- Conventional Sewer with BASIX – the sewer loading determined under the demand management scenarios, with conventional reticulation within the developments.
- RIGS with Baseline Demands - sewer loading determined under the baseline demand, with Reduced Infiltration Gravity Sewer (RIGS) reticulation within the developments.
- Rigs with BASIX - sewer loading based on reduced flows from the demand management scenarios, with RIGS reticulation within the developments.

The following approach was used to determine Peak Wet Weather Flows (PWWF) for each scenario:

- Domestic Dry Weather Flow was determined based on the internal use sourced from the DSS.
- Dry Weather Infiltration (DWI):
  - An estimate of 60 L/p/d for dry weather infiltration was adopted for conventional sewer networks (derived from TSC's current standard)
  - A value of 30 L/p/d was used in the RIGS case, constituting a 50% reduction in DWI;

- Peak Wet Weather Flow (PWWF):
  - For conventional reticulation systems a standard of 7 x ADWF was used in line with current TSC guidelines
  - For the RIGS systems a 50% reduction was assumed resulting in a factor of 3.5 x ADWF.
- A network factor of safety of 10% was added to the design flows to account for variation in performance

It is noted that the above standards are adopted for the assessment of scenarios in this study. Smart sewers are a recent innovation and their effectiveness in reducing dry and wet weather sewer flows has not been proven. It is therefore suggested that a more conservative standard be adopted by TSC in the early stages of implementation until the smart sewers are proven to be effective.

In order to evaluate the cost effectiveness of the demand management and RIGS scenarios in the new development areas, the additional infrastructure needed to service these areas was determined. Trunk mains and other infrastructure external to the developments were assessed individually but due a lack of detailed development plans within the development areas, conventional and RIGS reticulation systems were assessed on a cost per property basis.

The lack of detailed plans for the development areas means that a detailed assessment of sub-development level sewer loadings cannot be carried out. Therefore, the assumption was made that development with each area would be uniform and therefore WWF loadings were apportioned on a geographical area basis.

5.4.2.3 DESIGN FLOWS

For each of the cases outlined above the design average dry weather and peak wet weather flows were calculated. A summary is provided in Table 5-18.

Table 5-18 Design Wastewater Flows for Greenfield Areas

Contributing Area	Baseline Case (ML/d)		Demand Scenarios (ML/d)			
	Conventional Sewers		Conventional Sewers		RIGS	
	ADWF	PWWF	ADWF	PWWF	ADWF	PWWF
Banora Point STP Catchment						
Cobaki Lakes	2.3	17.5	2.1	16.5	1.9	7.5
Bilambil Heights	1.3	9.8	1.17	9.0	1.1	4.1
Terranora Area A	0.8	6.0	0.7	5.6	0.2	0.7
Total	4.3	33.3	4.0	31.2	3.2	12.3
Kingscliff STP Catchment						
Kings Forest	2.4	18.2	2.2	17.2	2.0	7.8

5.4.2.4 INFRASTRUCTURE ASSESSMENT

Where information was available, trunk mains and pumping stations were located as previously determined by the TSC investment plan, otherwise locations and routes were determined on the existing network and local geographical considerations. The following criteria were adopted for the initial design:

- Gravity and rising mains were sized in line with diameters currently used by TSC.
- Gravity main minimum grades determined from WSAA guidelines.
- A minimum velocity in gravity mains of 1m/s was used, conforming to WSAA guidelines.
- Pumps were assumed to have an overall efficiency of 75%.

The preliminary layout of required sewer infrastructure needed to service the new developments for the Barona Point and Kingscliff systems is given in Appendix N. Capacity of the required trunk infrastructure to deliver recycled water to the proposed developments are listed in Table 5-19.

Flows from the diversion of the Tweed Heads STP and a small sub-catchment in the vicinity of Bilambil Heights were included in the infrastructure assessment. An adjustment was made to the costs to account for this input.

Table 5-19 Major Infrastructure of Sewer System Augmentation

Trunk Infrastructure	Qty	Capacity Required		
		Baseline	Scenarios 1 to 3	Scenario 1 to 3 with RIGS
1. Barona Point System				
1.1 Trunk Mains				
1.1.1 SRM Terranora to STP	4135 m	250 mm	250 mm	200 mm
1.1.2 SGM Cobaki Lakes to STP - Sect 1	600 m	300 mm	300 mm	225 mm
1.1.3 SGM Cobaki Lakes to STP - Sect 2	830 m	375 mm	375 mm	300 mm
1.1.4 SRM Cobaki Lakes to STP - Sect 3	1300 m	300 mm	300 mm	200 mm
1.1.5 SRM Bilambil Heights to STP - Sect 1	840 m	250 mm	200 mm	150 mm
1.1.6 SRM Bilambil Heights to STP - Sect 2	1400 m	250 mm	250 mm	200 mm
1.1.7 SGM Area 1 Bilambil to Main - Sect 1	500 m	225 mm	150 mm	150 mm
1.1.8 SGM Area 1 Bilambil to Main - Sect 2	450 m	300 mm	300 mm	225 mm
1.1.9 SGM Area 2 Bilambil to Main - Sect 1	250 m	150 mm	150 mm	150 mm
1.1.10 SGM Area 2 Bilambil to Main - Sect 2	250 m	225 mm	225 mm	150 mm
1.1.11 SGM Area 3 Bilambil to Main	1100 m	225 mm	225 mm	225 mm
1.1.12 SRM Bilambil / Cobaki to SPS2052	2460 m	375 mm	375 mm	300 mm
1.1.13 SRM from SPS2053 STP - Sect 1	375 m	375 mm	300 mm	0 mm
1.1.14 SRM from SPS2053 STP - Sect 2	450 m	450 mm	375 mm	150 mm
1.2 Pumping Stations				
1.2.1 PS serving Terranora	1	50 KW, 69 L/s @ 54 m	50 KW, 65 L/s @ 51 m	30 KW, 32 L/s @ 48 m
1.2.2 LS serving Cobaki Lakes	1	2 KW, 50 L/s @ 3 m	1 KW, 47 L/s @ 3 m	1 KW, 24 L/s @ 3 m

Trunk Infrastructure	Qty	Capacity Required		
		Baseline	Scenarios 1 to 3	Scenario 1 to 3 with RIGS
1.2.3 PS serving Cobaki Lakes	1	100KW, 203L/s @ 35m	100 KW, 191 L/s @ 33 m	100 KW, 96 L/s @ 54 m
1.2.4 PS serving Bilambil Heights - No 1	1	30 KW, 67 L/s @ 30 m	30 KW, 62 L/s @ 29 m	20 KW, 31 L/s @ 45 m
1.2.5 PS serving Bilambil Heights - No 2	1	7 KW, 25 L/s @ 20 m	5 KW, 23 L/s @ 16 m	3 KW, 12 L/s @ 17 m
1.2.6 SPS 2052 serving Cobaki / Bilambil	1	250 KW, 316 L/s @ 58 m	250 KW, 296 L/s @ 54 m	100 KW, 148 L/s @ 49 m
1.2.7 PS serving Cobaki Lakes/Bilambil & diverted Tweed Heads flow	1	300 KW, 531 L/s @ 37 m	350 KW, 509 L/s @ 47 m	250 KW, 346 L/s @ 50 m
2. Kingscliff System				
2.1 Trunk Mains				
2.1.1 SRM Kings Forest to STP - Section 1	1700 m	300 mm	300 mm	250 mm
2.1.2 SRM Kings Forest to STP - Section 2	3900 m	375 mm	375 mm	300 mm
2.2 Pumping Stations				
2.2.1 PS at Kings Forest - No 1	1	100 KW, 211 L/s @ 32 m	100kW, 199L/s @ 32m	40 KW, 100 L/s @ 23 m
2.2.2 PS at Kings Forest - No 2	1	150 KW, 211 L/s @ 49 m	150 KW, 199 L/s @ 47 m	100 KW, 100 L/s @ 43 m

5.4.2.5 INFRASTRUCTURE COSTING

Current TSC unit costs were used for all infrastructure costs. An NPV was carried out assuming a discount rate of 7%, and a period of 30 years. Original capital works costs were derived from TSC's 10 year and long run financial plan, with the short term 10 year plan taking precedence where inconsistencies occurred.

It was assumed that all infrastructure required for these developments is constructed in 2012. The internal reticulation systems for each area were assumed to be developed over the subsequent 5 years, with costs distributed linearly over this period.

The assessment of capital costs was undertaken assuming the following:

- Costs of other major infrastructure are derived based on the 2006 unit rates provided by TSC.
- The cost to the developer to provide conventional reticulation was adopted as $3,628 per property based on assessment of similar developments.
- The cost to the developer to provide RIGS reticulation was adopted as $2,643 per property based a case study of the Pimpama Coomera scheme.

Operation and maintenance costs were considered for the distribution assets are estimated in accordance with the following assumptions:

- Electricity cost of $0.12 / kWh
- Average day demand was assumed.

A summary of the costs for the sewerage system are provided in Table 5-20.

Table 5-20 Summary of Sewer System Costs

Trunk Infrastructure	Total Cost			NPV		
	Baseline	Scenarios 1 to 3	Scenario 1 to 3 with RIGS	Baseline	Scenarios 1 to 3	Scenarios 1 to 3 with RIGS
1. Barona Point System						
1.1 Trunk Mains	$10,505,355	$9,594,185	$6,022,525	$7,010,847	$6,402,769	$4,019,189
1.2 Pumping Stations	$7,048,182	$7,069,931	$4,920,052	$4,703,670	$4,718,185	$3,283,443
1.3 Reticulation	$33,852,868	$33,852,868	$24,661,833	$17,287,962	$17,287,962	$12,594,290
1.4 Distribution Opex	$172,561/a	$172,933/a	$135,671/a	$1,296,129	$1,298,921	$1,019,043
Total NPV (1)				**$30,298,608**	**$29,707,837**	**$20,915,965**
2. Kingscliff System						
2.1 Trunk Mains	$4,265,500	$4,265,500	$2,974,100	$2,846,621	$2,846,621	$1,984,794
2.2 Pumping Stations	$2,500,885	$2,500,885	$1,656,071	$1,668,989	$1,668,989	$1,105,195
2.3 Reticulation	$18,140,000	$18,140,000	$13,215,000	$9,263,724	$9,263,724	$6,748,628
2.4 Distribution Opex	$57,491/a	$55,206/a	$38,794/a	$431,824	$414,657	$291,385
Total NPV				**$14,211,158**	**$14,193,991**	**$10,130,002**

Note 1 – Costs include for diversion of the Tweed Heads STP and additional area near Bilambil Heights

5.4.2.6 SUMMARY

Table 5-21 contains a summary of all the capital costs associated with the new developments under each scenario. Costs for the diversion of the Tweed Heads STP and an additional small development area near Bilambil Heights were excluded to determine an allocated cost to each development.

Table 5-21 Summary of Costs for Sewerage Options

Development	Scenario	Trunk Capital Cost	Opex Cost / annum at 2036	Reticulation Cost	NPV
Terranora	Baseline	$2,550,005	$12,703	$4,661,980	$4,177,963
	Scenarios 1 to 3	$2,528,906	$11,907	$4,661,980	$4,157,905
	Scenarios 1 to 3 with RIGS	$1,969,096	$8,746	$3,396,255	$3,114,185
Cobaki Lakes	Baseline	$6,867,376	$81,146	$17,414,400	$14,085,684
	Scenarios 1 to 3	$6,647,342	$79,081	$17,414,400	$13,923,332
	Scenarios 1 to 3 with RIGS	$4,477,633	$63,678	$12,686,400	$9,945,167
Bilambil Heights	Baseline	$5,231,952	$56,820	$11,776,488	$9,932,382
	Scenarios 1 to 3	$4,841,847	$54,655	$11,776,488	$9,655,784
	Scenarios 1 to 3 with RIGS	$3,122,145	$42,802	$8,579,178	$6,786,293
Kings Forest	Baseline	$6,766,385	$57,491	$18,140,000	$14,211,159
	Scenarios 1 to 3	$6,766,385	$55,206	$18,140,000	$14,193,992
	Scenarios 1 to 3 with RIGS	$4,630,171	$38,794	$13,215,000	$10,130,002
Total Greenfield	**Baseline**	**$21,415,718**	**$208,160**	**$51,992,868**	**$42,407,188**
	Scenarios 1 to 3	**$20,784,480**	**$200,849**	**$51,992,868**	**$41,931,013**
	Scenarios 1 to 3 (RIGS)	**$14,199,045**	**$154,020**	**$37,876,833**	**$29,975,647**

It can be seen that the demand management scenarios have little impact on predicted infrastructure costs. This is mainly because the decrease in ADWF due to the demand management options is generally not enough to allow for downsizing of mains, unless flows are near the pipe threshold. However, there are some savings to be made from downsizing of pumps and wet wells.

On the other hand, RIGS systems decrease WWFs by 50%, which is a large enough decrease to allow for considerable downsizing of mains to occur. This is reflected in the lower infrastructure costs. The overall capital cost of trunk system assets would reduce by around $7.2m or 34% over the conventional baseline case.

5.4.3 RECYCLED WATER SYSTEM

5.4.3.1 OVERVIEW

The initial option considered for the recycled water system was a centralised treatment approach where water would be produced at the Barona Point Water Reclamation Plan (WRP) and Kingscliff WRP. These plants would supply Class A+ recycled water to the five identified greenfield developments. The Cobaki Lakes, Bilambil Heights and Terranora developments would be served by the Barona Point WRP, and West Kingscliff and Kings Forest will be supplied by a new facility at Kingscliff WRP.

Alternatives to this approach would involve the construction of water mining plants closer to the Cobaki / Bilambil developments or use of the West Tweed WRP. These options were not considered in the initial assessment.

TSC has previously investigated the reuse of water from the treatment plants for open space irrigation using a quality of water lower than the Class A+ that would be required for the proposed dual reticulation systems. Consideration of combining these systems needs to be taken into account as part of the final decision making process.

5.4.3.2 APPROACH

A desktop analysis was undertaken to determine the required capacity for recycled water infrastructure to serve the greenfield developments. The approach to this assessment adopted the following key assumptions:

- The average recycled water demand is determined based on the end use assessment.
- Treatment facilities, pumping stations, reservoirs and trunk mains are sized based on the 2036 peak day demand.
- A peak day factor of 3.49 was adopted based on assessment of end use for similar recycled water systems at the Gold Coast. This is significantly higher than the potable water peaking factor due to the fact that the majority of the volume used during peak periods is irrigation which has been substituted with recycled water. That is the buffering of the other potable end uses has been removed, resulting in a significant increase in the peaking factor. In practice the factor will be modified by the proportion of SFR to MFR in the development, however for this assessment the simplifying assumption of SFR was used.
- System leakage of 10%.
- A minimum service pressure of 20m head.

5.4.3.3 RECYCLED WATER DEMANDS

Table 5-22 summarises the average and peak day demand derived for the five identified greenfield developments. Peak day demand is calculated using a peaking factor of 3.49.

Table 5-22 Adopted Recycled Water Demand

Identified Development	2036 Average Day Demand (ML/day)	2036 Peak Day Demand (ML/day)*
Cobaki Lakes	1.17	4.07
Bilambil Heights	0.77	2.68
Terranora	0.45	1.58
Barona Point Total	**2.38**	**8.32**
West Kingscliff	0.25	0.85
Kings Forest	1.21	4.23
Kingscliff Total	**1.46**	**5.08**

5.4.3.4 INFRASTRUCTURE REQUIRED

The preliminary layout of required infrastructure including recycled water treatment plants, trunk mains, pumping stations and reservoirs for the Barona Point and Kingscliff recycled water supply systems is given in Appendix O. Capacity of the required trunk infrastructure to deliver recycled water to the proposed developments (excluding local reticulation within the greenfield areas) is listed in Table 5-23.

Table 5-23 Summary of Trunk Recycled Water Infrastructure

Trunk Infrastructure	Capacity Required	Quantity
1. Barona Point System		
1.1 Treatment Plant and Balancing Storage	8.3 ML/day	1
1.2 Reservoirs		
1.2.1 Terranora	2 ML	1
1.2.2 Cobaki Lakes	3 ML	1
1.2.3 Cobaki Lakes HL	1 ML	1
1.2.4 Lower Bilambil Heights	1.5 ML	1
1.2.5 Upper Bilambil Heights	1.5 ML	1
1.3 Pump		
1.3.1 Pump serving Terranora	50 KW, 19 L/s @ 185 m	1
1.3.2 Pump serving Cobaki Lakes / Bilambil	110 KW, 78 L/s @ 90 m	1
1.3.3 Pump serving Upper Cobaki Lakes	10 KW, 12 L/s @ 50m	1
1.3.3 Pump serving Lower Bilambil Heights	40 KW, 31 L/s @ 91 m	1
1.3.4 Pump serving Upper Bilambil Heights	20 KW, 16 L/s @ 74 m	1
1.4 Trunk Mains		
1.4.1 RWTP to Terranora	200 mm	5,500 m
1.4.2 RWTP to Flow Split Point	375 mm	6,850 m
1.4.3 Flow Split Point to Cobaki Lakes	300 mm	2,500 m
1.4.4 Cobaki Low to High	150 mm	500 m
1.4.5 Flow Split Point to Lower Bilambil Heights	250 mm	2,100 m

Trunk Infrastructure	Capacity Required	Quantity
1.4.6 Flow Split Point to Upper Bilambil Heights	200 mm	2,300 m
2. Kingscliff System		
2.1 Treatment Plant and Balancing Storage	5.1 ML/day	1
2.2 Reservoirs		
2.2.1 Kings Forest	4.5 ML	1
2.3 Pumps		
2.3.1 Pump served West Kingscliff & Kings Forest	80 KW, 59 L/s @ 88 m	1
2.4 Trunk Mains		
2.4.1 WRP to Flow Split Point	300 mm	1,000 m
2.4.2 Flow Split Point to West Kingscliff	150 mm	2,500 m
2.4.3 Flow Split Point to Kings Forest	300 mm	7,200 m

5.4.3.5 COST ASSESSMENT

The assessment of capital costs was undertaken assuming the following:

- Costs of recycled water treatment plants was based on recent SEQ projects. A unit cost of $5m per ML of production was assumed for the micro-filtration and disinfection process required to achieve a Class A+ output.
- Costs of other major infrastructure are derived based on the 2006 unit rates provided by TSC.
- The cost to the developer to provide reticulation was adopted as $2,800 per lot based on assessment of similar developments.

Operation and maintenance costs were considered for the treatment plants and distribution assets are estimated in accordance with the following assumptions:

- Vendor quotations for membrane replacement
- Electricity cost of $0.12 / kWh
- Average day demand was assumed
- 10% labour of one operator ($100,000 per year) for distribution network
- 50% labour of one crew ($150,000 per year) for routine maintenance of distribution network

The NPV analysis was undertaken with a discount rate of 7%. It is noted that all capital work expenditure was assumed to be scheduled evenly from 2012 to 2014. Table 5-24 summarises the cost assessment results.

Table 5-24 Summary of Recycled Water Trunk System Costs

Trunk Infrastructure	Capital Cost	2007 NPV
1. Banora Point System		
Trunk Mains	$12,539,800	$8,368,553
Reservoirs	$3,190,380	$2,129,130
Pumping Stations	$1,598,713	$1,066,916
MF/UV Treatment Plants	$12,480,000	$8,328,645
Capital Cost Sub total	**$29,808,893**	**$19,893,244**
Treatment Opex	-	$533,830
Distribution Opex	-	$1,007,289
Total for Banora Point System		**$21,434,363**
2. Kingscliff System		
Trunk Mains	$6,038,300	$4,029,716
Reservoirs	$1,111,863	$742,012
Pumping Stations	$458,417	$305,929
MF/UV Treatment Plants	$7,650,000	$5,105,299
Capital Cost Sub total	**$15,258,580**	**$10,182,956**
Treatment Opex	-	$499,102
Distribution Opex	-	$833,701
Total for Kingscliff System		**$11,515,759**
Total Cost for Recycled Water Trunk System	**$45,067,472**	**$32,950,123**

An assessment of the costs was undertaken to determine the cost allocation for each of the greenfield development areas. These costs are summarised in Table 5-25.

Table 5-25 Summary of Recycled Water Costs by Development Area

Development	Total Capital Cost	Opex Cost / annum at 2036	Total Reticulation Cost	Net Present Value of Costs
Cobaki Lakes	$13,490,453	$9,676,800	$117,423	$17,933,269
Bilambil Heights	$10,407,859	$6,066,480	$77,032	$13,009,242
Terranora Area A	$5,910,580	$3,251,080	$45,516	$7,237,935
Kingscliff	$2,433,131	$1,665,720	$29,630	$3,432,941
Kings Forest	$12,825,449	$10,080,000	$146,212	$18,215,316

5.4.4 INDIRECT POTABLE REUSE ASSESSMENT

5.4.4.1 OVERVIEW

This section explores the feasibility of Scenario 4 which comprises the implementation of an Indirect Potable Reuse (IPR) scheme in conjunction with the use of rainwater tanks in new development areas. The scheme would collect and treat flows at the Banora Point and Kingscliff Sewage Treatment Plants (STPs) and transport the renewed water to Clarrie Hall Dam.

5.4.4.2 APPROACH

Estimates of design flows for infrastructure sizing were based on estimates of Average Dry Weather Flow for Banora Point and Kingscliff STPs in 2036. ADWFs were calculated from the non-residential and residential internal flow estimates, excluding irrigation flows. It was assumed that for efficient, cost effective IPR treatment only 75% of these flows would be available as product water. Table 5-26 summarises the design flows.

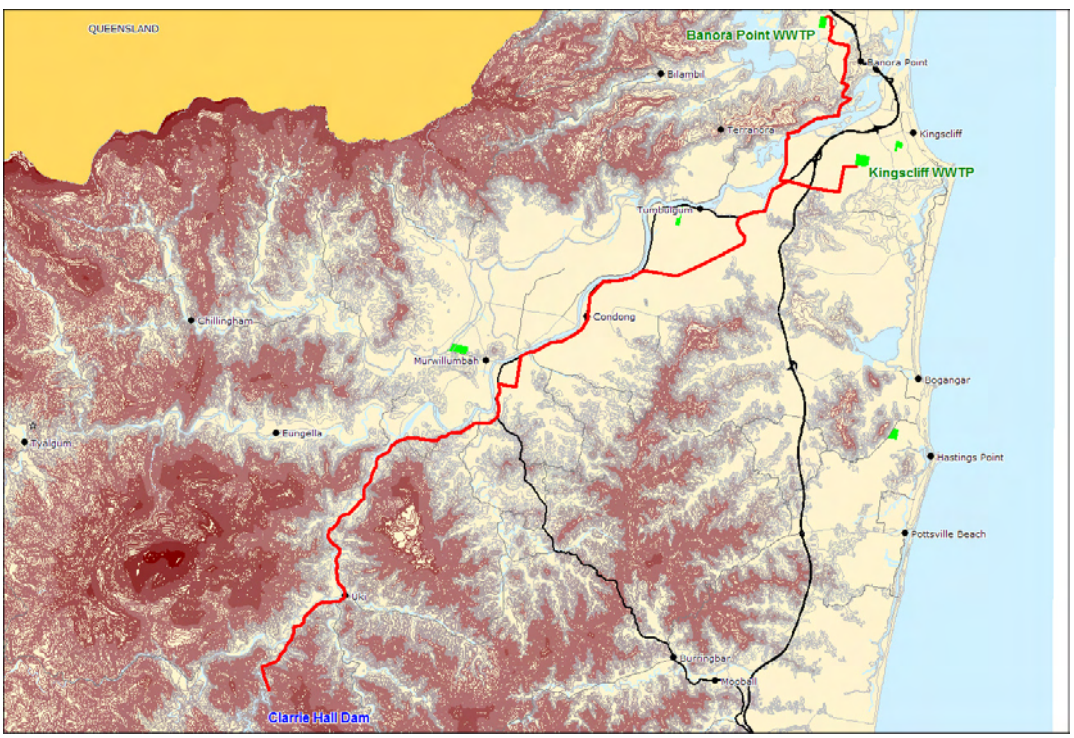
Table 5-26 IPR Design Flows

Treatment Plant	ADWF	Treatable STP Outflows (75% Return)	
	ML/d	ML/d	L/s
Banora Point STP	26.0	19.5	225.7
Kingscliff STP	11.0	8.3	95.5
Total	**37.0**	**27.8**	**321.2**

5.4.4.3 INFRASTRUCTURE ASSESSMENT

- The infrastructure required for the scheme was evaluated based on the assumptions above. A route was selected for the trunk main with associated pumping station locations selected as shown in Figure 5-8.

Figure 5-8 Possible Route to Clarrie Hall Dam



The following infrastructure was found to be required:

- Recycled water treatment plant consisting of micro-filtration, reverse osmosis and advanced oxidation at both Banora Point and Kingscliff STPs.
- Main (RM1a and RM1b) and associated pumping station from Banora Point STP to point of convergence with the Kingscliff main (200 kW pump serving 10.8 km of 450mm diameter main).
- Main (RM2) and associated pumping station from Kingscliff STP to point of convergence with Banora Point main (100 kW pump serving 3.6 km of 300mm diameter main).
- Main (RM3a & RM3b) from point of convergence of Kingscliff and Banora Point main to Clarrie Hall Dam (36 km of 600 mm diameter main).
- Pumping Station at point of convergence of Kingscliff and Banora Point main servicing the Clarrie Hall Main (400 kW pump).
- Booster Pumping Station, located approximately half way along the main trunk (250 kW pump).

Discharge structure at Clarrie Hall Dam.

5.4.4.4 INFRASTRUCTURE COSTING

Current TSC unit costs were used for all infrastructure costs. The Net Present Value (NPV) of future asset costs were used to determine the final discounted values. The NPV calculations assumed a discount rate of 7%. It was assumed that all the infrastructure is constructed in 2012 and the IPR plant costs are distributed equally over the 2 year period 2011 to 2012. IPR plant cost estimates were based on actual costs for recent projects in South East Queensland. A capital cost of $7,000,000 / ML of production was adopted for the smaller Kingscliff plant and $6,000,000 / ML for the larger Banora Point plant, taking into account some economies of scale.

Table 5-27 provides a summary of all the capital costs associated with an IPR network from Banora Point and Kingscliff STPs.

Table 5-27 Summary of Costs for Scenario 4 – Indirect Potable Reuse

Description	Net Present Value
Capital Cost - Mains	$49,838,590
Capital Cost - Discharge Structure	$549,641
Capital Cost - IPR Treatment Plants	$128,955,137
Capital Cost - Pumping Stations	$2,621,402
Opex Cost	$2,388,676/a
Total NPV	**$184,353,445**

It is noted that costs presented in Table 5-27 do not include for rainwater tank installation in new residential development.

It can be seen that discounted capital costs for installation of an IPR network are estimated to be of the order of $180m with an operational cost of $2.4m (approx. $0.25m/annum). Additional inflow to Clarrie Hall Dam will be approximately 28 ML/d or 10,220 ML/a at 2036. Such a scheme is unlikely to be cost effective when compared to other options for bulk supply augmentation.

5.5 ENVIRONMENTAL IMPACT OF SCENARIOS

An initial review of the environmental impacts was undertaken. The two major areas of focus were the change of greenhouse gas emissions and the quality impacts on receiving waters from the reduced discharge through STP outfalls. As a surrogate for the water quality impacts the percentage reduction to the discharges at 2036 was used.

5.5.1.1 GREENHOUSE GAS EMISSIONS

Greenhouse gas emissions for the proposed greenfield scenarios were assessed based on a quantitative review of energy consumption of the scenarios. The change in energy use will vary for the various aspects of the water cycle. The following impacts are evident:

- Reduced water use will reduce energy required for both water treatment and transfer.
- Reduced sewage dry weather flow will reduce energy use.
- Widespread use of rainwater tanks has an associated and quite inefficient use of energy for pumping.
- Recycled water has an energy impact due to treatment and transfer.
- Reduced household energy use due to lower demand on hot water.
- Reduced extractions from the river for potable water.

The greenhouse gas emissions were assessed for each of the developments and the various scenarios. Assessment does not include the embedded carbon in materials or equipment. Results of the assessment are summarised in Table 5-28.

Table 5-28 Summary of Greenhouse Gas Emission Reductions in 2036 (tonnes CO2/annum)

Greenfield Development	Scenario	Customer Hot Water Savings (1)	Potable Water System	Sewerage System	Recycled Water System	Rainwater Tank System	Total GGE Reduction (tonnes CO2)
Cobaki Lakes	Scenario 1	1,727	346	160	0	-346	1,887
	Scenario 2	1,727	409	160	- 435	0	1,861
	Scenario 3	1,727	597	160	- 435	-273	1,776
Bilambil Heights	Scenario 1	1,165	387	80	0	-225	1,407
	Scenario 2	1,165	442	80	- 373	0	1,314
	Scenario 3	1,165	635	80	- 373	-180	1,327
Terranora Area A	Scenario 1	578	54	36	0	-105	563
	Scenario 2	578	92	36	- 187	0	519
	Scenario 3	578	147	36	- 187	-80	494
West Kingscliff	Scenario 1	476	90	N/A	0	-82	484

Greenfield Development	Scenario	Customer Hot Water Savings (1)	Potable Water System	Sewerage System	Recycled Water System	Rainwater Tank System	Total GGE Reduction (tonnes CO2)
	Scenario 2	476	96	N/A	- 61	0	511
	Scenario 3	476	138	N/A	- 61	-70	483
Kings Forest	Scenario 1	1798	306	172	0	-360	1,916
	Scenario 2	1798	333	172	- 299	0	2,004
	Scenario 3	1798	490	172	- 299	-284	1,877
Total Greenfield	**Scenario 1**	**5,744**	**1,183**	**448**	**0**	**-1118**	**6,257**
	Scenario 2	**5,744**	**1,373**	**448**	**- 1,168**	**0**	**6,397**
	Scenario 3	**5,744**	**2,007**	**448**	**- 1,168**	**-887**	**6,144**

Note 1 – Assumes 68% electric hot water systems, 27% gas heating and 5% solar heating.

5.5.2 WATER QUALITY

The reduction in the discharge of effluent and therefore nutrients to the Tweed River will have a significant impact on waterway water quality. As the assessment of water quality is not part of this study, it is only possible to assess the volume of treated water that will be reused and as such not discharged to the river. Table **5-29** summarises the reduced discharges for the various scenarios. It is noted that these figures do not include for open space irrigation from these plants which would increase the volume of reuse.

Table 5-29 Reduction of River Discharges

Scenario	Reduction in Discharge at 2036 (ML/a)	
	Banora Point STP	Kingscliff STP
Scenario 1	0	0
Scenario 2	868	533
Scenario 3	868	533
Scenario 4	7,117	3,030

5.6 SUMMARY OF FUTURE GREENFIELD DEVELOPMENT SCENARIO ASSESSMENT

5.6.1 WATER SAVINGS

Water savings are outlined in Table 5-11. The assessment of water savings for the scenarios indicated that:

- Scenario 1 will save of the order of 34 to 38% in all areas except West Kingscliff, where the savings are likely to be around 9%.
- Scenario 2 will save of the order of 42% for all areas except West Kingscliff, where the savings will be lower at around 36%.
- Scenario 3 will save around 62% for all developments except West Kingscliff, where the savings are likely to be around 52%.

Of the total savings the largest of the developments (Cobaki Lakes and Kings Forest) account for 70% of the total. In total savings from these areas range from around 800 ML/a for Scenario 1 to 1,300 ML/a for Scenario 3. To put this in perspective the baseline forecast for 2036 is around 21,000 Ml/a.

5.6.2 OVERALL COST COMPARISON

An overall cost assessment was undertaken for each of the scenarios for each future development area. The total NPV contained costs for the following elements:

- Council Capital Costs – assumed to be costs related to the provision of headworks for potable water, recycled water and sewerage. For sewerage it was assumed that RIGS would be adopted.
- Customer Capital Costs – assumed to be the costs related to provision of rainwater tanks and reticulation costs for potable water, recycled water and sewerage.
- Council Operational Costs – assumed to be the on-going costs of operating the systems including , operational costs for pumping stations, marginal treatment costs (energy and chemicals), as well as the cost of compliance testing and inspections.
- Customer Operational Costs – assumed to be the costs of operating a rainwater tank as well as the benefits of lower energy costs from hot water savings.

The cost assessment is summarised in Table 5-30and Figure 5-10 for the total NPV and the per person cost respectively. A summary by development with assessment of the costs relating to the council and the customer is provided in Table 5-30.

Table 5-30 Summary of Costs for Greenfield Development Scenarios

Greenfield Development	Scenario	Capital Cost NPV			Operational Cost NPV			Total NPV	$/kL saved
		NPV - Council	NPV - Customer	Total Capital Works NPV	NPV - Council	NPV - Customer	Total Opex NPV		
Cobaki Lakes	Baseline	$12,069,585	$13,070,927	$25,140,512	$920,627	$0	$920,627	$26,061,139	
	Baseline (RIGS)	$10,474,767	$10,487,421	$20,962,188	$0	$0	$860,797	$21,822,985	
	Scenario 1	$9,946,978	$14,982,092	$24,929,070	$252,733	$1,297,723	$2,256,010	$27,185,080	2.14
	Scenario 2	$17,684,750	$12,669,596	$30,354,346	$1,573,247	$0	$2,257,376	$32,611,722	3.86
	Scenario 3	$17,684,750	$17,164,267	$34,849,017	$1,825,980	$1,297,723	$3,717,775	$38,566,792	3.98
Bilambil Heights	Baseline	$10,631,749	$8,663,705	$19,295,454	$497,615	$0	$497,615	$19,793,068	
	Baseline (RIGS)	$9,223,750	$6,916,608	$16,140,358	$0	$0	$448,900	$16,589,258	
	Scenario 1	$8,842,210	$9,878,205	$18,720,415	$199,682	$855,055	$1,474,976	$20,195,391	2.09
	Scenario 2	$14,781,202	$8,284,578	$23,065,780	$827,043	$0	$1,247,282	$24,313,062	4.14
	Scenario 3	$14,781,202	$11,246,175	$26,027,377	$1,026,725	$855,055	$2,260,130	$28,287,507	4.22
Terranora Area A	Baseline	$2,965,760	$3,741,999	$6,707,759	$199,206	$0	$199,206	$6,906,965	
	Baseline (RIGS)	$2,578,085	$3,050,373	$5,628,458	$0	$0	$185,641	$5,814,099	
	Scenario 1	$2,512,492	$4,361,436	$6,873,927	$132,779	$378,580	$668,340	$7,542,267	2.10
	Scenario 2	$6,097,398	$3,783,590	$9,880,989	$423,929	$0	$565,359	$10,446,348	4.22
	Scenario 3	$6,097,398	$5,094,653	$11,192,051	$556,709	$378,580	$1,050,379	$12,242,430	4.18
Kings Forest	Baseline	$9,230,183	$13,615,549	$22,845,732	$720,898	$0	$720,898	$23,566,629	
	Baseline (RIGS)	$6,798,165	$8,391,258	$15,189,423	$0	$0	$702,351	$15,891,774	
	Scenario 1	$6,952,936	$15,606,346	$22,559,281	$259,560	$1,351,795	$2,125,511	$24,684,792	3.22
	Scenario 2	$15,446,079	$13,197,496	$28,643,575	$1,266,068	$0	$1,772,484	$30,416,060	5.01
	Scenario 3	$15,446,079	$17,879,445	$33,325,524	$1,525,627	$1,351,795	$3,305,558	$36,631,083	4.75
West Kingscliff	Baseline	$421,538	$611,722	$1,033,260	$120,931	$0	$120,931	$1,154,191	
	Baseline (RIGS)	$421,538	$611,722	$1,033,260	$0	$0	$120,931	$1,154,191	
	Scenario 1	$385,737	$1,781,871	$2,167,608	$139,352	$337,764	$556,969	$2,724,576	2.41
	Scenario 2	$1,950,902	$987,193	$2,938,095	$411,031	$0	$489,722	$3,427,817	3.40
	Scenario 3	$1,950,902	$2,157,342	$4,108,244	$550,382	$337,764	$946,985	$5,055,229	4.00
Total	**Baseline**	**$35,318,814**	**$39,703,902**	**$75,022,717**	**$2,459,276**	**$0**	**$2,459,276**	**$77,481,993**	

Greenfield Development	Scenario	Capital Cost NPV			Operational Cost NPV			Total NPV	$/kL saved
		NPV - Council	NPV - Customer	Total Capital Works NPV	NPV - Council	NPV - Customer	Total Opex NPV		
Greenfield Development	**Baseline (RIGS)**	$29,496,305	$29,457,382	$58,953,687	$0	$0	$2,318,620	$61,272,307	
	Scenario 1	$28,640,351	$46,609,950	$75,250,301	$984,106	$4,220,918	$7,081,805	$82,332,106	2.45
	Scenario 2	$55,960,331	$38,922,453	$94,882,784	$4,501,318	$0	$6,332,224	$101,215,009	4.28
	Scenario 3	$55,960,331	$53,541,883	$109,502,213	$5,485,424	$4,220,918	$11,280,828	$120,783,041	4.29

Figure 5-9 Summary of Total NPV for Greenfield Development Scenarios

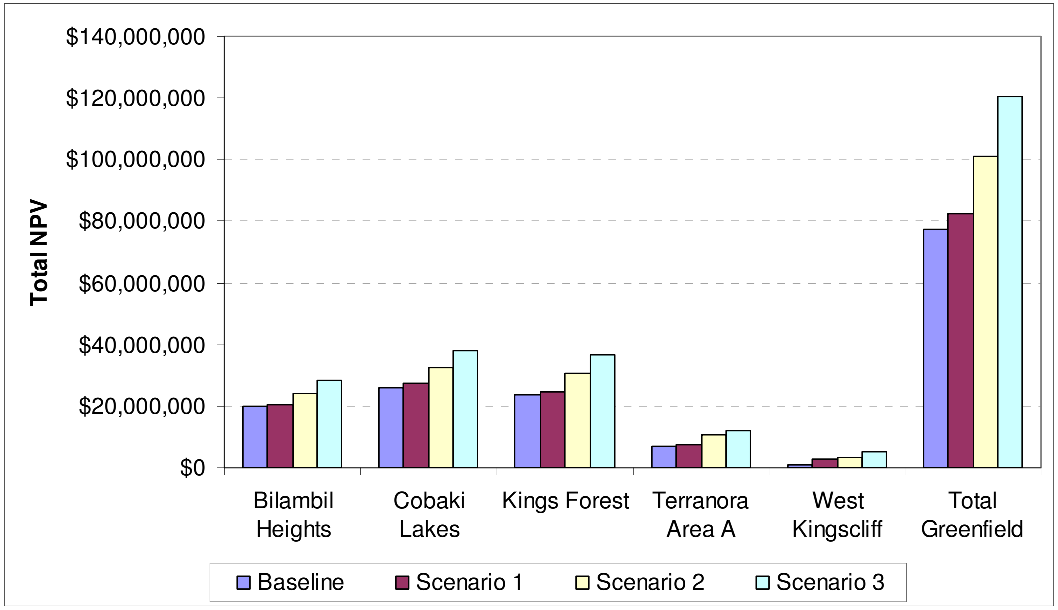
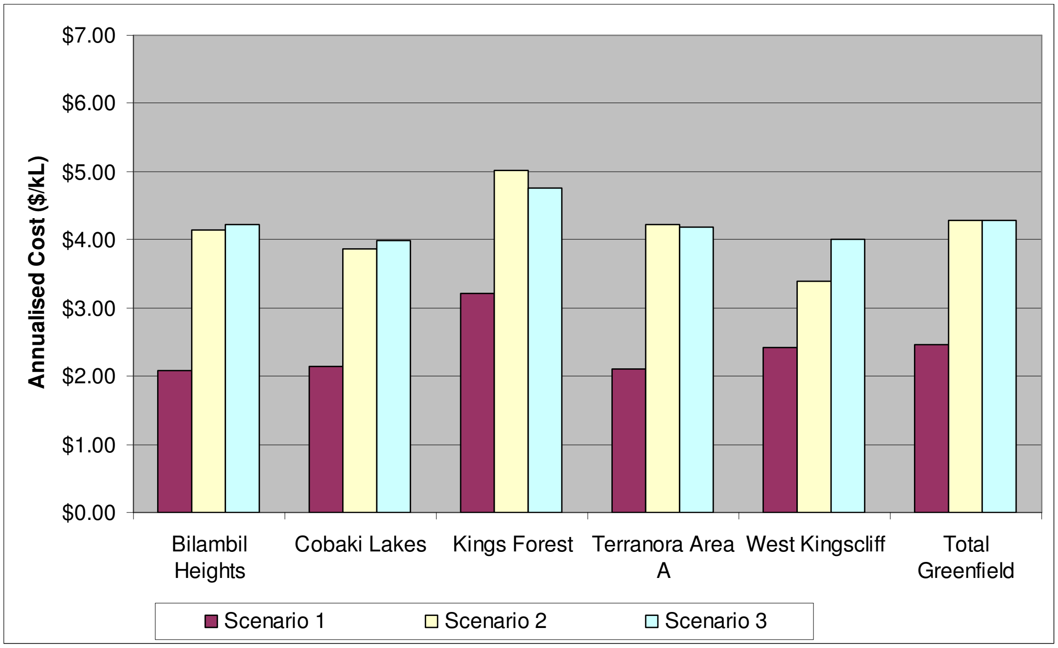


Figure 5-10 Estimated Annualised Cost ($/kL Saved) in Greenfield Development Areas



The cost summary indicates that:

- Scenario 1 has an increase of $4.7m (or 6%) in the capital NPV over the baseline case. If this assessment only included potable water costs there would be an increase of a further $4.1m to around $8.2m. The lower NPV is due to the downsizing of the sewerage system resulting from to the implementation of RIGS. This option also has the cost impost of rainwater tanks which increases the whole of community cost to be higher than the baseline.
- Scenario 2 and 3 have a significantly increased cost for capital works due to the inclusion of the recycled water system. Although these costs are offset through reductions in the potable supply system and the sewerage system, these are not sufficient to prevent major cost increases.
- Operational costs increase significantly for the addition of a recycled network.
- From an overall cost perspective the Scenario 1 has only a small increase (6%) in whole of life costs compared to the baseline, however Scenarios 2 and 3 (which include recycled water) have an increase of 17 and 56% respectively. The high cost of Scenario 3 is primarily the result of competition for water end uses for the two source substitution measures. Therefore the costs are doubled but the savings are not impacted to the same level.

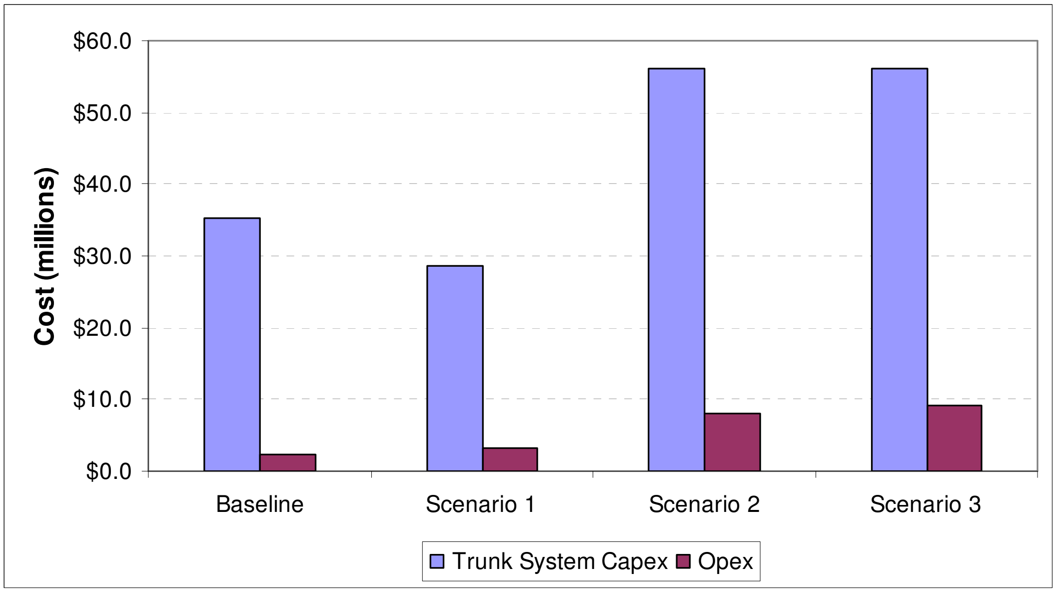
5.6.3 TRUNK SYSTEM COST COMPARISON

One of the major issues relating to the development of land is the level of infrastructure charges that are applied for access to water related services. The scope of this study did not include the full assessment of Headworks Charges or the impact of the scenarios on the current charges, however the trunk infrastructure assessments undertaken provide a guide to the relativity of the charges. Table 5-31 summarises the overall costs of the trunk infrastructure for the various scenarios.

Table 5-31 Summary of Trunk System Costs for Future Growth Area Scenarios

Future Growth Area	Scenario	Potable Water NPV	Sewerage NPV	Recycled Water NPV	Total Net Present Value
Cobaki Lakes	Baseline	$7,486,577	$4,583,008	N/A	$12,069,585
	Scenario 1	$6,958,788	$2,988,190	N/A	$9,946,978
	Scenario 2	$5,693,579	$2,988,190	$9,002,980	$17,684,749
	Scenario 3	$5,693,579	$2,988,190	$9,002,980	$17,684,749
Bilambil Heights	Baseline	$7,140,157	$3,491,592	N/A	$10,631,749
	Scenario 1	$6,758,617	$2,083,593	N/A	$8,842,210
	Scenario 2	$5,751,826	$2,083,593	$6,945,783	$14,781,202
	Scenario 3	$5,751,826	$2,083,593	$6,945,783	$14,781,202
Terranora Area A	Baseline	$1,263,991	$1,701,770	N/A	$2,965,760
	Scenario 1	$1,198,397	$1,314,095	N/A	$2,512,492
	Scenario 2	$838,822	$1,314,095	$3,944,481	$6,097,399
	Scenario 3	$838,822	$1,314,095	$3,944,481	$6,097,399
Kings Forest	Baseline	$4,714,572	$4,515,611	N/A	$9,230,183
	Scenario 1	$3,862,947	$3,089,988	N/A	$6,952,935
	Scenario 2	$3,353,111	$3,089,988	$9,002,980	$15,446,079
	Scenario 3	$3,353,111	$3,089,988	$9,002,980	$15,446,079
West Kingscliff	Baseline	$421,538	N/A	N/A	$421,538
	Scenario 1	$385,737	N/A	N/A	$385,737
	Scenario 2	$327,129	N/A	$1,623,773	$1,950,902
	Scenario 3	$327,129	N/A	$1,623,773	$1,950,902
Total Greenfield	**Baseline**	**$21,026,834**	**$14,291,980**	**N/A**	**$35,318,814**
	Scenario 1	**$19,164,486**	**$9,475,866**	**N/A**	**$28,640,352**
	Scenario 2	**$15,964,468**	**$9,475,866**	**$30,519,997**	**$55,960,331**
	Scenario 3	**$15,964,468**	**$9,475,866**	**$30,519,997**	**$55,960,331**

Figure 5-11 Summary of Trunk Capital and Operational NPV for Future Growth Areas



5.6.4 CUSTOMER COST COMPARISON

The cost to householders is an important issue to consider when assessing scenarios which ultimately must be paid for by the residents of a new development. An initial assessment of the change in cost burden on the Single Family Residential dwelling was undertaken to review the impact. Obviously the situation would be different for all households, however an example of a home built in 2012 was reviewed. The review is summarised in Table 5-32 and takes account of the major costs and benefits for the home owner. This calculation is undertaken for a period up to 2036 and does not consider the headworks or rates impact as these are considered separately.

Table 5-32 Direct Cost of Scenarios to SFR Customers (not including Headworks and Usage Charges) in Greenfield Developments

Scenario	Rainwater Tank		Potable Water	Recycled Water	Sewer	Annual Water Savings	Annual Hot Water Savings	Total NPV
	Capital Cost	Annual O&M						
Baseline	0	0	$2,800	0	$3,630	0	0	**$6,430**
Scenario 1	$3,000	$60	$2,800	0	$2,640	$81	$47	**$7,872**
Scenario 2	$3,000	$60	$1,880	$2,800	$2,640	$88	$47	**$6,196**
Scenario 3	$3,000	$60	$1,880	$2,800	$2,640	$149	$47	**$9,188**

Based on this assessment the adoption of rainwater tanks (Scenario 1) or dual reticulation (Scenario 2) alone results in a minimal increase in the direct cost to the household in the longer term. However, the cost to the customer of adopting both recycled water and rainwater tanks (Scenario 3) is increased by around 50% over the baseline costs. This is primarily due to the higher up front costs and the lower relative savings of this scenario.

5.6.5 COUNCIL COST COMPARISON

Costs to Council relate to the set up costs for programs and the on-going costs of compliance. For recycled water to be delivered to households Council would be required to develop a Recycled Water Management Plan which includes comprehensive monitoring and compliance testing regimes to reduce the risk of cross contamination in the potable system. For rainwater tanks a similar, but less complex or onerous system of compliance is necessary.

In addition, operation, maintenance and depreciation of assets must be funded for the recycled water system. These costs would normally be passed on to residents and businesses through annual rates. Options available for Council include:

- Recover all costs through user pays charging for the use of recycled water.
- Recover costs through an increase in the sewerage charge levied on the whole community. This recognises that removing nutrients from the waterways is a community responsibility that should be paid for by all rather than a small section of the community.
- Combination of the above, taking account of the benefits that the householder gains in terms on reduced water bills. For example the treatment costs may be spread over the whole community and the balance could be paid by the user.

Broadly estimated cost of recycled water is summarised in Table 5-33.

Table 5-33 Estimated Cost to Council of Recycled Water Management

Cost Description	Estimated Cost
Recycled Water	
Management Plan	$150,000
Compliance Testing	$50 /property/annum
Rainwater Tanks	
Management Plan	$30,000
Compliance Testing	$30 /property/annum

5.6.6 ENVIRONMENTAL COMPARISON

Based on the assessment of environmental impacts in Section 5.5, the following conclusions are evident:

- Scenarios 2 and 3 (recycled water) will reduce the discharge to the waterways by approximately 10 -12 % over the baseline forecast. Nutrient discharge will provide a similar level of reduction.

- Although it appears that Scenario 4 (Indirect Potable Reuse) will provide a reduction of 75% of the dry weather flow to the rivers, the level of nutrient reduction will be significantly less. This is due to the fact that the Reverse Osmosis brine needs to be discharged to the rivers. The brine contains the majority of the nutrients that are present. In essence the concentration of nutrients will be increased and this may have a more detrimental impact than the present discharge.
- Greenhouse gases for all options are essentially neutral as the additional energy usage for the recycled water and rainwater systems are offset by the savings in hot water generation.

5.7 ADDITIONAL ASSESSMENT OF COBAKI LAKES DEVELOPMENT OPTIONS

Additional assessment of options was undertaken as an addendum to the report (refer to Appendix P). The assessment considered the option of a stand alone decentralised option instead of centralised treatment at the Banora Point STP. Two options were reviewed as follows:

- Option 1 – Centralised Treatment at Banora Point STP. Under this option, sewage would be transferred to the existing Banora Point STP for treatment to Class A+ standard and then returned to the Cobaki Lakes development area for reuse. It would be proposed that the recycled water woul be used on external areas and
- Option 2 – Cobaki Lakes Treatment Facility. This option involves the construction of a sewage treatment plant at the southern end of the Cobaki Lakes development. A Class A+ water recycling facility would be constructed for use in the development residential and commercial sectors with the major end uses being landscaping, toilets and open space irrigation. Sewage from Bilambil Heights would also be treated at this facility. It is proposed that there would be no discharge from the site to the existing sewerage system.

For both options it was necessary to consider the collection and treatment of both the Cobaki Lakes and Bilambil Heights developments as either of these developments will trigger a requirement to upgrade the sewerage system between Cobaki Creek and the Banora Point STP.

Based on assessment of the two options for provision of recycled water to the Cobaki lakes development it is evident that Option 2, with a treatment plant located at the development is significantly lower in cost than a centralised system with treatment at Banora Point. Option 2 is approximately $5.1 m or 17% lower in NPV than Option 1. The major reasons for the difference in NPV are as follows:

- The Cobaki STP is constructed in 2 stages rather than a single large stage at Banora Point.
- Costs of transferring raw sewage and recycled water to and from the STP are greatly reduced.

Any decision to adopt one of these options must however take account of the additional costs for the implementation of the recycled water scheme. These costs relate to the development of education program, billing systems, testing and compliance and reporting. On the other hand there are savings related to the reduction in water use resulting from substitution of existing potable end uses with recycled water.

On the balance, costs of provision of recycled water to customers in the development will be higher than that of potable water. The benefits to the environment do need to be considered. Nutrient mass loads discharged to the Tweed River will be lowered as a result of the approach.

Obviously it will be necessary to gain State Government approval for a discharge to either Cobaki Creek or further downstream. If such a license is not granted, storage will be required on site with a dry weather capacity connection to the existing sewerage system at SPS 2052. The costs of such a connection were not included in the assessment.

It was concluded that although the capital and operating costs of the decentralised treatment option are lower than the option of treating all water at Banora Point, the overall cost of providing recycled water are substantially higher than for potable water. The overall cost to the community is higher than for potable water and these costs would need to be passed on through the price of recycled water. These higher costs are however balanced in some way by the reduction in nutrients and greenhouse gas generation for the business as usual option of centralised sewage treatment without recycling.

Council should therefore consider a local scheme to recycle water should the developer propose this approach. A detailed assessment of the impact on developer charges and rates should however be undertaken should a formal proposal be submitted.

6. OPTIONS ASSESSMENT FOR WHOLE OF COUNCIL

6.1 OVERVIEW

In addition to the assessment of demand management opportunities within the major future growth areas within TSC, further investigation into demand management measures for the whole of the shire has been undertaken. This assessment focuses on identifying and analysing the costs and benefits of implementing specific demand management measures in the existing or 'brownfield' areas of Tweed Shire, for example, leakage and pressure management.

This section of the report outlines the development of integrated water scenarios, the assessment of water forecasts and the costs and benefits of available options. Please note, this assessment incorporates the population and demand forecasts for all future development including the major developments.

6.2 DEMAND MANAGEMENT OPTIONS ASSESSMENT

6.2.1 SCENARIO DEFINITION

Four scenarios were developed in conjunction with council representatives. These scenarios comprise a range of water efficiency measures, source substitution and water loss management options. The scenarios are defined as follows:

- Scenario 1 – BASIX with a Rainwater Tank serving external, cold water for washing machines and toilets combined with the WELS Program.
- Scenario 2 – BASIX with a Rainwater Tank serving external, cold water for washing machines and toilets combined with the WELS Program and a Loss Management Program.
- Scenario 3 – Selected Demand Management Options including a range of measures to reduce water demand in the residential sector.
- Scenario 4 – Enhanced Demand Management Options including Scenario 3 measures plus Non Residential sector measures.

Each of the above scenarios reflects the current legislative requirements for new residential dwellings in NSW according to the Building Sustainability Index (BASIX). All scenarios consider the installation of water efficient fixtures including showerheads, taps and dual flush toilets. In accordance with BASIX these fixtures are required to be rated at 3 Stars or higher. Furthermore, a 5 kL rainwater tank servicing external uses, cold water for washing machine and toilets has been assumed to be connected to fulfil the BASIX requirements. The sizing of the rainwater was undertaken in Section 5.3.1 of this report.

Besides the water savings generated through BASIX, additional savings from residential and non-residential measures such as educational programs, residential audit programs, residential end use specific rebates and retrofit programs, the national water efficiency labelling and standards (WELS) scheme and the influence of future pricing paths have been considered.

6.2.2 SCENARIO 1 – BASIX / WELS PROGRAM

Scenario 1 reflects the current legislative requirements for new residential developments in NSW according to the Building Sustainable Index (BASIX) and the national Water Efficiency Labelling and Standards (WELS) scheme. This scenario mandates the installation of water efficient fixtures as discussed above, including a 5 kL rainwater tank.

The WELS program was introduced in 2005 by the Federal Government to encourage the purchase and installation of water efficient appliances and fixtures. This scenario enhances the market share of water efficient showerheads, washing machines and dishwashers.

6.2.3 SCENARIO 2 – BASIX/WELS PROGRAM AND LEAKAGE MANAGEMENT

Scenario 2 extends Scenario 1 to include a Loss Management Strategy with an aim to reduce the current losses to below 10% by 2010. Section 6.2.3.1 discusses Tweed Shire's current approach to water loss management in accordance to their Water Loss Management Program (WLMP), while Section 6.2.3.2 investigates the Active Leakage Management options that have been assessed in this scenario, such as the implementation of District Metering Areas (DMAs) and Pressure Management Areas (PMAs) to monitor and reduce losses.

6.2.3.1 CURRENT APPROACH TO WATER LOSS MANAGEMENT

Based on documents provided by TSC the current loss management strategy follows the framework provided by the state government sponsored Water Loss Management Program (WLMP). The current strategy includes the following activities to reduce leakage:

- Pipe Replacement Program: To upgrade poorly performing and aging pipes.
- Customer Service System: To improve the response times for reporting and actioning water breaks.
- Meters on Water Standpipes: To enforce the use of metered standpipes to accurately record the volume of water taken from the system by water carters.
- Water Meter Replacement Program: To replace all domestic water meters every 10 years to achieve the accuracy required by the Australian Standard.

Although these actions are essential to reduce the level of NRW, the program does not currently include any elements of active leakage management, such as pressure management or leakage detection and repair. Based on the current approach it is not likely that the NRW target of 10% set under the IWCM Concept Study and adopted by Council will be met.

6.2.3.2 ACTIVE LEAKAGE MANAGEMENT OPTIONS

In accordance with the recommendations of the WBI (refer to Section 4.2.4.2), a range of active leakage reduction activities are required to reduce water losses to below 10%. Costs and benefits of these active leakage reduction options are assessed as part of this study.

The key assumptions and adopted cost rates are also listed below (based on data provided by TSC and recent information from leakage reduction program in South East Queensland):

- Active Leakage Detection and Repair:
  - Number of bursts in existing system: 0.4/km
  - Cost for leakage inspection: $209/km
  - Repair costs: 1,880 per leak
  - Percentage reduction in avoidable losses on repair: 75%
  - Life span for loss reduction: 3 years
- Pressure Management Areas (PMA)
  - Number of service connections per PMA: 1,500
  - Number of PMAs: 13
  - Cost for the PMA establishment: $150,000 per PMA
  - Operation and Maintenance Cost: $15,000 /annum
  - Percentage of system covered by Pressure Management: 60%
  - Percentage of reduction in pressure in PMA: 20% (50m to 40m head)
- District Metering Area (DMA)
  - Number of service connections per DMA: 1,500
  - Number of DMAs: 7
  - Cost for the DMA establishment: $50,000 per DMA
  - Operation and Maintenance Cost: $15,000 /annum

By applying the above cost rates and assumptions, the current water losses percentage (13.6%) could be reduced to 9.6% in 2011 if the WLMP actions are implemented from 2008. An annual water saving of 320 ML/a or 0.88 ML/d could be achieved by 2011. The capital cost to implement the active leakage program is estimated to be approximately $2.8m, with a on-going operation and maintenance cost of $0.3 to $0.5m /a.

6.2.4 SCENARIO 3 – SELECTED DEMAND MANAGEMENT OPTIONS

Scenario 3 is a further extension of Scenario 2 but including a suite of demand management initiatives, such as residential retrofits, rebates for water efficient fixtures and a residential audit program, designed to develop long term reductions in water use.

Table 6-1 summarises the demand management measures available for Scenario 3, and details key assumptions for each.

Table 6-1 Overview of Possible Demand Management Options

PROGRAM	TARGET SECTOR	TAKE UP RATE	WATER SAVINGS
WELS PROGRAM			
WATER EFFICIENT SHOWERHEADS	ALL RESIDENTIAL	INCREASED SALE OF EFFICIENT SHOWERHEADS BY	15 % SAVINGS OF CURRENT SHOWER DEMAND

PROGRAM	TARGET SECTOR	TAKE UP RATE	WATER SAVINGS
	DWELLINGS	5%	
WATER EFFICIENT WASHING MACHINES		INCREASED SALE OF EFFICIENT WASHING MACHINES BY 7%	30% SAVINGS OF ORIGINAL HOUSEHOLD WASHING MACHINE DEMAND
WATER EFFICIENT DISHWASHERS		INCREASED SALE OF EFFICIENT DISHWASHERS BY 2%	20% SAVINGS OF ORIGINAL DISHWASHER DEMAND
EDUCATION			
BEHAVIOURAL CHANGES AND AWARENESS	ALL SINGLE AND MULTI-FAMILY RESIDENTIAL DWELLINGS	100% OF RESIDENTIAL ACCOUNTS	1% SAVINGS FOR ALL INTERNAL END USES AND 2% OF EXTERNAL END USES
LANDSCAPE USE EFFICIENCY AWARDS	EXISTING RESIDENTIAL DWELLINGS	10 % OF RESIDENTIAL ACCOUNTS	10% OF EXTERNAL AND IRRIGATION DEMAND
BASIX EFFICIENT FIXTURE REQUIREMENTS			
WATER EFFICIENT TAPS (MINIMUM 3 STAR)	ALL NEW SINGLE AND MULTI-FAMILY RESIDENTIAL DWELLINGS	100 % OF NEW RESIDENTIAL ACCOUNTS	20 % SAVINGS OF CURRENT DEMAND FOR TAPS AND SINKS
WATER EFFICIENT SHOWER HEADS (MINIMUM 3 STAR)		100 % OF NEW RESIDENTIAL ACCOUNTS	15 % SAVINGS OF CURRENT SHOWER DEMAND
WATER EFFICIENT DUAL FLUSH TOILET (MINIMUM 3 STAR)		100 % OF NEW RESIDENTIAL ACCOUNTS	40 % SAVINGS CURRENT EXISTING TOILET DEMAND
BASIX SOURCE SUBSTITUTION (RAINWATER TANKS)			
5KL RAINWATER TANK	ALL NEW SINGLE AND MULTI-FAMILY RESIDENTIAL DWELLINGS	100 % OF NEW RESIDENTIAL ACCOUNTS	CONNECTED TO EXTERNAL TAPS, TOILET AND COLD WATER LAUNDRY.
LOSS MANAGEMENT PROGRAM			
LEAKAGE DETECTION AND PRESSURE REDUCTION PROGRAM	NON REVENUE WATER	SAVINGS ACHIEVED OVER 3 YEARS AND MAINTAINED	REDUCTION OF NRW FROM 13.6 % TO BELOW 10 % OF PRODUCTION
RESIDENTIAL RETROFIT SERVICE			
COUNCIL SUBSIDISED VOLUNTARY RESIDENTIAL RETROFIT SERVICE	EXISTING RESIDENTIAL DWELLINGS	25 % OF EXISTING SINGLE AND MULTI-FAMILY RESIDENTIAL DWELLINGS (7,400 RETROFITS BY 2011)	PROGRAM TARGETING THE RETROFIT OF WATER INEFFICIENT SHOWERHEADS AND TAPS TO 3 STAR OR BETTER. 10 % SAVINGS OF CURRENT DEMAND FOR TAPS AND A 15 % SAVINGS OF CURRENT SHOWER DEMAND
RESIDENTIAL END USE SPECIFIC REBATE PROGRAM			

PROGRAM	TARGET SECTOR	TAKE UP RATE	WATER SAVINGS
WASHING MACHINE REBATE	EXISTING RESIDENTIAL DWELLINGS	10 % OF EXISTING SINGLE AND MULTI-FAMILY RESIDENTIAL DWELLINGS (3,200 REBATES BY 2011)	30 % SAVING FROM THE CURRENT DEMAND FOR WASHING MACHINES
SHOWERHEAD REBATE		15 % OF EXISTING SINGLE AND MULTI-FAMILY RESIDENTIAL DWELLINGS (4,600 REBATES BY 2011)	15 % SAVINGS OF CURRENT SHOWER DEMAND
RAINWATER TANK REBATE		10 % OF EXISTING SINGLE FAMILY RESIDENTIAL DWELLINGS (1,800 REBATES BY 2011)	YIELDING 80 % OF CURRENT EXTERNAL DEMANDS

An assessment of the water savings and annualised costs of the individual measures described above was undertaken and the results are provided in Table 6-2.

Table 6-2 Individual Measures - Water Savings and Annualised Cost

Measure Description	Annual Potable Water Savings (ML/a)			Annualised Cost ($/kL)
	2016	2036	Avg.	
BASIX Fixtures and WELS	219	532	290	$0.02
BASIX - Internal/External Rainwater Tank (5 kL)	827	2,611	1,277	$4.42
Inclining Block Tariff	33	60	36	$0.04
Residential Education Program	76	73	70	$0.88
Landscape Use Efficiency Awards	62	71	57	$1.17
Residential Rebate Program - Showerheads	29	10	20	$0.51
Residential Rebate Program - Washing Machines	16	4	11	$14.23
Residential Rebate Program - Rainwater Tanks	91	104	85	$4.64
Pressure and Leakage Management Program	532	813	556	$0.94
Residential Retrofit	77	65	68	$1.34
Total	**1,900**	**3,993**	**2,328**	

Based on the results of the above assessment the majority of the proposed demand management measures assessed are likely to be cost effective. The exceptions were the rebate programs for rainwater tanks and washing machines, which were not included in the program.

It is noted that the majority of water savings result from two programs – BASIX with rainwater tanks for infill development and the loss reduction program.

6.2.5 SCENARIO 4 – FULL SUITE OF DEMAND MANAGEMENT OPTIONS WITH ENHANCED NON RESIDENTIAL EFFICIENCIES

Scenario 4 utilises the demand management options developed for Scenario 3, and includes an estimated 10% reduction in demand for all existing and new non residential accounts to be achieved by 2010. It is assumed that this level of demand reduction could be achieved through the introduction of programs such as business audit program and demand management plans for high water users as well as education and possible rebate programs designed to encourage the retrofit of water efficient fixtures e.g. spray rinse valves or waterless urinals. The non-residential efficiency will be subject to further assessment in Stage 2 of the Demand Management Strategy.

6.3 REVISED DEMAND FORECAST

A summary of the future water demand management outcomes for Tweed Shire, based on the assessment of demand for each scenario is provided in the following figures and tables. The assessment indicated that on an annual basis the following savings can be achieved in 2036:

- Scenario 1 will save approximately 16% over the baseline.
- Scenario 2 will save approximately 20% over the baseline.
- Scenario 3 will save approximately 21% over the baseline.
- Scenario 4 will save approximately 23% over the baseline.

Table 6-3 Total Annual Water Demand Forecast

Scenario	Annual Demand (ML/a)						
	2006	2012	2016	2021	2026	2031	2036
Baseline Forecast	9,804	11,160	13,207	15,278	16,840	18,425	20,280
Scenario 1 – BASIX / WELS	9,804	10,737	12,158	13,618	14,716	15,827	17,129
Scenario 2 - BASIX /WELS and Loss Management Program	9,804	10,293	11,620	12,990	14,024	15,073	16,304
Scenario 3 – Scenario 2 plus Active Demand Management Options	9,804	10,014	11,353	12,731	13,770	14,822	16,053
Scenario 4 – Scenario 3 plus Non Residential Demand Management	9,804	9,970	11,236	12,536	13,505	14,485	15,635

Figure 6-1 Total Water Demand Forecast

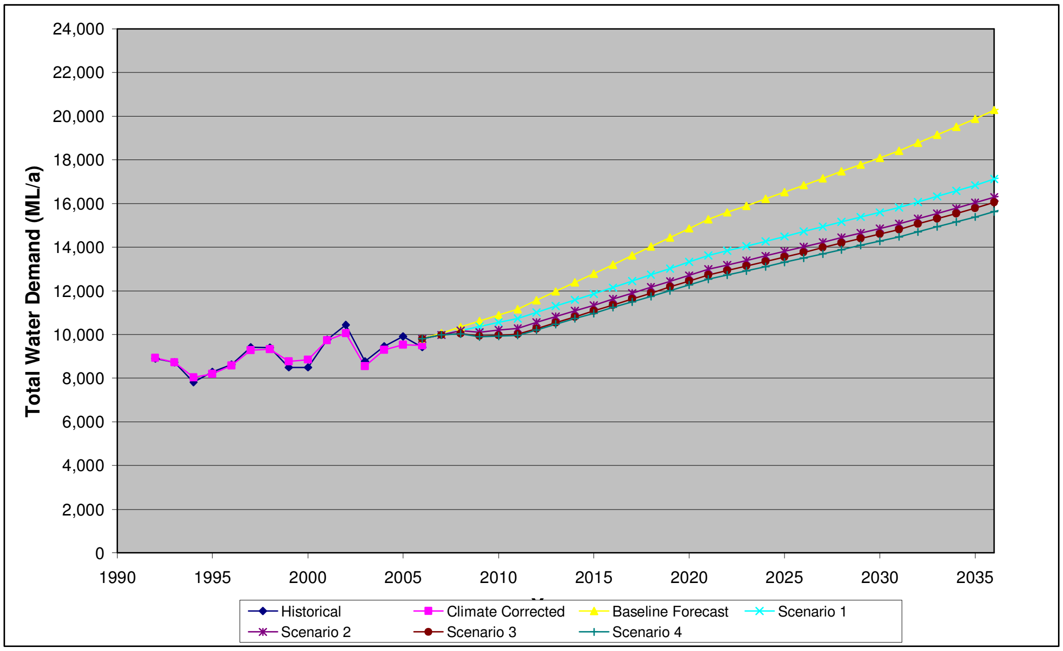
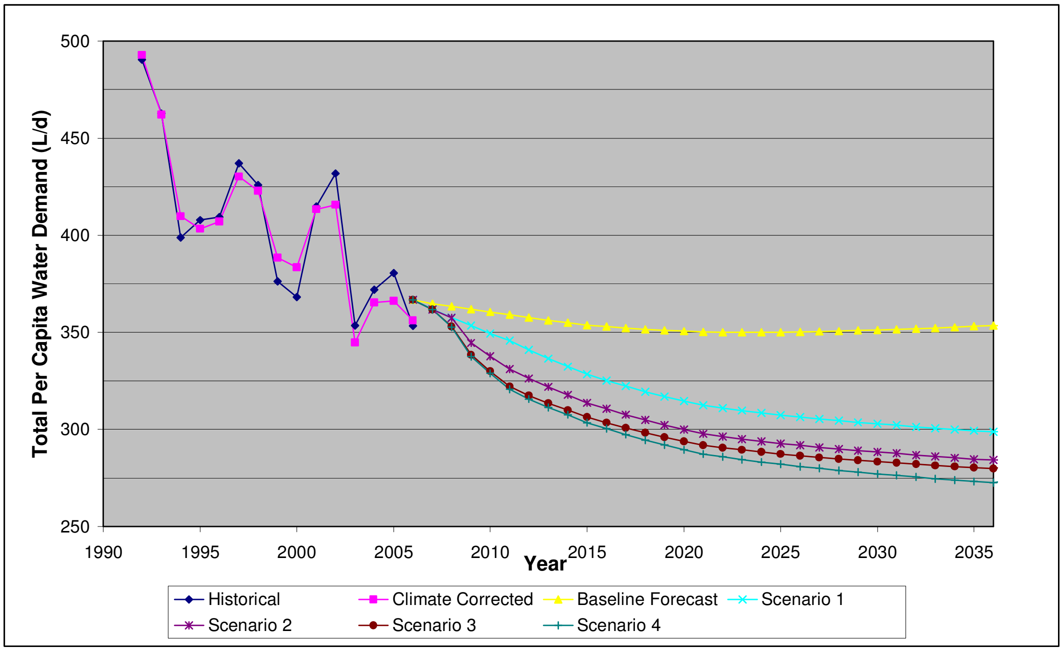


Table 6-4 Total Per Capita Water Demand Forecast

Scenario	Per Capita Demand (L/person/day)						
	2006	2012	2016	2021	2026	2031	2036
Baseline Forecast	367	359	353	350	350	352	354
Scenario 1 – BASIX / WELS	367	346	325	312	306	302	299
Scenario 2 - BASIX /WELS and Loss Management Program	367	331	311	298	292	288	284
Scenario 3 – Scenario 2 plus Active Demand Management Options	367	322	303	292	286	283	280
Scenario 4 – Scenario 3 plus Non Residential Demand Management	367	321	300	287	281	276	273

Figure 6-2 Total Per Capita Water Demand Forecast



A summary of the savings from the various scenarios is given in Table 6-5 to Table 6-8 and graphically in Figure 6-3 to Figure 6-6.

Table 6-5 Sectoral Annual Water Demand Forecast – Scenario 1

Sector	Annual Water Demand (ML/a)						
	2006	2012	2016	2021	2026	2031	2036
Single Family Existing	4,635	4,523	4,409	4,325	4,260	4,209	4,186
Single Family Greenfield	0	172	581	995	1,342	1,688	2,068
Single Family Infill	0	65	109	156	188	221	258
Multi-Family Existing	1,781	1,724	1,662	1,599	1,544	1,497	1,464
Multi-Family Greenfield	0	102	317	534	709	881	1,071
Multi-Family Infill	0	229	383	551	662	775	904
Commercial	1,400	1,641	1,991	2,336	2,589	2,838	3,123
Industrial	67	71	75	79	83	87	91
Irrigation	1	2	2	2	3	3	3
Public	464	544	660	774	858	941	1,035
Bulk Sales	181	182	184	185	187	188	189
Non Revenue Water	1,274	1,482	1,784	2,080	2,292	2,499	2,735
Total	**9,804**	**10,737**	**12,158**	**13,618**	**14,716**	**15,827**	**17,129**

Table 6-6 Sectoral Annual Water Demand Forecast – Scenario 2

Sector	Annual Water Demand (ML/a)						
	2006	2012	2016	2021	2026	2031	2036
Single Family Existing	4,635	4,523	4,409	4,325	4,260	4,209	4,186
Single Family Greenfield	0	172	581	995	1,342	1,688	2,068
Single Family Infill	0	65	109	156	188	221	258
Multi-Family Existing	1,781	1,724	1,662	1,599	1,544	1,497	1,464
Multi-Family Greenfield	0	102	317	534	709	881	1,071
Multi-Family Infill	0	229	383	551	662	775	904
Commercial	1,400	1,641	1,991	2,336	2,589	2,838	3,123
Industrial	67	71	75	79	83	87	91
Irrigation	1	2	2	2	3	3	3
Public	464	544	660	774	858	941	1,035
Bulk Sales	181	182	184	185	187	188	189
Non Revenue Water	1,274	1,037	1,245	1,452	1,600	1,745	1,910
Total	**9,804**	**10,293**	**11,620**	**12,990**	**14,024**	**15,073**	**16,304**

Table 6-7 Sectoral Annual Water Demand Forecast – Scenario 3

Sector	Annual Water Demand (ML/a)						
	2006	2012	2016	2021	2026	2031	2036
Single Family Existing	4,635	4,316	4,207	4,128	4,065	4,017	3,994
Single Family Greenfield	0	172	579	992	1,337	1,683	2,062
Single Family Infill	0	64	108	156	188	220	257
Multi-Family Existing	1,781	1,655	1,602	1,542	1,491	1,446	1,414
Multi-Family Greenfield	0	102	317	534	708	880	1,070
Multi-Family Infill	0	228	383	550	661	774	903
Commercial	1,400	1,641	1,991	2,336	2,589	2,838	3,123
Industrial	67	71	75	79	83	87	91
Irrigation	1	2	2	2	3	3	3
Public	464	544	660	774	858	941	1,035
Bulk Sales	181	182	184	185	187	188	189
Non Revenue Water	1,274	1,037	1,245	1,452	1,600	1,745	1,910
Total	**9,804**	**10,014**	**11,353**	**12,731**	**13,770**	**14,822**	**16,053**

Table 6-8 Sectoral Annual Water Demand Forecast – Scenario 4

Sector	Annual Water Demand (ML/a)						
	2006	2012	2016	2021	2026	2031	2036
Single Family Existing	4,635	4,316	4,207	4,128	4,065	4,017	3,994
Single Family Greenfield	0	172	579	992	1,337	1,683	2,062
Single Family Infill	0	64	108	156	188	220	257
Multi-Family Existing	1,781	1,655	1,602	1,542	1,491	1,446	1,414
Multi-Family Greenfield	0	102	317	534	708	880	1,070
Multi-Family Infill	0	228	383	550	661	774	903
Commercial	1,400	1,610	1,907	2,196	2,399	2,596	2,823
Industrial	67	70	73	76	78	81	85
Irrigation	1	1	2	2	2	3	3
Public	464	534	632	728	795	861	936
Bulk Sales	181	181	181	180	180	179	178
Non Revenue Water	1,274	1,037	1,245	1,452	1,600	1,745	1,910
Total	**9,804**	**9,970**	**11,236**	**12,536**	**13,505**	**14,485**	**15,635**

Figure 6-3 Water Demand Profile – Scenario 1

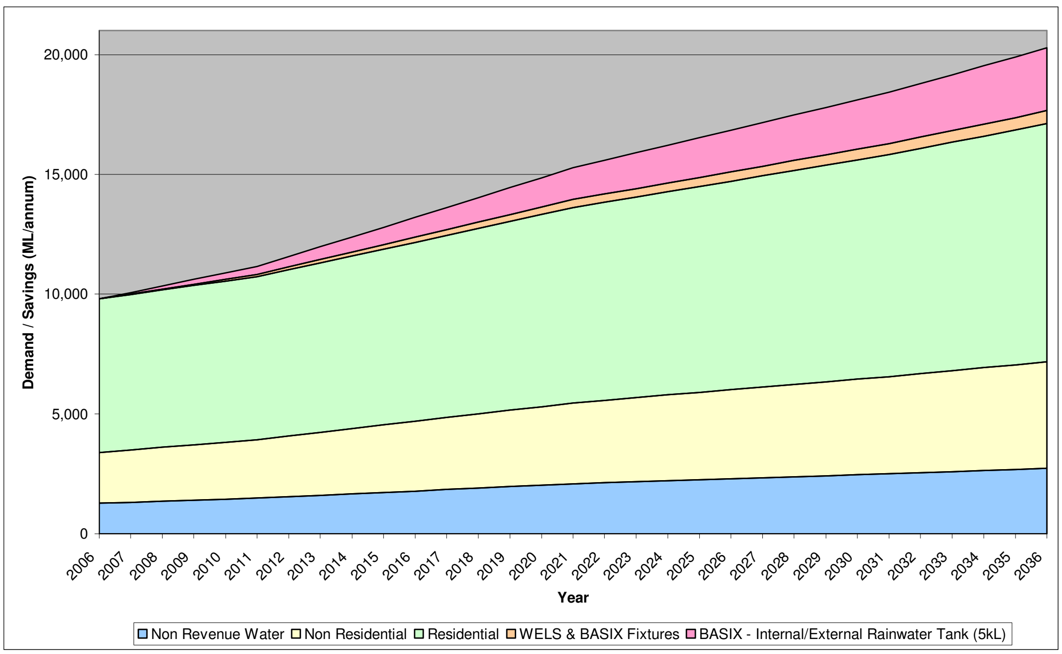


Figure 6-4 Water Demand Profile – Scenario 2

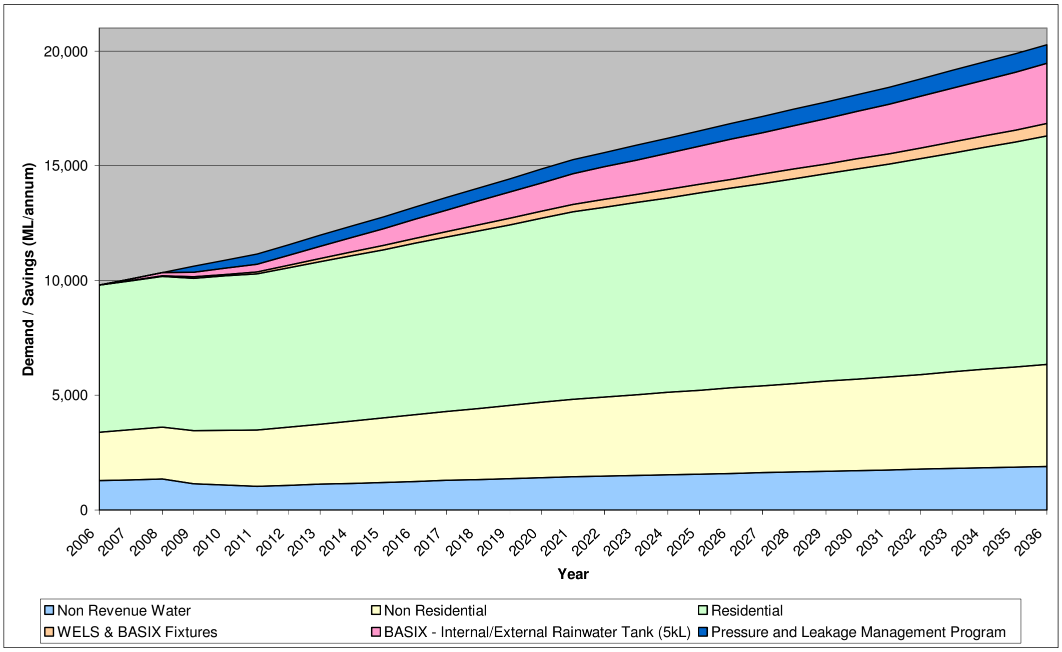


Figure 6-5 Water Demand Profile – Scenario 3

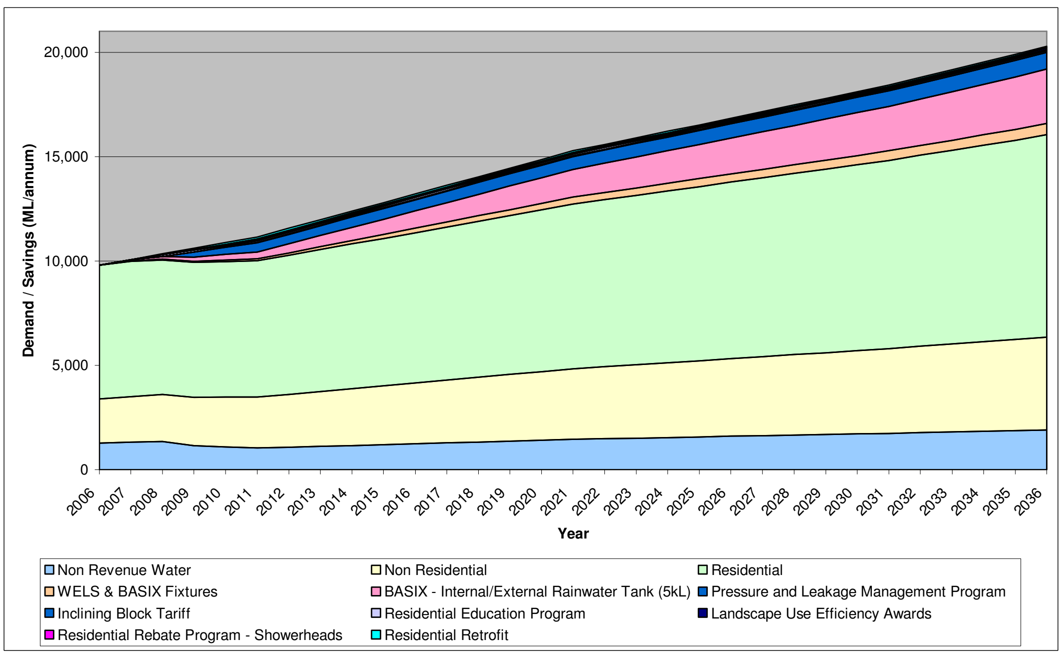
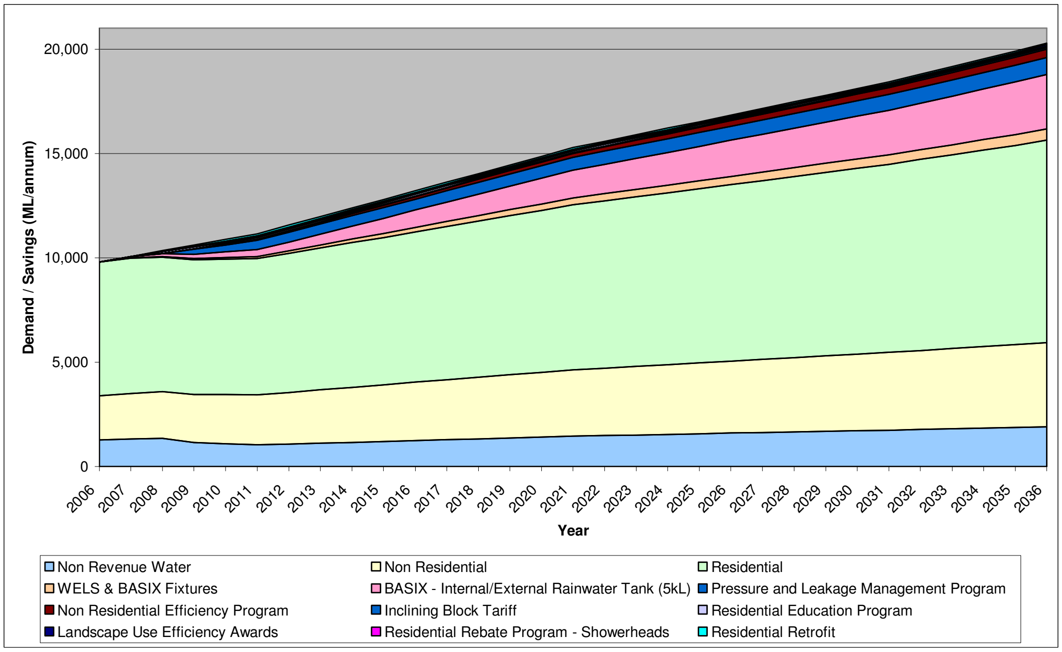


Figure 6-6 Water Demand Profile – Scenario 4



6.4 PROGRAM COSTS

An overall cost assessment was undertaken for each of the four scenarios. A summary of the assessment is provided in the tables below. The total NPV contained costs for the following elements:

- Council Capital Costs – assumed to be capital costs of works to council.
- Customer Capital Costs – assumed to be the costs related to provision of rainwater tanks and other fixtures and fittings.
- Council Operational Costs – assumed to be the on-going cost of maintaining programs and for compliance testing and inspections.
- Customer Operational Costs – assumed to be the costs of operating a rainwater tank as well as the benefits of lower energy costs from hot water savings.

Table 6-9 Individual Demand Measurement Results – Scenario 1

Measure Description	Net Present Value of Forecast Expenditure							
	CAPEX			OPEX			Total NPV	Annualised Cost ($/kL)
	Council NPV	Customer NPV	Total Capital NPV	Council NPV	Customer NPV	Total OPEX NPV		
BASIX Fixtures and WELS	$0	$72,120	$72,120	$0	$0	$0	**$72,120**	**$0.02**
BASIX - Internal/External Rainwater Tank (5kL)	$0	$56,241,488	$56,241,488	$1,947,303	$11,858,863	$13,806,166	**$70,047,654**	**$4.42**
Total	**$0**	**$56,313,608**	**$56,313,608**	**$1,947,303**	**$11,858,863**	**$13,806,166**	**$70,119,774**	**$3.60**

Table 6-10 Individual Demand Measurement Results – Scenario 2

Measure Description	Net Present Value of Forecast Expenditure							
	CAPEX			OPEX			Total NPV	Annualised Cost ($/kL)
	Council NPV	Customer NPV	Total Capital NPV	Council NPV	Customer NPV	Total OPEX NPV		
BASIX Fixtures and WELS	$0	$72,120	$72,120	$0	$0	$0	**$72,120**	**$0.02**
BASIX - Internal/External Rainwater Tank (5kL)	$0	$56,241,488	$56,241,488	$1,947,303	$11,858,863	$13,806,166	**$70,047,654**	**$4.42**
Pressure and Leakage Management Program	$2,887,978	$0	$2,887,978	$3,568,283	$0	$3,568,283	**$6,456,261**	**$0.94**
Total	**$2,887,978**	**$56,313,608**	**$59,201,586**	**$5,515,586**	**$11,858,863**	**$17,374,449**	**$76,576,035**	**$2.91**

Table 6-11 Individual Demand Measurement Results – Scenario 3

Measure Description	Net Present Value of Forecast Expenditure							
	CAPEX			OPEX			Total NPV	Annualised Cost ($/kL)
	Council NPV	Customer NPV	Total Capital NPV	Council NPV	Customer NPV	Total OPEX NPV		
BASIX Fixtures and WELS	$0	$72,120	$72,120	$0	$0	$0	$72,120	**$0.02**
BASIX - Internal/External Rainwater Tank (5kL)	$0	$56,241,488	$56,241,488	$1,947,303	$11,858,863	$13,806,166	$70,047,654	**$4.42**
Inclining Block Tariff	$17,469	$0	$17,469	$0	$0	$0	$17,469	**$0.04**
Residential Education Program	$344,032	$0	$344,032	$415,891	$0	$415,891	$759,923	**$0.88**
Landscape Use Efficiency Awards	$88,123	$679,807	$767,930	$53,005	$0	$53,005	$820,935	**$1.17**
Residential Rebate Program - Showerheads	$71,846	$53,154	$125,000	$0	$0	$0	$71,846	**$0.51**
Pressure and Leakage Management Program	$2,887,978	$0	$2,887,978	$3,568,283	$0	$3,568,283	$6,456,261	**$0.94**
Residential Retrofit	$963,009	$156,408	$1,119,416	$0	$0	$0	$1,119,416	**$1.34**
Total	**$4,300,640**	**$57,149,832**	**$61,450,453**	**$5,984,483**	**$11,858,863**	**$17,843,345**	**$79,293,779**	**$2.69**

7. PREFERRED OPTION ASSESSMENT

7.1 APPROACH

A Triple Bottom Line (TBL) assessment of the scenarios was undertaken utilising a Multi Criteria Assessment (MCA) approach that was based on broad issues identified through the issues assessment in the TSC Concept Study and discussions with TSC.

This section of the report outlines the results to the preliminary TBL assessment undertaken by MWH. The assessment should be tested against the stakeholder group to confirm and finalise the preferred option.

The following TBL assessment criteria were adopted for the study:

- Environmental
    - Minimise Greenhouse Gas Emissions
    - Minimise Pollutants Entering Waterways
    - Minimise Extractions From Rivers
- Social
    - Accepted by Community
    - Secures Water Supply
    - Enhances Service Levels
- Economic
    - Whole of Life Cost
    - Impact on Rates

7.2 GREENFIELD DEVELOPMENT PROGRAM

7.2.1 TBL ASSESSMENT

The TBL assessment was undertaken for each individual greenfield development area. Each area may have higher greenhouse gases or a significantly higher cost of infrastructure compared to another development. A summary of the Assessment is provided in Table 7-1.

Table 7-1 Triple Bottom Line Assessment of Greenfield Development Scenarios

Development	Scenario	Description	Minimise Greenhouse Gas Emissions	Minimise Pollutants Entering Waterways	Minimise Extractions From Rivers	Enviro Average Score	Accepted by Community	Secures Water Supply	Enhances Service Levels	Social Average Score	Whole of Life Cost	Impact on Rates	Economic Average Score	Total Score
Cobaki Lakes	Scenario 1	Basix + Rainwater Tank	4	2	3	3.00	5	3	3	3.67	5	4	4.50	11.17
	Scenario 2	Basix + Recycled Water	4	4	4	4.00	3	4	2	3.00	4	2	3.00	10.00
	Scenario 3	Basix + Rainwater Tank +Recycled Water	3	5	5	4.33	4	5	1	3.33	2	2	2.00	9.67
	Scenario 4	Indirect Potabel Reuse and Rainwater Tanks	2	2	5	3.00	1	4	2	2.33	1	1	1.00	6.33
	Scenario 5	BASIX with Fourth Pipe Recycling System	3	3	5	3.67	4	3	2	3.00	2	2	2.00	8.67
Bilambil Heights	Scenario 1	Basix + Rainwater Tank	3	2	2	2.33	5	3	3	3.67	5	4	4.50	10.50
	Scenario 2	Basix + Recycled Water	2	3	3	2.67	3	4	2	3.00	4	2	3.00	8.67
	Scenario 3	Basix + Rainwater Tank +Recycled Water	2	4	4	3.33	4	3	1	2.67	1	2	1.50	7.50
	Scenario 4	Indirect Potabel Reuse and Rainwater Tanks	2	2	4	2.67	1	4	2	2.33	1	1	1.00	6.00
	Scenario 5	BASIX with Fourth Pipe Recycling System	3	3	5	3.67	4	3	2	3.00	2	2	2.00	8.67
Terranora Area A	Scenario 1	Basix + Rainwater Tank	4	2	2	2.67	5	2	3	3.33	5	4	4.50	10.50
	Scenario 2	Basix + Recycled Water	4	3	3	3.33	3	3	2	2.67	4	2	3.00	9.00
	Scenario 3	Basix + Rainwater Tank +Recycled Water	3	4	4	3.67	4	4	1	3.00	1	2	1.50	8.17
	Scenario 4	Indirect Potabel Reuse and Rainwater Tanks	2	2	4	2.67	1	4	2	2.33	1	1	1.00	6.00
	Scenario 5	BASIX with Fourth Pipe Recycling System	3	3	5	3.67	4	3	2	3.00	2	2	2.00	8.67
West Kingscliff	Scenario 1	Basix + Rainwater Tank	4	2	2	2.67	5	2	3	3.33	5	4	4.50	10.50
	Scenario 2	Basix + Recycled Water	4	3	3	3.33	3	3	2	2.67	4	2	3.00	9.00
	Scenario 3	Basix + Rainwater Tank +Recycled Water	4	4	4	4.00	4	3	1	2.67	3	2	2.50	9.17
	Scenario 4	Indirect Potabel Reuse and Rainwater Tanks	2	2	4	2.67	1	4	2	2.33	1	1	1.00	6.00
	Scenario 5	BASIX with Fourth Pipe Recycling System	3	3	5	3.67	4	3	2	3.00	2	2	2.00	8.67
Kings Forest	Scenario 1	Basix + Rainwater Tank	4	2	3	3.00	5	3	3	3.67	5	4	4.50	11.17
	Scenario 2	Basix + Recycled Water	3	4	4	3.67	3	4	2	3.00	4	2	3.00	9.67
	Scenario 3	Basix + Rainwater Tank +Recycled Water	3	5	5	4.33	4	5	1	3.33	2	2	2.00	9.67
	Scenario 4	Indirect Potabel Reuse and Rainwater Tanks	2	2	4	2.67	1	4	2	2.33	1	1	1.00	6.00
	Scenario 5	BASIX with Fourth Pipe Recycling System	3	3	5	3.67	4	3	2	3.00	2	2	2.00	8.67

7.2.2 PREFERRED SCENARIO – GREENFIELD DEVELOPMENT

Based on the Triple Bottom Line assessment of the development scenarios it is evident that the preferred option is Scenario 1, comprising the implementation of BASIX (efficient showerheads and taps, dual flush toilets) together with rainwater tanks (5 kL for Single Family Residential dwellings) to service external, toilet flushing and cold water to washing machines.

The major reasons for the selection of Greenfield Development Scenario 1 are as follows:

- Scenario 1 has the lowest costs to the community. The majority of the capital cost and on-going costs are the responsibility of the householder. Council will need to have a management plan including regular inspections to ensure that health and water quality aspects are addressed through regular maintenance.
- Scenario 1 has the best return on investment with savings of 34 to 38% of the baseline demand forecasts. This compares to around 42% for Scenario 2 (recycled water) and 61% for Scenario 3 (rainwater tanks and recycled water). However due to the high costs of developing a dual reticulation system the cost of water saved for the higher water saving options is very high.
- From an environmental perspective Scenario 1 is not the highest performer, due to the fact that Scenarios 2 and 3 reduce return effluent flows to the waterways by more than 10%. Rainwater tanks will however have a modest impact on urban runoff in the greenfield areas as part of an overall Water Sensitive Urban Design solution.
- Scenario 1 will have a broad community acceptance compared to Scenarios 2 and 3. Although there has been significant support for recycled water in Pimpama Coomera, there are local and regional water management drivers that do not exist in Tweed Shire.

Adoption of Scenario 1 does not come without risk. The wide scale use of rainwater tanks in urban areas is only starting to occur in Australia, therefore the level of yield from the tanks is not guaranteed. Achievement of the yield of around 80 kL/d will not be achieved without education on the part of council as well as the implementation of a regular program of inspection.

An exception to the preferred scenario is the West Kingscliff development. Due to the proximity of the development to the sewage treatment plant the cost of return flows to the area are low compared to the other developments. There are however risks as the actual use for recycled water in this development are unknown. Currently the proposal is to develop service industry, which does not generally have a high water use. Therefore it would be recommended that recycled water in the form of dual reticulation be considered further at the development application stage.

Assessment of the recycled water scenarios undertaken in this report was based on the use of centralised treatment facilities aimed at aligning with Tweed Shire's current business, and to provide economies of scale with respect to the treatment plants and staff. An alternative would be to develop a water mining plant at or near the major developments. For example a plant could be constructed at Cobaki Lakes, Terranora or Kings Forest to service local development. However the reduced cost of recycled water trunk mains and pumping would need to be offset against the additional cost of treating dry weather flow to a standard suitable for membrane treatment. No savings would be achieved through the sewerage collection system as the wet weather flows would be passed through to the centralised treatment plants. The additional on-going costs of staff resources to operate decentralised plants would also impact on the costs.

Considering the above issues it is recommended that:

- For the Cobaki Lakes, Bilambil Heights, Terranora and Kings Forest developments council adopts Scenario 1
- For West Kingscliff, recycled water be made available if there is a sufficient level of end use in the industrial land uses.

7.3 WHOLE OF COUNCIL PROGRAM

7.3.1 TBL ASSESSMENT

A TBL assessment was undertaken for each of the whole of council scenarios. The assessment is summarised in Table 7-2.

7.3.2 PREFERRED SOLUTION

Based on the Triple Bottom Line assessment of the whole of council scenarios it is evident that the preferred option is Scenario 4, comprising the implementation of BASIX with 5,000 L rainwater tanks, the implementation of a pressure and leakage management program, the implementation of demand management measures for both the residential and non-residential sectors. The major reasons for the selection of this scenario are the following:

- Scenario 3 has the highest savings potential at the lowest cost per kL saved to the community as a whole. This cost is however higher than the marginal cost of potable water due mainly to the overall cost of rainwater tanks. Scenario 4 includes water savings from a non-residential program that has not been evaluated, but is expected to result in savings of around 10% at a similar cost to the residential program. This will be quantified in the Stage 2 DMS.
- The majority of the capital cost and on-going costs are the responsibility of the householder. Council will need a management plan including regular inspections to ensure that health and water quality aspects are addressed through regular maintenance.
- From an environmental perspective Scenario 4 is the best performer, with reductions in river extractions due to the additional reductions in demand.
- Scenario 4 would have broad community acceptance as it involves all sectors of the community and council contributing to achieve a water reduction target.

Table 7-2 Triple Bottom Line Assessment of Scenarios

Scenario	Description	Minimise Greenhouse Gas Emissions	Minimise Pollutants Entering Waterways	Minimise Extractions From Rivers	Average Environmental Score	Accepted by Community	Secures Water Supply	Enhances Service Levels	Average Social Score	Whole of Life Cost	Impact on Rates	Average Economic Score	Total Score
Scenario 1	BASIX Fixtures and WELS and Rainwater Tank	4	2	3	3.00	5	3	3	3.67	5	4	4.50	**11.17**
Scenario 2	BASIX Fixtures and WELS, Rainwater Tank and Pressure and Leakage Management Program	4	2	3	3.00	5	3.5	4	4.17	5	4	4.50	**11.67**
Scenario 3	Scenario 2 plus Selected Residential Demand Management Options	5	3	4	4.00	4	4	4	4.00	4	3	3.50	**11.50**
Scenario 4	Scenario 3 plus Non Residential Demand Management Options	5	3	4	4.00	4	4.5	4.5	4.33	4	3	3.50	**11.83**

Adoption of Scenario 4 does not come without risk. The wide scale use of rainwater tanks in urban areas is only starting to occur in Australia, therefore the level of yield from the tanks is not guaranteed. Achievement of the yield of around 80 kL/d will not be possible without community education and a regular program of inspection.

Considering the above issues it is recommended that:

- Scenario 4 is adopted for Tweed Shire, with a key focus on developing an extensive active leakage control and pressure management program.
- Rainwater tank education programs be developed, focussed on the correct use and maintenance including a regular program of inspections.
- An on-going communication and education program be adopted as part of the preferred program to ensure that savings are maintained in future.
- The inclining block tariff structure be maintained and enhanced to provide a price signal for high users.
- Options for a non-residential demand management program be considered further.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

The following conclusions can be drawn from the assessment of options for the Tweed Shire Demand Management Strategy:

1. The current population of the Tweed Shire that is served by the Bray Park Water Treatment Plant is estimated to be 73,185.
2. Population served by Brays Park WTP is expected to grow to 157,048 by 2036, mostly due to the development of large greenfield areas and the redevelopment and infill development of the Tweed Heads area.
3. Occupancy rates are expected to fall between 2006 and 2036. For single family residences the rate will fall from 2.8 to 2.5 persons/dwelling, and for multi family dwellings from 1.95 to 1.7 persons/dwelling.
4. The average per capita usage in Tweed Shire is 370 L/person/day (including losses), which is a fall from pre-drought (2002) demands.
5. Average residential use for 2004/5 was 231 kL/household/annum. Although this was higher than recent figures for some northern NSW coastal centres it is not known whether these centres were drought affected. Based on comparisons with South East Queensland studies this demand is substantially lower than demand in adjacent local government areas.
6. The Baseline demand case for the whole shire, taking account of the natural replacement rate for fittings and fixtures, indicates that the demand in 2036 will be approximately 20,280 ML/annum.
7. Five integrated water cycle scenarios were developed for the major greenfield development areas of Cobaki Lakes, Bilambil Heights, Terranora Area A, West Kingscliff and Kings Forest. The scenarios reviewed were:
    - Scenario 1 – Implementation of BASIX including a rainwater tank
    - Scenario 2 – Implementation of BASIX together with recycled water for external and toilet use.
    - Scenario 3 – Implementation of BASIX with a rainwater tank and recycled water.
    - Scenario 4 – Indirect potable reuse and rainwater tanks for new development.
    - Scenario 5 – Scenario 3 with a separation of the greywater and blackwater systems (not taken forward to detailed assessment).
8. Each of these assessed scenarios included the use of Reduced Infiltration Gravity Sewers (RIGS).
9. The results of the assessment of Greenfield Scenarios 1, 2 and 3 is summarised as follows:
    - Rainwater tanks would need to be 5 kL in size and would save around 80 kL/a for the average household.

- Reduction of potable water use was determined to be approximately 36%, 42% and 61% for Scenarios 1, 2 and 3 respectively for all greenfield developments except West Kingscliff. Reductions for individual areas varied slightly dependent on the sectoral distribution.
- Water savings for West Kingscliff are lower than the other greenfield areas as this development is non-residential and the external water savings are lower. The actual savings will depend on the available end uses of water in the development.
- Scenario 1 has the lowest costs to the community. The majority of the capital cost and on-going costs are the responsibility of the householder.
- Scenario 1 has the best return on investment with savings of 34 to 38% of the baseline demand forecasts. This scenario also has the lowest cost per kilolitre of savings.
- The cost of the recycled water scenarios is significantly higher than Scenario 1 due to the high cost of providing a third pipe network and establishing membrane treatment.
- From an environmental perspective Scenarios 2 and 3 reduce return effluent flows to the waterways by more than 10%. Scenario 1 will have a modest impact on urban water quality through the reduction of pollutants to waterways.

10. Additional work indicated that a dual reticulation scheme for Cobaki Lakes would be more cost beneficial if the treatment plant was located close to the development. This option should be further pursued should the developer propose a dual reticulation solution.
11. The assessment of Scenario 4 (Indirect Potable Reuse) indicated that:
    - By 2036 a total volume of 28 ML/d or 10,220 ML/a could be provided.
    - The total NPV for implementation of the IPR scheme alone would be of the order of $184m.
12. Four future demand scenarios were developed and assessed for the all existing and new development within Tweed Shire. The scenarios reviewed were:
    - Scenario 1 – Implementation of BASIX including a rainwater tank (5,000 L for detached dwellings).
    - Scenario 2 – An extension of Scenario 1 with an extensive active leakage control and pressure management program.
    - Scenario 3 – An extension of Scenario 2, including the implementation of selected demand management measures, including education programs, residential audit programs, a retrofit service and rebate scheme.
    - Scenario 4 – An extension of Scenario 3 with an assumed enhanced non residential efficiency saving of 10%.
13. The results of the assessment for the whole of shire is summarised as follows:
    - Rainwater tanks would need to be 5,000 L in size and would save around 80 kL/a for the average household if connected internally to toilets, cold water laundry and external taps.
    - Reduction of potable water use was determined to be approximately 16 %, 20%, 21% and 23% for Scenarios 1, 2, 3 and 4 respectively.

- Scenario 3 has the highest savings potential at the lowest cost per kL saved to the community as a whole. This cost is however higher than the marginal cost of potable water due mainly to the overall cost of rainwater tanks. Scenario 4 includes water savings from a non-residential program that has not been evaluated, but is expected to result in savings of around 10% at a similar cost to the residential program. These predicted savings will be quantified in the Stage 2 report targeting non-residential demand.
- The majority of the capital cost and on-going costs are the responsibility of the householder. Council will need a management plan including regular inspections to ensure that health and water quality aspects are addressed through regular maintenance.
- From an environmental perspective Scenario 4 is the best performer, with reductions in river extractions due to the additional reductions in demand.
- Scenario 4 would have broad community acceptance as it involves all sectors of the community and council contributing to achieve a water reduction target.

8.2 RECOMMENDATIONS

Based on the assessment of options in this report it is recommended that:

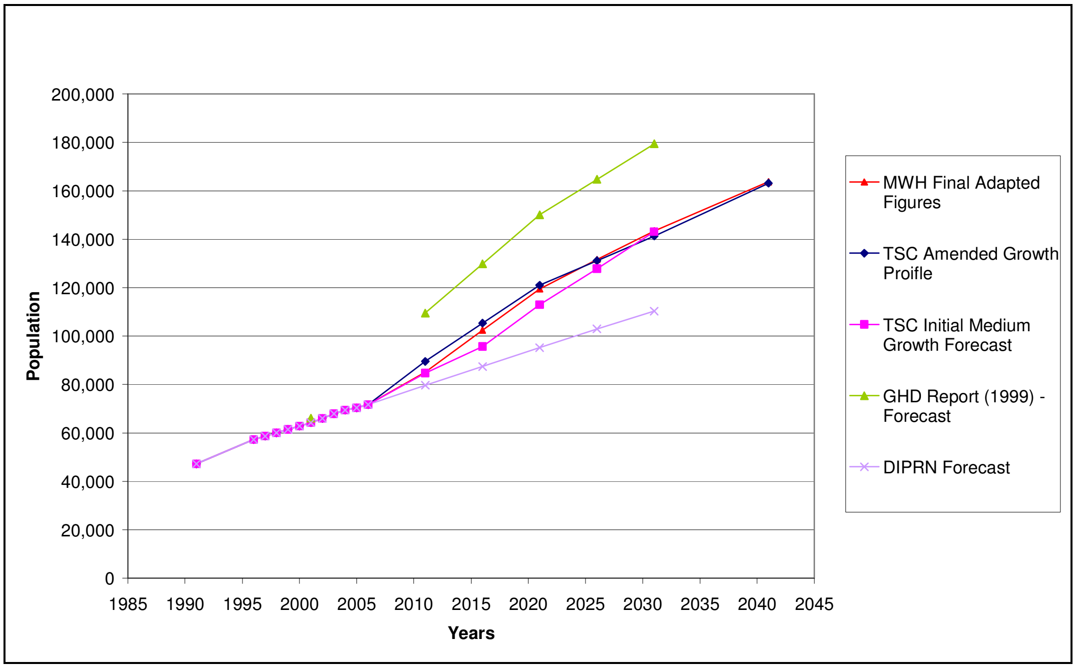
1. Greenfield Scenario 1 be adopted for the Cobaki Lakes, Bilambil Heights, Terranora and Kings Forest developments. This will include the adoption of BASIX with 5,000 L rainwater tanks (minimum of 160 m^2 roof area) connected to external uses, toilet flushing and cold water to washing machines. In addition new dwellings will have dual flush toilets as well as 3 star showerheads and taps.
2. For West Kingscliff, recycled water be made available to future industrial land use areas where demand is identified.
3. Scenario 4 be adopted for the whole of Tweed Shire, with a key focus on developing an extensive active leakage control and pressure management program.
4. Rainwater tank education programs be developed, focused on the correct use and maintenance including a regular program of inspections.
5. An on-going communication and education program be developed as part of the preferred program to ensure that savings are maintained in future.
6. The inclining block tariff structure be maintained and enhanced to provide a price signal for high users.
7. Options for a non-residential demand management program be considered further.
8. A review be undertaken of the potable water design standards based on the demand assessment undertaken in this report. A regular assessment should then be undertaken to review the adopted design standards.

APPENDIX A

GREENFIELD POPULATION FORECASTS

The following figure depicts the historical and future serviced population forecasts developed over the past 10 years for regional and infrastructure planning in Tweed Shire.

Figure A1 Tweed Shire – Historic and Future Serviced Population Forecast



The table below summarises the anticipated population for the various areas of Tweed Shire and shows the distribution of Infill and Greenfield sites for the proposed new greenfield development areas. The information was provided by TSC and was adapted by MWH to match the predicted lot development of the new growth areas new and expected persons per account estimations.

Table A1 Future Growth and Development Distribution by Suburb / Development Area

Locality	2001	2011	2021	2031	2041	Infill	Greenfield
Tweed Heads	6,853	7,800	8,000	8,000	8,000	100%	0%
Tweed Heads New Infill	-	2,000	4,000	6,000	10,000	100%	0%
Tweed Heads West	7,673	8,400	8,664	8,719	8,719	100%	0%
Tweed Heads South & Banora Pt	16,771	19,098	21,424	23,751	26,077	30%	70%
Bilambil Heights	2,395	2,498	2,601	2,705	2,808	30%	70%
Bilambil & Piggabeen	907	1,110	1,314	1,517	1,720	0%	100%
Cobaki	-	1,000	6,000	10,000	11,040	0%	100%
Highlands Estate	29	625	625	625	625	0%	100%
McAllisters	-	-	-	2,110	2,110	0%	100%
Adjacent to Terranora Resort	244	250	1,500	3,010	3,010	0%	100%
Terranora Resort	-	-	1,600	3,564	3,564	0%	100%
Terranora Rural	2,209	2,836	3,463	4,090	4,717	0%	100%
Area E	-	-	2,000	2,000	2,000	0%	100%
Fingal	626	784	960	1,176	1,176	100%	0%

Locality	2001	2011	2021	2031	2041	Infill	Greenfield
Chinderah	1,794	2,243	2,754	2,754	2,754	100%	0%
Kingscliff	5,049	5,270	5,270	5,270	5,322	100%	0%
West Kingscliff	-	-	1,400	2,800	2,800	0%	100%
Cudgen Village	579	656	733	811	888	50%	50%
Rest of Rural A	907	1,122	1,122	1,122	1,122	0%	100%
Kings Forest	-	-	5,000	5,000	11,500	0%	100%
Casuarina	-	4,500	5,000	5,000	5,000	100%	0%
Lot 490 & Sea Side City	-	-	2,500	2,500	2,500	0%	100%
Salt	-	2,000	2,500	2,500	2,500	100%	0%
Cabarita	2,621	3,301	3,981	4,662	5,342	70%	30%
Hastings Pt	722	877	1,031	1,185	1,339	100%	0%
Pottsville	2,137	2,664	3,248	3,959	3,959	100%	0%
Pottsville Waters	1,271	1,350	1,400	1,500	1,500	100%	0%
Black Rocks	-	1,000	1,280	1,280	1,280	0%	100%
Tanglewood	98	100	1,200	1,200	1,200	0%	100%
Koala Beach	98	2,600	2,800	2,800	2,800	0%	100%
Seabreeze	-	1,800	2,000	2,000	2,000	0%	100%
Dunloe Park	-	-	-	-	5,000	0%	100%
Cowel Park	73	90	105	120	120	0%	100%
Burringbar Area	1,244	1,510	1,775	2,040	2,305	0%	100%
Rural North West	196	272	348	424	500	0%	100%
Tumbulgum	414	503	591	679	767	50%	50%
Wardrop Valley	2,236	2,876	3,516	4,156	4,796	0%	100%
Murwillumbah	7,246	8,191	9,051	10,001	10,001	0%	100%
Condong	231	253	275	297	319	100%	0%
Total Population	**64,624**	**89,577**	**121,030**	**141,325**	**163,180**		

APPENDIX B

HISTORICAL WATER RESTRICTIONS AND WATER CHARGES

A summary of the historical water restrictions and pricing regimes was provided by TSC and is summarised in the tables below.

Table B1 Overview of Historical Water Restriction

Bray Park System		
Start	Finish	Level of Restriction
28/10/2002		DAM CAPACITY 50 % - LEVEL 1 RESTRICTIONS
18/11/2002		DAM CAPACITY 45 % - LEVEL 2 RESTRICTIONS
5/02/2003		DAM CAPACITY 35 % - LEVEL 3 RESTRICTIONS
	27/02/2003	ALL RESTRICTIONS LIFTED

Table B2 ***Overview of Water Usage Pricing Structure***

	TARIFF FOR RESIDENTIAL CUSTOMERS	COMPONENT IN ANNUAL CHARGES: RESIDENTIAL	LAND VALUE COMPONENT IN ANNUAL CHARGES: NON-RESIDENTIAL	WATER USAGE CHARGES BELOW	WATER USAGE CHARGES	WATER USAGE CHARGES ABOVE	WATER USAGE CHARGES	MINIUMUM ANNUAL RESIDENTIAL CHARGE	DEVELOPER CHARGE
Year		**Y/N**	**Y/N**	**kL**	**$/KL**	**kL**	**$**	**$**	**$/ ET**
1991	ALLOWANCE	YES	YES	371	0	371	0.69	256	2100
1992	ALLOWANCE	YES	YES	371	0	371	0.69	256	2750
1993	ALLOWANCE	YES	YES	369	0	369	0.71	262	2750
1994	ALLOWANCE	YES	YES	186	0	186	0.73	136	2900
1995	ALLOWANCE	YES	YES	370	0	370	0.75	278	2900
1996	ALLOWANCE	YES	YES	368	0	368	0.77	284	3230
1997	ALLOWANCE	YES	YES	360	0	360	0.77	277	3230
1998	ALLOWANCE	YES	YES	265	0	265	0.7	212	3310
1999	ALLOWANCE	NO	NO	250	0	250	0.72	215	3350
2000	ALLOWANCE	NO	NO	250	0	250	0.72	215	3480
2001	ALLOWANCE	NO	NO	250	0	250	0.73	220	3590
2002	2 PART	NO	NO	250	0	250	0.75	226	3840
2003	2 PART	NO	NO	0	0	0	0.6	105	4000
2004	2 PART	NO	NO	0	0	0	0.62	106	4110
2005	2 PART	NO	NO	0	0	0	0.68	106	4325
2006	2 PART	NO	NO	0	0	0	0.82	90	Varies
2007							1.04	95	
2008							1.21	97	

APPENDIX C

END USE BREAKDOWN – BASELINE SCENARIO FOR WHOLE SHIRE

Additional information relating to the adopted end use breakdown demand, as discussed in Section 4.3 is provided in the tables below.

Table C1 provides detailed volumes for the specific end-use demands for MFR in the baseline year of 2007, whereas Figures C1 and C2 depict the results for MFR.

Table C1 Baseline Summary 2007 – Internal/ External End-Use Breakdown

Customer Sector	Internal Breakdown (L/ Account/ Day)							Total Usage (L/ ET/ Day)	
	Toilet	Shower	Laundry	Bath	Dishwasher	Taps	Leakage	Internal	External
SFR	81	198	134	9	8	76	45	549	161
New SFR	50	188	118	9	8	76	45	493	161
MFR	56	138	93	6	5	53	31	383	28
New MFR	35	131	82	6	5	53	31	343	28
COM	Each non-residential sector has their own specific end uses used in the study, e.g. Industrial Process, Tourist Kitchen Spray, and Public Toilets.								
IND									
PUB									
BS									

Figure C1 Existing Multi-Family – Internal/ External Consumption

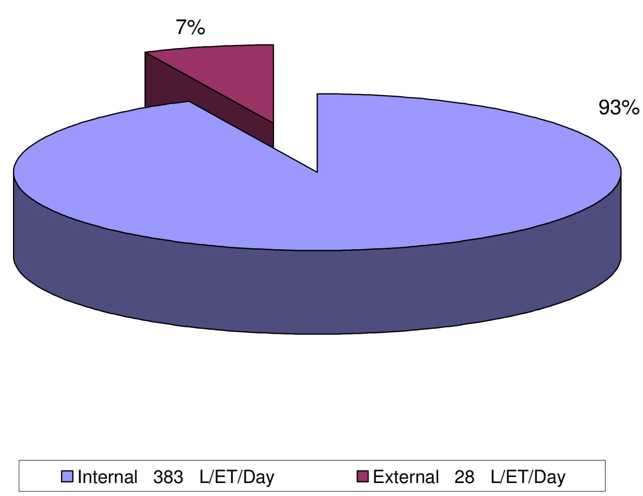
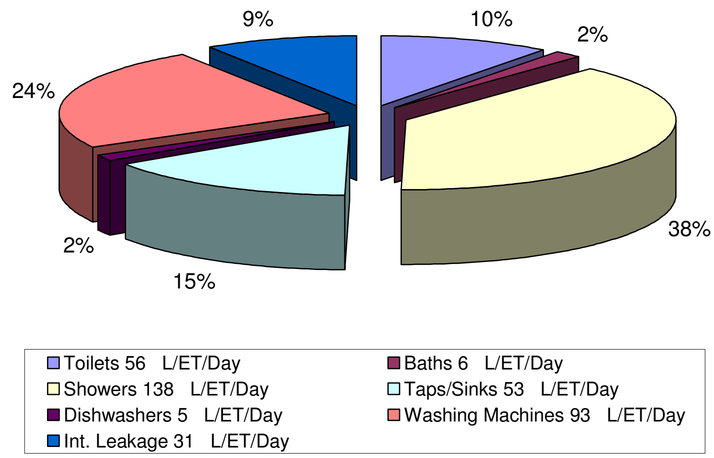


Figure C2 Existing Multi-Family – Internal Consumption Breakdown



APPENDIX D

SUMMARY OF SCENARIO ASSUMPTIONS

Scenario	Programme / Measures	Customer Sector	Penetration	Water Savings	Utility Cost per Account	Customer Unit Cost	Fixed Setup Cost	Setup Cost per Account	Admin Cost – Mark-up (% per participant)	Admin Cost - Fixed	Administration Cost- Per Account ($ per participant)
WELS & BASIX Fixture Programme											
BASIX	Water Efficient Taps/ Sinks	All Residential	100% of all new residential accounts	20% of Taps/ Sinks End-Use	-	-	-	-	-	-	-
BASIX	Water Efficient Showerheads	All Residential	80% of all new residential accounts	See Fixture Details	-	-	-	-	-	-	-
WELS	Water Efficient Dishwashers	All Residential	5% of all new and existing accounts	20% of Dishwasher End-Use	-	-	-	-	-	-	-
WELS	Water Efficient Washing Machines	All Residential	Refer to Market Share (7% increased sale)	30% of WM End-Use	-		-	-	-	-	-
Education											
BASIX & All Demand Management	Behavioural Changes and Awareness	All Residential	100% of all new residential accounts	1% of all indoor and 2% of outdoor use	$2	$0	$0	$1	0%	$50,000 – split between 5 growth areas	$2
BASIX & All Demand Management	Non-Residential – Management Training	All Non-Residential	80% of commercial, public and irrigation	10% of external and internal irrigation	$0	$0	$0	$5	10%	$50,000 – split between 5 growth areas	$0

Rainwater Tanks											
Scenario 1	5kL Rainwater Tank connected to Indoor (Toilet/ WM) and Outdoor	All Residential	100% of all new residential accounts	66% (SFR), 80% (MFR) of connected end uses	$0	SFR - $3,000 plus maintenance , proportional for MFR	$0	$0.00	0%	$10,000	$10
Scenario3	5kL Rainwater Tank connected to Indoor (Shower/ WM) only	All Residential	100% of all residential accounts	67% (SFR), 47% (MFR) of connected end uses	$0	SFR - $,3000 plus maintenance , proportional for MFR	$0	$0.00	0%	$10,000	$10
Recycled Water											
Scenario 2 and Scenario 3	RCW for Outdoor and Toilet - Residential	All Residential	100% of all residential accounts	100% of potable water saving for external and toilet demand	$3500 per account plus$ 75 Annual O&M costs	$0	Combined Cost of Recycle Plant and RCW Distribution System	$0	$0	$75	$0
		All Non-Residential	100% of all non- residential accounts			$0		$0	$0	$75	$0
Non-Residential Demand Management											
BASIX & All Demand Management	Water Management Plan for new non-residential developments	All Non-Residential	100% of all non- residential accounts	20% of total demand	$0	$0	$0	$0	10%	$10,000 split between 5 growth areas	$25

APPENDIX E

RESIDENTIAL END USE BREAKDOWN FOR NEW GROWTH AREAS

The following tables and figures provide an overview about the end use breakdowns for the two residential sectors from the proposed start year 2012 up to 2036, when development of the new growth areas has been fully completed. It is assumed that new water efficient fixtures according to BASIX have been installed.

Table E1 Singe Residential End Use Breakdown

		2012	2016	2021	2026	2031	2036
SFR PPA	PPA	2.74	2.69	2.64	2.59	2.54	2.5
Toilets	L/ET/day	42.6	41.7	40.8	39.9	38.9	38.0
Baths	L/ET/day	8.2	8.5	8.8	9.2	9.5	9.8
Showers	L/ET/day	180	175	171	166	162	158
Taps/Sinks	L/ET/day	73.5	72.8	71.5	70.2	68.8	67.5
Dishwashers	L/ET/day	7.3	7.6	7.9	8.2	8.5	8.8
Washing Machines	L/ET/day	102	100	97	94	91	89
Int. Leakage	L/ET/day	27.2	27.4	27.5	27.5	27.5	27.5
Irrigation	L/ET/day	155	163	170	176	182	189
Other	L/ET/day	29.1	30.5	31.8	33.0	34.2	35.4
Ext Leakage	L/ET/day	9.7	9.8	9.9	9.8	9.8	9.8
Total	**L/ET/day**	**635**	**636**	**635**	**633**	**632**	**632**

Table E2 MFR Residential End Use Breakdown

		2012	2016	2021	2026	2031	2036
MFR PPA	PPA	1.92	1.89	1.84	1.79	1.74	1.70
Toilets	L/ET/day	29.8	29.4	28.5	27.6	26.7	25.8
Baths	L/ET/day	5.7	5.9	6.2	6.4	6.6	6.9
Showers	L/ET/day	126	123	119	115	111	107
Taps/Sinks	L/ET/day	51.4	51.2	49.9	48.6	47.2	45.9
Dishwashers	L/ET/day	5.1	5.3	5.5	5.7	5.9	6.1
Washing Machines	L/ET/day	71.6	70.1	67.4	64.8	62.6	60.6
Int. Leakage	L/ET/day	19.1	19.2	19.2	19.2	19.2	19.2
Irrigation	L/ET/day	39.5	41.4	43.1	44.8	46.4	48.0
Other	L/ET/day	7.4	7.8	8.1	8.4	8.7	9.0
Ext Leakage	L/ET/day	2.5	2.5	2.5	2.5	2.5	2.5
Total	**L/ET/day**	**358**	**356**	**349**	**343**	**337**	**331**

Figure E1 Internal End Use Breakdown – New SFR Developments in 2012

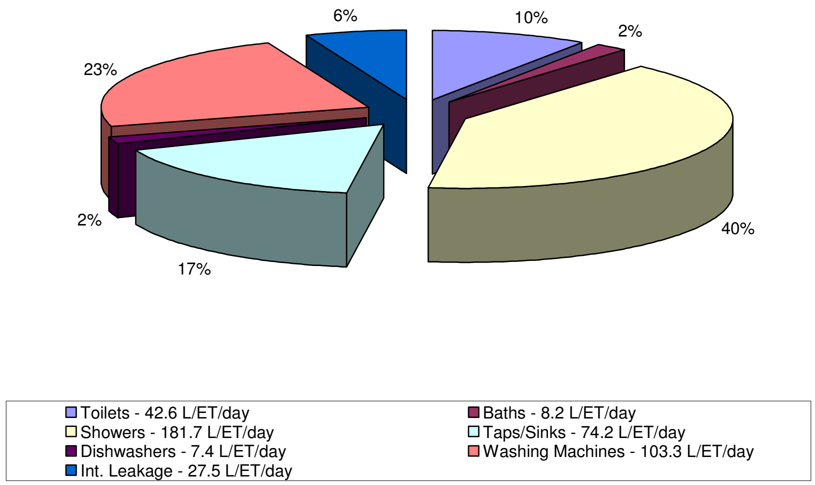
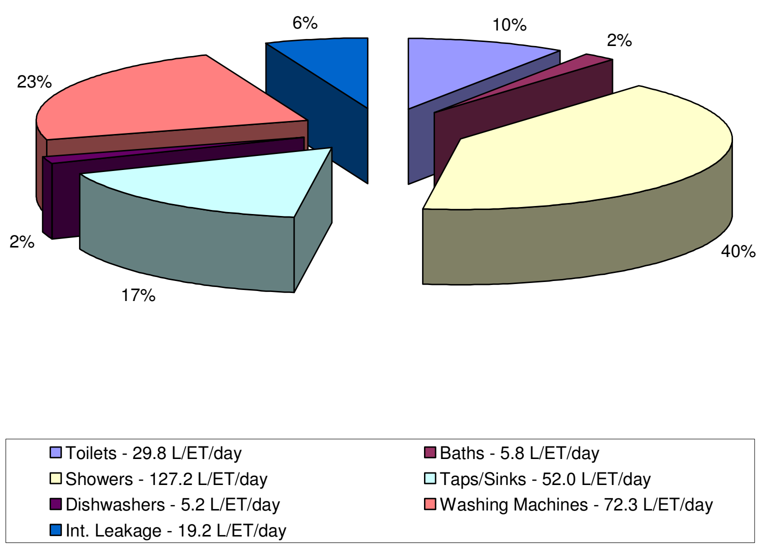


Figure E2 Internal End Use Breakdown – New MFR Developments in 2012



APPENDIX F

DETAILED DEMAND FORECAST RESULTS – GREENFIELD DEVELOPMENT AREAS

In addition to the summarised results of the demand management analysis, further information is provided in this appendix for the total sectoral water demand breakdown and the multi-residential (MFR) demand profile.

Table F1 Total Sectoral Annual Water Demand Forecast – Scenario 1 – Combined Greenfield Development Areas

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	57.0	282	558	828	1,093	1,360
Multi-Family Greenfield	23.9	118	230	337	440	541
Commercial	0.1	7.2	16.0	25.0	34.0	44.8
Industrial	0.4	2.0	4.0	6.1	8.1	10.1
Irrigation	1.7	8.6	18.4	28.6	39.4	50.8
Public	3.7	18.6	37.5	56.6	75.9	95.5
Total	**87**	**436**	**865**	**1,281**	**1,690**	**2,103**

Table F2 Sectoral Annual Water Demand Forecast – Scenario 2 – Combined Greenfield Development Areas

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	57.4	281	549	805	1,052	1,297
Multi-Family Greenfield	28.1	138	268	390	506	620
Commercial	0.1	4.2	9.3	14.5	19.5	25.6
Industrial	0.4	2.0	4.0	6.1	8.1	10.1
Irrigation	0.0	0.1	0.2	0.3	0.4	0.5
Public	1.7	8.7	17.4	26.0	34.7	43.4
Total	**88**	**434**	**848**	**1,242**	**1,621**	**1,996**

Table F3 Sectoral Annual Water Demand Forecast – Scenario 3 – Combined Greenfield Development Areas

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	32.7	161	316	466	611	756
Multi-Family Greenfield	18.7	92	180	263	342	421
Commercial	0.1	4.2	9.3	14.5	19.5	25.6
Industrial	0.4	2.0	4.0	6.1	8.1	10.1
Irrigation	0.0	0.1	0.2	0.3	0.4	0.5
Public	1.7	8.7	17.4	26.0	34.7	43.4
Total	**54**	**268**	**527**	**776**	**1,016**	**1,256**

Table F4 Residential Demand (L/Person/Day) including SFR and MFR for Combined Greenfield Development Areas

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast New Growth Areas	219	221	224	228	232	237
Scenario 1 - BASIX with Rainwater Tank (5kL)	147	148	149	150	152	153
Scenario 2 - BASIX with Dual Reticulation	155	155	155	154	154	154
Scenario 3 - BASIX with Rainwater Tank (5kL) and Dual Reticulation	93	94	94	94	94	95

The following tables and figures summarise the water demand forecast for a new multi-residential dwelling under the different scenarios. Results for SFR are given in the main report (Section 5.3).

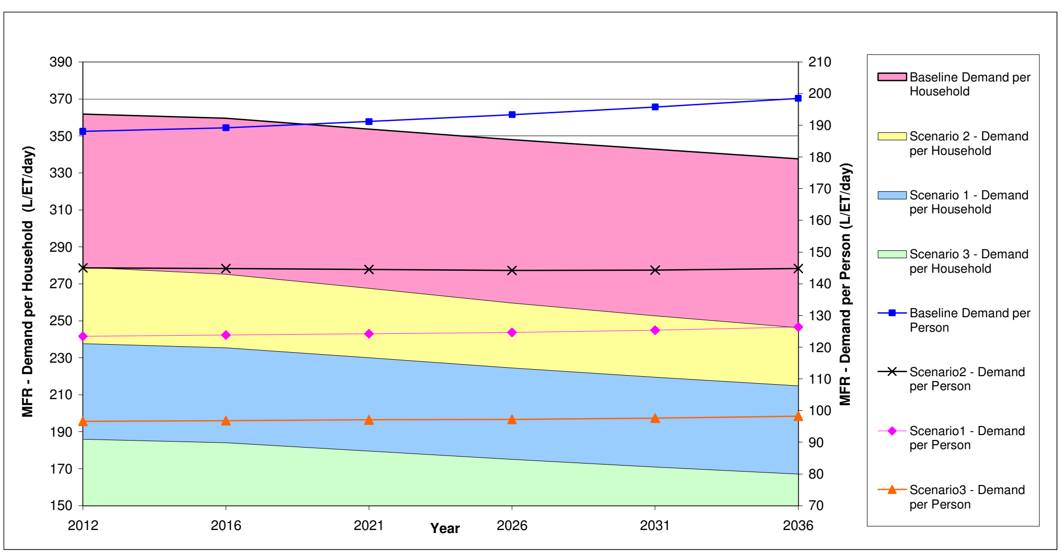
Table F5 MFR Demand per Account (L/ET/Day)

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast New Growth Areas	362	360	354	348	343	338
Scenario 1 - BASIX with Rainwater Tank (5kL)	238	235	230	224	219	215
Scenario 2 - BASIX with Dual Reticulation	279	275	267	260	253	246
Scenario 3 - BASIX with Rainwater Tank (5kL) and Dual Reticulation	186	184	180	175	171	167

Table F6 MFR Demand per Person (L/EP/Day)

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast New Growth Areas	188	189	191	193	196	199
Scenario 1 - BASIX with Rainwater Tank (5kL)	123	124	124	125	125	126
Scenario 2 - BASIX with Dual Reticulation	145	145	145	144	144	145
Scenario 3 - BASIX with Rainwater Tank (5kL) and Dual Reticulation	97	97	97	97	98	98

Figure F1 Demand Forecast - Multi-Family Residential Dwelling



APPENDIX G

SCENARIO DEMAND FORECASTS - BILAMBIL HEIGHTS

The following figures and tables summarise the future water demand management outcomes for Bilambil Heights.

Table G1 Total Annual Water Demand Forecast – Bilambil Heights

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast New Growth Areas	29	143	285	425	564	705
Scenario 1 - BASIX with Rainwater Tank (5kL)	19	91	178	267	353	440
Scenario 2 - BASIX with Dual Reticulation	19	88	172	254	334	412
Scenario 3 - BASIX with Rainwater Tank (5kL) and Dual Reticulation	12	58	114	170	225	279

Figure G1 Total Water Demand Forecast – Bilambil Heights

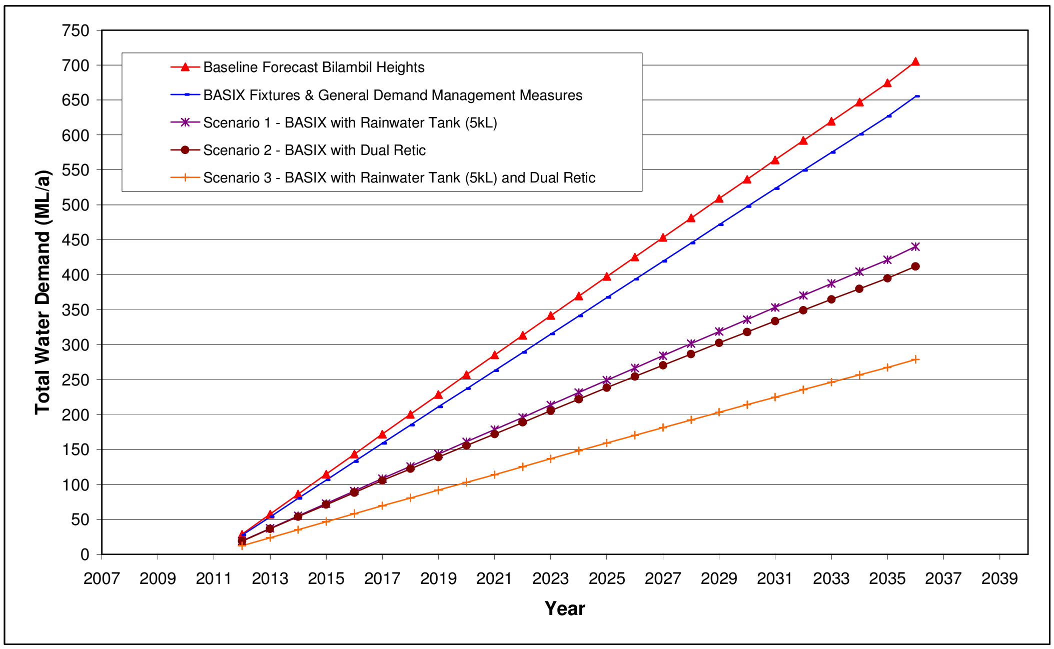


Table G2 Total Per Capita Water Demand Forecast – Bilambil Heights

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast New Growth Areas	257	262	266	271	275	281
Scenario 1 - BASIX with Rainwater Tank (5kL)	171	165	166	170	172	175
Scenario 2 - BASIX with Dual Reticulation	170	161	160	162	163	164
Scenario 3 - BASIX with Rainwater Tank (5kL) and Dual Reticulation	108	106	106	108	110	111

Figure G2 Total Per Capita Water Demand Forecast – Bilambil Heights

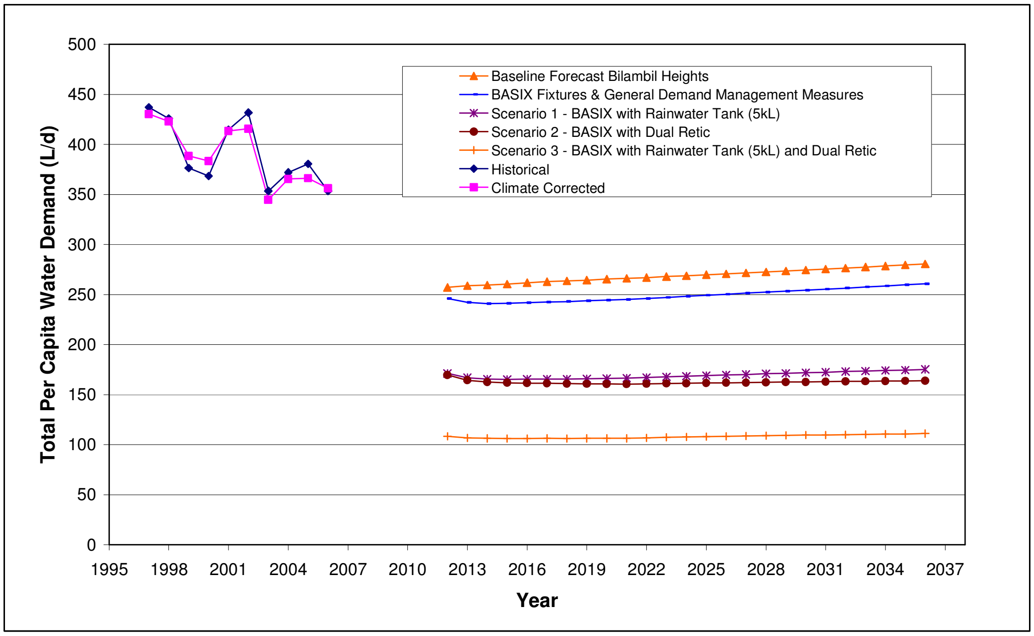


Table G3 Sectoral Annual Water Demand Forecast – Scenario 1 – Bilambil Heights

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	10.9	54	107	158	209	260
Multi-Family Greenfield	5.3	26	51	75	98	121
Commercial	0.14	1.76	3.85	5.82	7.95	10
Industrial	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation	0.35	1.80	3.85	6.01	8.28	11
Public	0.76	3.85	7.76	12	16	20
Total	**18**	**88**	**174**	**257**	**339**	**422**

Table G4 Sectoral Annual Water Demand Forecast – Scenario 2 – Bilambil Heights

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	11.0	54	105	154	201	248
Multi-Family Greenfield	6.3	31	60	87	113	139
Commercial	0.1	1	2	3	5	6
Industrial	0.0	0	0	0	0	0
Irrigation	0.0	0	0	0	0	0
Public	0.4	2	4	5	7	9
Total	**18**	**87**	**171**	**250**	**326**	**402**

Table G5 Sectoral Annual Water Demand Forecast – Scenario 3 – Bilambil Heights

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	6.2	31	60	89	117	145
Multi-Family Greenfield	4.2	21	40	59	76	94
Commercial	0.1	1	2	3	5	6
Industrial	0.0	0	0	0	0	0
Irrigation	0.0	0	0	0	0	0
Public	0.4	2	4	5	7	9
Total	**11**	**54**	**107**	**157**	**205**	**253**

Table G6 Individual Demand Measurement Results – Scenario 1 – Bilambil Heights

Summaries NPV Costs Scenario 1	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$6,758,617	$2,228,714	$8,987,331			$94,224
Sewer (without RIGS)	$2,083,593	$4,687,894	$6,771,487			$326,014
Rainwater Tanks	$-	$3,882,050	$3,882,050	$261,742	$1,120,803	$1,382,545
Recycled Water	$-	$-	$-	$-	$-	$-
Total	**$8,842,210**	**$10,798,658**	**$19,640,868**	**$261,742**	**$1,120,803**	**$1,802,784**

Table G7 Individual Demand Measurement Results – Scenario 2 – Bilambil Heights

Summaries NPV Costs Scenario 2	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$5,751,826	$1,444,822	$7,196,648			$94,224
Sewer (without RIGS)	$2,083,593	$4,687,894	$6,771,487			$326,014
Rainwater Tanks	$0	$0	$0	$0	$0	$0
Recycled Water	$9,104,504	$2,820,652	$11,925,156	$1,084,085	$0	$1,084,085
Total	**$16,939,923**	**$8,953,368**	**$25,893,291**	**$1,084,085**	**$0**	**$1,504,324**

Table G8 Individual Demand Measurement Results – Scenario 3 – Bilambil Heights

Summaries NPV Costs Scenario 3	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$5,751,826	$1,444,822	$7,196,648			$52,335
Sewer (without RIGS)	$2,083,593	$4,687,894	$6,771,487			$326,014
Rainwater Tanks	$0	$3,882,050	$3,882,050	$261,742	$1,120,803	$1,382,545
Recycled Water	$9,104,504	$2,820,652	$11,925,156	$1,084,085	$0	$1,084,085
Total	**$16,939,923**	**$12,835,418**	**$29,775,341**	**$1,345,828**	**$1,120,803**	**$2,844,980**

Figure G3 Water Demand Profile – Scenario 1 – Bilambil Heights

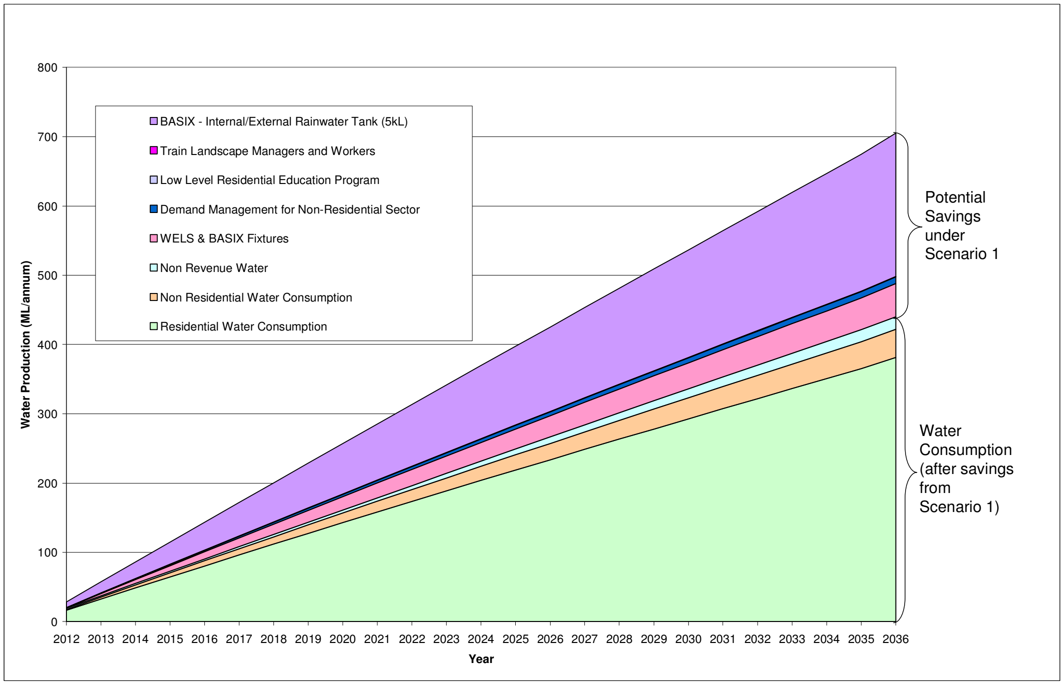


Figure G4 Water Demand Profile – Scenario 2 – Bilambil Heights

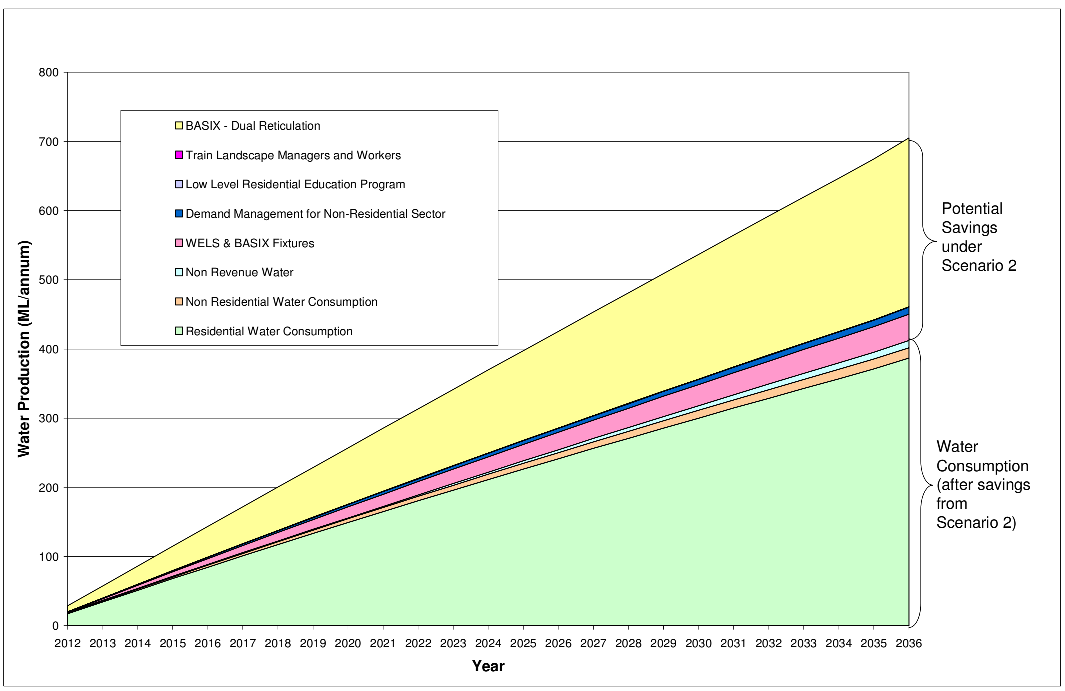


Figure G5 Water Demand Profile – Scenario 3 – Bilambil Heights

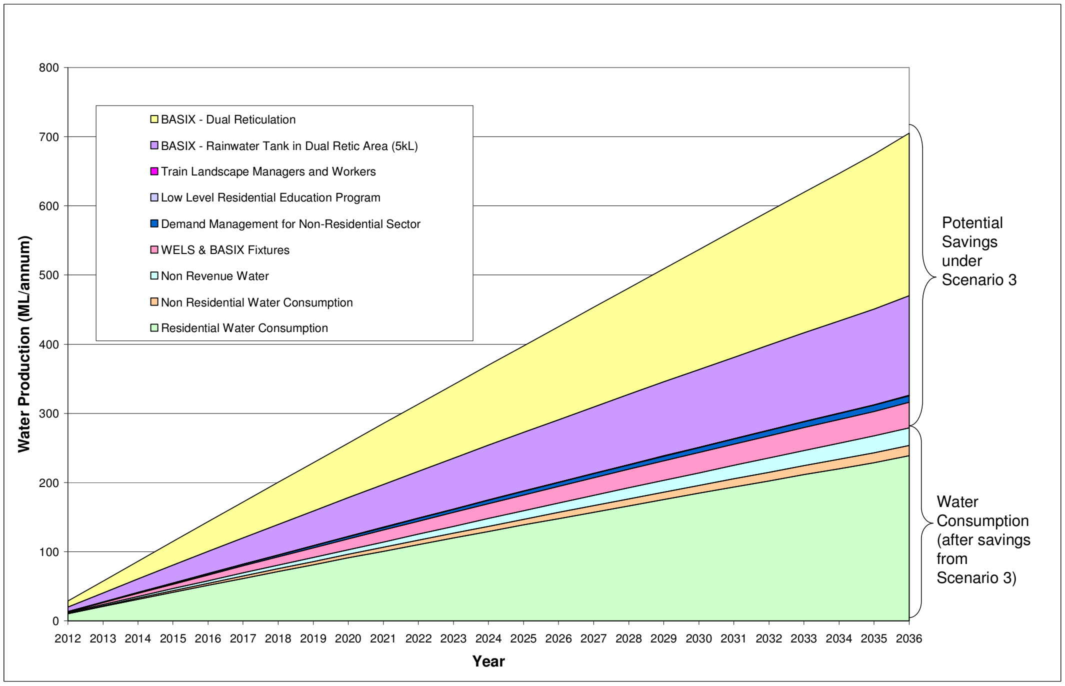


Figure G6 Average Water Savings by Component – Scenario 1 – Bilambil Heights

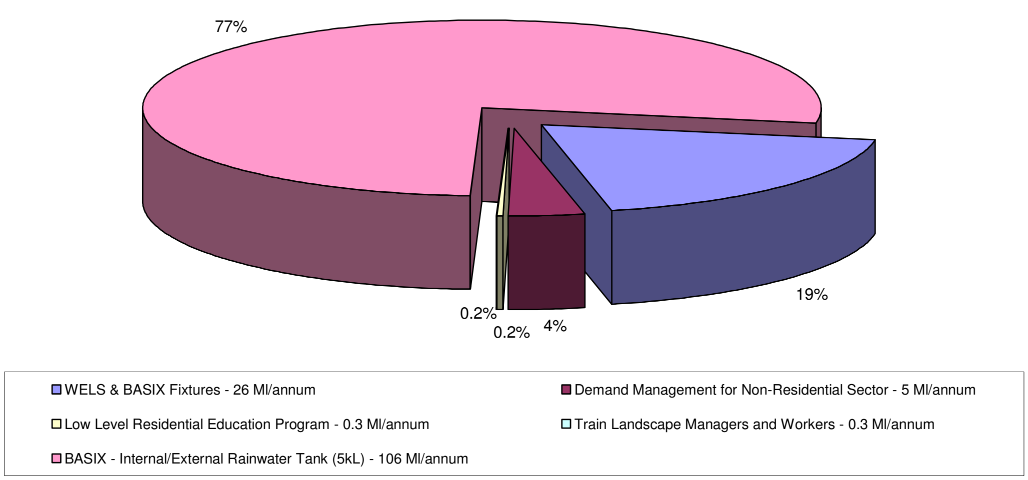


Figure G7 Average Water Savings by Component – Scenario 2 – Bilambil Heights

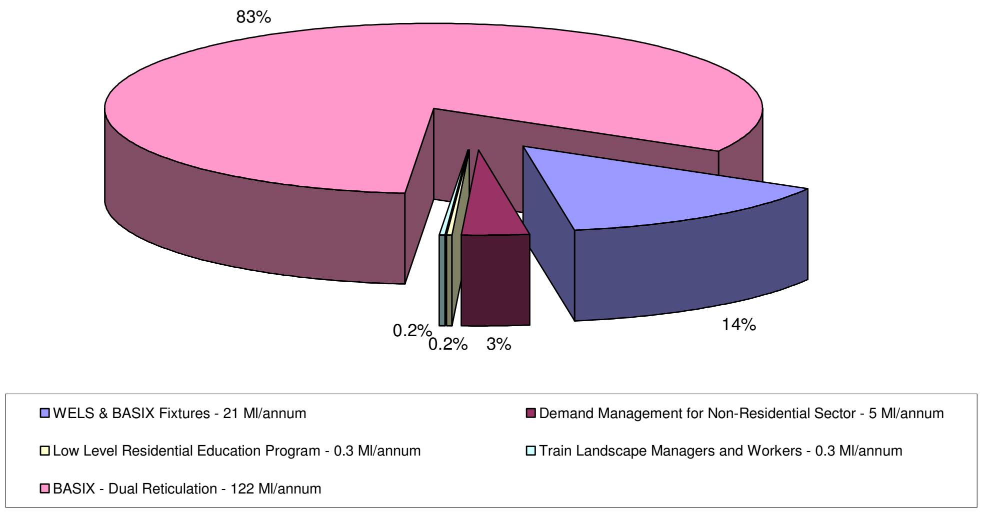
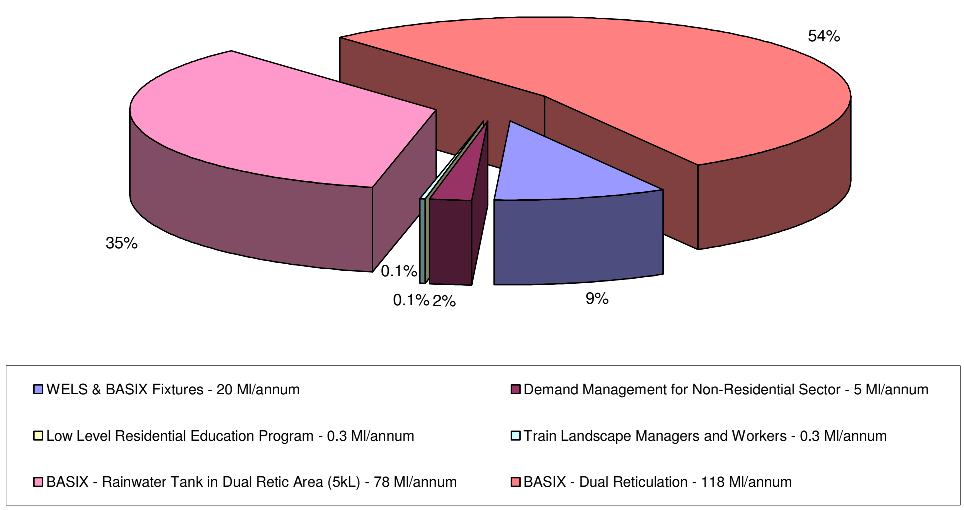


Figure G8 Average Water Savings by Component – Scenario 3 – Bilambil Heights



APPENDIX H

SCENARIO DEMAND FORECASTS - COBAKI LAKES

The figures and tables below outline the future water demand management outcomes for Cobaki Lakes.

Table H1 Total Annual Water Demand Forecast – Cobaki Lakes

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast New Growth Areas	43	214	426	636	844	1054
Scenario 1 - BASIX with Rainwater Tank (5kL)	29	138	271	405	536	669
Scenario 2 - BASIX with Dual Reticulation	28	133	257	380	498	615
Scenario 3 - BASIX with Rainwater Tank (5kL) and Dual Reticulation	18	86	167	249	329	407

Figure H1 Total Water Demand Forecast – Bilambil Heights

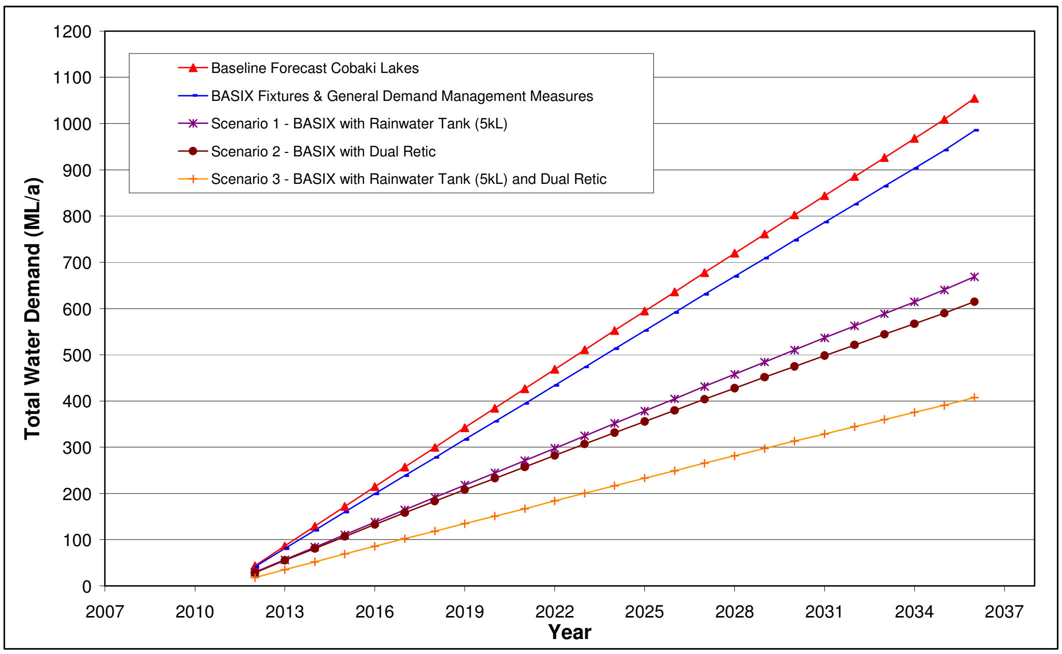


Table H2 Total Per Capita Water Demand Forecast – Cobaki Lakes

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast New Growth Areas	256	258	262	266	271	276
Scenario 1 - BASIX with Rainwater Tank (5kL)	173	165	166	169	172	175
Scenario 2 - BASIX with Dual Reticulation	168	160	158	159	160	161
Scenario 3 - BASIX with Rainwater Tank (5kL) and Dual Reticulation	105	103	103	104	106	107

Figure H2 Total Per Capita Water Demand Forecast – Cobaki Lakes

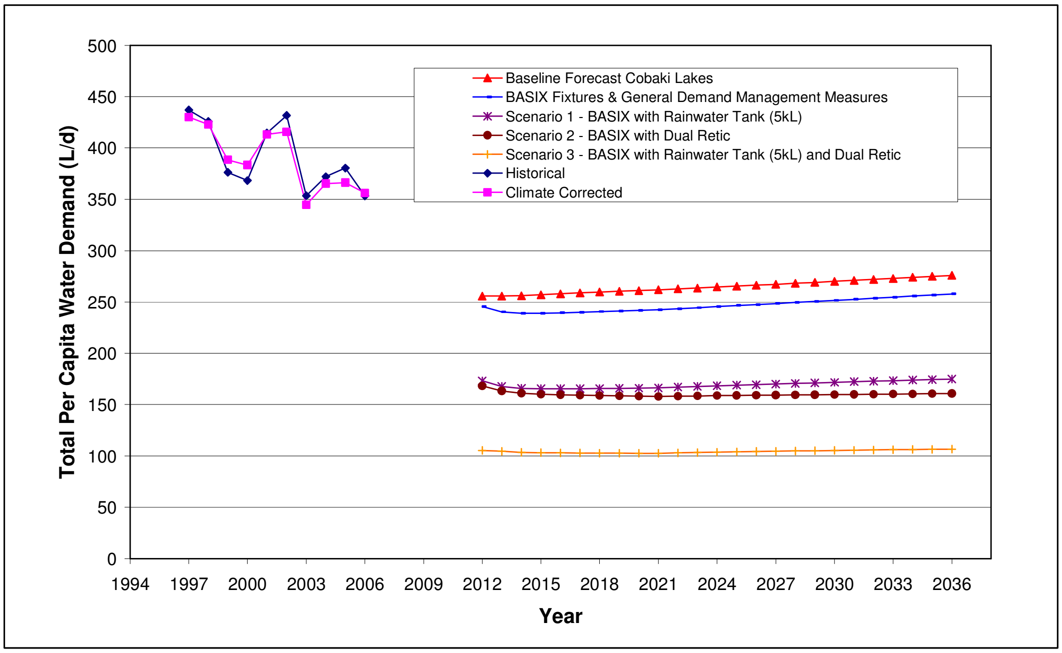


Table H3 Sectoral Annual Water Demand Forecast – Scenario 1 – Cobaki Lakes

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	19.0	94	186	277	366	455
Multi-Family Greenfield	6.7	33	64	94	122	151
Commercial	0.29	1.35	2.73	4.12	5.68	7
Industrial	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation	0.48	2.46	5.27	8.23	11.33	15
Public	0.55	2.80	5.64	9	11	14
Total	**27**	**134**	**264**	**391**	**516**	**642**

Table H4 Sectoral Annual Water Demand Forecast – Scenario 2 – Cobaki Lakes

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	18.6	91	178	260	340	419
Multi-Family Greenfield	7.8	38	75	109	141	173
Commercial	0.2	1	2	2	3	4
Industrial	0.0	0	0	0	0	0
Irrigation	0.0	0	0	1	1	1
Public	0.3	2	3	4	5	7
Total	**27**	**132**	**257**	**376**	**490**	**603**

Table H5 Sectoral Annual Water Demand Forecast – Scenario 3 – Cobaki Lakes

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	10.6	52	102	151	198	244
Multi-Family Greenfield	5.2	26	50	73	95	117
Commercial	0.2	1	2	2	3	4
Industrial	0.0	0	0	0	0	0
Irrigation	0.0	0	0	1	1	1
Public	0.3	2	3	4	5	7
Total	**16**	**80**	**157**	**231**	**302**	**373**

Table H6 Individual Demand Measurement Results – Scenario 1 – Cobaki Lakes

Summaries NPV Costs Scenario 1	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$6,958,788	$3,555,230	$10,514,018			$281,669
Sewer (without RIGS)	$2,988,190	$6,932,191	$9,920,381			$423,885
Rainwater Tanks	$0	$5,891,597	$5,891,597	$331,282	$1,701,050	$2,032,332
Recycled Water	$0	$0	$0	$0	$0	$0
Total	**$9,946,978**	**$16,379,018**	**$26,325,996**	**$331,282**	**$1,701,050**	**$2,737,886**

Table H7 Individual Demand Measurement Results – Scenario 2 – Cobaki Lakes

Summaries NPV Costs Scenario 2	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$5,693,579	$2,304,770	$7,998,349			$260,245
Sewer (without RIGS)	$2,988,190	$6,932,191	$9,920,381			$423,885
Rainwater Tanks	$0	$0	$0	$0	$0	$0
Recycled Water	$11,801,071	$4,499,485	$16,300,556	$1,632,713	$0	$1,632,713
Total	**$20,482,840**	**$13,736,446**	**$34,219,285**	**$1,632,713**	**$0**	**$2,316,843**

Table H8 Individual Demand Measurement Results – Scenario 3 – Cobaki Lakes

Summaries NPV Costs Scenario 3	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$5,693,579	$2,304,770	$7,998,349			$170,187
Sewer (without RIGS)	$2,988,190	$6,932,191	$9,920,381			$423,885
Rainwater Tanks	$0	$5,891,597	$5,891,597	$331,282	$1,701,050	$2,032,332
Recycled Water	$11,801,071	$4,499,485	$16,300,556	$1,632,713	$0	$1,632,713
Total	**$20,482,840**	**$19,628,043**	**$40,110,883**	**$1,963,995**	**$1,701,050**	**$4,259,118**

Figure H3 Water Demand Profile – Scenario 1 – Cobaki Lakes

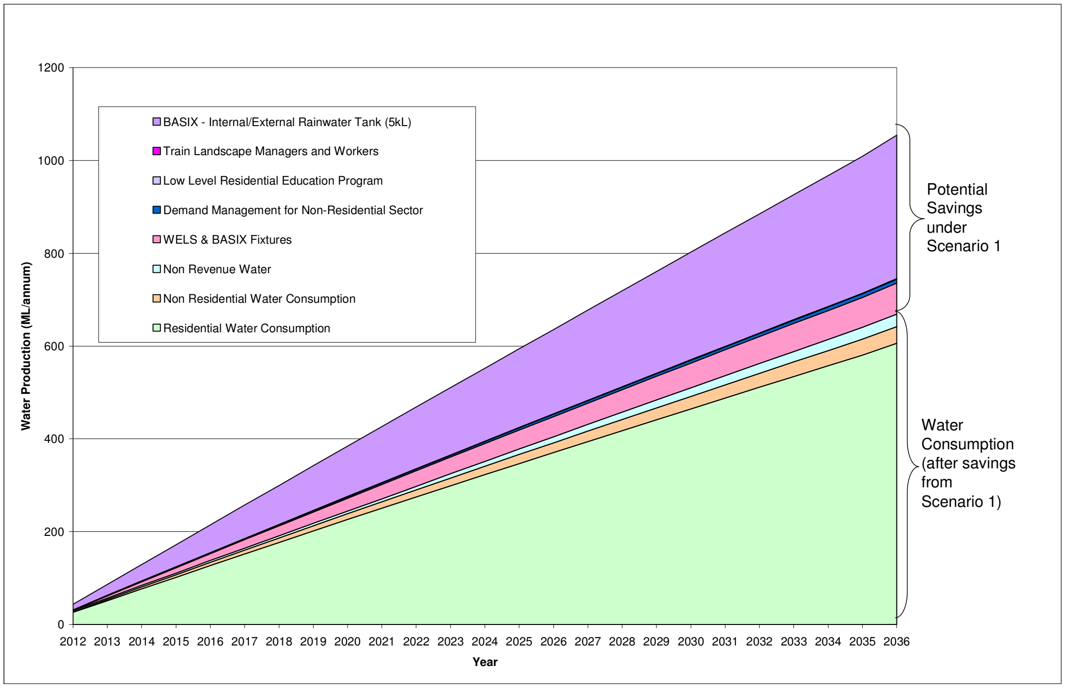


Figure H4 Water Demand Profile – Scenario 2 – Cobaki Lakes

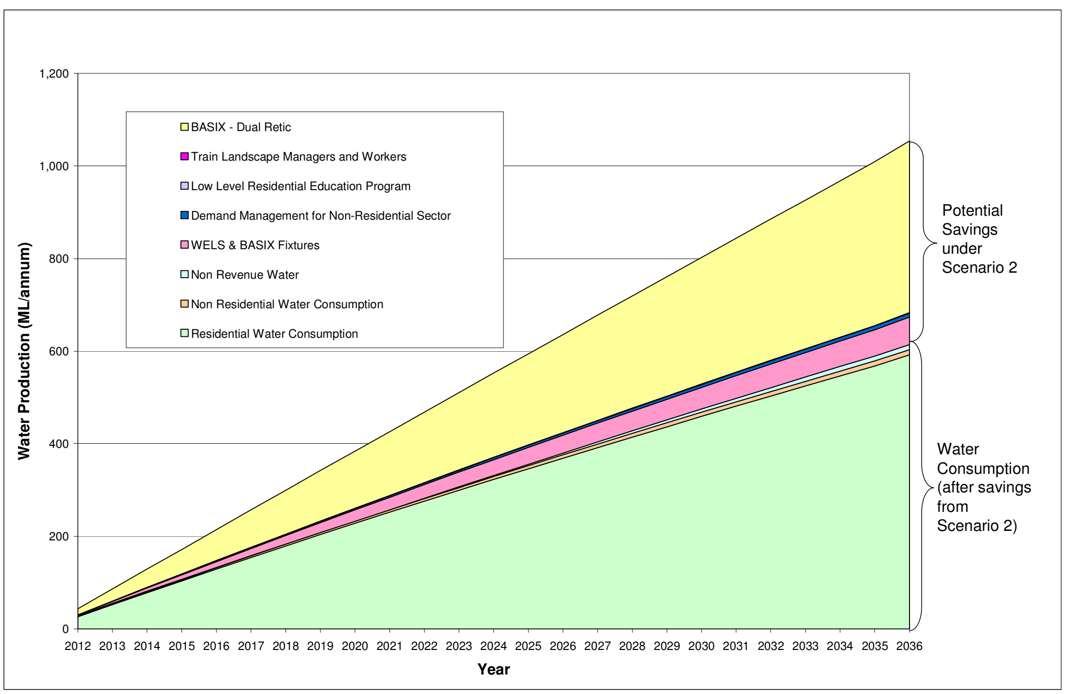


Figure H5 Water Demand Profile – Scenario 3 – Cobaki Lakes

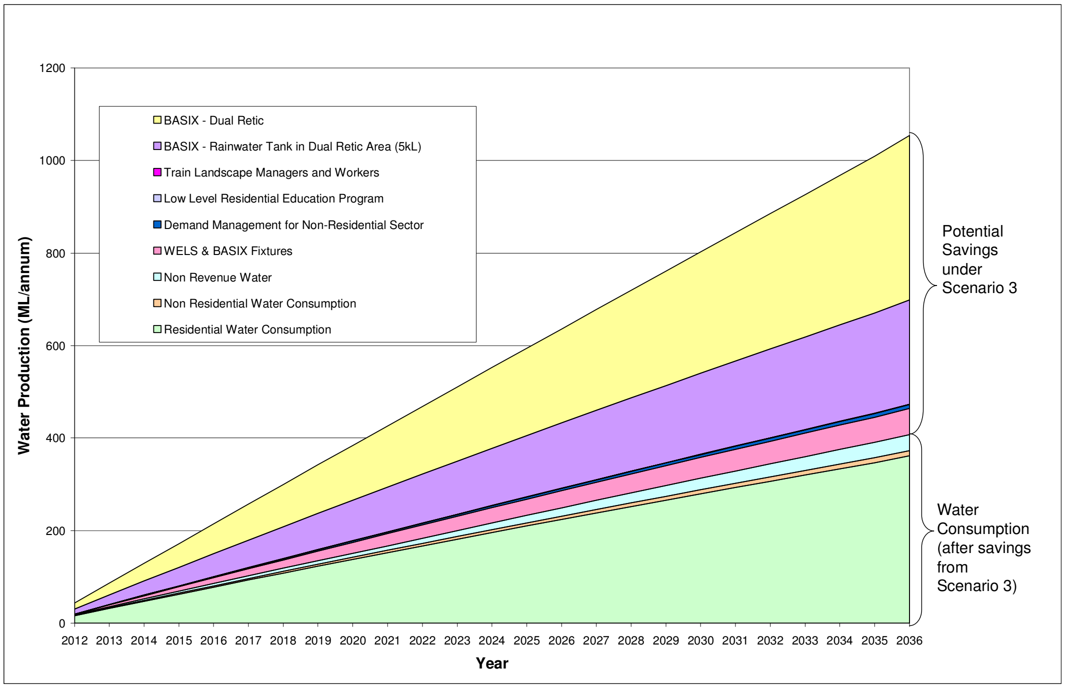


Figure H6 Average Water Savings by Components – Scenario 1 – Cobaki Lakes

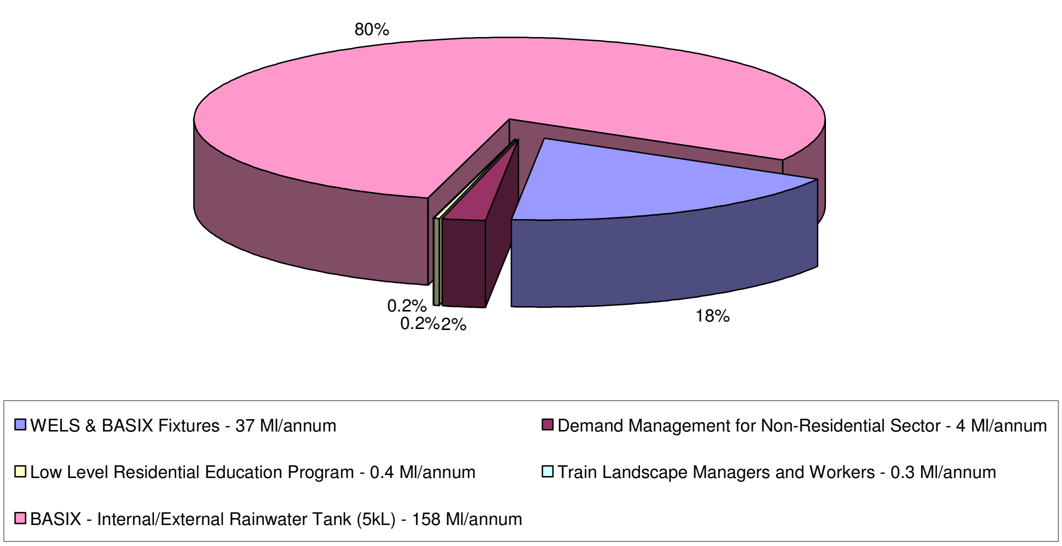


Figure H7 Average Water Savings by Components – Scenario 2 – Cobaki Lakes

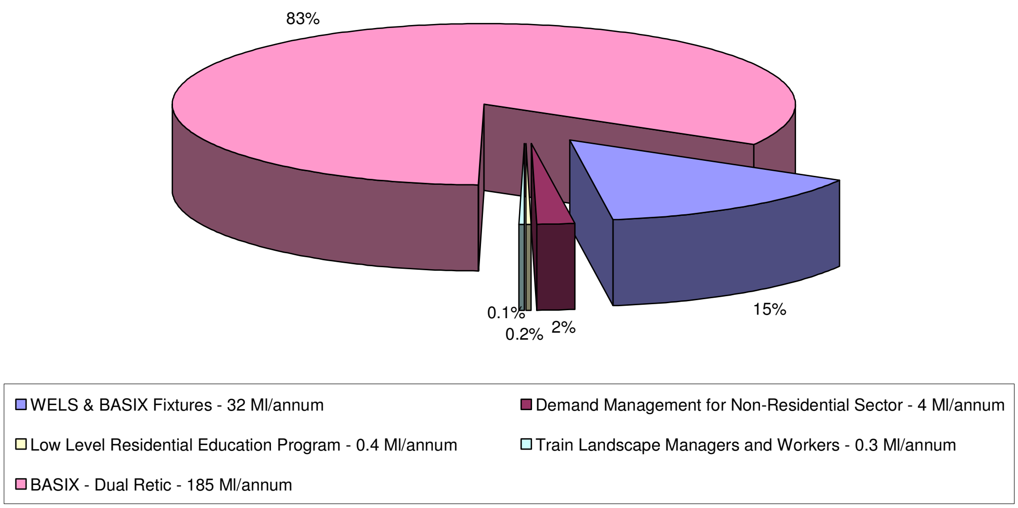
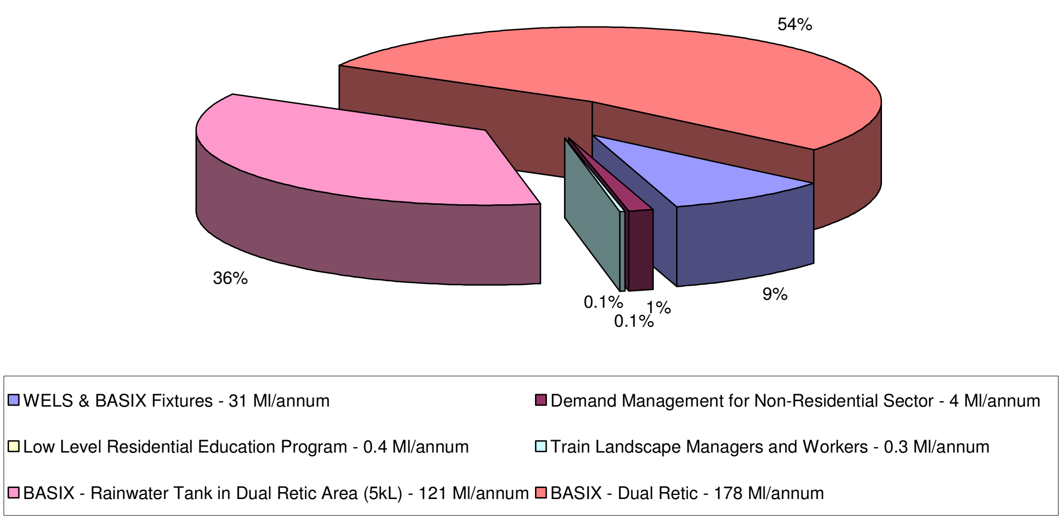


Figure H8 Average Water Savings by Components – Scenario 3 – Cobaki Lakes



APPENDIX I

SCENARIO DEMAND FORECASTS - KINGS FOREST

The figures and tables below outline the future water demand management outcomes for Kings Forest.

Table I1 Total Annual Water Demand Forecast – Kings Forest

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast New Growth Areas	45	223	443	661	877	1096
Scenario 1 - BASIX with Rainwater Tank (5kL)	30	143	281	420	557	695
Scenario 2 - BASIX with Dual Reticulation	30	138	267	395	518	639
Scenario 3 - BASIX with Rainwater Tank (5kL) and Dual Reticulation	19	89	173	259	342	424

Figure I1 Total Water Demand Forecast – Kings Forest

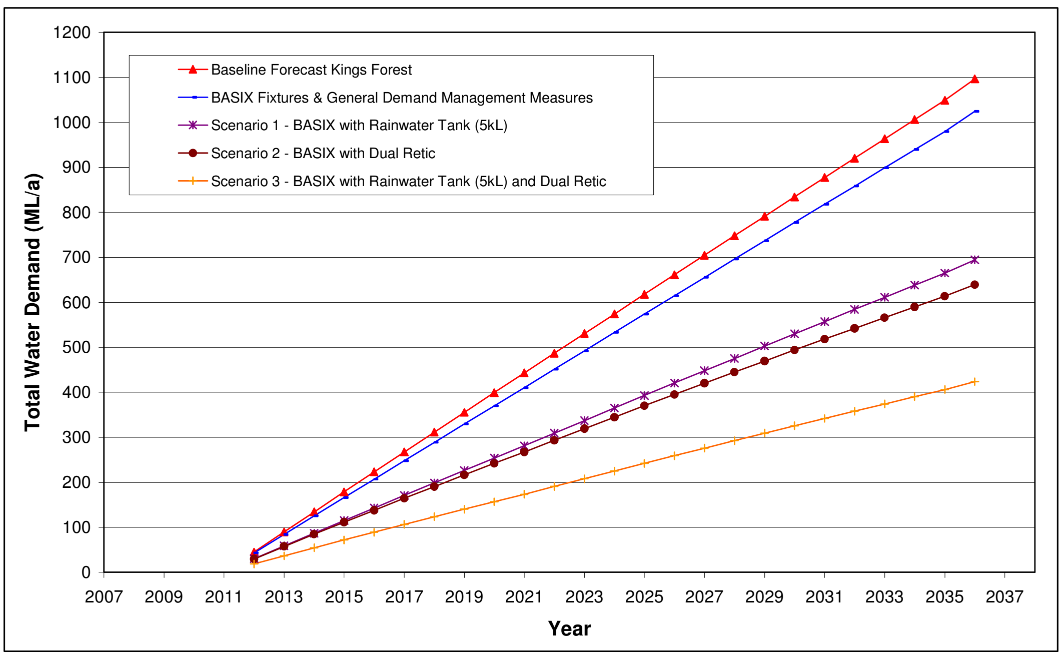


Table I2 Total Per Capita Water Demand Forecast – Kings Forest

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast New Growth Areas	255	258	261	266	271	275
Scenario 1 - BASIX with Rainwater Tank (5kL)	173	165	166	169	172	174
Scenario 2 - BASIX with Dual Reticulation	168	159	158	159	160	161
Scenario 3 - BASIX with Rainwater Tank (5kL) and Dual Reticulation	105	103	102	104	105	106

Figure I2 Total Per Capita Water Demand Forecast – Kings Forest

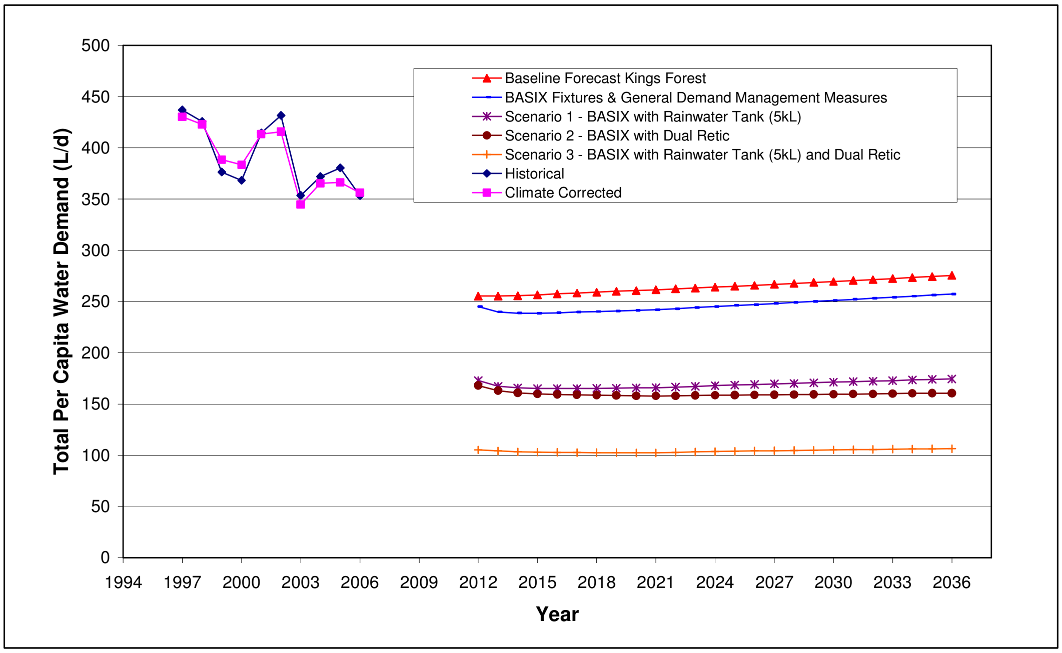


Table I3 Sectoral Annual Water Demand Forecast – Scenario 1 – Kings Forest

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	19.8	98	194	288	381	474
Multi-Family Greenfield	6.9	34	67	98	127	157
Commercial	0.29	1.33	2.67	4.04	5.56	7
Industrial	0.00	0.00	0.00	0.00	0.00	0.00
Irrigation	0.48	2.46	5.27	8.23	11.33	15
Public	0.55	2.80	5.64	9	11	14
Total	**28**	**139**	**275**	**407**	**536**	**667**

Table I4 Sectoral Annual Water Demand Forecast – Scenario 2 – Kings Forest

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	19.3	94	185	271	354	437
Multi-Family Greenfield	8.1	40	78	113	147	180
Commercial	0.2	1	2	2	3	4
Industrial	0.0	0	0	0	0	0
Irrigation	0.0	0	0	1	1	1
Public	0.3	2	3	4	5	7
Total	**28**	**137**	**268**	**391**	**510**	**628**

Table I5 Sectoral Annual Water Demand Forecast – Scenario 3 – Kings Forest

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	11.0	54	106	157	206	255
Multi-Family Greenfield	5.4	27	52	76	99	122
Commercial	0.2	1	2	2	3	4
Industrial	0.0	0	0	0	0	0
Irrigation	0.0	0	0	1	1	1
Public	0.3	2	3	4	5	7
Total	**17**	**84**	**164**	**240**	**314**	**388**

Table I6 Individual Demand Measurement Results – Scenario 1 – Kings Forest

Summaries NPV Costs Scenario 1	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$3,862,947	$3,703,364	$7,566,312			$233,686
Sewer (without RIGS)	$3,089,988	$7,221,032	$10,311,020			$280,470
Rainwater Tanks	$0	$6,137,080	$6,137,080	$340,230	$1,771,928	$2,112,157
Recycled Water	$0	$0	$0	$0	$0	$0
Total	**$6,952,936**	**$17,061,477**	**$24,014,412**	**$340,230**	**$1,771,928**	**$2,626,313**

Table I7 Individual Demand Measurement Results – Scenario 2 – Kings Forest

Summaries NPV Costs Scenario 2	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$3,353,111	$2,400,802	$5,753,913			$225,947
Sewer (without RIGS)	$3,089,988	$7,221,032	$10,311,020			$280,470
Rainwater Tanks	$0	$0	$0	$0	$0	$0
Recycled Water	$11,219,344	$4,686,964	$15,906,307	$2,309,009	$0	$2,309,009
Total	**$17,662,443**	**$14,308,797**	**$31,971,240**	**$2,309,009**	**$0**	**$2,815,426**

Table I8 Individual Demand Measurement Results – Scenario 3 – Kings Forest

Summaries NPV Costs Scenario 3	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$3,353,111	$2,400,802	$5,753,913			$147,666
Sewer (without RIGS)	$3,089,988	$7,221,032	$10,311,020			$280,470
Rainwater Tanks	$0	$6,137,080	$6,137,080	$340,230	$1,771,928	$2,112,157
Recycled Water	$11,219,344	$4,686,964	$15,906,307	$2,309,009	$0	$2,309,009
Total	**$17,662,443**	**$20,445,878**	**$38,108,320**	**$2,649,239**	**$1,771,928**	**$4,849,302**

Figure I3 Water Demand Profile – Scenario 1 – Kings Forest

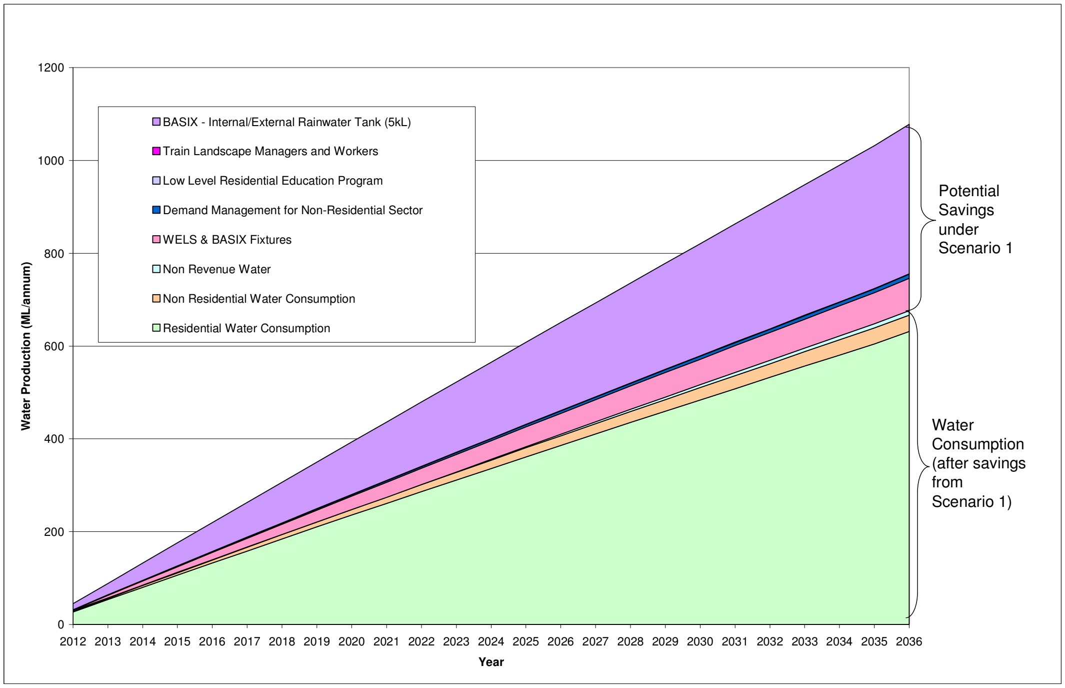


Figure I4 Water Demand Profile – Scenario 2 – Kings Forest

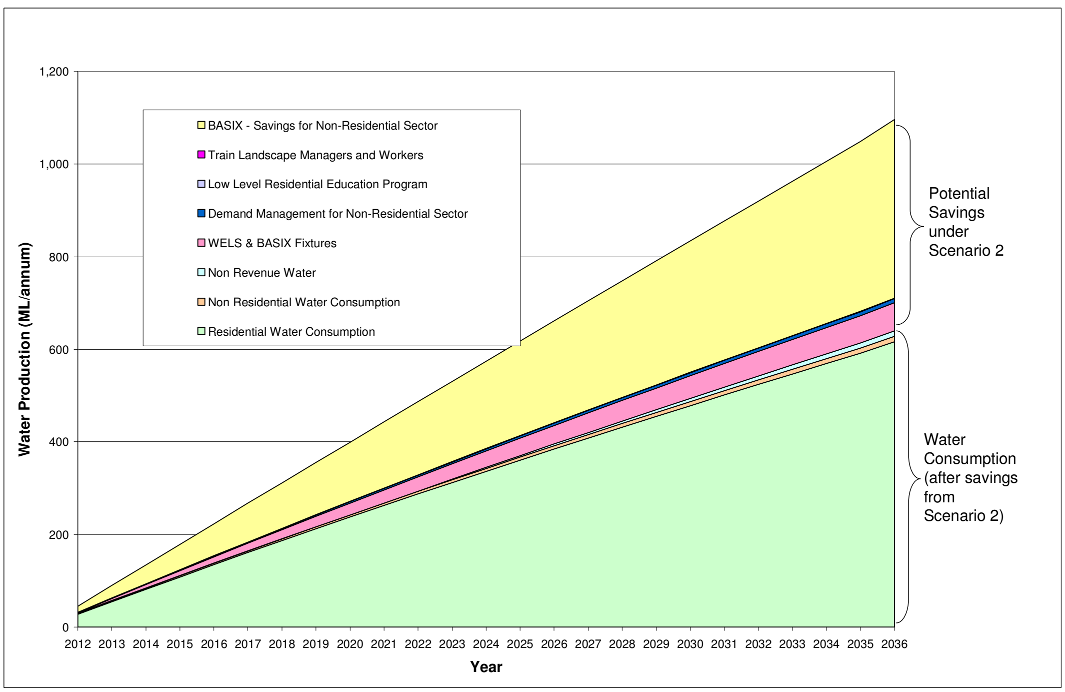


Figure I5 Water Demand Profile – Scenario 3 – Kings Forest

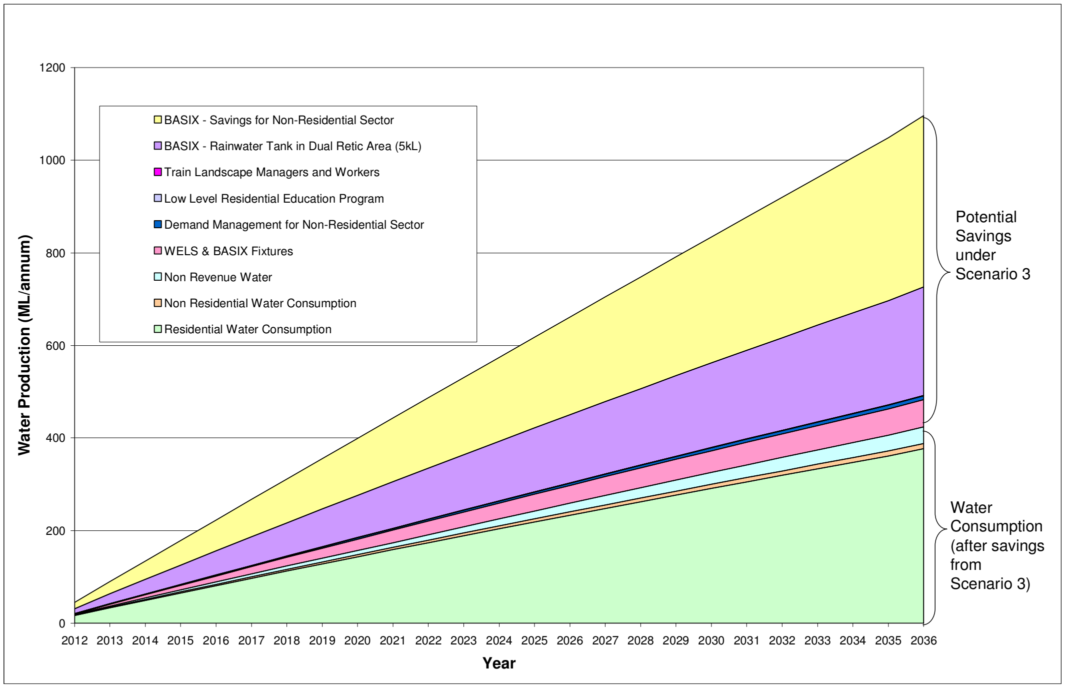


Figure I6 Average Water Savings by Component – Scenario 1 – Kings Forest

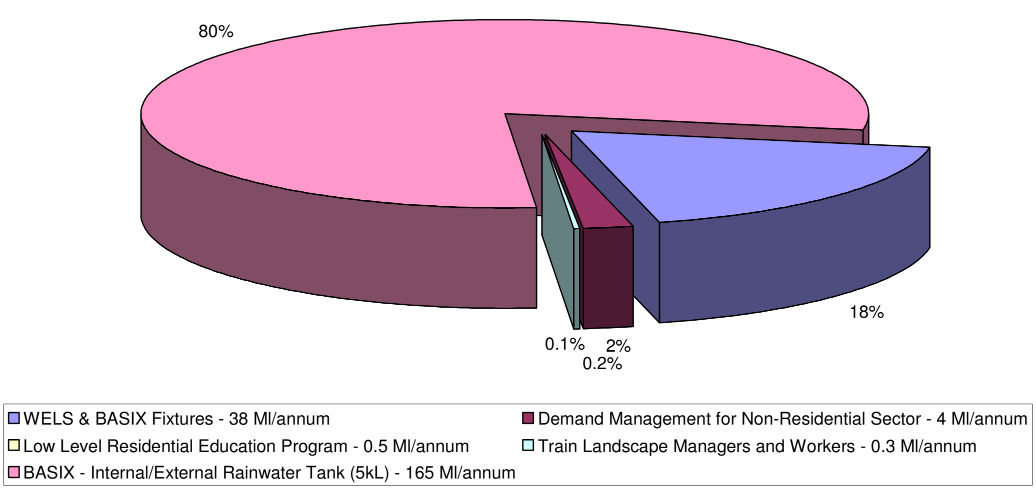


Figure I7 Average Water Savings by Component – Scenario 2 – Kings Forest

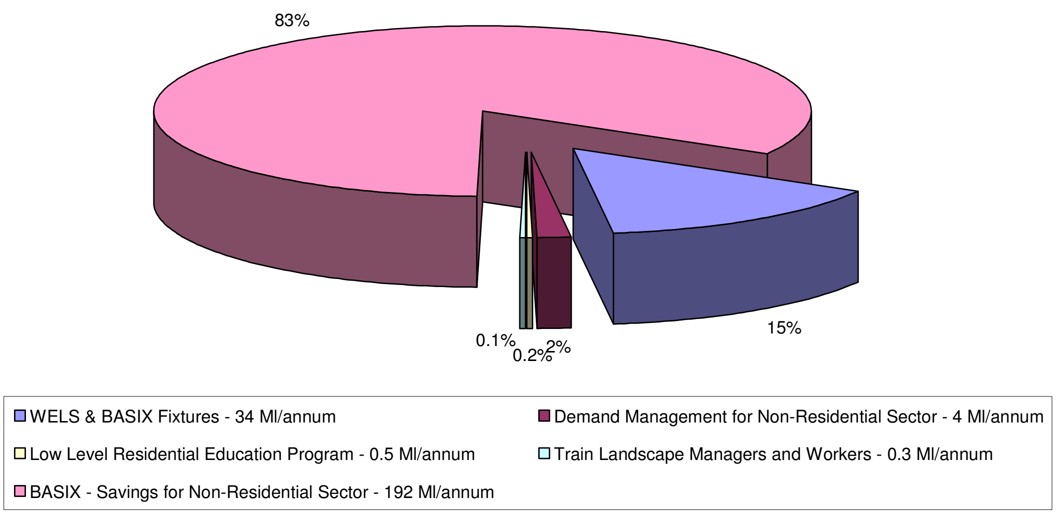
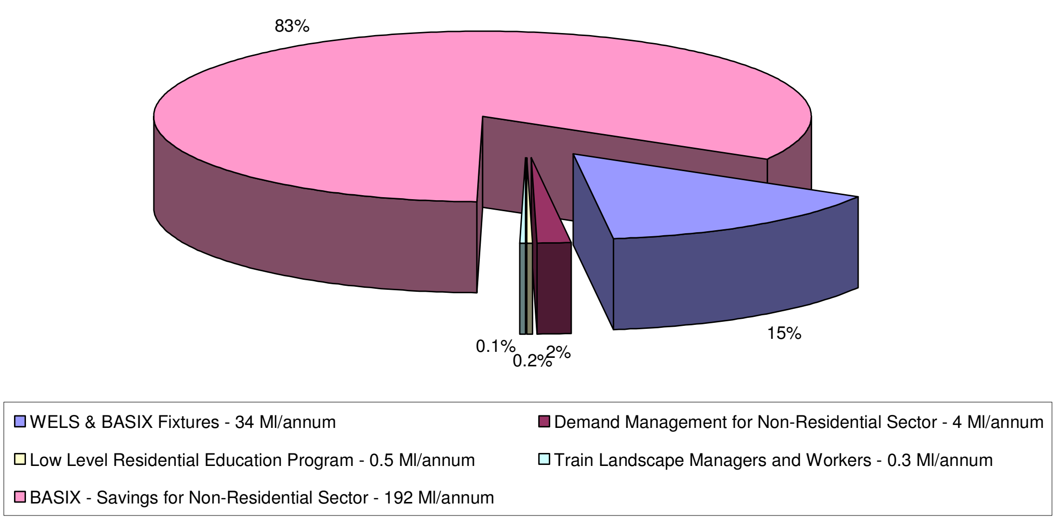


Figure I8 Average Water Savings by Component – Scenario 3 – Kings Forest



APPENDIX J

SCENARIO DEMAND FORECASTS - TERRANORA AREA A

The figures and tables below outline the future water demand management outcomes for Terranora Area A.

Table J1 Total Annual Water Demand Forecast – Terranora

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast New Growth Areas	15	75	149	224	298	373
Scenario 1 - BASIX with Rainwater Tank (5kL)	10	50	99	148	197	246
Scenario 2 - BASIX with Dual Reticulation	9	43	83	123	162	200
Scenario 3 - BASIX with Rainwater Tank (5kL) and Dual Reticulation	6	28	55	82	109	135

Figure J1 Total Water Demand Forecast – Terranora

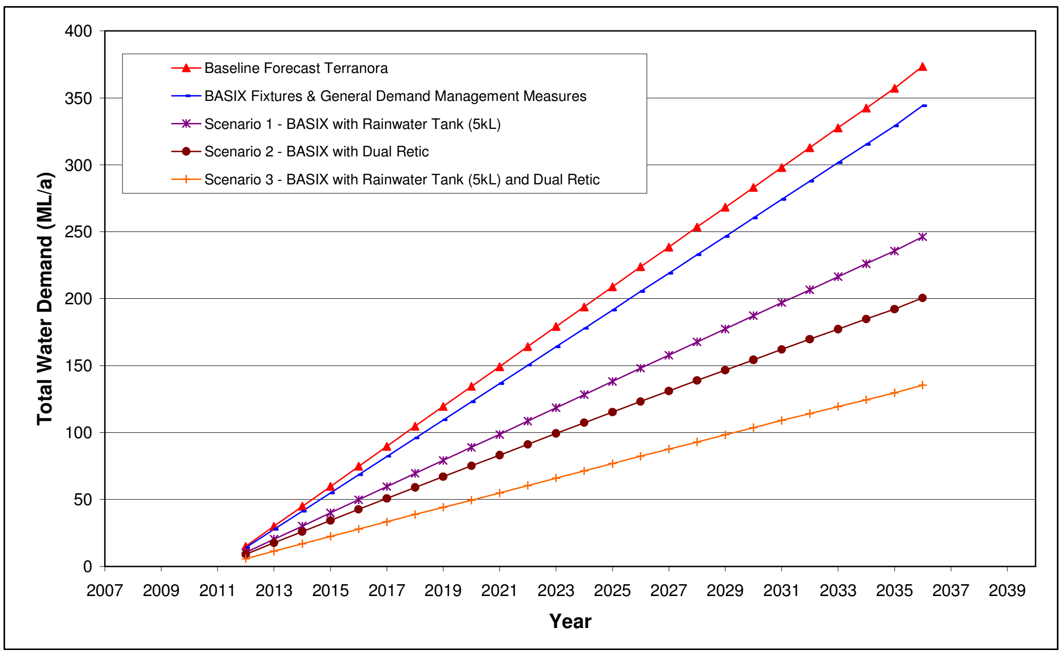


Table J2 Total Per Capita Water Demand Forecast – Terranora

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast New Growth Areas	303	309	314	320	327	333
Scenario 1 - BASIX with Rainwater Tank (5kL)	211	205	208	212	216	220
Scenario 2 - BASIX with Dual Reticulation	184	176	175	176	178	179
Scenario 3 - BASIX with Rainwater Tank (5kL) and Dual Reticulation	117	115	115	118	119	121

Figure J2 Total Per Capita Water Demand Forecast – Terranora

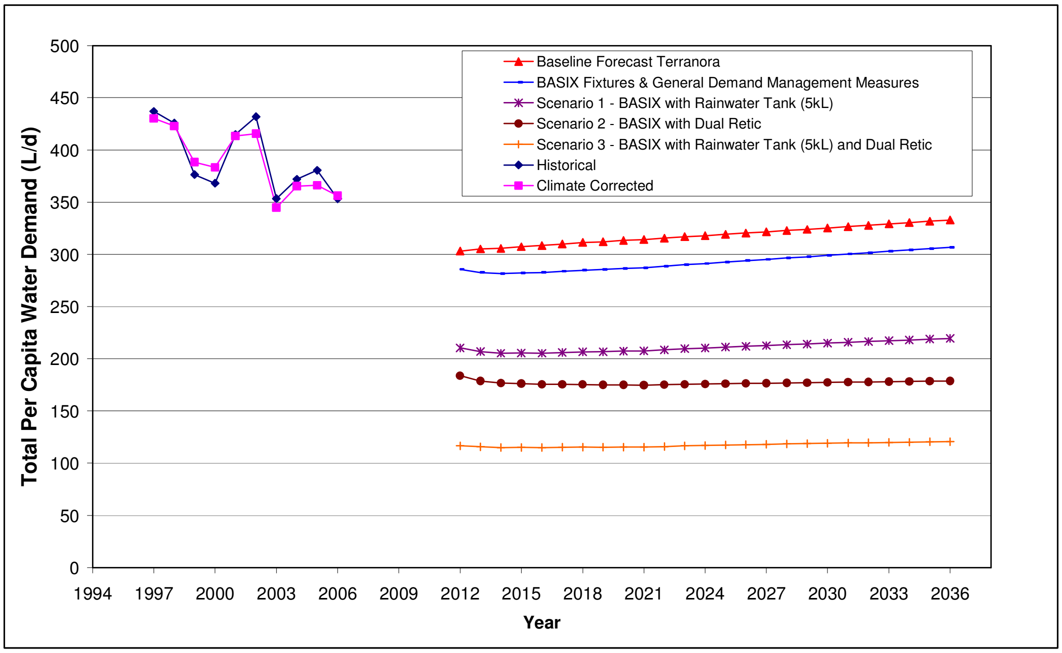


Table J3 Sectoral Annual Water Demand Forecast – Scenario 1 – Terranora

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	7.3	36	72	106	141	175
Multi-Family Greenfield	0.6	3.0	5.9	8.6	11.3	13.9
Commercial	0.00	0.3	0.8	1.4	1.8	2.3
Industrial	0.00	0.0	0.0	0.0	0.0	0.0
Irrigation	0.22	1.2	2.5	3.8	5.3	6.8
Public	1.42	7.2	14.6	22.0	29.6	37.2
Total	**10**	**48**	**95**	**142**	**189**	**235**

Table J4 Sectoral Annual Water Demand Forecast – Scenario 2 – Terranora

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	7.1	35	68	100	131	161
Multi-Family Greenfield	0.7	3.5	6.9	10.0	13.0	15.9
Commercial	0.0	0.2	0.4	0.8	1.1	1.3
Industrial	0.0	0.0	0.0	0.0	0.0	0.0
Irrigation	0.0	0.0	0.0	0.0	0.1	0.1
Public	0.7	3.4	6.8	10.1	13.5	16.9
Total	**9**	**42**	**82**	**121**	**158**	**195**

Table J5 Sectoral Annual Water Demand Forecast – Scenario 3 – Terranora

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	4.1	20	39	58	76	94
Multi-Family Greenfield	0.5	2.4	4.6	6.7	8.8	11
Commercial	0.0	0.2	0.4	0.8	1.1	1.3
Industrial	0.0	0.0	0.0	0.0	0.0	0.0
Irrigation	0.0	0.0	0.0	0.0	0.1	0.1
Public	0.7	3.4	6.8	10	14	17
Total	**5**	**26**	**51**	**76**	**99**	**123**

Table J6 Individual Demand Measurement Results – Scenario 1 – Terranora

Summaries NPV Costs Scenario 1	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$1,198,397	$1,194,568	$2,392,965			$94,224
Sewer (without RIGS)	$1,314,095	$1,855,805	$3,169,900			$62,756
Rainwater Tanks	$0	$1,718,536	$1,718,536	$174,047	$496,241	$670,288
Recycled Water	$0	$0	$0	$0	$0	$0
Total	**$2,512,492**	**$4,768,909**	**$7,281,400**	**$174,047**	**$496,241**	**$827,268**

Table J7 Individual Demand Measurement Results – Scenario 2 – Terranora

Summaries NPV Costs Scenario 2	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$838,822	$774,409	$1,613,232			$78,674
Sewer (without RIGS)	$1,314,095	$1,855,805	$3,169,900			$62,756
Rainwater Tanks	$0	$0	$0	$0	$0	$0
Recycled Water	$5,170,410	$1,511,840	$6,682,251	$555,685	$0	$555,685
Total	**$7,323,327**	**$4,142,055**	**$11,465,382**	**$555,685**	**$0**	**$697,115**

Table J8 Individual Demand Measurement Results – Scenario 3 – Terranora

Summaries NPV Costs Scenario 3	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$838,822	$774,409	$1,613,232			$52,335
Sewer (without RIGS)	$1,314,095	$1,855,805	$3,169,900			$62,756
Rainwater Tanks	$0	$1,718,536	$1,718,536	$174,047	$496,241	$670,288
Recycled Water	$5,170,410	$1,511,840	$6,682,251	$555,685	$0	$555,685
Total	**$7,323,327**	**$5,860,591**	**$13,183,918**	**$729,731**	**$496,241**	**$1,341,063**

Figure J3 Water Demand Profile – Scenario 1 – Terranora

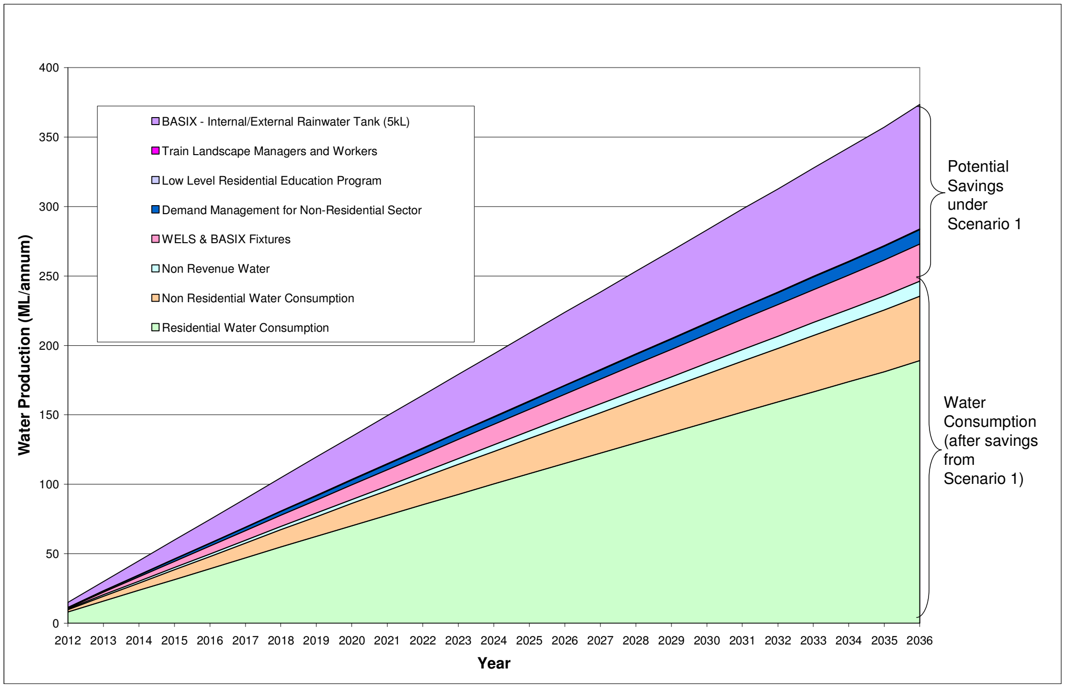


Figure J4 Water Demand Profile – Scenario 2 – Terranora

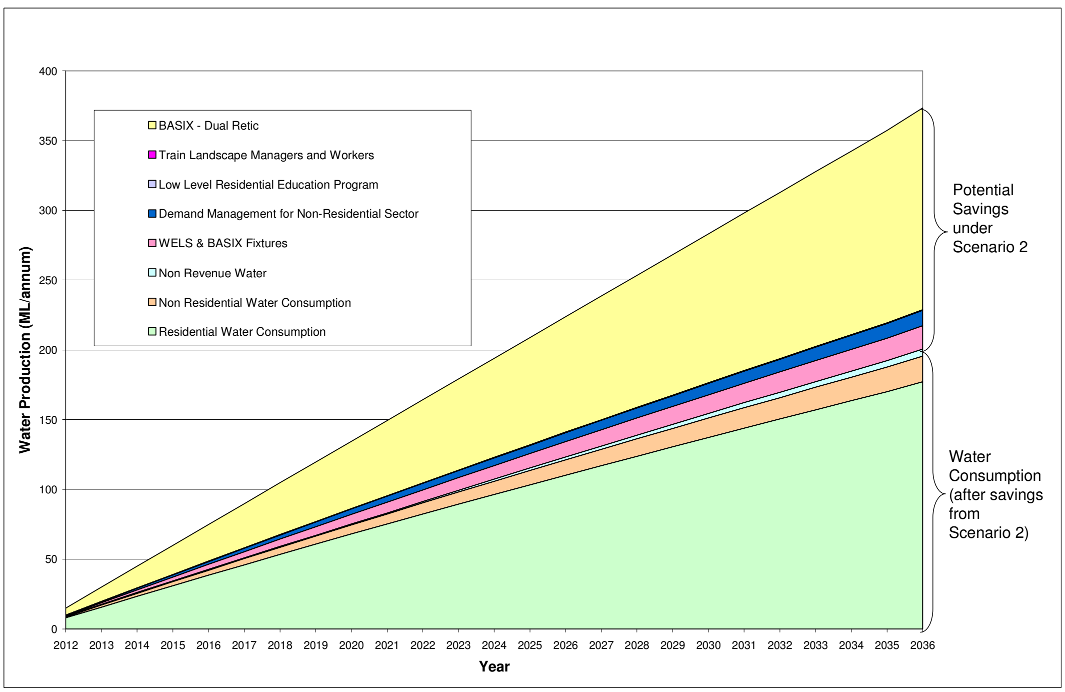


Figure J5 Water Demand Profile – Scenario 3 – Terranora

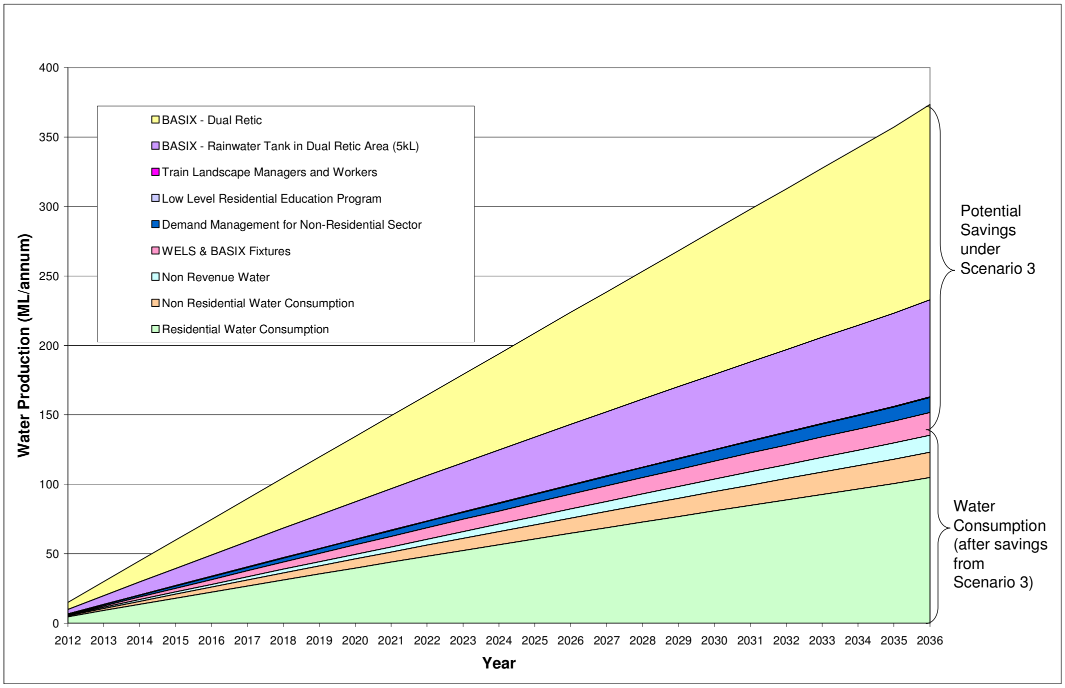


Figure J6 Average Water Savings by Component – Scenario 1 – Terranora

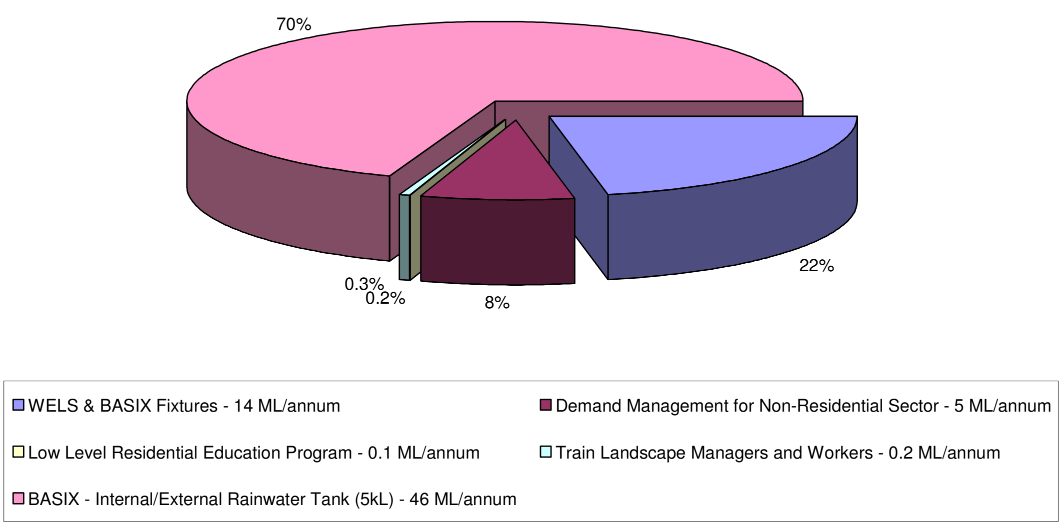


Figure J7 Average Water Savings by Component – Scenario 2 – Terranora

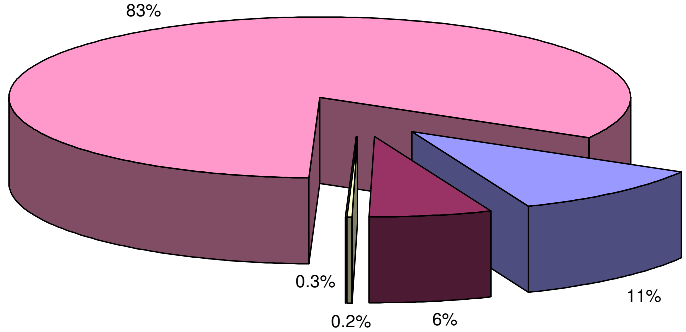
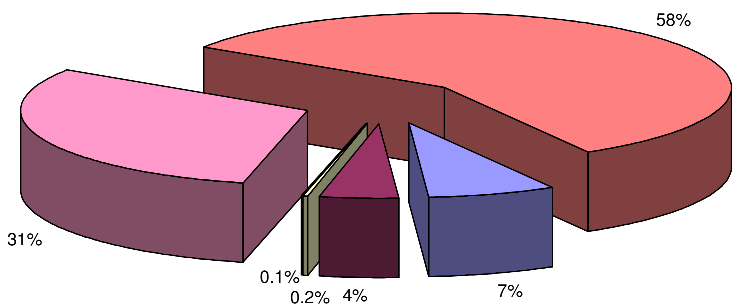


Figure J8 Average Water Savings by Component – Scenario 3 – Terranora



APPENDIX K

SCENARIO DEMAND FORECASTS - WEST KINGSCLIFF

The figures and tables below outline the future water demand management outcomes for West Kingscliff.

Table K1 Total Annual Water Demand Forecast – West Kingscliff

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast New Growth Areas	12	59	118	175	231	286
Scenario 1 - BASIX with Rainwater Tank (5kL)	8	39	77	115	152	189
Scenario 2 - BASIX with Dual Reticulation	8	40	77	113	148	182
Scenario 3 - BASIX with Rainwater Tank (5kL) and Dual Reticulation	6	29	57	85	111	137

Figure K1 Total Water Demand Forecast – West Kingscliff

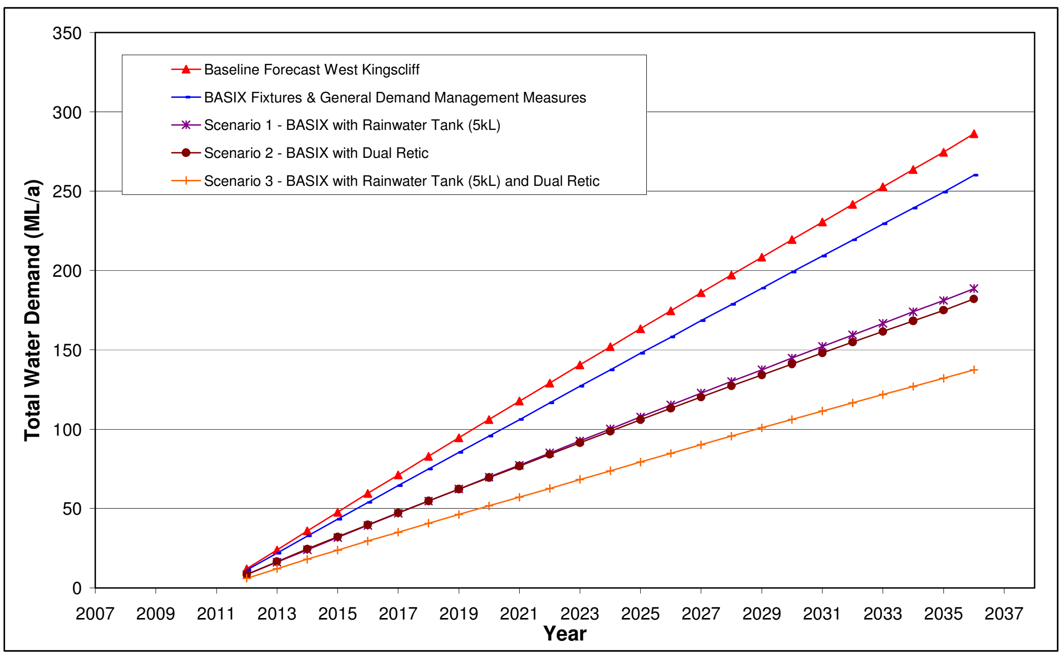


Table K2 Total Per Capita Water Demand Forecast – West Kingscliff

Scenario	2012	2016	2021	2026	2031	2036
Baseline Forecast New Growth Areas	272	274	278	283	287	292
Scenario 1 - BASIX with Rainwater Tank (5kL)	189	182	183	186	190	192
Scenario 2 - BASIX with Dual Reticulation	190	183	182	183	184	186
Scenario 3 - BASIX with Rainwater Tank (5kL) and Dual Reticulation	137	136	135	137	139	140

Figure K2 Total Per Capita Water Demand Forecast – West Kingscliff

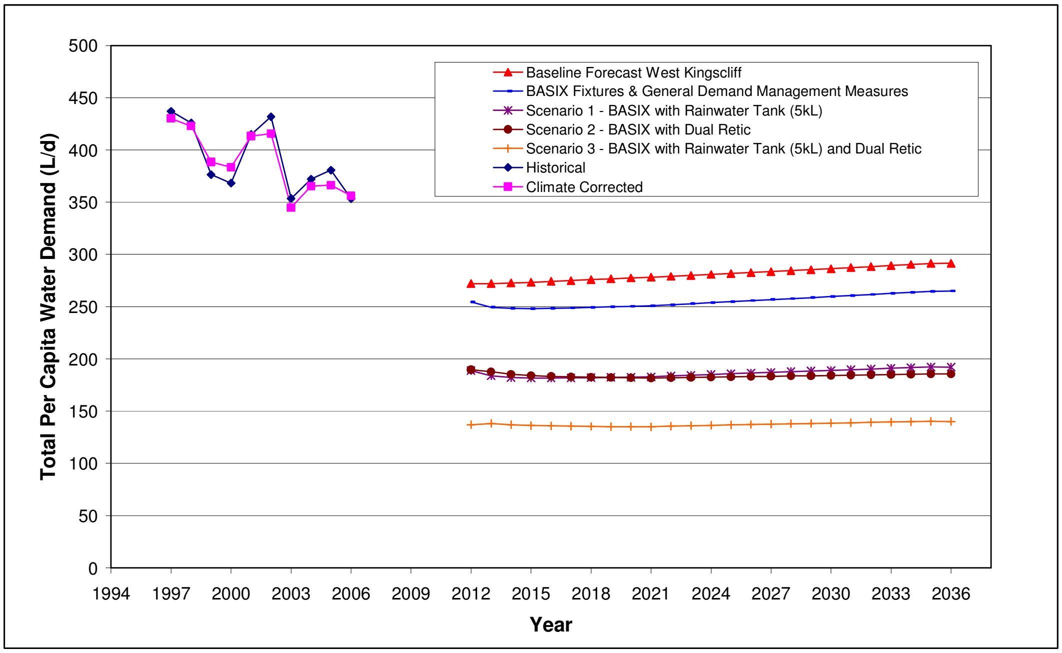


Table K3 Sectoral Annual Water Demand Forecast – Scenario 1 – Kings Forest

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	1.4	7	14	21	27	34
Multi-Family Greenfield	4.4	22	42	62	80	99
Commercial	0.72	3.68	7.42	11.21	15.03	18
Industrial	0.40	2.03	4.04	6.05	8.07	10.08
Irrigation	0.13	0.70	1.49	2.32	3.20	4
Public	0.38	1.92	3.88	6	8	10
Total	**7**	**37**	**73**	**108**	**142**	**176**

Table K4 Sectoral Annual Water Demand Forecast – Scenario 2 – West Kingscliff

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	1.4	7	13	20	26	31
Multi-Family Greenfield	5.1	25	49	71	93	114
Commercial	0.4	2	5	7	9	11
Industrial	0.4	2	4	6	8	10
Irrigation	0.00	0.11	0.13	0.14	0.15	0.16
Public	0.2	1	2	3	4	5
Total	**8**	**38**	**73**	**107**	**139**	**170**

Table K5 Sectoral Annual Water Demand Forecast – Scenario 3 – West Kingscliff

Sector	2012	2016	2021	2026	2031	2036
Single Family Greenfield	0.8	4	8	11	15	18
Multi-Family Greenfield	3.4	17	33	48	63	77
Commercial	0.4	2	5	7	9	11
Industrial	0.4	2	4	6	8	10
Irrigation	0.0	0.1	0.1	0.1	0.2	0.2
Public	0.2	1	2	3	4	5
Total	**5**	**26**	**51**	**75**	**98**	**121**

Table K6 Individual Demand Measurement Results – Scenario 1 – West Kingscliff

Summaries NPV Costs Scenario 1	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$385,737	$611,722	$997,459			$79,853
Sewer (without RIGS)	N/A	N/A	N/A	N/A	N/A	N/A
Rainwater Tanks	$0	$1,533,826	$1,533,826	$182,662	$442,740	$625,402
Recycled Water	$0	$0	$0	$0	$0	$0
Total	**$385,737**	**$2,145,549**	**$2,531,285**	**$182,662**	**$442,740**	**$705,255**

Table K7 Individual Demand Measurement Results – Scenario 2 – West Kingscliff

Summaries NPV Costs Scenario 2	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$327,129	$396,565	$723,694			$78,692
Sewer (without RIGS)	N/A	N/A	N/A	N/A	N/A	N/A
Rainwater Tanks	$0	$0	$0	$0	$0	$0
Recycled Water	$2,128,435	$774,194	$2,902,628	$538,777	$0	$538,777
Total	**$2,455,564**	**$1,170,758**	**$3,626,322**	**$538,777**	**$0**	**$617,469**

Table K8 Individual Demand Measurement Results – Scenario 3 – West Kingscliff

Summaries NPV Costs Scenario 3	Net Present Value of Forecast Expenditure					
	CAPEX			OPEX		
	NPV - Authority	NPV - Customer	Total NPV	NPV - Authority	NPV - Customer	Total NPV
Potable Water	$327,129	$396,565	$723,694			$58,839
Sewer (without RIGS)	N/A	N/A	N/A	N/A	N/A	N/A
Rainwater Tanks	$0	$1,533,826	$1,533,826	$182,662	$442,740	$625,402
Recycled Water	$2,128,435	$774,194	$2,902,628	$538,777	$0	$538,777
Total	**$2,455,564**	**$2,704,585**	**$5,160,148**	**$721,439**	**$442,740**	**$1,223,018**

Figure K3 Water Demand Profile – Scenario 1 – West Kingscliff

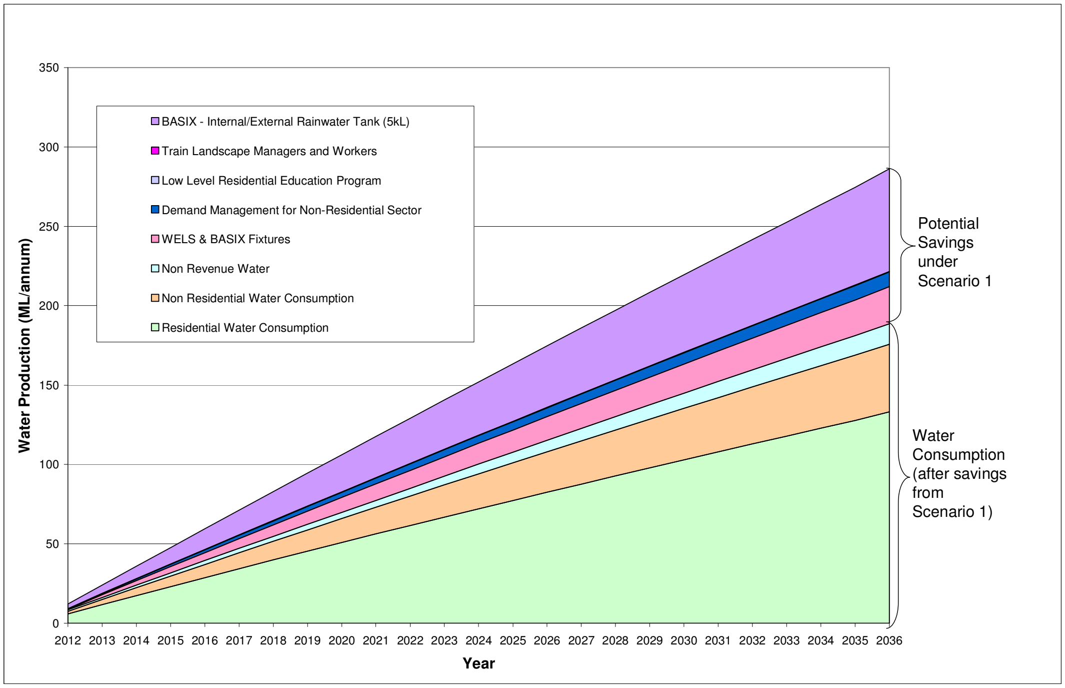


Figure K4 Water Demand Profile – Scenario 2 – West Kingscliff

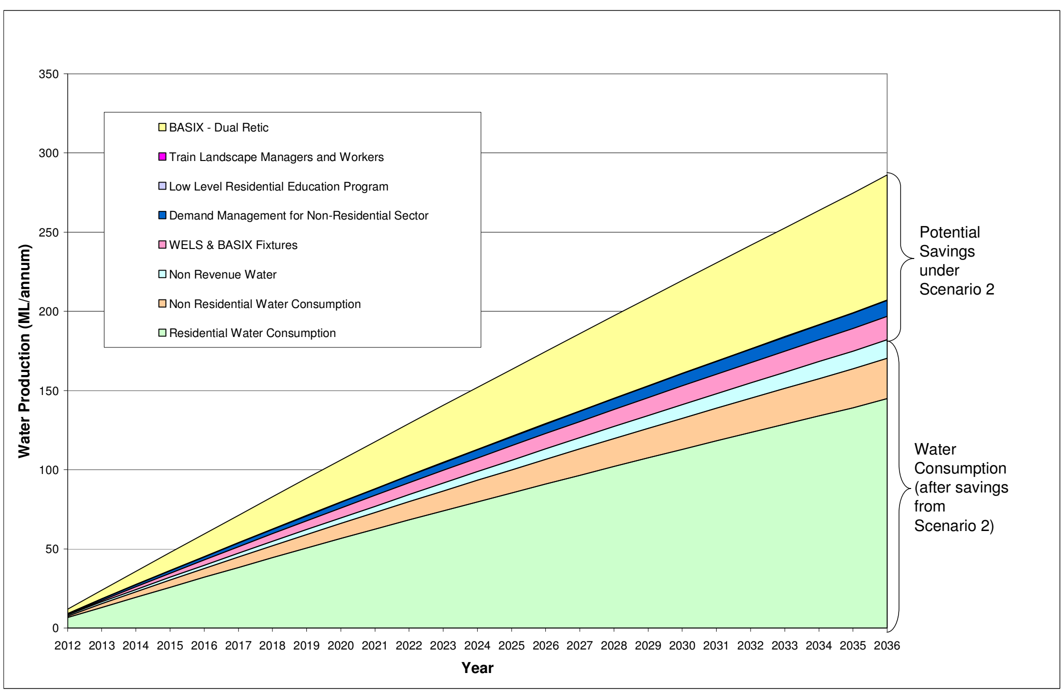


Figure K5 Water Demand Profile – Scenario 3 – West Kingscliff

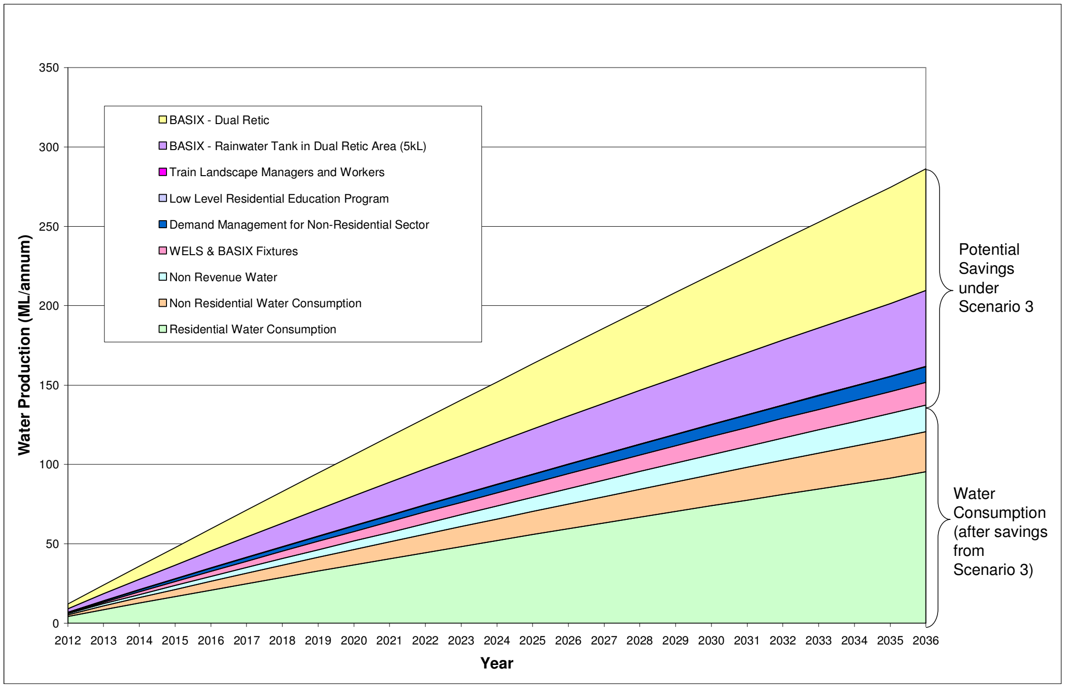


Figure K6 Average Water Savings by Component – Scenario 1 – West Kingscliff

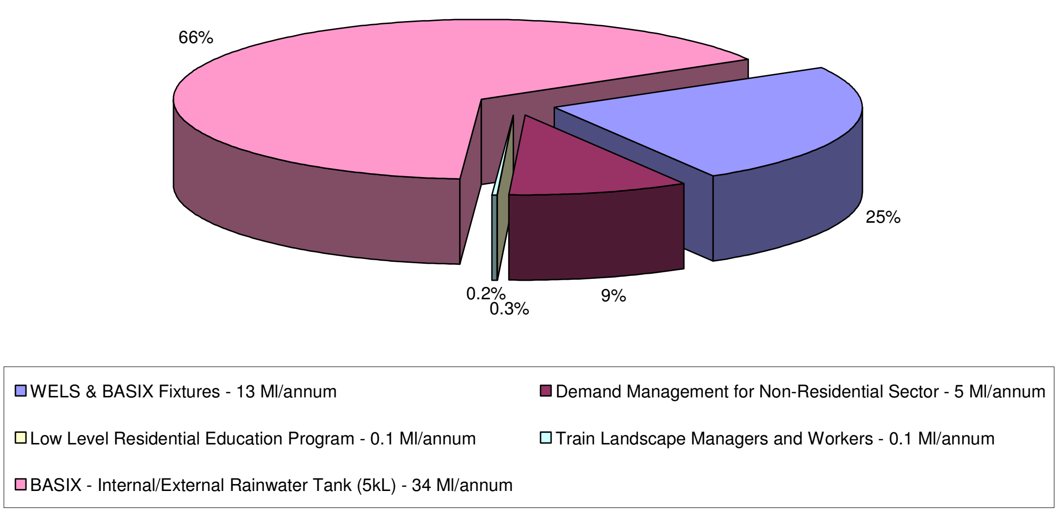


Figure K7 Average Water Savings by Component – Scenario 2 – West Kingscliff

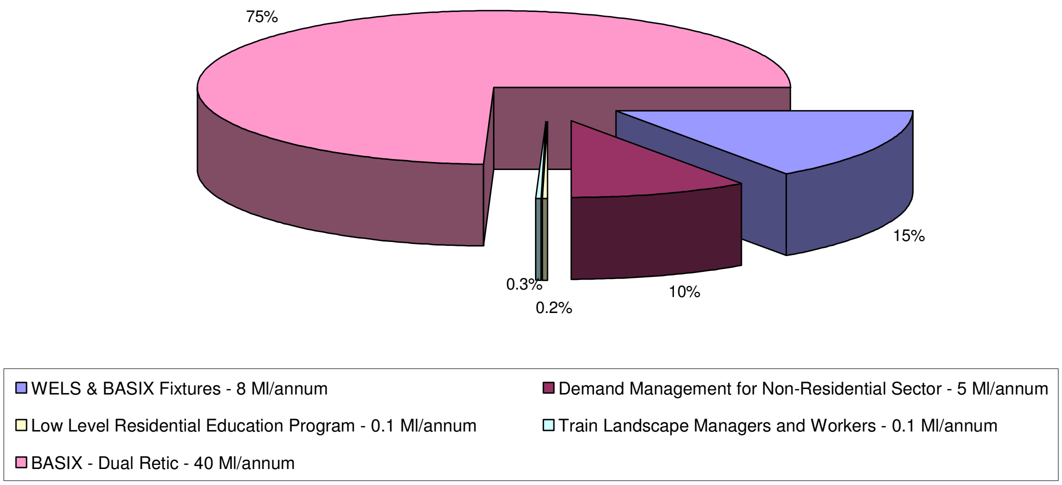
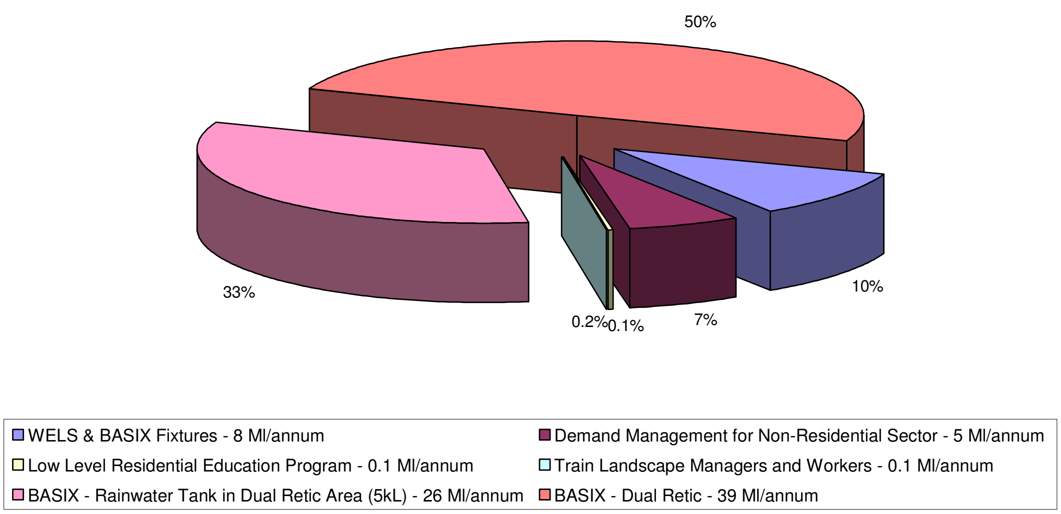


Figure K8 Average Water Savings by Component – Scenario 3 – West Kingscliff



APPENDIX L

RAINWATER TANK YIELD ASSESSMENT

The simulation of rainwater tanks has been undertaken using a probabilistic demand model. The probabilistic model simulates the climate-drive and random aspects of both water demand and rainfall over a large number of "virtual" properties. The simulation was undertaken for two rainwater tank sizes (i.e. 3 kL and 5 kL tanks), a variety of roof sizes and connected end uses. The first assessment study analysed the potential tank yield for all external end uses and toilet demand over time for a singe family residential property. In the second assessment study the potential yield of a rainwater tank connected to internal end uses for shower and washing machine was determined. The results of the analyses in terms of average daily yield and the percentage reduction in residential potable demand for the connected end-uses are shown in the figures below. The results suggest that a reasonably small tank (e.g. 3 kL or 5 kL) could provide significant reductions in demand. For the overall demand management scenarios a 5 kL tank has been chosen.

Figure L1 Rainwater Tank Yield – Connected to all external end-uses and toilet – Scenario 1

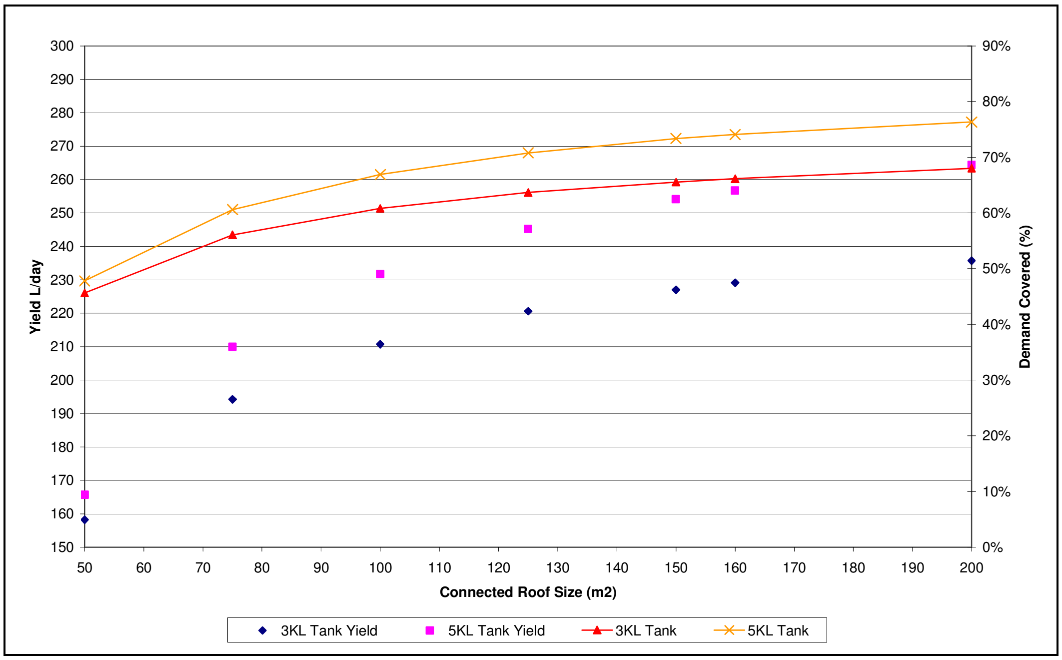
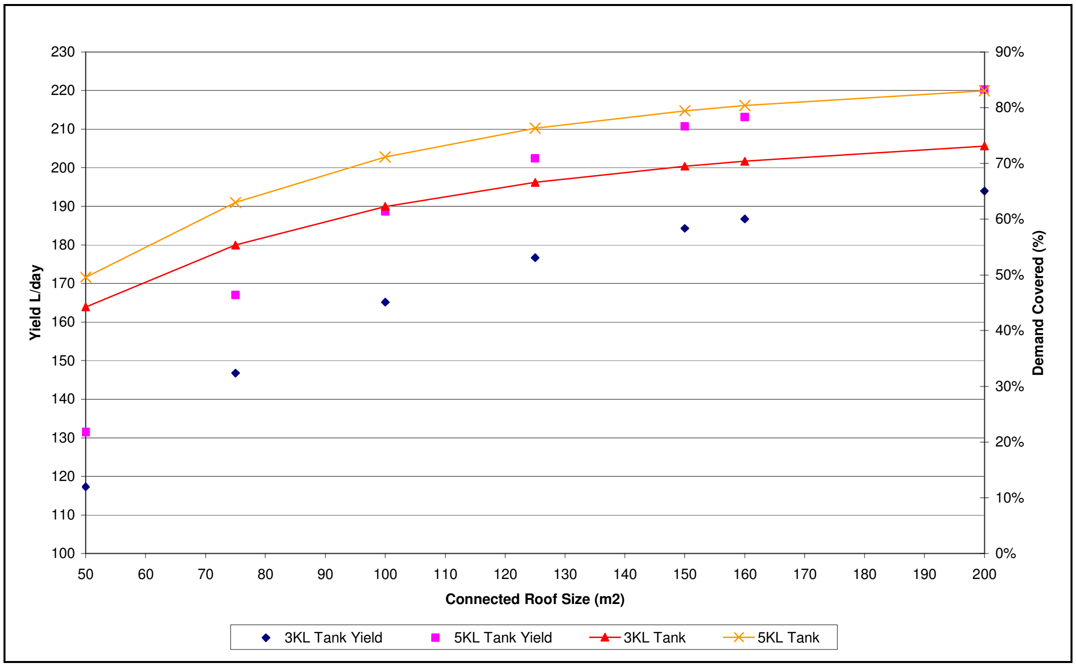


Figure L2 Rainwater Tank Yield – Connected to Shower and Washing Machine – Scenario 3



APPENDIX M

POTABLE WATER INFRASTRUCTURE PLAN

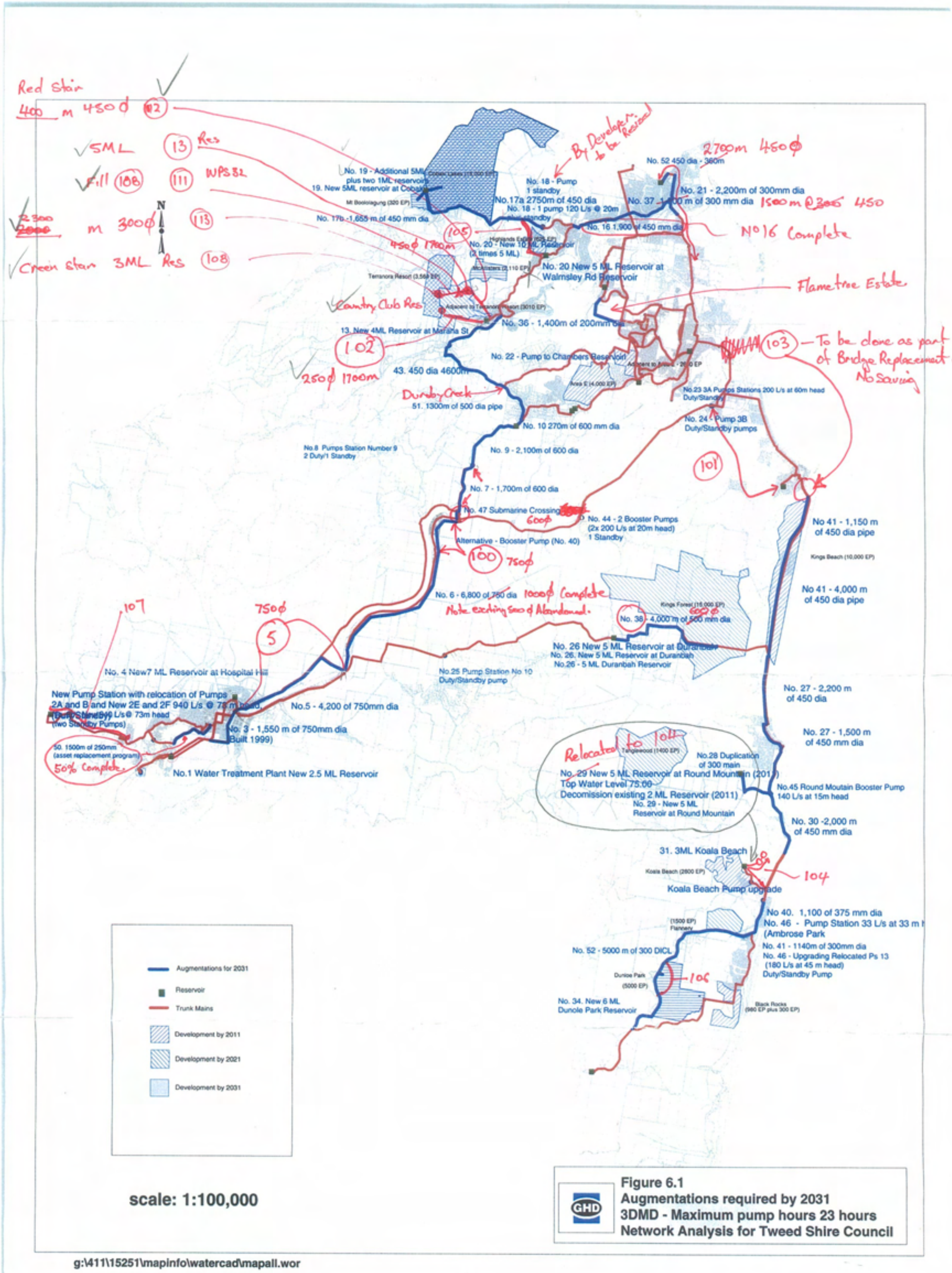


Figure 6.1
Augmentations required by 2031
3DMD - Maximum pump hours 23 hours
Network Analysis for Tweed Shire Council

g:\411\15251\mapinfo\watercad\mapall.wor

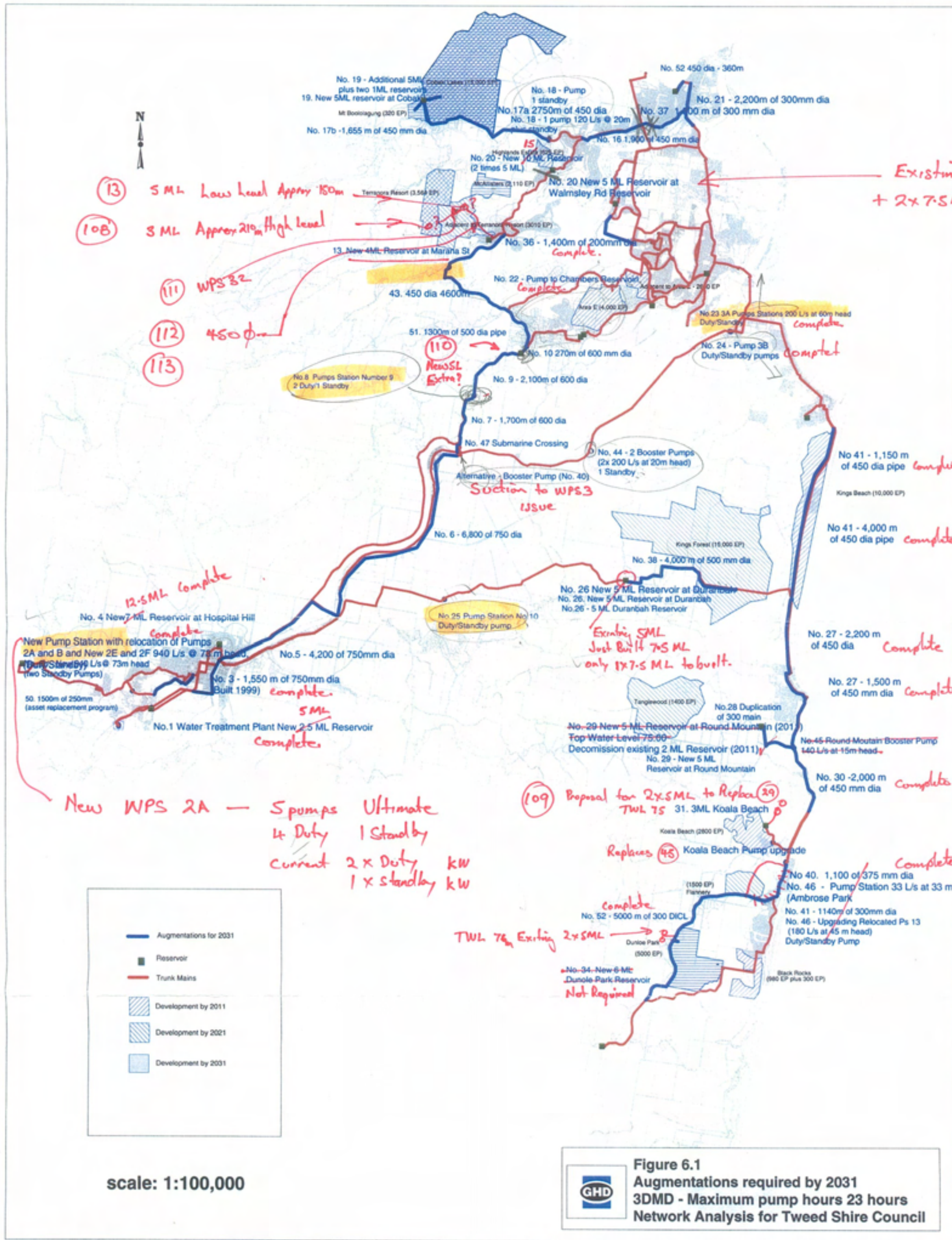
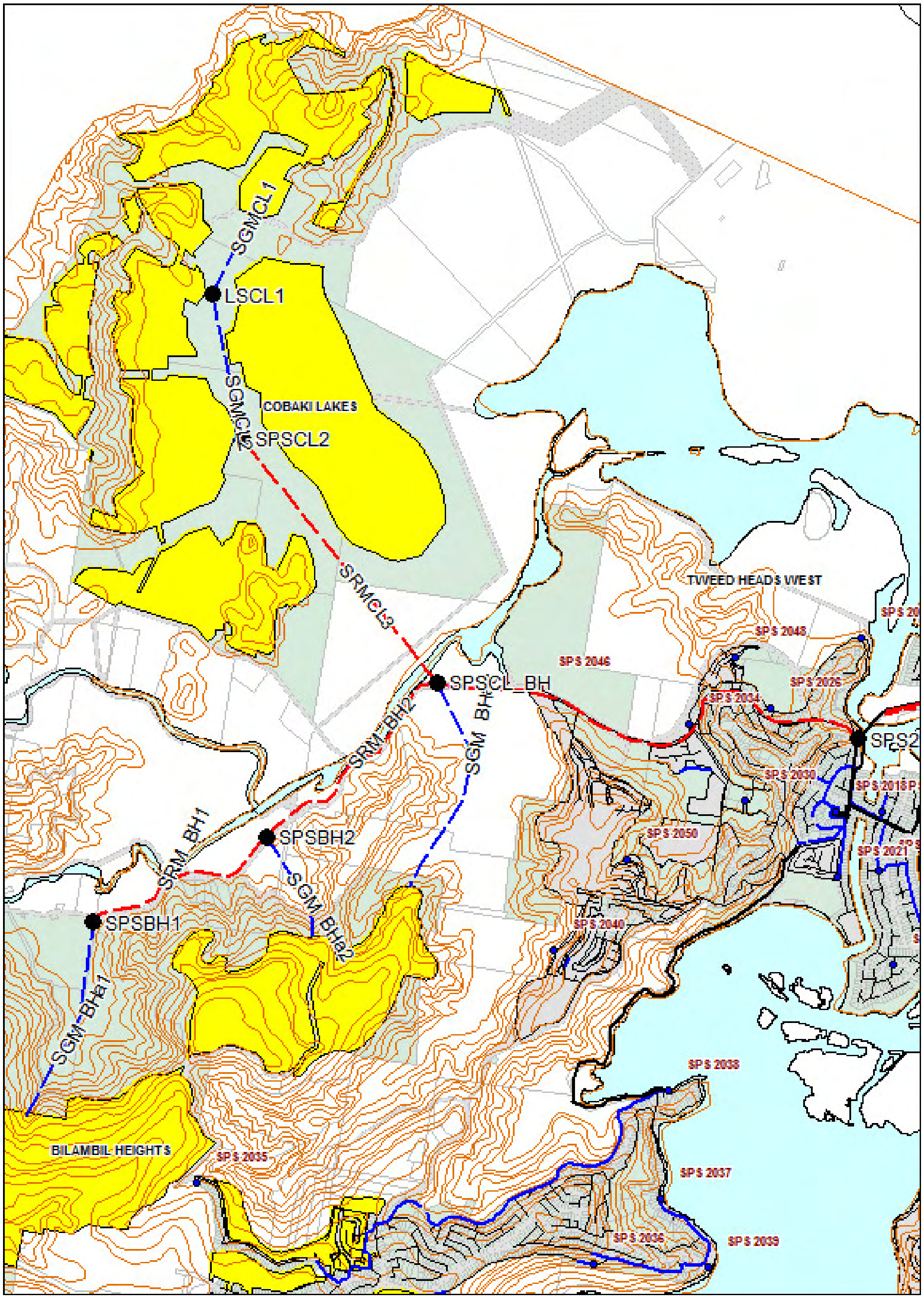


Figure 6.1
Augmentations required by 2031
3DMD - Maximum pump hours 23 hours
Network Analysis for Tweed Shire Council

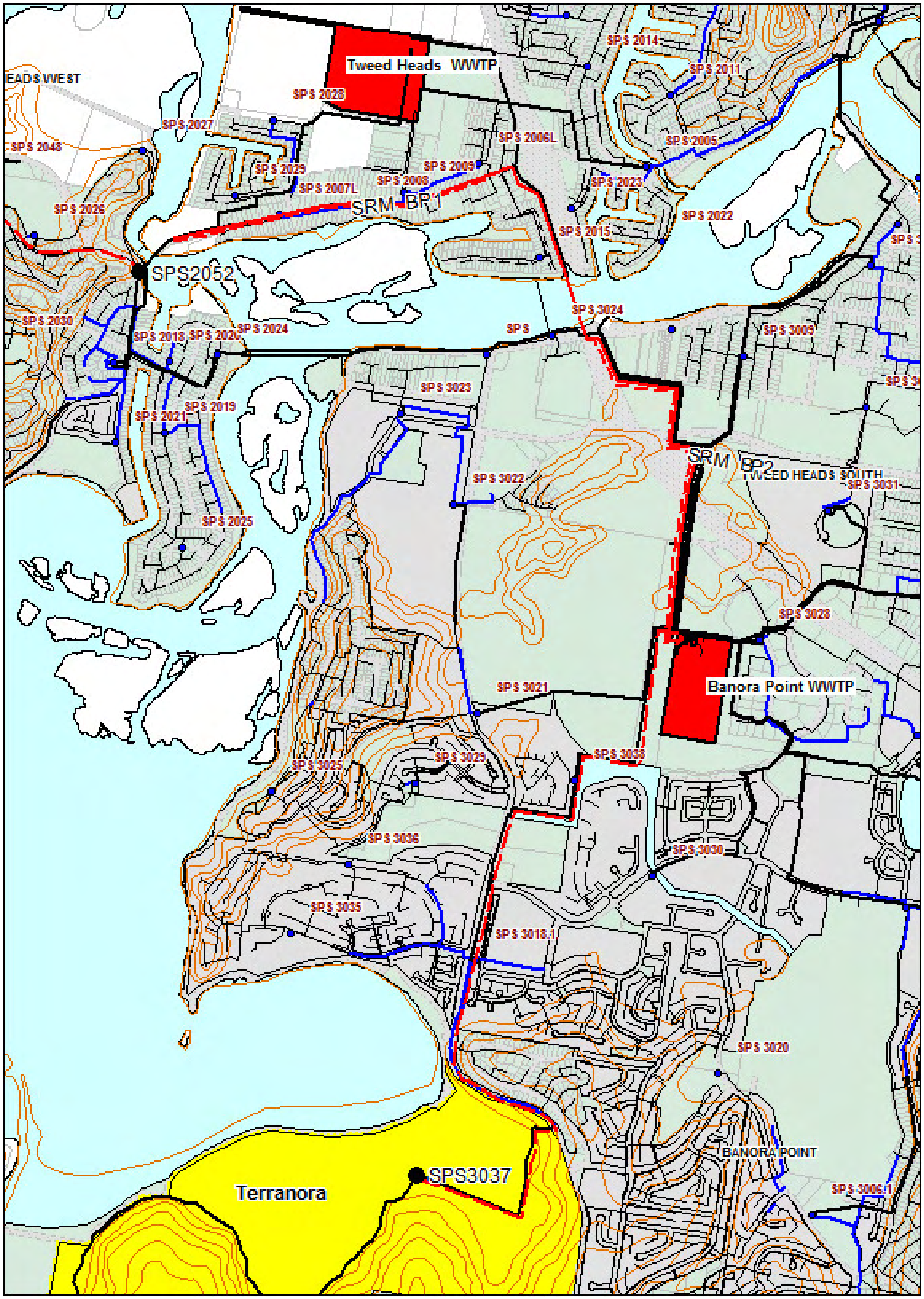
g:\411\15251\mapinfo\watercad\mapall.wor

APPENDIX N

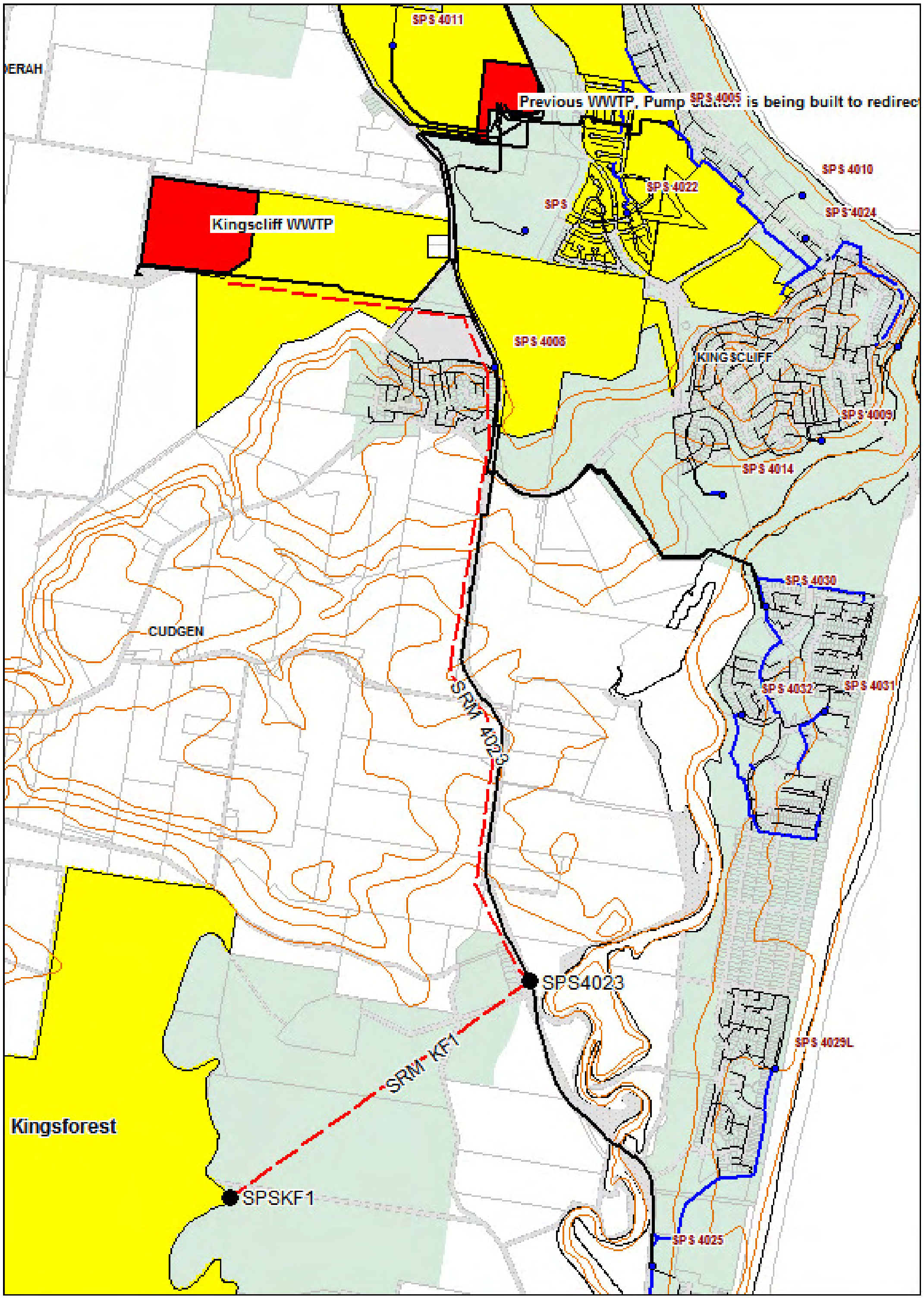
SEWER INFRASTRUCTURE PLANS


SGMCL1
LSCL1
SGMCL2
COBAKI LAKES
SPSCL2
SRMCL3
TWEED HEADS WEST
SPS 2048
SPS 2046
SPSCL_BH
SPS 2034
SPS 2026
SPS2
SRM_BH2
SGM_BH
SPS 2030
SPS 2018
SRM_BH1
SPSBH2
SPS 2050
SPS 2021
SGM_BH2
SPSBH1
SPS 2040
SGM_BH1
SPS 2038
BILAMBIL HEIGHTS
SPS 2035
SPS 2037
SPS 2036
SPS 2039

MWH

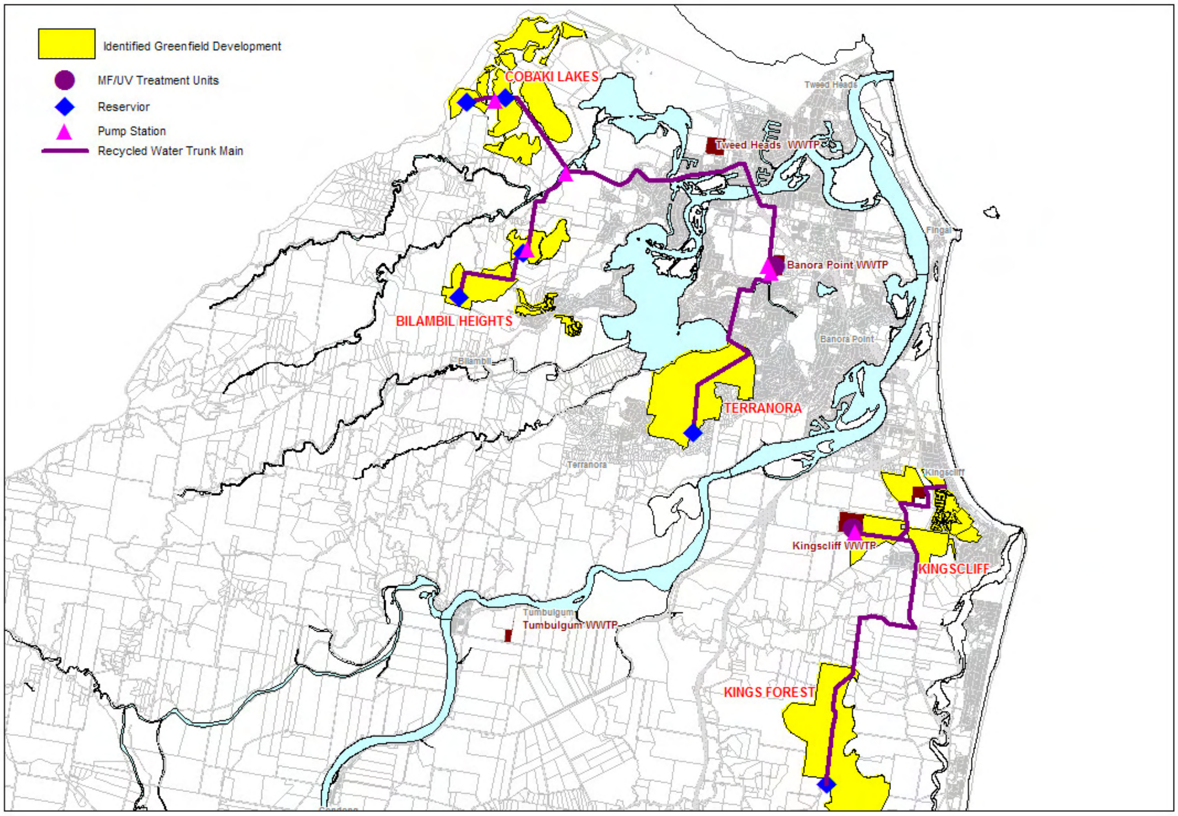


Tweed Heads WWTP
EADS WEST
SPS 2028
SPS 2027
SPS 2048
SPS 2029
SPS 2007L
SPS 2008
SPS 2009
SPS 2006L
SPS 2014
SPS 2011
SPS 2005
SPS 2023
SPS 2022
SPS 2015
SPS 2026
SRM BR1
SPS2052
SPS 2030
SPS 2018
SPS 2020
SPS 2024
SPS
SPS 3024
SPS 3009
SPS 3023
SPS 2021
SPS 2019
SRM BP2
TWEED HEADS SOUTH
SPS 3031
SPS 3022
SPS 2025
SPS 3028
Banora Point WWTP
SPS 3021
SPS 3038
SPS 3025
SPS 3029
SPS 3036
SPS 3030
SPS 3035
SPS 3018.1
SPS 3020
BANORA POINT
SPS3037
Terranora
SPS 3006/1


SPS 4011
ERAH
Previous WWTP, Pump station is being built to redirec
SPS 4005
SPS 4010
SPS 4022
SPS
SPS 4024
Kingscliff WWTP
SPS 4008
KINGSCLIFF
SPS 4009
SPS 4014
SPS 4030
CUDGEN
SPS 4032
SPS 4031
SRM 4023
SPS4023
SPS 4029L
SRM KF1
Kingsforest
SPSKF1
SPS 4025

APPENDIX O

RECYCLED WATER INFRASTRUCTURE PLAN



Identified Greenfield Development
MF/UV Treatment Units
Reservior
Pump Station
Recycled Water Trunk Main
COBAKI LAKES
Tweed Heads
Tweed Heads WWTP
Banora Point WWTP
BILAMBIL HEIGHTS
Banora Point
TERRANORA
Terranora
Kingscliff
Kingscliff WWTP
KINGSCLIFF
Tumbulgum
Tumbulgum WWTP
KINGS FOREST

APPENDIX P

REVIEW OF OPTIONS FOR COBAKI LAKES

MWH

MWH Ref:

07 November 2007

Mr Robert Seibert
Department of Commerce
Lismore NSW

Dear Robert

Addendum to Demand Management Strategy Report - Assessment of Options For Cobaki Lakes Development

Further to your request we have assessed options for the development of a integrated water solution for the Cobaki Lakes development. The assessment is an addendum to the Demand Management report and considers the option of a stand alone decentralised option instead of centralised treatment at the Banora Point STP.

Details of the assessment are outlined in the discussion below.

1. Outline of Options

Two options were reviewed as follows:

- Option 1 – Centralised Treatment at Banora Point STP. Under this option, sewage would be transferred to the existing Banora Point STP for treatment to Class A+ standard and then returned to the Cobaki Lakes development area for reuse. It would be proposed that the recycled water woul be used on external areas and
- Option 2 – Cobaki Lakes Treatment Facility. This option involves the construction of a sewage treatment plant at the southern end of the Cobaki Lakes development. A Class A+ water recycling facility would be constructed for use in the development residential and commercial sectors with the major end uses being landscaping, toilets and open space irrigation. Sewage from Bilambil Heights would also be treated at this facility. It is proposed that there would be no discharge from the site to the existing sewerage system.

For both options it was necessary to consider the collection and treatment of both the Cobaki Lakes and Bilambil Heights developments as either of these developments will trigger a requirement to upgrade the sewerage system between Cobaki Creek and the Banora Point STP.

The estimated EP served for Cobaki Lakes is 10,822 EP and for Bilambil Heights is 7,273 EP, giving a total population served of 18,095 EP.

2. Option 1 – Infrastructure and Cost Estimate

Option 1 was based on work undertaken in the Demand Management Strategy. Sewage is transferred to the Banora Point STP and treated prior to being further treated in a micro-filtration plant to a Class A+ standard, for use on landscaping and for toilet flushing. However due to the high cost and significant level of greenhouse gases generated through the high pumping head, recycling at the Bilambil Heights development was rejected. Therefore it was necessary to revise the costs of the recycling system including the treatment plant and the return main.

The infrastructure capacity was revised taking account of the lower return flow. Required infrastructure is summarised in Table 8-1.

Table 8-1 : Option 1 - Summary of Required Recycled Water Infrastructure

Item	Description	Capacity Required	Quantity
1	Water Treatment Plant and Balancing Storage	2.4 ML/day	1
2	Cobaki Lakes Reservoir	5 ML	1
3	Cobaki Lakes HL Reservoir	2 ML	1
4	Banora Point PS	40 kW, 33 L/s @ 81 m	1
5	Cobaki lakes HL PS	10 kW, 12 L/s @ 50 m	1
6	Main from STP to Cobaki Reservoir	250 mm	9,350 m
7	Main from Cobaki to HL	150 mm	500 m

An estimate of cost was undertaken based on similar assumptions outlined in Section 5.4 of the Demand Management Strategy report. Estimates of capital works are provided in Table 8-2.

Table 8-2 : Option 1 - Summary of Recycled Water Infrastructure Costs

Item	Description	Estimated Capital Cost	NPV to 2036
1	Trunk Mains	$5,419,150	$3,616,521
2	Reservoirs	$1,877,594	$1,253,030
3	Pumping Stations	$413,156	$275,724
4	MF/UV Treatment Plant	$6,240,000	$3,549,137
	Capital Cost Totals	**$13,949,900**	**$8,694,411**

An estimate was made of the operations cost of the recycled water treatment plant and pumping costs from the plant to the Cobaki Lakes development. A summary of the costs are given in Table 8-3. It is noticed that the treatment opex includes for operators, membrane replacement, chemicals and energy. Distribution opex only includes for the energy costs related to the transfer to the Cobaki reservoirs.

Table 8-3 : Option 1 – Summary of Recycled Water Operational Costs

Item	Description	NPV to 2036
1	Treatment Opex @ $0.30/kL	$414,139
2	Distribution Opex (Energy only)	$46,367
	Total Opex NPV	**$460,506**

Costs of the sewerage collection were assessed as part of the Demand Management Strategy Report. The infrastructure required for the transfer of sewage from the Cobaki Lakes and Bilambil Heights developments includes the construction of regional pumping stations as well as rising mains from Cobaki Creek along Kennedy Drive to the Banora Point STP.

The capital and operating costs for the provision of sewerage collection infrastructure summarised in Table 8-4.

Table 8-4 : Option 1 – Summary of Sewerage Collection System Costs (Cobaki Creek PS to Banora Point STP)

Item	Description	Estimated Capital Cost	NPV to 2036
1	Capital Cost	$7,758,696	$5,177,839
2	Opex (Energy only)		$228,720
	Total Sewerage System NPV		$5,406,559

In addition to the cost of sewerage collection infrastructure, consideration needs to be given to the impact of the developments on the Banora Point STP. It is proposed to upgrade this plant before 2010 from 62,000 to 80,000 EP. This upgrade will not be sufficient to service the ultimate capacity of the Cobaki Lakes and Bilambil Heights developments and a further upgrade of around 18,000 EP will be required. It is estimated that the timing of this work will need to be around 2015. It is estimated that the upgrade would cost $27m. Operation costs also need to be considered as part of the assessment. A summary of the STP costs are provided in Table 8-5.

Table 8-5 : Option 1 – Summary of Sewerage Treatment Costs (Banora Point STP)

Item	Description	Estimated Capital Cost	NPV to 2036
1	Capital Cost	$27,000,000	$15,714,246
	Total Sewerage System NPV		**$15,714,246**

A summary of the costs related to Option 1 is provided in Table 8-6.

Table 8-6 : Option 1 – Summary of Costs

Item	Description	Estimated Capital Cost	NPV to 2036
1	Recycled Water Capital Cost	$13,949,900	$8,694,411
2	Recycled Water Opex Cost		$460,506
3	Sewerage Collection Capital Cost	$7,758,696	$5,177,839
4	Sewerage Collection Opex Cost		$228,720
5	Sewerage Treatment Capital Cost	$27,000,000	$15,714,246
6	Sewerage Treatment Opex Cost		$0
	Total Capital Cost	**$48,708,596**	
	Total NPV		**$30,275,722**

3. Option 2 – Infrastructure and Cost Estimate

Option 2 involves the construction of a sewage treatment plant in the southern area of the Cobaki Lakes development near to Cobaki Creek. Sewage from both Cobaki Lakes and Bilambil Heights will be treated at the proposed STP, to achieve the benefits of reduced capital works in transport infrastructure back to Banora Point STP. The exact location of the STP would be determined by the developer depending on distances to residential areas, flood plain limits and other constraints.

The guiding principle of this option is to reuse the dry weather flow within the development for residential external irrigation, toilet flushing and for open space irrigation of parks and other open space. Wet weather flows would be discharged at an approved location. Class A+ recycled water would be supplied back to reservoirs within the system. During off peak periods recycled water would be transferred to ponds at either the treatment plant or possibly a golf course. During peak periods all recycled water would be utilised for the residential area and major open space areas such as the golf course would be irrigated from the storage ponds.

The recycled water scheme from Option 1 was reviewed and pipe diameters revised between the STP and the storage reservoirs. A summary of the required infrastructure is given in Table 8-7 and shown in Figure 1.

Table 8-7 : Option 2 - Summary of Required Recycled Water Infrastructure

Item	Description	Capacity Required	Quantity
1	Treatment Plant and Balancing Storage	2.4 ML/day	1
2	Cobaki Lakes Reservoir	5 ML	1
3	Cobaki Lakes HL Reservoir	2 ML	1
4	Banora Point PS	40 KW, 33 L/s @ 76 m	1
5	Cobaki lakes HL PS	10 kW, 12 L/s @ 50 m	1
6	Main from STP to Cobaki Reservoir	200 mm	2,100 m
7	Main from Cobaki to HL	150 mm	500 m

A summary of the capital costs and associated NPV is given in Table 8-8. Based on this assessment a saving of approximately $4.27m in capital costs is evident over Option 1 due to the shorter rising main.

Table 8-8 : Option 2 - Summary of Recycled Water Infrastructure Costs

Item	Description	Estimated Capital Cost	NPV to 2036
1	Trunk Mains	$1,150,100	$767,530
2	Reservoirs	$1,877,594	$1,253,030
3	Pumping Stations	$413,156	$275,724
4	MF/UV Treatment Plant	$6,240,000	$3,549,137
	Capital Cost Totals	**$9,680,850**	**$5,845,420**

The operations cost of the recycled water treatment plant is assumed to be the same as for a centralised plant. Additional costs for having two STPs in lieu of the single plant at Banora are accounted for in the overall STP operations and maintenance costs discussed below.

Sewerage system collection infrastructure for Option 2 will be met entirely by the developers of the Cobaki Lakes and Bilambil Heights developments. The connection point for both developers will be the Cobaki STP. Therefore operational costs of the sewerage transfer costs are not required to be accounted for as the Option 1 costs were only for the transfer from Cobaki Creek PS to the Banora Point STP, i.e. the difference between the options.

One of the major cost issues with Option 2 is the operation costs of an additional STP at Cobaki Lakes. As discussed above, such plant will require staffing for operations and maintenance as well as higher costs for operation of a biosolids handling facility. The estimated costs of the plant operation will include a full time operator, and 1 crew of 2 staff involved in operations and maintenance. The annual cost of staffing is estimated to be $288,000 / annum (including 20% on-costs). This is in addition to the normal operating costs related to energy and chemicals.

The STP is assumed to be constructed in two 9,000 EP stages at a total cost of $30m. Stage 1 would cost around $17m and Stage 2 around $13m.

A summary of the costs of the STP is given in Table 8-9.

Table 8-9 : Option 2 – Summary of Sewerage Treatment Costs (Banora Point STP)

Item	Description	Estimated Capital Cost	NPV to 2036
1	Capital Cost	$30,000,000	$17,266,991
2	Opex		$1,549,467
	Total Sewerage System NPV		**$18,816,458**

A summary of the costs related to Option 1 is provided in Table 8-6.

Table 8-10 : Option 2 – Summary of Costs

Item	Description	Estimated Capital Cost	NPV to 2036
1	Recycled Water Capital Cost	$9,680,850	$5,845,420
2	Recycled Water Opex Cost		$460,506
3	Sewerage Collection Capital Cost	$0	$0
4	Sewerage Collection Opex Cost		$0
5	Sewerage Treatment Capital Cost	$33,000,000	$17,266,991
6	Sewerage Treatment Opex Cost		$1,549,467
	Total Capital Cost	**$42,680,850**	
	Total NPV		**$25,122,384**

4. Water Supply Savings

For the two options considered as part of this assessment, the use of recycled water for the external use and toilet flushing will reduce the reliance on potable water from the Tweed Shire water supply system, including dams, treatment and transfer. Based on the assessment of scenarios outlined in the Demand Management Strategy Report, the reduction in peak day demand would be 2.3 ML/d compared to the current demands. In addition a reduction of average annual demand of around 60% will occur assuming that rainwater tanks will be installed together with dual reticulation.

Estimates of the savings which may accrue from the reduction in annual potable water demand have not been calculated for Cobaki Lakes alone. However based on the previous cost assessment it is not likely that the avoided costs would be greater than an NPV cost of around $3m.

5. Other Costs to Council

Implementation of a recycled water scheme to supply residences and businesses has a range of associated costs relating to inspection, education, metering and billing, on-going compliance testing and reporting. Although these costs will be met by the users as part of the pricing structure for recycled water it is worth noting that the cost are substantial. Additional costs are estimated as follows:

- Set-up costs for recycled water program (i.e. educational program): $500,000
- Annual field and laboratory test: $50/ customer

Table 11 summarises the estimated set-up and annual compliance costs for dual reticulation for the new residential developments in Cobaki Lakes.

Table-8-11 Estimated Set-up and Compliance Costs

Item	Description	Estimated Cost	NPV to 2036
1	Set up and Compliance Costs	$5,899,462	$1,929,740

6. Comparison of Costs

Based on the assessment of the options as outlined above a summary of estimated costs is provided in the table below.

Table 8-12 : Summary of Costs

Item	Description	Estimated Capital Cost	NPV to 2036
Option 1 – Treatment at Banora Point STP			
1	Sewerage Collection and Treatment	$34,758,696	$21,120,805
2	Recycled Water Treatment and Distribution	$13,949,900	$9,154,917
	Total Costs - Option 1	**$48,708,596**	**$30,275,722**

Item	Description	Estimated Capital Cost	NPV to 2036
Option 2 – Treatment at Cobaki Lakes STP			
1	Sewerage Collection and Treatment	$33,000,000	$18,816,458
2	Recycled Water Treatment and Distribution	$9,680,850	$6,305,926
	Total Costs - Option 2	**$42,680,850**	**$25,122,384**
	Difference (Option 1 – Option 2)	**$6,027,746**	**$5,153,338**

It is noted that if recycled water is to be implemented in Cobaki Lakes a range of other costs will need to be taken into account. These are discussed above and are summarised as follows:

- Savings in the potable water system are estimated at this stage at an NPV of $3m.
- Additional costs related to the provision of the recycled water reticulation system need to be considered even if these costs are passed on to purchasers of land in the development.
- Additional costs of the operations and maintenance of two water systems in the development will be applicable however have not been estimated for this report.
- Additional costs to council of inspection, education, metering and billing, on-going compliance testing and reporting need to be considered. This is estimated as an initial set up cost of around $0.5m and an NPV of $1.9m. These costs will be passed through to developer in inspection costs and to customers in the water price.

7. Discussion of Options

Based on assessment of the two options for provision of recycled water to the Cobaki lakes development it is evident that Option 2, with a treatment plant located at the development is significantly lower in cost than a centralised system with treatment at Banora Point. Option 2 is approximately $5.1 m or 17% lower in NPV than Option 1. The major reasons for the difference in NPV are as follows:

- The Cobaki STP is constructed in 2 stages rather than a single large stage at Banora Point.
- Costs of transferring raw sewage and recycled water to and from the STP are greatly reduced.

Any decision to adopt one of these options must however take account of the additional costs for the implementation of the recycled water scheme. These costs relate to the development of education program, billing systems, testing and compliance and reporting. On the other hand there are savings related to the reduction in water use resulting from substitution of existing potable end uses with recycled water.

On the balance, costs of provision of recycled water to customers in the development will be higher than that of potable water. The benefits to the environment do need to be considered. Nutrient mass loads discharged to the Tweed River will be lowered as a result of the approach.

Obviously it will be necessary to gain State Government approval for a discharge to either Cobaki Creek or further downstream. If such a license is not granted, storage will be required on site with a dry weather capacity connection to the existing sewerage system at SPS 2052. The costs of such a connection are not included in this assessment.

8. Conclusions

In conclusion, it is noted that although the capital and operating costs of the decentralised treatment option are lower than the option of treating all water at Banora Point, the overall cost of providing recycled water are substantially higher than for potable water. The overall cost to the community is higher than for potable and this will be evident in price of housing and in the price of recycled water following implementation.

These higher costs are however balanced in some way by the reduction in nutrients and greenhouse gas generation for the business as usual option of centralised sewage treatment without recycling.

MWH Australia Pty Ltd

MWH

BUILDING A BETTER WORLD

TWEED SHIRE COUNCIL

DEMAND MANAGEMENT STRATEGY - STAGE 2

NON-RESIDENTIAL PROGRAM EVALUATION

A1187200

DECEMBER 2009

This document has been prepared specifically for Tweed Shire Council in relation to this project and should not be relied upon by other parties nor used for any other purpose without the specific permission of MWH.

REVISION SCHEDULE

REV. NO.	DATE	DESCRIPTION	PREPARED BY	REVIEWED BY	APPROVED BY
1.0	18/06/2009	Draft Report	T. Moore	S. O'Brien	M. Bowman
2.0	26/08/2009	Final Report	T. Moore	S. O'Brien	M. Bowman
2.1	21/12/2009	Amended Final	T. Moore	External review by T. Mackney	M. Bowman

EXECUTIVE SUMMARY

The preparation of a Water Supply Demand Management Strategy (DMS) was identified as the main action in the Tweed Integrated Water Cycle Management Strategy.

The DMS is being delivered in two stages; Stage 1 was adopted as an interim strategy by Council on 27 January 2009. The recommended demand management scenario from the Stage 1 report included an estimate of potential water savings from a non-residential program. This report, Stage 2, has quantified these savings by conducting a full evaluation of potential non-residential demand management measures in the Shire. The outcomes of this report, in combination with the outcomes from the Stage 1 report, will then be used to develop a final DMS for TSC.

This report identifies a range of non-residential demand management measures that are appropriate for achieving long term conservation, and evaluates the costs and benefits of each in terms of water and wastewater savings. Based on these analyses, a recommendation for cost effective demand management measures has been made.

Non-residential water use represented 29% of all customer water usage in TSC based on 2008 water consumption data. Over the past 7 years this value has fluctuated between 26% and 30%, with an average of 28%. The breakdown of residential and non-residential use in TSC for 2008 is shown in Figure E 1.

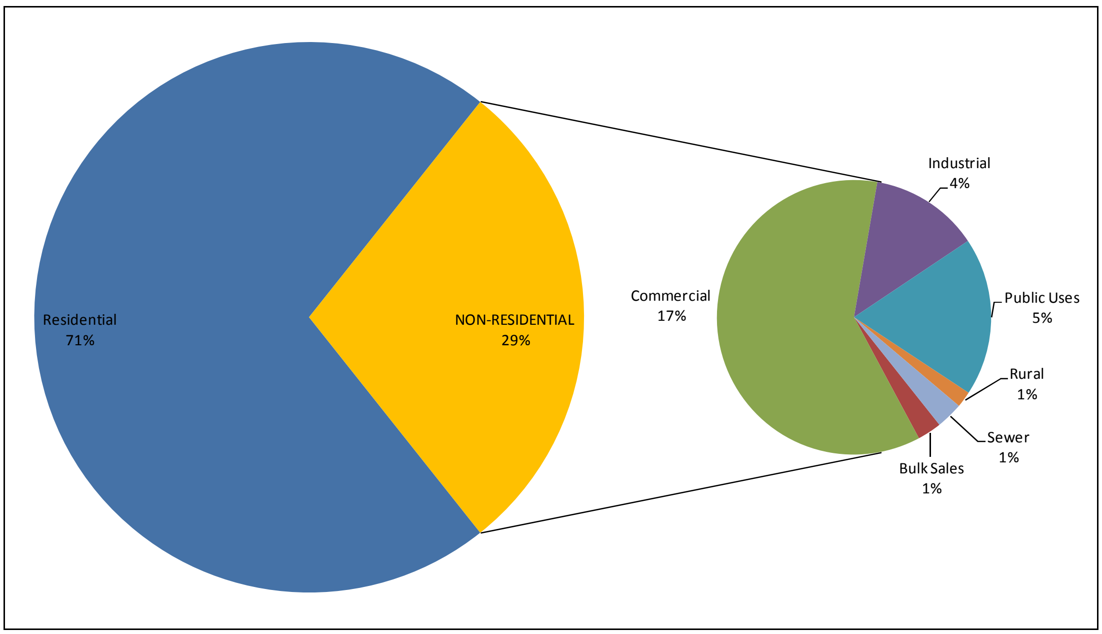


Figure E 1:TSC Sectoral Water Use (2007/08)

A description of each of the non-residential sectors is as follows:

- **Commercial**: Commercial is the general category for businesses. Water use is dominated by staff and / or customer water use. It includes businesses such as caravan parks, restaurants and cafes, shopping centres, hotels/motels, clubs and office buildings. This sector does not include multi-family residences or agriculture.

- **Industrial**: Industrial usage comprises customers who are primarily manufacturers or processors of materials. This sector includes TSC water treatment and land fill facilities.
- **Public Use**: Public usage encompasses customers dedicated to public service, including aged care facilities, hospitals, schools, government buildings and TSC operated sports grounds, parks and gardens. Please note, Institutional accounts are included in the Pubic sector.
- **Rural**: Agriculture and farming.
- **Bulk Sales**: Water sold directly to customers from metered standpipes.
- **Sewage**: Water used in sewage treatment and sewage pump stations.

A summary of total water demand by each of these sectors is provided in Figure E 2. Commercial water use represents 60% of the non-residential water consumption in TSC, followed by Public Use (19%) and Industrial (13%).

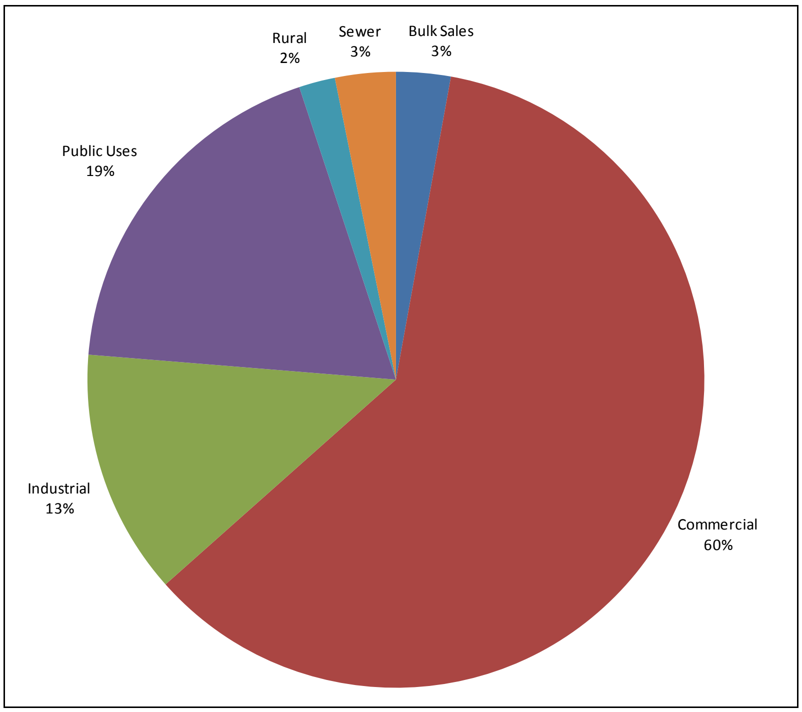


Figure E 2: Non-residential Water Use by Sector (2007/08)

The development of a demand management strategy requires accurate and reliable forecasting of water demand. The baseline forecast is shown in Figure E 3, and has been made without regard to continuing naturally occurring conservation or programmed conservation measures. Figure E 4 shows the demand forecast relative to the historical non-residential demand in TSC.

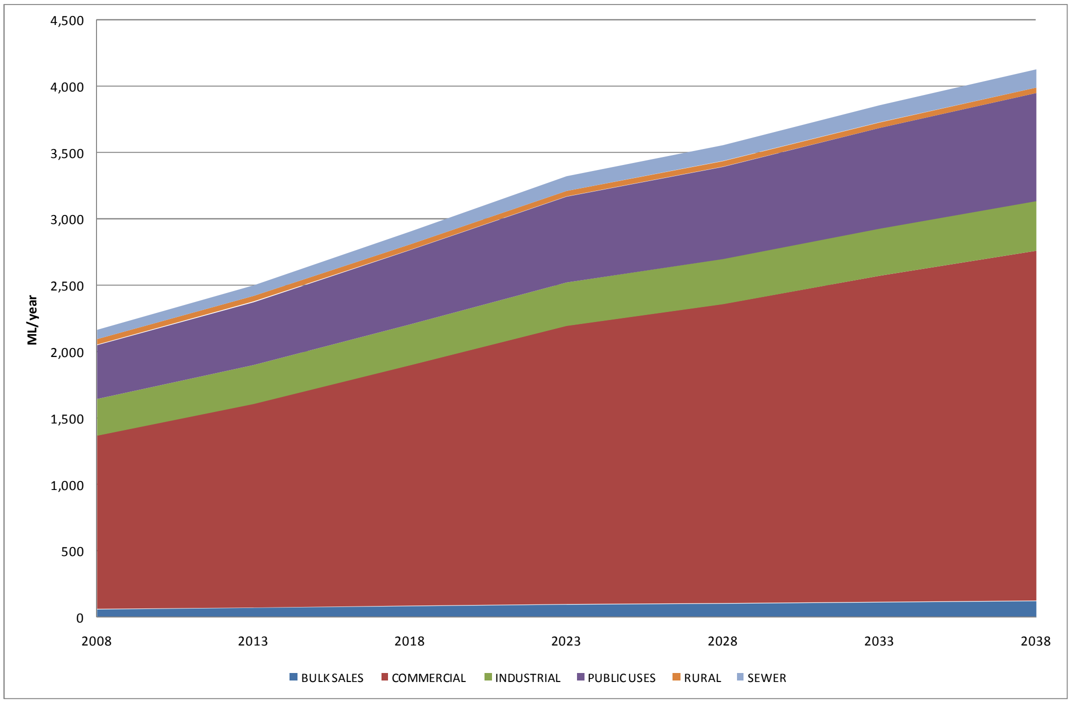


Figure E 3: Non-residential Baseline Consumption Forecast by Sector

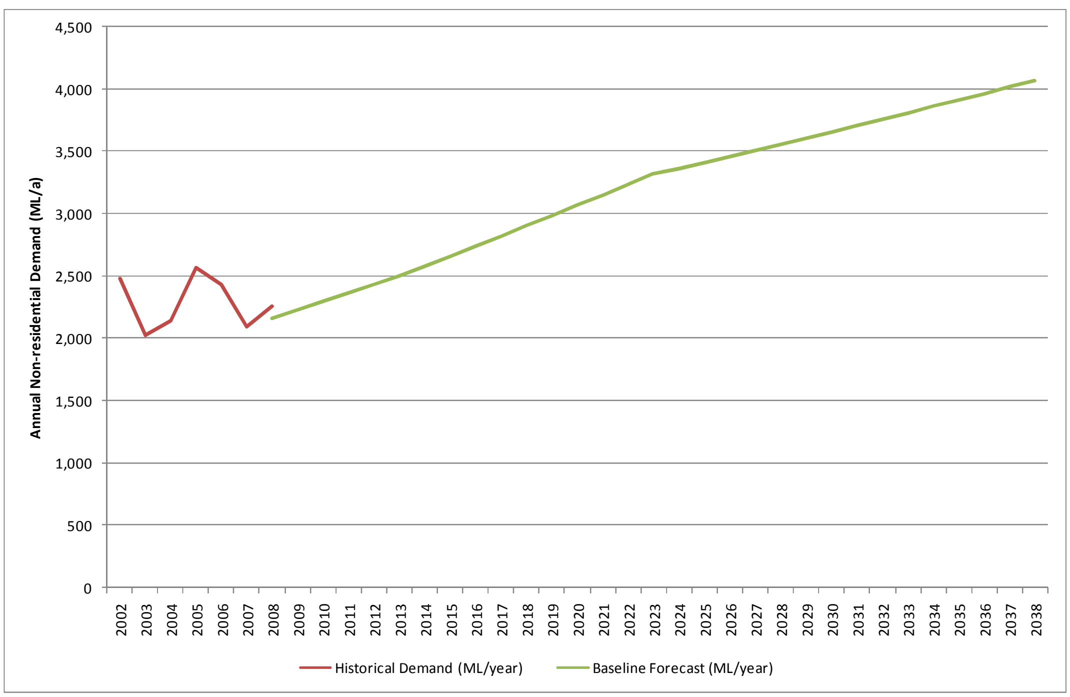


Figure E 4: Non-residential Baseline Consumption Forecast with Historical Demand

In order to identify large water consuming sub-sectors within the non-residential sector, customer sectorisation was performed by analysing TSC billing databases in conjunction with land use classification information. Following this, customers were ranked by water use in order to establish the focus for the development of demand management program. Based upon these results, further analysis was undertaken to establish common end-uses across the high water consuming sub-sectors.

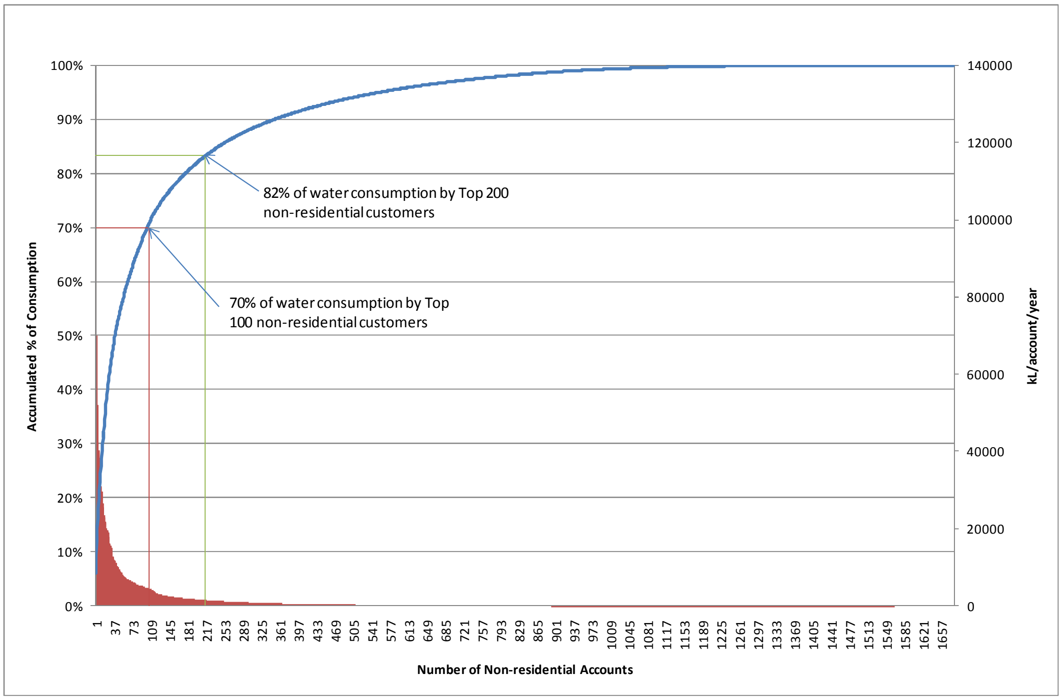


Figure E 5: TSC Non-residential Customers Ranked by Water Use (all accounts)

As shown in Figure E 5, it was found that the top 5% of customers (top 100) are responsible for 70% of the total non-residential demand. The significance of this is highlighted by the fact that the next 100 users (top 100-200 ranked users) consume only 12% of the total non-residential demand. The 200 to 300 ranked customers consume only 6% of the total non-residential demand, which further illustrates the diminishing returns. This demonstrates that to maximise water savings any demand management measures should focus predominantly on the top 100 users.

Based on an assessment of water demand and account usage a range of sub-sectors were identified for targeting in programs, summarised in Table E 1.

Table E 1: Summary of Targeted Non-Residential Sub-Sectors

SUB-SECTOR	CUSTOMER TYPE	% NON-RES USE	TOTAL ACCOUNTS	ACCOUNTS IN TOP 100	AVERAGE ACCOUNT USE IN TOP 100 (ML/YEAR)
Com	Caravan Parks	15.0%	25	20	15.5
Com	Clubs inc Sports Clubs	11.2%	26	9	24.8
Public	TSC Open Space Irrigation	8.9%	216	12	10.2
Com	Shopping Centres	4.8%	6	7	15.6
Pub	Aged Care	4.8%	18	10	8.8

Com	Mobile home park	3.9%	3	3	27.8
Ind/Sewer	TSC Facilities	4.2%	9	4	20.8
Ind	Industry	12.3%	151	9	25.8
Pub	Hospital	1.5%	2	2	16.7

To identify global opportunities for demand management in the non-residential sector, a review of successful water conservation measures in NSW, interstate, nationally and internationally was undertaken. The review revealed both common attributes and innovative approaches to non-residential demand management. A comprehensive list of 40 potential demand management measures was then compiled, based upon the review of sectoral water use and major users, end uses identified to have high savings potentials, and the review of successful water conservation programs.

A qualitative assessment was undertaken of the long list of measures for the sector based on a triple bottom line multi-criteria assessment. The assessment reduced the number of measures which were then considered in detail based on their water savings and costs from both a customer and council perspective. For each measure an annualised costs and cost-benefit from the TSC perspective was then calculated. Based on this assessment the preferred measures (i.e. those with a cost-benefit > 1) where recommended for implementation by TSC. The cost-effectiveness and annual average water savings for each of the preferred measures, and the total non-residential program, are shown below in Table E 2.

Table E 2: Cost Effectiveness and Water Savings for the Recommended Non-residential Program (2008-2036)

SECTOR	COUNCIL NPV ($)	CUSTOMER NPV ($)	TOTAL NPV ($)	AVERAGE ANNUAL POTABLE SAVINGS (ML/YEAR)	ANNUALISED COST ($/KL)
Major Users Audit	$199,520	$88,834	$288,354	198	$0.12
Commercial Business Water Audit Program	$187,864	$66,119	$253,983	87	$0.24
Aged Care Audit	$60,524	$27,319	$87,843	30	$0.24
TSC Open Space Irrigation Audit	$82,855	$0	$82,855	24	$0.28
Waterwise Non-residential Education	$93,933	$10,779	$104,712	28	$0.30
Training Landscape Managers	$5,088	$14,147	$19,235	2	$0.75
Non-res Efficient Fittings Regulation and Management	$109,385	$765,559	$874,944	113	$0.64
Total	**$739,170**	**$972,756**	**$1,711,926**	**483**	**$0.29**

Table E 3 and Figure E 6 below outline the water demand management forecast outcomes with the implementation of the preferred demand management measures.

Figure E 6: Non-residential Managed Demand Forecast

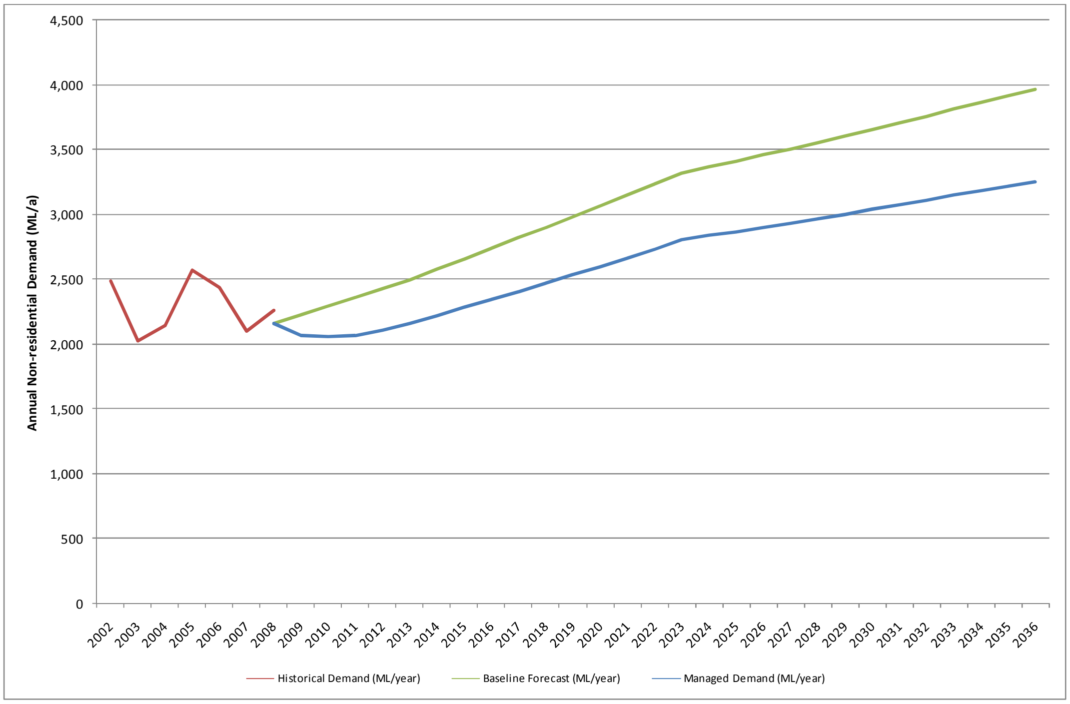


Table E 3: Non-residential Managed Demand Forecast

	2008	2013	2018	2023	2028	2033	2038
Managed Demand (ML/year)	2,162	2,161	2,471	2,803	2,964	3,144	3,329
Savings (ML/year)	-	338	432	517	590	667	741
Savings (%)	-	14%	15%	16%	17%	18%	18%

The following conclusions can be drawn based on the assessment of water demand management measures for the Tweed Shire Demand Management Strategy Stage 2:

1. The non-residential sector accounts for an average of 28% of customer water use in TSC.

2. The top 100 water using non-residential accounts (which represent approximately 5% of all non-residential accounts) are responsible for 70% of non-residential use.

3. The commercial sector is the highest non-residential water user at 60% of the total use. Homogeneity of end uses and the large number of commercial customers in the top 100 make this sector attractive for achieving significant, long-term water savings at a reasonable cost. High water using sub-sectors include caravan parks, clubs, shopping centres and mobile home parks.

4. The public sector includes aged care facilities, schools, TSC buildings, TSC open space (e.g. sports grounds and parks and gardens) and hospitals, and constitutes 19% of non-residential consumption. The high water using sub-sectors include aged care facilities, TSC open space irrigation and, to a lesser extent, hospitals.

5. The diversity of water usage within the industrial sector is the highest of that in any sector due to the specific nature of manufacturing processes employed in each business. This sector makes up 13% of the total water demand in TSC, however, nearly 70% of this is consumed by just 5 users.

6. Sewer, Bulk Sales and Rural contribute a total of 8% of the non-residential demand, which is less than 3% of the total TSC water demand.

7. To identify global opportunities for demand management in the non-residential sector, a review of successful water conservation measures in NSW, interstate, nationally and internationally was undertaken. The review revealed both common attributes and innovative approaches to non-residential demand management.

8. A long list of demand management measures was created for TSC based on:

    - An assessment of non-residential demand including a detailed assessment of top water users and sub-sectors;

    - An assessment of end uses within each of the targeted sub-sectors;

    - A review of non-residential demand management programs and measures adopted in NSW, interstate and overseas; and

    - Consideration of future growth in the non-residential sector.

9. A qualitative assessment was undertaken of the long list of measures for the sector based on a triple bottom line multi-criteria assessment. The assessment reduced the number of measures to 23 which were then considered in detail.

10. The short listed options were evaluated in detail based on their water savings and costs from both a customer and council perspective. For each measure an annualised $/kL value and cost-benefit from the TSC perspective was calculated.

11. Seven measures have been recommended for implementation by TSC in the short term, this includes audits of major users (>20 ML/year), audit of caravan parks, clubs and shopping centres, and the development of a non-residential education program.

12. Measures that may become viable in the future include audits of large industrial facilities and the requirement for new large users to develop a water management plan at the DA stage.

13. The implementation of the recommended measures could potentially reduce non-residential use by 18% in 2038.

Based on the assessment of non-residential demand management for TSC, it is recommended that:

- TSC develop an auditing program targeting the major users (>20 ML/year). Following the marketing and successful implementation of this program it is recommended that that the balance of the caravan parks, shopping centres, clubs and aged care facilities within the top 100 be targeted. Auditing programs should include the requirement to conduct a leakage assessment using data-loggers.

- The auditing of major water using parks and gardens should be undertaken and reinforced by training for TSC parks and gardens staff. Ideally, this should be complemented by the development of Open Space Irrigation Guidelines which would govern how parks and gardens and sports grounds within TSC are irrigated and managed in the future.

- TSC consider the introduction of regulations to control non-residential internal fitting and fixtures including taps, showers, toilets and possibly urinals. This should be complemented by the requirement for any new major user (e.g. 5 ML/year) to complete a water management plan at the DA stage. The Plan may include the provision that customers must use of an alternative water source e.g. rainwater, stormwater, recycled water etc, for non-potable water uses on-site.

- A non-residential education program be developed targeting the key sub-sectors identified. This could involve the preparation of fact sheets targeting water use efficiency within each of the targeted sectors e.g. caravan parks, clubs. There is significant amount of resources available on the internet relating to these sectors, including guidelines and check lists, which can be adapted and used by TSC as part of the education program.

- As part of the overall communications strategy, council liaise with key state government departments regarding the implementation of water efficiency programs (i.e. audits, retrofits) for state government buildings, such as hospitals and schools. It is also recommended that TSC organise workshops with Chamber of Commerce as well as other industry and commercial representatives to form relationships and disseminate key information regarding conservation programs to target sectors.

CONTENTS

TWEED SHIRE COUNCIL

DEMAND MANAGEMENT STRATEGY - STAGE 2
NON-RESIDENTIAL PROGRAM EVALUATION

FIGURES

TABLES

APPENDICES

1. INTRODUCTION

1.1 BACKGROUND

The preparation of a Water Supply Demand Management Strategy (DMS) was identified as the main action in the Tweed Integrated Water Cycle Management Strategy. The DMS is being delivered in two stages; Stage 1 was adopted as an interim strategy by Council on 27 January 2009.

The recommended demand management scenario from the Stage 1 report (Scenario 4) included an estimate of potential water savings from a non-residential program. This report, Stage 2, will quantify these savings by conducting a full evaluation of potential non-residential demand management measures in the Shire. The outcomes of this report, in combination with the outcomes from the Stage 1 report, will then be used to develop an overall DMS for TSC.

Ultimately, TSC aims to have an effective strategy to manage and monitor demand which is consistent with the organisation's overall water supply business directions and compliant with the DWE *Best Practice Management Guidelines (May 2004).*

1.2 OBJECTIVES

Non-residential customers are responsible for an average of 28% of the total potable water demand in TSC. Non-residential customers use water in many different ways at different levels of magnitude, and water needs and quality depend on the end use of the water. Non-residential customers also tend to be organisationally diverse in their operation, for example, hospitals versus caravan parks versus industrial plants. These characteristics make non-residential customers more heterogeneous than residential customers, making it difficult to design and implement water conservation programs. With this heterogeneity, however, comes opportunity. In non-residential sectors, there are many aspects in which even minor changes in water use practice and equipment can save significant volumes of water.

This report identifies a range of non-residential demand management measures that are appropriate for achieving long term conservation, and evaluates the costs and benefits of each in terms of water and wastewater savings. Based on these analyses, a recommendation for cost effective demand management measures has been made.

1.3 SCOPE

The scope of works for Stage 2 of the TSC DMS is as follows:

- Forecasting of baseline non-residential use considering previous studies and the latest land use, employment, demographic and water use data;
- Review of data and customer sectorisation by analysing TSC billing databases in conjunction with land use classification information to establish large water consuming sub-sectors in the non-residential sector;
- Ranking of customers by water use to assess who should be targeted as part of any proposed measures and programs;
- Analysis of key water end-uses across the large water consuming sub-sectors;
- Review of the success of other non-residential demand programs in other jurisdictions to determine which elements can be successfully applied to TSC;
- Preparation of a long list of potential non-residential demand management measures to improve the efficiency of the sector;
- Assessment of the long list using triple bottom line criteria and selection of a short list of opportunities to be assessed in detail for water savings and cost;

- Identification of the costs and the benefits of short listed opportunities taking account of TSC perspectives;
- Identification of any barriers to the implementation of measures; and
- Recommendation of measures to achieve cost-effective water conservation in non-residential water use.

2. DEMAND ANALYSIS AND BASELINE FORECAST

2.1 INTRODUCTION

The development of a water demand management plan requires the accurate and reliable forecasting of water demand.

2.2 DEMAND ASSESSMENT

2.2.1 URBAN WATER USE

Non-residential water use represented 29% of all customer water usage in TSC based on 2008 water consumption data. Over the past 7 years this value has fluctuated between 26% and 30%, with an average of 28%. The breakdown of residential and non-residential use in TSC for 2008 is shown in Figure 2-1.

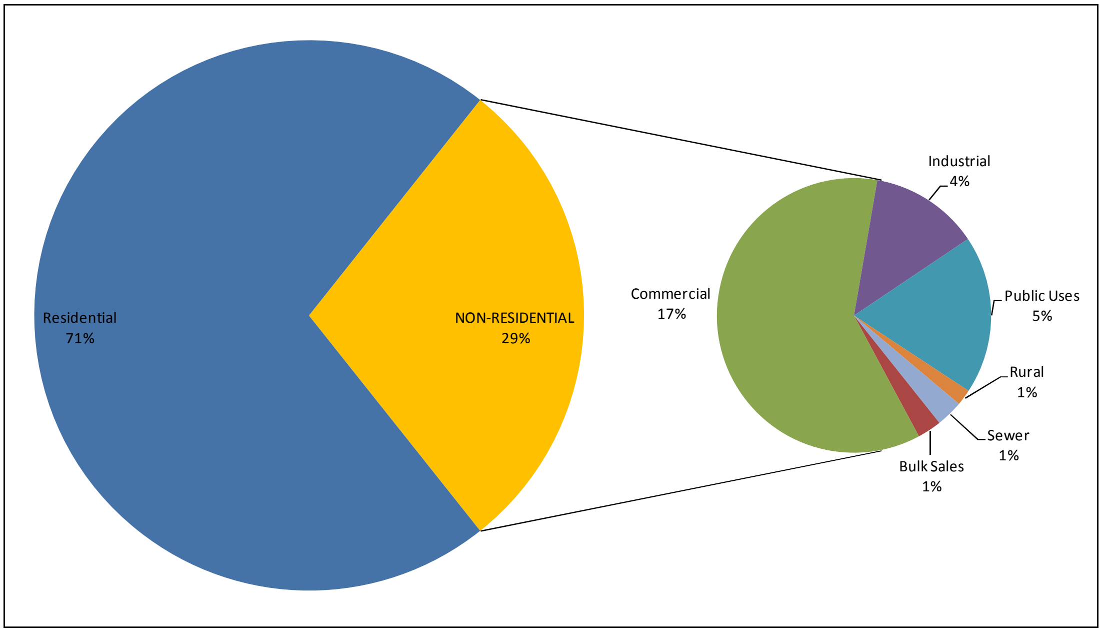


Figure 2-1: TSC Sectoral Water Use (2007/08)

2.2.2 SECTORAL WATER USE

A description of each of the non-residential sectors is as follows:

- **Commercial**: Commercial is the general category for businesses. Water use is dominated by staff and / or customer water use. It includes businesses such as caravan parks, restaurants and cafes, shopping centres, hotels/motels, clubs and office buildings. This sector does not include multi-family residences or agriculture.
- **Industrial**: Industrial usage comprises customers who are primarily manufacturers or processors of materials. This sector includes TSC water treatment and land fill facilities.
- **Public Use**: Public usage encompasses customers dedicated to public service, including aged care facilities, hospitals, schools, government buildings and TSC operated sports grounds, parks and gardens. Please note, Institutional accounts are included in the Pubic sector.

- **Rural**: Agriculture and farming.
- **Bulk Sales**: Water sold directly to customers from metered standpipes.
- **Sewage**: Water used in sewage treatment and sewage pump stations.

A summary of total water demand by each of these sectors is provided in Figure 2-1. Commercial water use represents 60% of the non-residential water consumption in TSC, followed by Public Use (19%) and Industrial (13%).

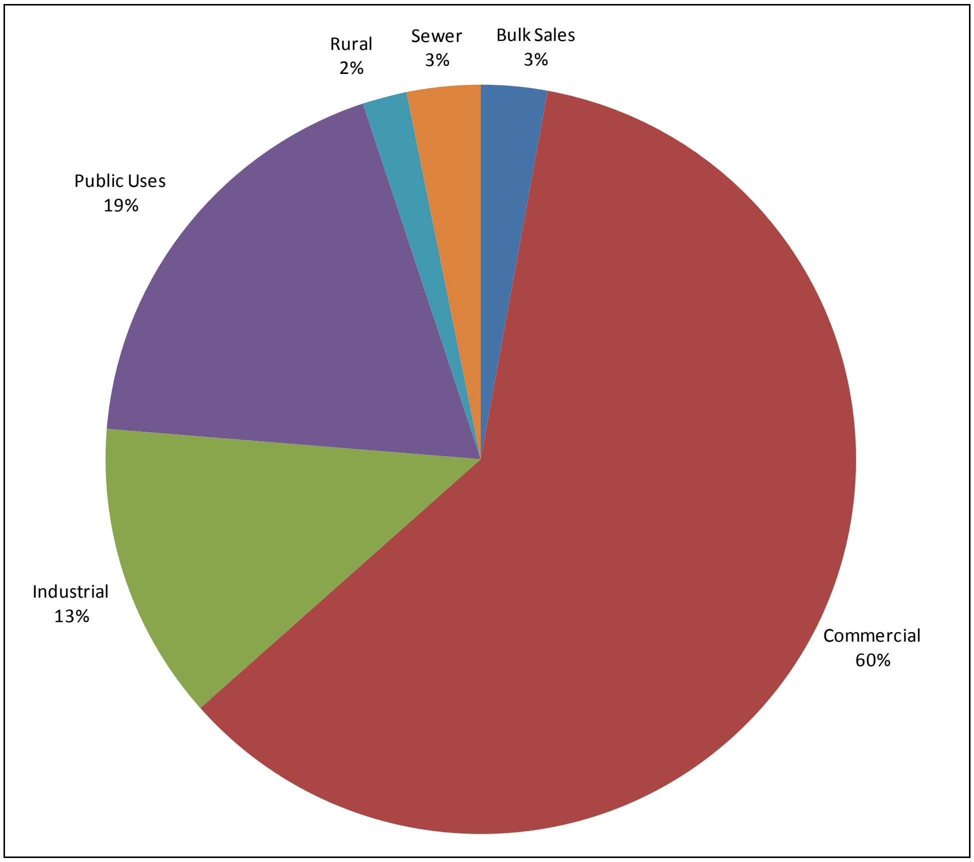


Figure 2-2: Non-residential Water Use by Sector (2007/08)

A summary of annual consumption, number of accounts and average water use per account is provided in Table 2-1.

Table 2-1: **TSC Water Use by Sector (2007/08)**

SECTOR	CONSUMPTION (ML/YEAR)	NUMBER OF ACCOUNTS	AVERAGE ACCOUNT USE (L/ACC/DAY)
Residential #	5,389,365	20,986	704
Non-Residential			
Bulk Sales	*61,527*	*103*	*1,637*
Commercial	*1,308,584*	*830*	*4,319*
Industrial	*278,082*	*152*	*5,012*
Public Uses	*402,616*	*422*	*2,614*
Rural (non-res only)	*41,009*	*13*	*8,643*
Sewer	*68,510*	*162*	*1,159*
Total Non-Residential	2,160,328	1,682	3,519
TOTAL/AVERAGE	**7,549,693**	**22,668**	**912**

233 Rural accounts identified as being Rural Residential have been transferred to the Residential sector.

As can be seen in Table 2-1, the average water use per account in the non-residential sector is much higher than that in the residential sector, however, the total number of total accounts is lower. This allows for targeted, high impact measures and programs to be implemented in the sector.

2.3 BASELINE CONSUMPTION FORECAST

The development of a demand management strategy requires accurate and reliable forecasting of water demand. This tables and figures below summarise the baseline forecast which has been performed for Tweed Shire non-residential consumption, based upon projected account growth and 2008 average per-account demand (refer to Table 2-1).

At the time of investigation no information regarding future non-residential developments in the Shire was available. Therefore, the following assumptions for Shire-wide growth were agreed with TSC as part of the development of Stage 1 of the strategy:

- Commercial Sector – Growth proportional to residential population growth
- Industrial Sector – Assumed growth rate of 1% each year, which is similar to historic growth. Growth will in future be limited by the available land.
- Public Sector – Growth proportional to residential population growth.
- Rural Sector – No growth assumed.

Account growth projections are presented in Table 2-2.

The baseline forecast is outlined in Table 2-3 and illustrated in Figure 2-3, and has been made without regard to continuing naturally occurring conservation or programmed conservation measures. Figure 2-4 shows the demand forecast relative to the historical non-residential demand in TSC.

Table 2-2: Forecast Non-Residential Account Growth

SECTOR	NUMBER OF ACCOUNTS							ADOPTED GROWTH RATE
	2008	2013	2018	2023	2028	2033	2038	
Bulk Sales	103	121	143	165	177	193	207	As per pop growth
Commercial	830	975	1,151	1,330	1,429	1,558	1,672	As per pop growth
Industrial	152	160	168	178	185	195	205	1% per annum
Public Uses	422	496	585	676	727	792	850	As per pop growth
Rural	13	13	13	13	13	13	13	0%
Sewer	162	190	225	260	279	304	326	As per pop growth

Table 2-3: TSC Non-Residential Baseline Consumption Forecast

SECTOR	CONSUMPTION (ML/YR)						
	2008[1]	2013	2018	2023	2028	2033	2038
Bulk Sales	62	72	85	99	106	116	124
Commercial	1,309	1,539	1,816	2,099	2,255	2,458	2,637
Industrial	278	292	307	326	340	357	375
Public Uses	403	473	559	646	694	756	811
Rural	41	41	41	41	41	41	41
Sewer	69	81	95	110	118	129	138
Total	**2,162**	**2,498**	**2,903**	**3,320**	**3,554**	**3,856**	**4,127**

[1] There is a slight increase of <0.1% compared with the baseline demand due to rounding

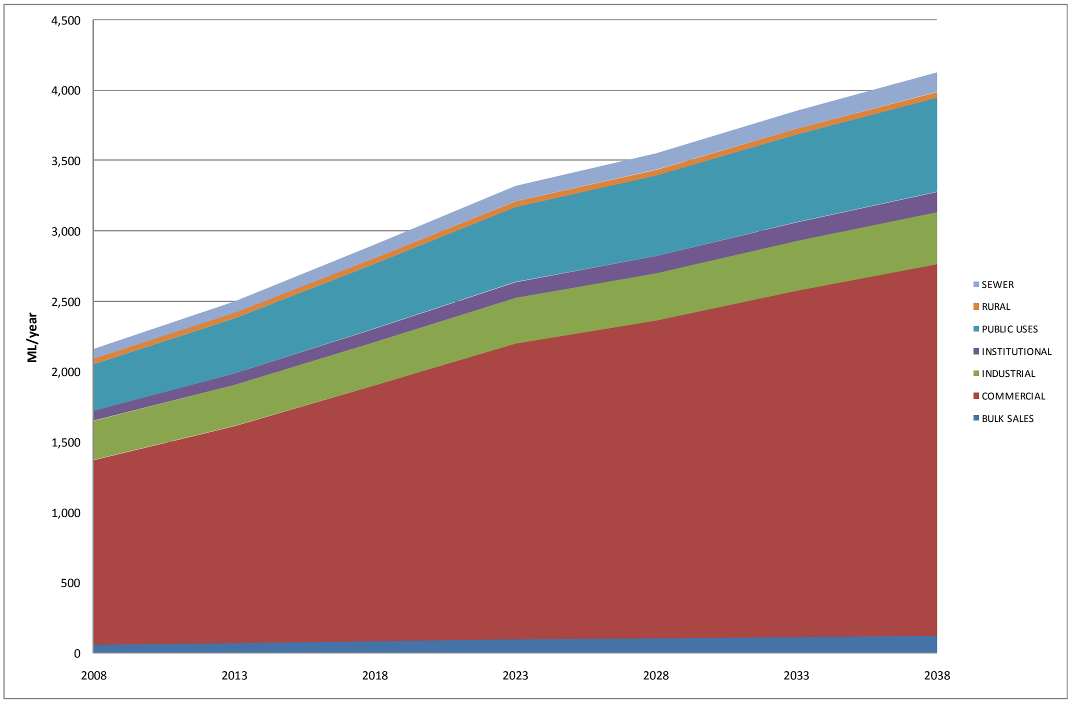


Figure 2-3: Non-residential Baseline Consumption Forecast by Sector

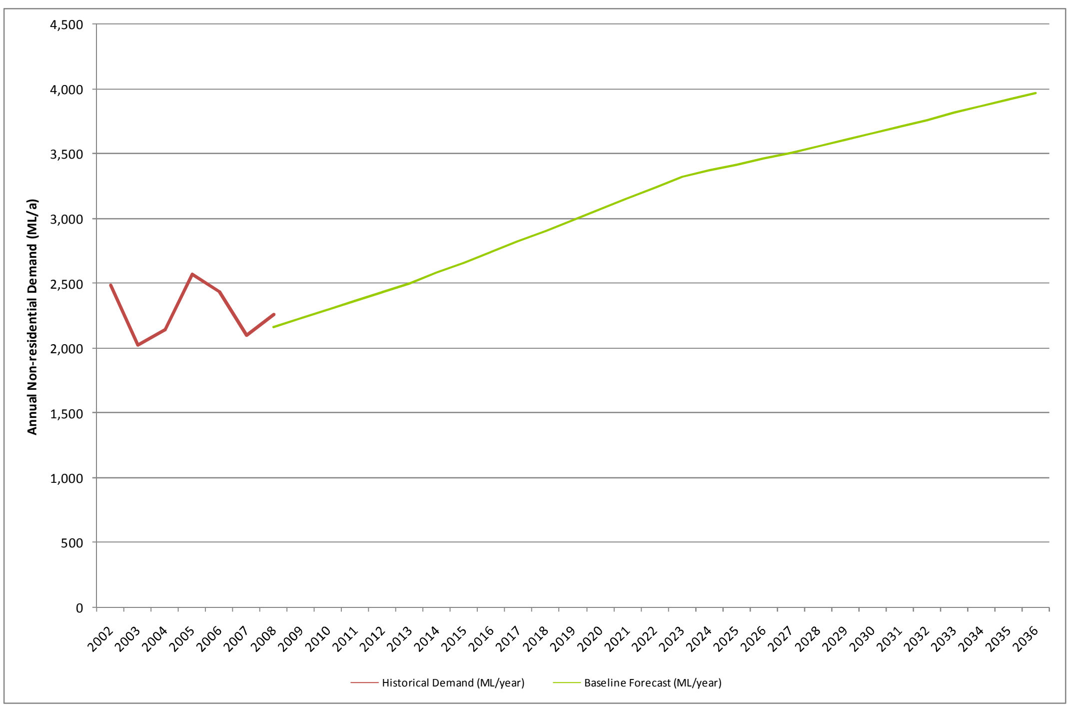


Figure 2-4: Non-residential Baseline Consumption Forecast with Historical Assessment

3. DEMAND MANAGEMENT MEASURES SCREENING

3.1 INTRODUCTION

This section of the report outlines demand management measures that may be applicable to TSC's customer base together with details of the screening process used to short list measures for further evaluation.

3.2 BASIS FOR LISTING MEASURES

A long list of demand management measures was developed for consideration, based upon:

- Review of sectoral water use and major users within those sectors;
- Review of end uses to determine those with high savings potentials; and
- Review of other successful programs.

These assessments are outlined in sections 3.3 to 3.6 below.

3.3 REVIEW OF SECTORAL WATER USE AND MAJOR USERS

The first step in planning a demand management strategy is to understand the non-residential customer base. Through the categorisation and ranking of customer water use by analysis of water billing data, more effective targeting and marketing of demand management programs can be achieved.

The non-residential sector exhibits the most diverse water use in a water service provider's customer base. Characterising water use enables conservation initiatives to be targeted to those customers and end uses which may achieve the highest return on investment, allowing for best usage of limited resources and funds. Assessment of demand needs to provide an understanding of:

- Sub-sectoral use to understand the high sub-sectoral users and individual consumers; and
- End use within the sub-sectors.

Demand assessment for this project was undertaken using information extracted from the TSC billing database together with associated land use data (business type).

3.3.1 ACCOUNT RANKING BY WATER USE

All non-residential users were ranked in order of water consumption (based on 2007/08 billing data). This process assists in determining the number (or percentage) of users that should be targeted based on the greatest potential for water savings. Results of this analysis are shown in Figure 3-1 as a cumulative percentage of demand.

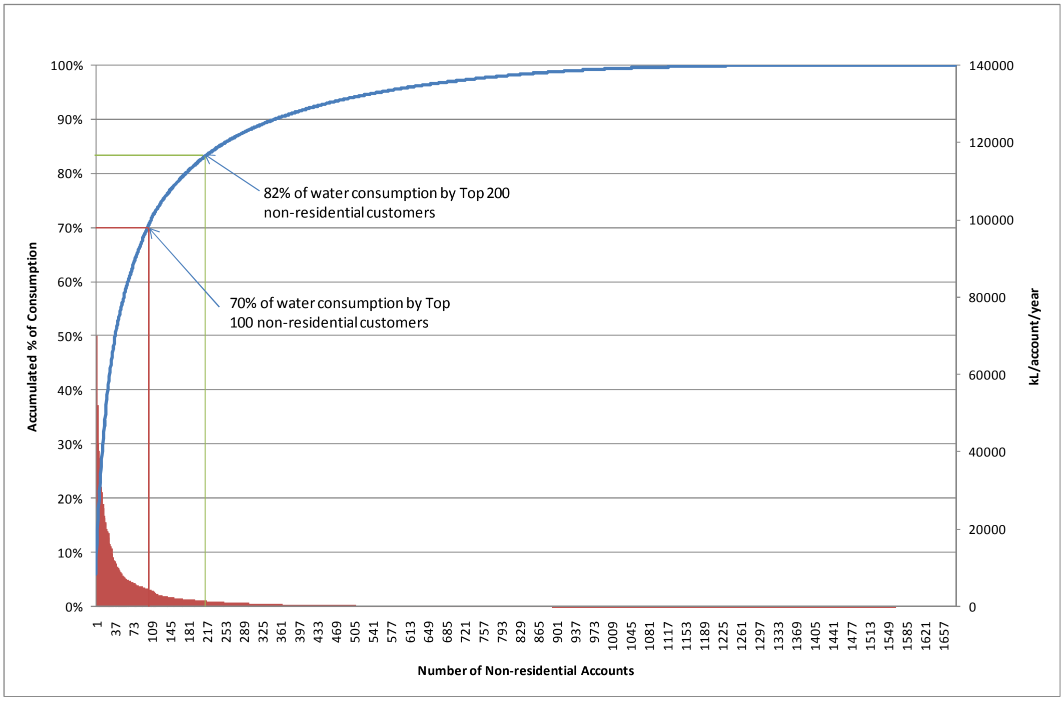


Figure 3-1: TSC Non-residential Customers Ranked by Water Use (all accounts)

As shown in Figure 3-1, the top 5% customers (top 100) consume 70% of the total non-residential demand. The significance of this is highlighted by the fact that the next 100 users (top 100-200 ranked users) consume only 12% of the total non-residential demand. The 200 to 300 ranked customers consume only 6% of the total non-residential demand, further illustrating the diminishing returns. This demonstrates that demand management should focus predominantly on the top 100 users.

The assessment of non-residential customer usage is summarised as follows:

- 10 users account for 25% of total non-residential consumption (17.5% of total consumption);
- 38 users account for 50% of total non-residential consumption (35% of total consumption);
- 131 users account for 75% of total non-residential consumption (53% of total consumption); and
- 349 users account for 90% of total non-residential consumption (63% of total consumption).

A similar ranking exercise was carried out for the top 100 users to further understand major water users, i.e. the number of users over 10 ML/year and 20 ML/year. These thresholds were arbitrarily chosen, however, they have been used as thresholds for other water utilities in defining major water users[2]. The results are shown in Figure 3-2.

---

[2] In SEQ all non-residential users who consumed > 10 ML/year were required to complete a Water Efficiency Management Plan in which they were required to develop a plan to reduce demand by 25% or demonstrate 'best practice'.

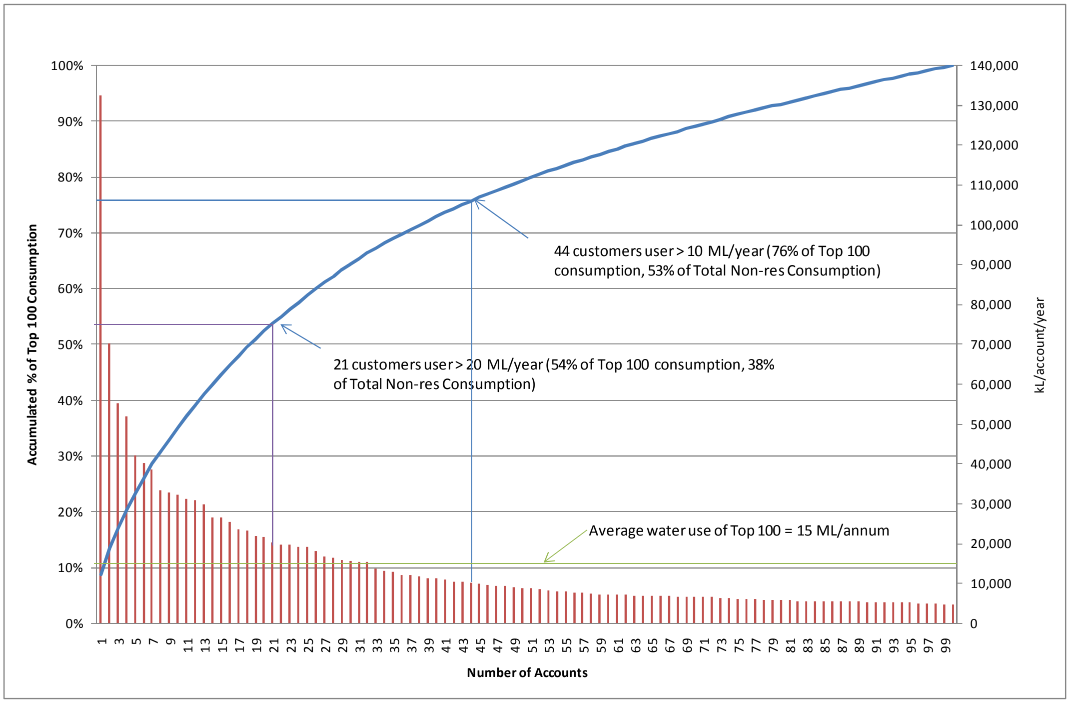


Figure 3-2: TSC Non-residential Customers Ranked by Water Use (Top 100)

Figure 3-2 shows that there are 44 customers using over 10 ML/year and 21 customers using 20 ML/year. The 20 ML/year customers consume 38% of the total non-residential demand and provide an obvious starting point for measures such as water auditing programs.

3.3.2 SUB-SECTOR WATER USE

Establishing the high water consuming sub-sectors and their end use behaviour is also required to focus programs on achieving maximum benefit at highest return. Non-residential water use was further categorised into sub-sectors based on details provided in the TSC billing data base, as shown in Table 3-1. The total consumption is ranked alongside the consumption per account as shown in Figure 3-3 and the number of accounts in Figure 3-4 in each sub-sector for targeting purposes.

.

Table 3-1: TSC Water Use by Sub-Sector (2007/08)

SECTOR	SUB-SECTOR	TOTAL CONSUMPTION (KL/YEAR)	NUMBER OF ACCOUNTS	AVERAGE ACCOUNT USE (KL/ACC/YEAR)	PERCENTAGE OF DEMAND (%)
Commercial/ Industrial	Shops/offices/factories	449,360	731	615	21%
Commercial	Caravan Park	323,360	25	12,934	15%
Commercial	Club inc Sports Clubs	240,962	26	9,268	11%
Commercial	Shopping Centre	102,812	6	17,135	5%
Commercial	Mobile home park	83,290	3	27,763	4%
Commercial	Motel	66,738	28	2,384	3%
Commercial	Farmland / commercial	40,913	11	3,719	2%
Commercial	Hotel	24,057	13	1,851	1%
Public	Tweed SC - Open Space	191,417	216	886	9%
Public	Aged Care	102,707	18	5,706	5%
Public/ Sewer	Tweed SC - WTP/STP/Landfill	90,178	9	10,020	4%
Public	School	76,307	62	1,231	4%
Public	Hospital	33,430	2	16,715	2%
Public	TSC - Buildings	15,568	23	677	1%
Public	Church	12,763	55	232	1%
Industrial	Sugar Mill	174,513	2	87,257	8%
Mixed	Other	70,237	338	208	3%
Bulk Sales	Standpipes	61,716	104	593	3%
Vacant/Nil Consumption	-	0	10	-	-
	Total	**2,160,328**	**1,682**	**3,519**	**100%**

.

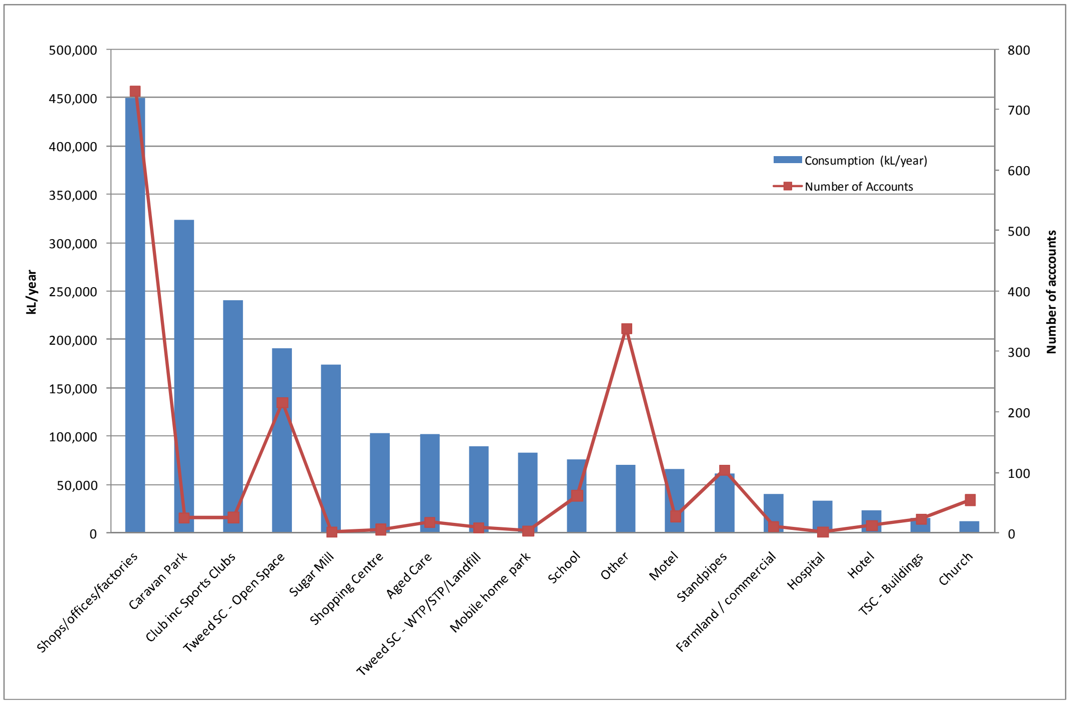


Figure 3-3: Total Water Use and Number of Accounts by Sub-sector (all accounts)

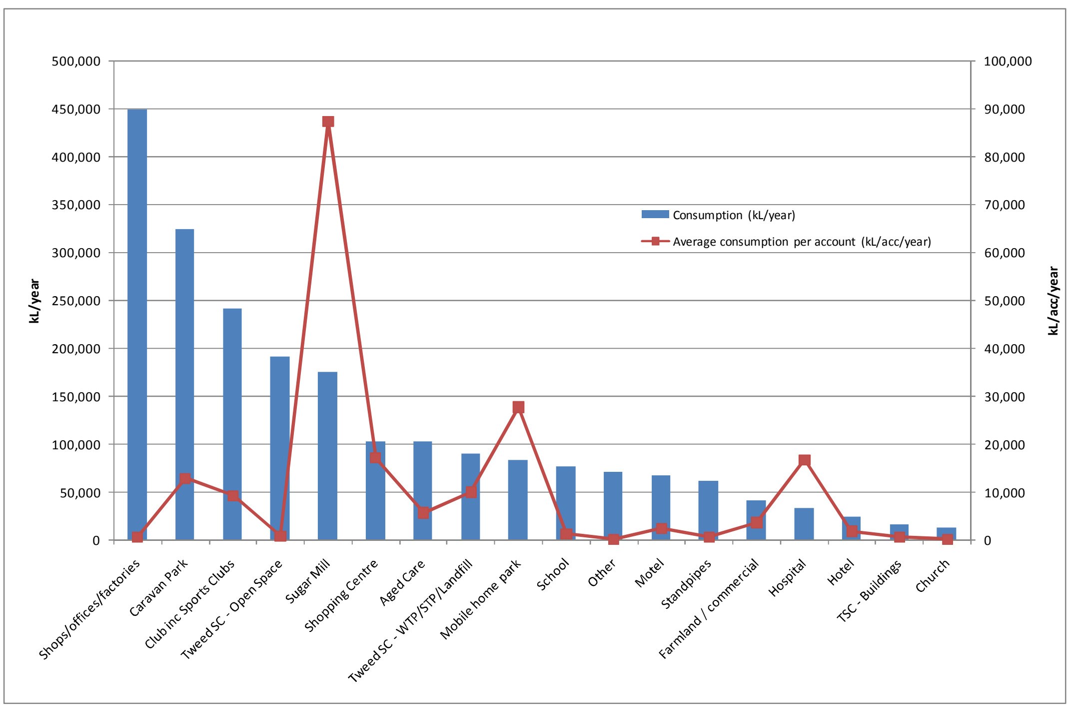


Figure 3-4: Total and Average Water Use per Account by Sub-sector (all accounts)

A similar assessment was carried out for the top 100 users to determine which sub-sectors within the top 100 should be targeted. The results are shown in Figure 3-5 and Figure 3-6.

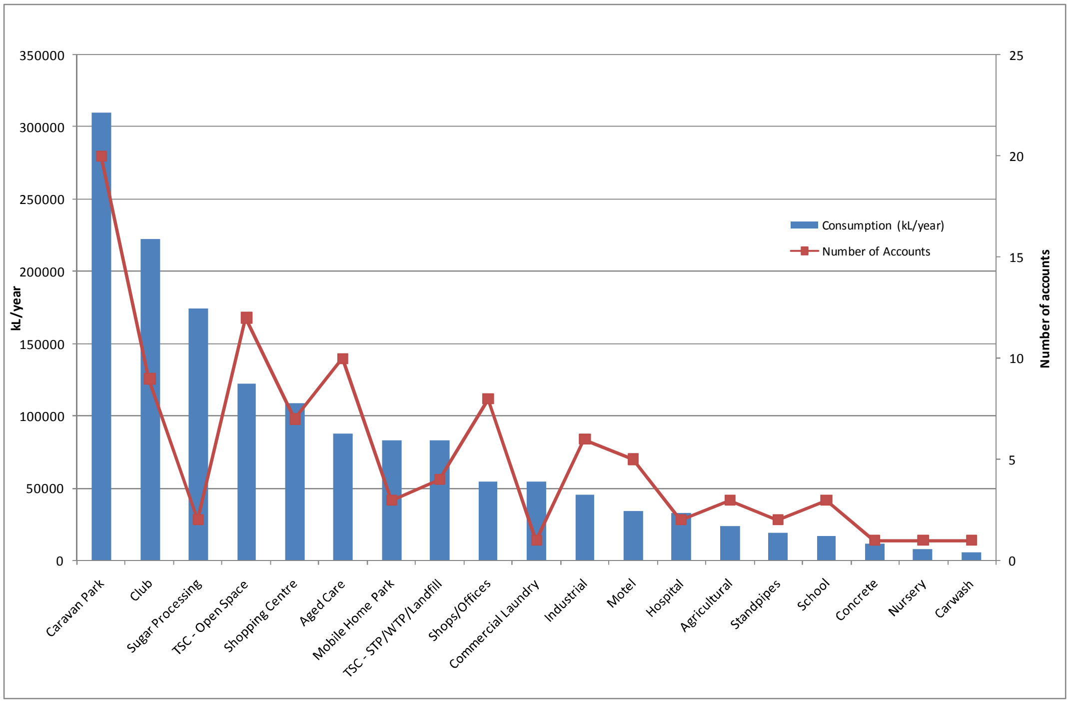


Figure 3-5: Water Use and Average Water Use per Accounts by Sub-sector (Top 100)

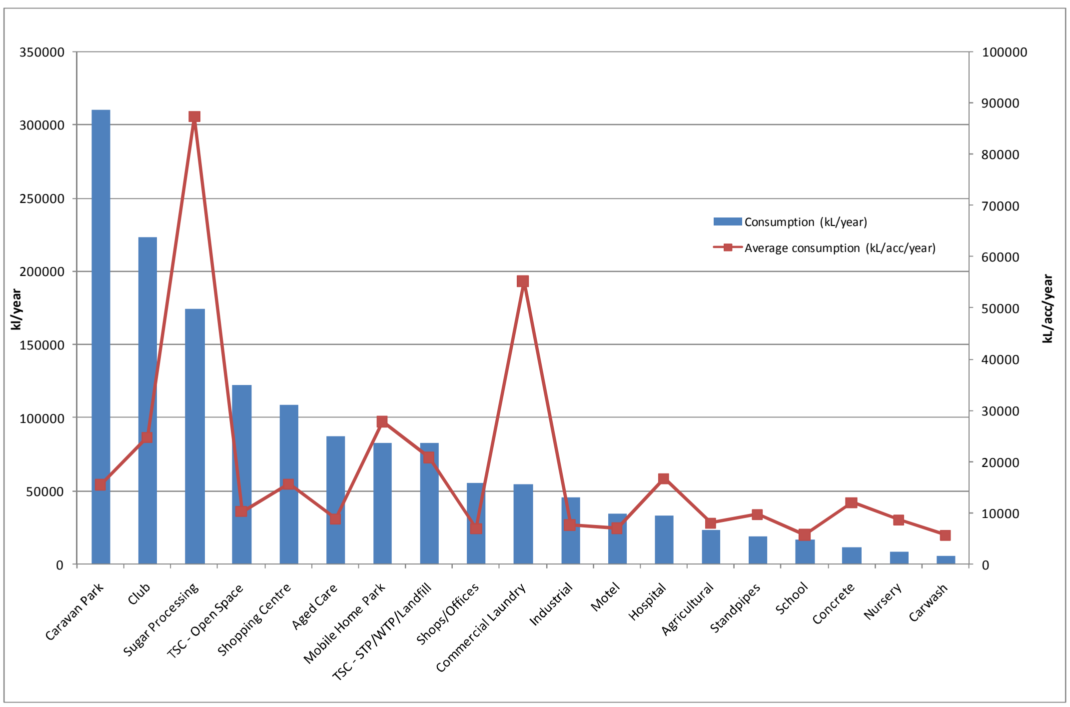


Figure 3-6: Total Water Use and Average Water Use per Accounts by Sub-sector (Top 100 Accounts)

3.3.3 SUMMARY OF MAJOR USERS AND SECTORAL ASSESSMENT

The outcomes of the non-residential demand assessment indicate that:

- Shop/factories/offices is the largest water consuming sub-sector, however, this sub-sector is made up of a large number of accounts with a low average water use per account. Savings in this sector may be difficult to achieve given the high customer numbers and low overall water per account;
- Caravan Parks are the second largest water user (and the largest within the top 100 sub-sectors) with a large water use per account and 20 accounts in the top 100;
- Clubs including sports clubs are large water consumers with 16 accounts in the top 100;
- TSC Open Space Irrigation is the fourth largest water user. As the sub-sector is made up of a large number of accounts the average water use per account is low. However, the top 100 analysis reveals that there are some major users in the top 100 (12 accounts), and as such, it should be a priority sub-sector;
- Shopping centres are large overall users (6th overall) with very high average water use per account. There are 7 accounts in the top 100.
- Aged Care facilities are large overall users (7th overall) with an average water use around 6 ML/account/year. There are 10 accounts in the top 100.
- Tweed Shire Council facilities, such as water treatment, sewage treatment and land fill, are the 8th largest water user, with 4 accounts in the top 100.
- Mobile home parks are the 9th largest water user. There are only 3 accounts each with a very high water use per account. Although these accounts have a very high residential population there is potential to achieve water savings by targeting common end uses such as irrigation, pool water use and leaks.
- In general industrial users are included in the Shop/factories/offices sub-sector and as such have a low average use. However, there are 9 industrial customers in the top 100 who consume almost three-quarters of the total Industrial sector demand.
- Hospitals have high per account usage, however, there are only 2 in the top 100 and only represent a small percentage of the total non-residential demand.

Based on an assessment of water demand and account usage a range of sub-sectors were identified for targeting in programs, refer to Table 3-2 below.

Table 3-2: Summary of Targeted Sub-sectors

SECTOR	CUSTOMER TYPE	% NON-RES USE	TOTAL ACCOUNTS	ACCOUNTS IN TOP 100	AVERAGE ACCOUNT USE IN TOP 100 (ML/YEAR)
Com	Caravan Parks	15.0%	25	20	15.5
Com	Clubs inc Sports Clubs	11.2%	26	9	24.8
Public	TSC Open Space Irrigation	8.9%	216	12	10.2
Com	Shopping Centres	4.8%	6	7	15.6
Pub	Aged Care	4.8%	18	10	8.8
Com	Mobile home park	3.9%	3	3	27.8
Ind/Sewer	TSC Facilities	4.2%	9	4	20.8

Ind	Industry[3]	12.9%	152	9	25.8
Pub	Hospital	1.5%	2	2	16.7

3.4 END USE ASSESSMENT

Evaluation of water efficiency opportunities requires the identification and targeting of specific end uses. Designing and tailoring water demand programs can be improved by understanding where water us used. For example, if 90% of water is used for cooling, a program to inspect cooling tower water efficiency should be implemented. An increasing amount of research is becoming available on typical end uses for different sites. Individual audits conducted on sites within TSC can further increase the store of available information which can be used to enhance the program over time.

3.4.1 WATER END USE FOCUS AREAS

Based on the above assessment and experience in water conservation in other programs such as the Queensland Water Efficiency Management Plans, the main areas for potential water conservation in non-industrial water users are:

- Restrooms;
- Kitchens;
- Laundries;
- Irrigation;
- Cooling towers;
- Fire testing; and
- Leaks.

3.4.1.1 RESTROOM END USES

Water consumption via toilets, urinals and basins are universal across all sub-sectors and often represent a high proportion of water use. End use distribution based on water audit information shows toilets as being the main consumer in many businesses, followed by urinals and basins.

Water use intensity for showers is varied across the sector and can be classified as sub-sector specific. The customer categories with high shower use include:

- Caravan Parks;
- Clubs;
- Shopping Centres;
- Aged Care; and
- Hospitals.

[3] Industrial includes the large concrete manufacturer and sugar refinery accounts identified in the top 100

3.4.1.2 KITCHEN BASED END USES

Water use associated with kitchen based activities is sub-sector specific with hotels, motels, clubs, aged care and hospitals representing areas of significant use. The end uses of particular interest include sink taps, dish rinsing fixtures, dishwashers, Asian wok stoves and ice making devices.

Asian restaurants tend to have high water consumption as a result of wok stoves. Investigations show that wok stoves use 5,500 L/day of water on average (Sydney Water, 2009). It is estimated that only 10% of the water consumed by a wok stove is actually required for food preparation, the remainder goes to waste (Sydney Water, 2009).

Dish rinsing is another high usage where food is served, as normal practice is to rinse plates prior to loading to a dishwasher. Rinsing often uses continuously running taps resulting in significant wastage.

3.4.1.3 LAUNDRY END USES

Laundry facilities exist in a number of the major sub-sectors, and there is also a large commercial laundry facility in the top water users. The commercial organisations most likely to contain laundry facilities include:

- Caravan Parks;
- Hospitals; and
- Aged Care.

Where these commercial enterprises do not have in-house laundry facilities, the service is out-sourced to a commercial laundry business. Such laundries are high water users and may be included in specific water conservation actions proposed for this end use.

3.4.1.4 IRRIGATION

Irrigation of landscaped areas is often a major contributor to water consumption in the following organisations:

- Clubs with playing surfaces;
- Open Space Irrigation;
- Caravan Parks;
- Mobile Homes; and
- Aged Care.

One of the major uses of irrigation is the upkeep of sporting fields, golf courses and resort landscaping. Opportunities relate to both irrigation practices and the sources of water.

3.4.1.5 COOLING TOWER CONSUMPTION

Studies indicate that cooling towers are the major water consumer in many commercial buildings, such as shopping centres, clubs and hospitals. National studies have shown this equipment to be inefficient. Check lists and guides have been produced by Queensland Water Commission and Sydney Water which can assist in the auditing of this equipment.

Sub-sectors that utilise cooling towers include:

- Clubs;
- Shopping Centres;

- Hospitals; and
- Aged Care.

3.4.1.6 FIRE SYSTEM TESTING

Regular on-site testing of fire systems is required under the Building Fire Safety Regulation 1991, which is subordinate legislation to the Fire and Rescue Service Act 1990. The Regulation requires testing to be carried out in accordance with relevant standards within s.15 'Testing of special fire services', which in this case refers to AS 1851 – 2005 'Maintenance of Fire Protection Systems and Equipment'.

Most water audits reviewed as part of this study have failed to take into account the substantial volume of potable water consumed during fire pump testing. Testing of fire pump systems generally incorporates the disposal of test water, with organisations reusing the water being the minority rather than the norm. The following sub-sectors use water during fire testing:

- Shopping Centres;
- Clubs; and
- Hospitals.

The testing of fire systems has the potential to waste large amounts of potable water. To limit the waste of potable water efforts should be made to store testing water to supplement other on-site end use consumption, apply measures to limit test frequency and modify or design systems to limit test duration.

Depending on the standard of test water further end use could be supplemented, however it is recommended that uses be limited to minimise direct contact.

3.4.1.7 LEAKS

Based on evidence from water surveys, water leakage can be a major problem in non-residential sector particularly in sub-sectors with internal buried pipelines such as hospital complexes, caravan parks and schools.

An assessment of "base flow" using a data logger installed on the main meter or sub-meters is the best method to detect any non-visible leakage on-site. Base flow is the water that is consumed by a site during non-working hours usually shown by a constant consumption during these hours. Data loggers can be purchased for around $500 which includes the required software and cables.

3.4.1.8 MISCELLANEOUS AND PROCESS END USES

Hospitals have unique water saving opportunities associated medical equipment such as, liquid ring vacuum pumps, x-ray and other photography equipment, sterilising equipment and boilers. Industrial customers in the top 100 water users will also have unique water saving opportunities depending on the type of process operations used. Opportunities for water efficiency and source substitution associated for these end uses are usually assessed on a case-by-case basis.

3.5 SUMMARY OF TARGETED SUB-SECTORS AND END USES

A summary of the outcomes from the sectoral analysis and the evaluation of key end uses are provided in the following sections.

3.5.1 COMMERCIAL

The commercial sector is the largest non-residential water user at 60% of the total use. Homogeneity of end uses and the large number of commercial customers in the top 100 make this sector attractive for achieving significant, long-term water savings at a reasonable cost. Specific sub-sectors to be targeted include caravan parks, clubs, shopping centres and mobile home parks.

A sub-sector breakdown for accounts within the commercial sector (within the top 100) is provided in Figure 3-7 below.

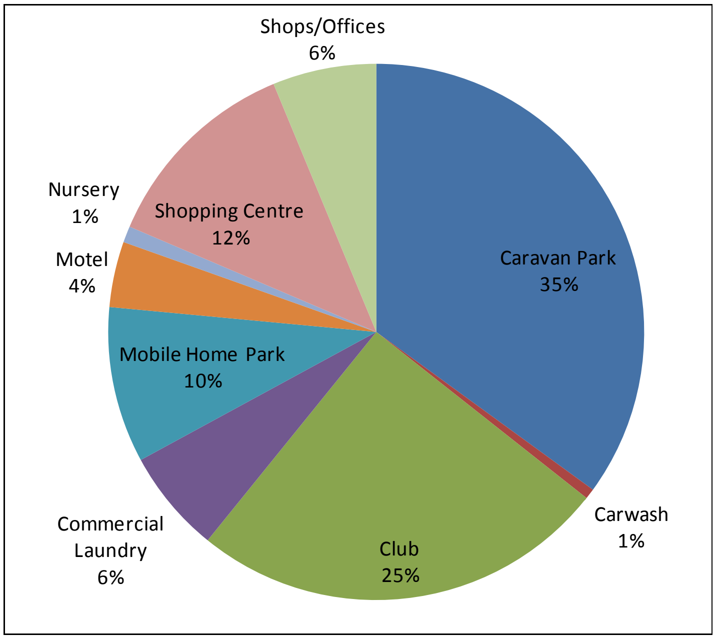


Figure 3-7: Commercial Sub-Sectors within the Top 100 Users

3.5.2 PUBLIC

The public sector includes aged care facilities, schools, TSC buildings, TSC open space (e.g. sports grounds and parks and gardens) and hospitals, and constitutes 19% of non-residential consumption. This sector does have potential for water conservation, but usually specific approaches need to be employed for each customer type. Water conservation measures should be targeted towards users in the top 100 including aged care facilities, TSC open space irrigation and, to a lesser extent, hospitals.

A sub-sector breakdown for accounts within the public sector (within the top 100) is provided in Figure 3-8 below.

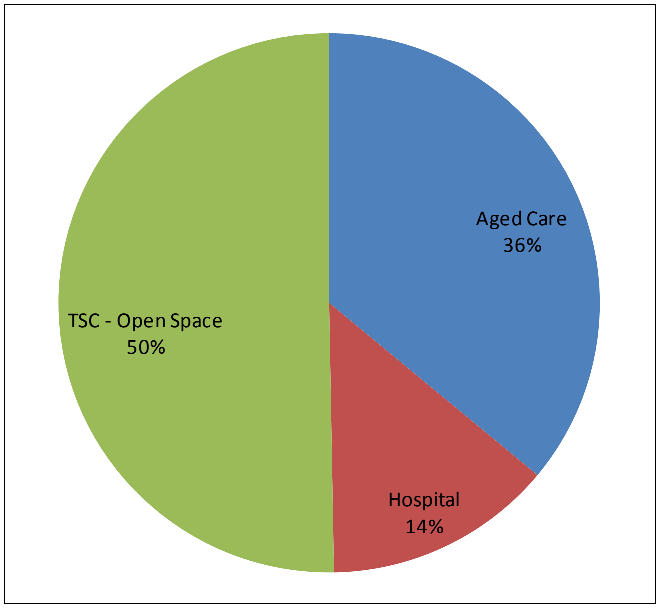


Figure 3-8: Public Sub-Sectors within the Top 100 Users

3.5.3 INDUSTRIAL

The diversity of water usage within the industrial sector is the highest of that in any sector due to the specific nature of manufacturing processes employed in each business. This sector makes up 13% of the total water demand in TSC, however, nearly 70% of this is consumed by just 5 users. The highest industrial user, being the sugar mill at Condong, consumes more than half of the total industrial demand. Accordingly, to achieve the most cost-effective impact only high water users should be targeted as part of the non-residential demand management measures.

End use reduction in this sector is often difficult due to the specific individual needs of each business. Despite this, there is a potential for saving through water recycling schemes. Recycling is currently being used at the Condong sugar mill and could also be effectively used for industries such as concrete and concrete product manufacturing or for cooling in manufacturing processes.

It is recommended that the industrial sector only be targeted where there is scope for a large water user to refine an end use or process, or where there is potential for recycling, such as in sugar refineries, TSC facilities and concrete manufacturing.

A sub-sector breakdown for accounts within the industrial sector (within the top 100) is provided in Figure 3-9 below.

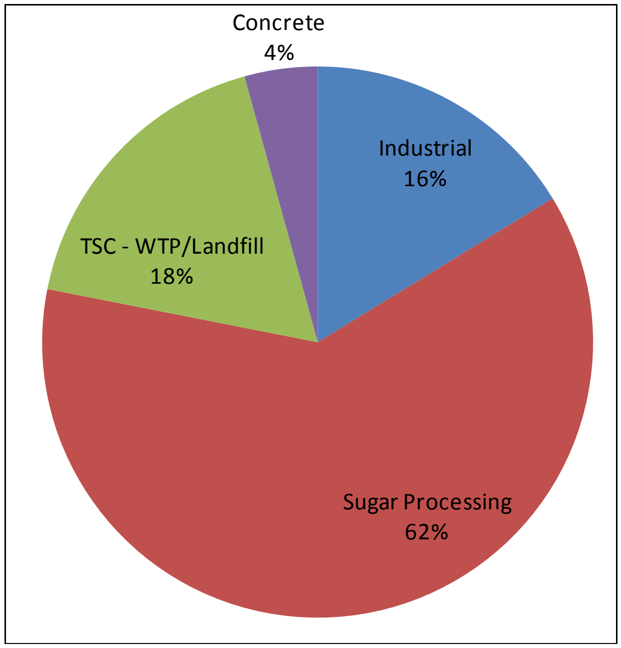


Figure 3-9: Industrial Sub-sectors within the Top 100

3.5.4 SEWER, BULK SALES AND RURAL

Sewer, Bulk Sales and Rural contribute a total of 8% of the non-residential demand, which is less than 3% of the total TSC water demand. In practice, these sectors should only be targeted once water efficiency in other sectors, such as residential, commercial, public and industrial have been successfully completed, that is, unless easy wins can be identified such as the use of recycled water at Sewage Treatment Plants.

3.6 REVIEW OF OTHER SUCCESSFUL PROGRAMS

An assessment of water conservation measures in NSW, interstate, nationally and internationally was undertaken to identify global opportunities for demand management in the non-residential sector. Knowledge gained locally and overseas provides an insight into successes and issues relating to measures and initiatives trialled for this sector. It is noted that non-residential water conservation is in a relatively early stage in Australia, although significant work has been completed in recent years, far more work has been undertaken in the more mature markets such as the United States (US). The complete review of demand management measures can be found in Appendix A.

The review of measures locally and overseas has revealed common attributes and in some cases further innovative approaches. The conservation programs being implemented in Australia and overseas for non-residential consumers include a combination of the following attributes:

- Most programs are specifically targeted to large consumers;
- Successful programs in Australia promote a user pays principle but offer incentives in the form of payment options;
- Water audits are the basic assessment tool used to identify end use behaviour and assess cost effective actions to reduce consumption;
- Customer relationships are important to ensure acceptance of recommendations;
- Support for water conservation measures at the management level of businesses is essential. This can be achieved through:

  - Voluntary participation, through marketing the benefits in terms of potential savings;
  - Undertaking a diagnostic service, e.g. One-2-Five™; or
  - Regulating mandatory conservation measures.
- Incentives are often provided to support detailed water audits. These incentives may take the following forms:
  - Rebates on audits or retrofits;
  - Loans e.g. pay by savings; or
  - Discounts on water charges.
- Follow up communication with the business is required to assess the implementation of water audit recommendations;
- Appropriate economic assessment is required to establish the business case for any proposed measures;
- Adequate resourcing is required for program implementation;
- Cost effective measures generally involve a 2-4 year payback period; and
- Understanding and removal of barriers to provide an easy path to water conservation is a key factor in successful programs.

3.7 MEASURES LONG LIST

Based upon the review of sectoral water use and major users within those sectors; the review of end uses to determine those with high savings potentials; and the review of other successful programs a long list of 40 measures has been developed. The complete long list of measures is provided in Table 3-3.

Table 3-3: Long list of Demand Management Measures

NO	MEASURE	IMPLEMENTATION METHOD	POSSIBLE INCENTIVE	APPLICABLE SUB-SECTORS	MEASURE DESCRIPTION
1	Shower Regulation	Council Regulation	-	All new non-residential	Council will pass a regulation that requires 3 star or higher rated showerheads in all new development.
2	Toilet Regulation	Council Regulation	-	All new non-residential	Council will pass a regulation that requires 6/3 dual flush toilets (3 star WELS) in all new development.
3	Urinal Regulation	Council Regulation	-	All new non-residential	Council will pass a regulation that requires 4 star or higher rated urinals in all new development.
4	Tap Regulation	Council Regulation	-	All new non-residential	Council will pass a regulation that requires 3 star or higher rated taps in all new development.
5	Washing Machine Regulation	Council Regulation	-	All new non-residential	Council will pass a regulation that requires only front loading washing machines to be sold in the Council area.
6	Sub-metering	Council Regulation	-	All new non-residential	Individual sub-metering in all new multi-tenanted businesses (shopping centres and multi-family residential).
7	Alternative water source	Council Regulation	-	All new non-residential	Requirement for new businesses to use an alternative water source (e.g. rainwater, grey water, recycled water) as part of any new development
8	Water Management Plan	Council Regulation	-	All new non-residential	New non-residential customers with a projected water use > 5 ML/year would be required to develop a water management plan at the DA stage to demonstrate how water will be efficiently managed on-site.
9	Efficient Irrigation System	Regulations, Education	Rebate	All non-residential irrigation	Requirement for installation of irrigation systems that are efficient and installed by certified irrigation professionals (through Irrigation Australia). Target irrigation areas over 500 m^2. Possible rebate on water efficient irrigation components e.g. soil moisture sensors and rain switches.

NO	MEASURE	IMPLEMENTATION METHOD	POSSIBLE INCENTIVE	APPLICABLE SUB-SECTORS	MEASURE DESCRIPTION
10	Water Management Audit/Diagnostic	Council/customer agreement	-	Caravan Parks Aged Care Shopping Centres Clubs Hospitals Industrial	Council would offer a water management diagnostic for Major water users. The diagnostic system can use the One-2-Five™ system developed by Energetics or similar. This can be used to gain commitment from businesses to reduce water use. Can be included as part of a general site audit.
11	Major Users Water Audit	Council Audit	Free or subsidised audit; Discount on water bills	Major Users (>20 ML/year)	The Council would offer a water audit for the major users (>20 ML/year). The auditor would provide the results of the audit, rebate forms for appropriate water savings fixtures, and recommendations for conservation.
12	Targeted Business Water Audit	Council Audit	Free or subsidised audit; Discount on water bills	Caravan Parks Aged Care Shopping Centres Clubs	The Council would target particular sub-sectors and send water auditors to customers in the top 100 water users. The auditor would provide the results of the audit, rebate forms for appropriate water savings fixtures, and recommendations for conservation.
13	Bathroom Audit - Shower - Toilets - Taps - Urinals	Council Audit; Plumber	Free or subsidised audit; Discount on water bill; Optional low flow fixtures rebate and leak repair	Caravan Parks Aged Care Shopping Centres Clubs Motels Hospitals Industrial	The Council would provide for an audit of the bathrooms of the top 100 high water-using businesses. The auditor would examine the bathrooms for low flow shower, toilet, tap, and urinal fixtures and for any leaks. The auditor would then provide the results along with recommendations for low water-using fixtures. As an optional incentive, the Council may provide rebates on the installation of low-flow fixtures e.g. taps, showers, urinals and toilets.

NO	MEASURE	IMPLEMENTATION METHOD	POSSIBLE INCENTIVE	APPLICABLE SUB-SECTORS	MEASURE DESCRIPTION
14	Pool Audit (cover, filter backwash)	Council Audit	Free or subsidised audit; Discount on water bill	Caravan Parks Aged Care Clubs Motels/Hotels Hospitals Schools	The Council would provide a water audit of pool cleaning and upkeep practices, checking for use of a cover, whether a filter backwash system is used, and for any leaks. The auditor would provide the results of the audit and recommendations for conservation. This measure could be combined with other audits.
15	Laundry Audit	Council Audit	Free or subsidised audit; Discount on water bill	Aged Care Motels Hospitals	The Council would provide a water audit of the laundry to examine the washing procedure. The auditor would provide the results of the audit and recommendations for conservation. This measure could be combined with other audits.
16	Restaurant Audit	Council Audit	Free or subsidised audit; Discount on water bill	Shopping Centres Clubs Motels/Hotels Hospitals Aged Care	The Council would provide a water audit of the restaurants and kitchens. The auditor would examine food preparation and cleaning practices, and examine the restaurant for any leaks. The auditor would provide the results of the audit and recommendations for conservation. This measure could be combined with other audits.
17	Pre-rinse Spray Valves Retro-fit	Council Audit; Education	Rebate; Discount on water bill	Shopping Centres Clubs Large restaurants	Provide a rebate for the installation of low flow spray valves for the rinse and clean operation in restaurants and other commercial kitchens. Modelled on the Sydney Water program. Could be included as part of restaurant audit.

NO	MEASURE	IMPLEMENTATION METHOD	POSSIBLE INCENTIVE	APPLICABLE SUB-SECTORS	MEASURE DESCRIPTION
18	Cooling Tower Audit	Council Audit	Free or subsidised audit; Discount on water bill	Shopping Centres Clubs Motels/Hotels Hospitals Aged Care	The Council would provide a water audit of the businesses' cooling towers to determine the type of fixtures and practices being used to operate and maintain the air conditioning system. The auditor would provide the results of the audit and recommendations for conservation. This measure is most effective when combined with general audits. Auditing procedures are well documented and checklists are available from both the Sydney Water and QWC web-sites.
19	Cooling tower sub-meter rebate	Council Audit; Education	Free or subsidised audit; Discount on water bill	Shopping Centres Clubs Motels Hospitals Aged Care	Offer a rebate to buildings that install sub-meters to measure the make-up and bleed-off water of the facility cooling towers. Provide educational brochures and a phone contact of a knowledgeable person to provide conservation information.
20	Optimisation of Cooling Tower Operation (Cycles of Concentration)	Regulation; Education	-	Shopping Centres Clubs Motels Hospitals Aged Care	Prohibit discharge of cooling tower blow down unless the TDS of the water is at least a certain level (that would ensure 5-10 cycles of concentration).
21	Waterless Woks Promotion and Rebate	Council Audit; Education	Free or subsidised audit; Rebate; Discount on water bill	Shopping Centres Clubs Hotels Large restaurants	Council to audit restaurant water use and educate customers on the benefits of converting to waterless woks. Council may offer a rebate to encourage businesses to upgrade their woks to waterless models.

NO	MEASURE	IMPLEMENTATION METHOD	POSSIBLE INCENTIVE	APPLICABLE SUB-SECTORS	MEASURE DESCRIPTION
22	Replacement of Water-cooled Ice Machines	Council Audit; Education	Free or subsidised audit; Rebate; Discount on water bill	Clubs Motels Large restaurants	The Council would conduct an audit and provide information encouraging restaurants to change from water-cooled icemaker compressors to air-cooled ice makers. The Council may offer a rebate to encourage applicable restaurants to upgrade their icemakers with water-efficient models.
23	TSC Facilities Audit	Council Audit; Education	-	Public Buildings	The Council would provide a water audit of the local government major water using facilities in the top 100. The auditor would provide the results of the audit and recommendations for conservation.
24	Self-Closing Taps	Education; Customer purchase	Rebate	Caravan Parks Aged Care Shopping Centres Clubs Motels Hospitals	The Council would encourage businesses to purchase automatic or manual self-closing valves for their common restrooms through educational brochures. The shut off valve can either be automatic and use a sensor or be manually turned on and shut-off on a timer.
25	Leakage Assessment Audit	Council Audit; Education	Free or subsidised audit;	Caravan Parks Aged Care Shopping Centres Clubs Motels/Hotels Hospitals Industrial Open Space Irrigation	The Council would conduct an audit of users in the top 100 to determine the baseflow during periods of zero flow. This would involve installing data loggers on the main meter for a set period (2-4 weeks). The auditor would provide audit results and recommendations, including directions on leak repair. Focus would be on customers with internal pipe networks. This measure may be combined with general business audits.

NO	MEASURE	IMPLEMENTATION METHOD	POSSIBLE INCENTIVE	APPLICABLE SUB-SECTORS	MEASURE DESCRIPTION
26	Audit of Hospital Process Use	Council Audit; Education	Free or subsidised audit; Rebate	Hospitals	The Council would conduct an audit of x-ray, other photographic machines, boilers, sterilisers, liquid ring vacuum pumps at the high water-using hospitals. The auditor would provide the results of the audit and recommendations for conservation. The Council could offer rebates for water-efficient equipment upgrades. This measure could be combined with other audits.
27	Audit of Top Industrial Water Users	Council Audit; Education	Free or subsidised audit; Rebate	Industrial	The Council would conduct an audit of process end-use for industrial businesses within the top 100 and prepare recommendations for conservation. The Council could offer rebates for water-efficient equipment upgrades. This measure could be combined with other audits. Businesses include concrete manufacturers and sugar refining. These audits require a higher degree of technical and process knowledge, and hence, are more expensive by nature.
28	Specific Recycle Water Projects	-	-	Public open space/industrial	Opportunities identified for urban irrigation include: • Arkinstall Park Municipal Oval and Tweed Heads Cemetery. • Barry Sheppard Oval, Cabarita Beach Pony Club and the Les Burger Field at Bogangar. • The Chinderah Golf Course and the Chinderah Ti Tree Plantation. • Council's nursery at Uki.

NO	MEASURE	IMPLEMENTATION METHOD	POSSIBLE INCENTIVE	APPLICABLE SUB-SECTORS	MEASURE DESCRIPTION
					• Turf farm at Round Mountain Road. • The Club Banora Golf Course. • The South Tweed Heads Football Club. • Various parks and reserves; and • Various school grounds.
29	Capacity Buy-back Program	Council Promotion	Low interest loan or grant	All large non-residential users i.e. greater than 10 ML/day	Council would set-up a low interest loan or grant program to buy back capacity from large users who install water efficient equipment. The customer would propose a project (possibly as the result of a water audit) and the Council would estimate the water savings and calculate a rebate based on their avoided costs for new capacity. Customer would receive an upfront payment upon signing a contract to install the equipment.
30	TSC Open Space Irrigation Audit	Council audit; Education	-	Open Space Irrigation	The Council would provide outdoor audits of all top water-using public open space facilities within the top 100. The auditor would determine how irrigation practices are undertaken, present the results of the audit, and provide recommendations for the facility to conserve water including irrigating during appropriate times, not irrigating upon pavement and use of evapo-transpiration programs, if available.

NO	MEASURE	IMPLEMENTATION METHOD	POSSIBLE INCENTIVE	APPLICABLE SUB-SECTORS	MEASURE DESCRIPTION
31	Open Space Irrigation Guidelines	Council Regulation	-	Open Space Irrigation	The Council would draft and encourage adoption of a Council regulation for the efficient irrigation and maintenance of Council operated open spaces and sports grounds. The Council would provide personnel to educate those affected by the regulation and ensure effective implementation once the regulation is adopted.
32	Train landscape managers	Education (workshop)	-	Open Space Irrigation	The Council would provide a free workshop to train landscape managers on the amount of water necessary for irrigation; and the importance and potential savings from water conservation and using native or low water-using plants. Advice would also be provided on setting irrigation time clocks; how to find and repair simple leaks; and proper turf care (fertilising, mowing, thatch removal, etc.).
33	Recycled Water Use	Regulations; Education	-	Open Space Irrigation Sports Clubs	The Council would produce and sell filtered secondary treated wastewater to interested large landscape water managers for irrigation of sites such as golf courses. The Council would seek to create such a market while meeting all health regulations.
34	Landscape Water Budgets	Council to provide	-	Sports Clubs	The Council would provide each large irrigation customer with a monthly irrigation water budget. The budget would account for landscape type, landscape area, irrigation method, and reflect the normal monthly climate. The Council would put the water budget information on the water bill for the customer. SEQ currently has a similar program in place where each Active Playing Surface receives a monthly allocation of town water for irrigation purposes.

NO	MEASURE	IMPLEMENTATION METHOD	POSSIBLE INCENTIVE	APPLICABLE SUB-SECTORS	MEASURE DESCRIPTION
35	Public Building Retrofit	Council Regulation	-	Public Buildings	Council would pass a regulation that required all Council owned and leased buildings to be retrofitted within a specified time (two years). Retrofitting would include toilets, showers, taps, urinals and other fixtures to be determined.
36	WaterWise program	Council Promotion; Education	-	All existing non-residential	The Council would develop a general education package with information about the WaterWise program for non-residential users, promoting water efficiency and solutions. May include specifically targeted programs for caravan parks, shopping centres, aged care and clubs.
37	Plumber Training	Council provided	Free	All non-residential	The Council would develop training materials for local plumbers. Attendees would receive training on the importance of and options for water conservation. Attendees would receive a certificate which can be used in their advertising.
38	Awards Programs	Council to supply	-	All non-residential	The Council would provide a yearly award to the company that presented the most dedication to water conservation. The Council would ensure that the award gained public attention in order to encourage other customers to think about and employ water savings.
39	Waterwise Schools Program	Council to supply training materials; Encourage schools to participate	-	Schools	The council would provide school conservation programs with workbooks and presentations, teaching materials and other educational tools to teach students the importance of conserving water. The Council would sponsor water conservation poster contests, and other fun, yet educational, activities for the school children.
40	Liaison with NSW Health and Department of Education and Training	Council to engage	-	Schools Hospitals	Council to liaise with key state government departments regarding the implementation of water efficiency programs (i.e. audits, retrofits) for top using state government buildings, such as hospitals and schools.

NO	MEASURE	IMPLEMENTATION METHOD	POSSIBLE INCENTIVE	APPLICABLE SUB-SECTORS	MEASURE DESCRIPTION
41	Council promotion of Federal and State Programs	Education	-	All non-residential	Council to actively promote and disseminate key information regarding State and Federal conservation programs to key stakeholders and target sectors.
42	Workshops with Chamber of Commerce as well as other industry and commercial representatives	Education (workshop)	-	All non-residential	Council to organise workshops with Chamber of Commerce as well as other industry and commercial representatives to form relationships and disseminate key information regarding conservation programs to target sectors.

3.8 MEASURES SCREENING

In order to rank the long list of measures and identify those likely to be included for detailed assessment a simple triple bottom line assessment with the following criteria was used:

- Environmental
  - Significance of water use savings
  - Sustainability of water savings
  - Provide energy use reductions (in addition to water use efficiency)
- Social
  - Improves public awareness (as a side benefit of water use efficiency)
  - Equitable across customer base (within the sector that the measure applies); and
  - Level of regulatory obstacles to implementation
- Economic
  - Likely payback period
  - Local benefit (employment)

Each of the measures was scored against each of these criteria and ranked. The screening matrix used to determine this list is provided in Appendix B. A total of 23 measures were selected for detailed evaluation.

3.9 SHORT LIST OF MEASURES

Each of the short listed measures is described in the following sections. Please note, these are potential measures which could be implemented by TSC.

Measure 1 - Audit of Major Users (>20 ML/year)

This would involve an audit the major users in the Shire with the provision of a report with recommendations for water conservation. As an incentive, the audit could be provided free of charge or partially funded by TSC. Some key users in the Major Users are specialised businesses e.g. commercial laundry, sugar refinery. Specialist knowledge of these industries is necessary in order to properly engage these customers and provide meaningful conservation opportunities.

Measure 2.1 - Audit of Caravan Parks (Top 100)

Council would provide an audit service for all caravan parks in the top 100. As an incentive, the audit could be provided free of charge or partially funded by TSC. The auditor would provide the results of the audit and recommendations for conservation. This measure could also include rebates on water efficient taps, showers and toilets.

Measure 2.2 - Audit of Clubs (Top 100)

Council would provide an audit service for all clubs in the top 100. As an incentive, the audit could be provided free of charge or partially funded by TSC. The auditor would provide the results of the audit and recommendations for conservation. This measure could also include rebates on water efficient taps, showers and toilets.

Measure 2.3 - Audit of Shopping Centres (Top 100)

Council would provide an audit service to all shopping centres in the top 100. As an incentive, the audit could be provided free of charge or partially funded by TSC. The auditor would provide the results of the audit and recommendations for conservation. This measure could also include rebates on water efficient taps, showers and toilets.

Measure 3 - Audit of Major Aged Care Facilities (Top 100)

The Council would provide a water audit of the aged care facilities in the top 100. As an incentive, the audit could be provided free of charge or partially funded by TSC. The auditor would provide the results of the audit and recommendations for conservation.

Measure 4 - Public Buildings Retrofit

Under this measure, Council would pass a regulation that required all Council owned and leased buildings to be retrofitted with a specified time (two years). Retrofitting would include toilets, showers, taps, urinals and other fixtures to be determined.

Measure 5 - Audit of Open Space Irrigation (Top 100)

The Council could provide an outdoor audit of all top water-using public open space facilities within the top 100. The auditor would determine how irrigation practices are undertaken, present the results of the audit, and provide recommendations for the facility to conserve water including irrigation during appropriate times, avoiding irrigating on pavement and use of evapo-transpiration programs, if available.

Measure 6 - Water Efficiency Shower Regulations

Council would regulate the installation of water efficient showers for all new development.

Measure 7 - Audit of Major TSC Facilities (Top 100)

The Council would conduct a water audit of the local government major water using facilities in the top 100. The auditor would provide the results of the audit and recommendations for conservation.

Measure 8 - Open Space Irrigation Guidelines

The Council would draft and encourage adoption of a Council regulation for the efficient irrigation and maintenance of Council operated open spaces and sports grounds. The Council would provide personnel to educate those affected by the regulation and ensure effective implementation once the regulation is adopted.

For Council parks and gardens and sports grounds, a Landscape Guideline providing guidance to Council irrigators on water efficient irrigation practices could be easily implemented and monitored. For the top users this may include an audit by a Certified Irrigation Professional. A similar precedent has been established by SA Water who has developed an Irrigation of Public Open Space Code. Source substitution with recycled water or stormwater should also be considered.

Measure 9 - Water Efficiency Tap Regulation

Council would regulate the installation of water efficient taps for all new development.

Measure 10 - Water Management Plan

New non-residential customers with a projected water use of greater than 5 ML/year (approximately 1 in 20 new accounts based on the current percentage of users > 5 ML/year) would be required to develop a water management plan at the development application stage to demonstrate how water will be efficiently managed on-site.

Measure 11 - Leakage Assessment

The Council would provide a service to conduct an audit of users in the top 100 to determine the baseflow during periods of zero flow. As an incentive, the audit could be provided free of charge or partially funded by TSC. This would involve installing data loggers on the main meter for a set period (2-4 weeks). The auditor would provide audit results and recommendations, including directions on leak repair. As an incentive, the assessment could be subsidised or provided free of charge to encourage uptake.

Leakage reduction is generally an extremely cost effective initiative, particularly in facilities such as shopping centres, schools and hospitals where networks of in ground pipes exist.

This measure could be a stand-alone measure or be combined with general business audits discussed above.

Measure 12 - Non-residential Waterwise Education Program

The Council would develop a general education package with information about the WaterWise program for non-residential users, promoting water efficiency and solutions. This may include specifically targeted programs for caravan parks, shopping centres, aged care and clubs.

Measure 13 - Water Efficiency Toilet Regulation

Council would regulate the installation of water efficient toilets for all new development.

Measure 14 - Specific Recycled Water Opportunities

The Tweed Shire Council Recycled Water Opportunities report (MWH, 2006) identifies several potential reuse projects:

- Arkinstall Park Municipal Oval and Tweed Heads Cemetery.
- Barry Sheppard Oval, Cabarita Beach Pony Club and the Les Burger Field at Bogangar.
- The Chinderah Golf Course and the Chinderah Ti Tree Plantation.
- Council's nursery at Uki.
- Turf farm at Round Mountain Road.

An assessment of recycled water opportunities was conducted for the Banora Point and Tweed Head West STPs as part of the Environmental Impact Statement (EIS) prepared for the upgrade of the two plants. The primary reuse opportunities identified for the areas surrounding the plants were:

- Urban irrigation;
- Residential non-potable supply.

Industrial reuse was considered, however, "there is no significant industrial development in the area and any reuse is likely to be incidental to a residential reuse scheme".

Opportunities identified for urban irrigation include:

- The Club Banora Golf Course
- The South Tweed Heads Football Club

- Various parks and reserves; and

- Various school grounds.

Opportunities for recycled water use should be assessed on a case-by-case basis; possible targets for future recycled water use include open space irrigation and large industrial users.

Measure 15 - Awards

The Council would provide a yearly award to the company that presented the most dedication to water conservation. The Council would ensure that the award gained public attention in order to encourage other customers to think about and employ water savings.

Measure 16 – Train Landscape Managers

The Council would provide a free workshop to train landscape managers on the amount of water necessary for irrigation; and the importance and potential savings from water conservation and using native or low water-using plants. Advice would also be provided on setting irrigation time clocks; how to find and repair simple leaks; and proper turf care (fertilising, mowing, thatch removal, etc.).

Measure 17 - Management Diagnostic

Council would fund or subsidise a water management diagnostic for large water users. The diagnostic system could use the One-2-Five™ system developed by Energetics or similar. This could be used to gain commitment from businesses to a sustainable water management plan.

The management diagnostic could be used as a forerunner to a general site audit.

Measure 18 - Audit of Major Industrial Users (Top 100)

The Council would conduct an audit of process end-use for industrial businesses within the top 100 and prepare recommendations for conservation. As an incentive, the audit could be provided free of charge or partially funded by TSC. The Council could offer rebates for water-efficient equipment upgrades. This measure could be combined with other audits.

Key industrial businesses include concrete manufacturers and sugar refining. These audits require a higher degree of technical and process knowledge.

Measure 19 - Open Space Irrigation Budgets

The Council would provide each large irrigation customer with a monthly irrigation water budget. The budget would account for landscape type, landscape area, irrigation method, and reflect the normal monthly climate. The Council would put the water budget information on the water bill for the customer.

SEQ currently has a similar program in place where each Active Playing Surface receives a monthly allocation of town water for irrigation purposes.

Measure 20 - Council Promotion of Federal and State Programs

Council to actively promote and disseminate key information regarding State and Federal conservation programs to key stakeholders and target sectors.

Measure 21 - Liaison with other key stakeholders

Council to liaise with key state government departments regarding the implementation of water efficiency programs (i.e. audits, retrofits) for top using state government buildings, such as hospitals and schools.

Council to organise workshops with Chamber of Commerce as well as other industry and commercial representatives to form relationships and disseminate key information regarding conservation programs to target sectors.

4. EVALUATION OF MEASURES

In section 3, alternative water conservation measures were short listed for consideration and possible implementation. In this section, a detailed analysis of each of the measures will be undertaken, and the benefits and costs for implementation of each measure will be determined through calculation of:

- Water savings potentials for each measure;
- Expected market penetration or 'uptake rate' of each measure;
- Costs avoided through water and wastewater savings (based on TSC key performance indicators for 2009); and
- Costs of program implementation.

Based upon these calculations, benefit cost analysis and annualised cost (costs per kL water saved on an annual basis) has been used to identify economically viable options for demand management. This analysis is essentially an economic screening process which can be used in development of the final demand management program.

Please note that two of the short listed measures (Measures 20 and 21) have not been evaluated any further as it assumed that they will form part of the TSC communication strategy and are relatively inexpensive to implement, for example, liaison with other key stakeholders and TSC promotion of state and federal programs.

4.1 SECTORAL WATER SAVINGS FOR CONSERVATION MEASURES

Estimated water savings are useful to help utility planners forecast the impact of measures on future demand. Savings usually develop slowly, reaching full maturity after full market penetration has been achieved. This may occur five to ten years after implementation.

Data that is required when forecasting water savings include locality specific data on baseline water use, demographics, market penetration, and unit water savings.

Baseline Water Use and Demographics

Baseline water consumption for each targeted end use was calculated, based upon the following TSC data:

- Number of accounts per non-residential sector (2008);
- Non-residential account growth (per capita) from 2008 baseline; and
- Average consumption for each non-residential sector (2008).

As some measures target specific sub-sectors it was necessary to calculate average consumption per account within each sub-sector, for example, caravan parks within the top 100. This means that the savings for these measures can be assessed with greater accuracy.

A proportion of total use was assumed for each targeted end use based upon data from the NSW Department of Energy, Utilities and Sustainability[4] (2006). Average per account water use for 2008 for each targeted sector was multiplied by the projected number of accounts, and by the end use percentage of total use, to determine end use consumption figures for each measure. These figures provided a basis from which savings potentials could be estimated.

---

[4] Integrated Water Cycle Management, Demand Side Management Decision Support System – Simplified (2006)

Market Penetration

Market penetration or 'uptake rates' were estimated based upon previous studies conducted by MWH, which used information collected from community surveys, discussions with service providers and experience in similar programs such as the SEQ WEMP and BWEP programs.

Unit Water Savings

Potentials for reduction in water use (unit savings) assumed for the study is presented in Table 4-1 (savings for auditing programs are shown in Appendix C). In 2003, Tweed Shire Council introduced volumetric charges for wastewater, which has contributed to a reduction in water use. To allow for the impact of the introduction of volumetric wastewater charging a 10% reduction in the assumed water savings percentage (as shown in Appendix C) has been incorporated for the water auditing and leak detection programs.

Unit water savings, in conjunction with uptake rates, were applied to baseline water consumption to determine the volume of savings possible through demand management measures. Estimated water savings for each shortlisted conservation measure are summarised in Table 4-1.

Long-term Water Savings

Once the measure had reached full implementation, the analysis assumes that any appropriate follow-up work is carried out to sustain the level of savings during the measure's ramp-up period.

4.2 PROGRAM COSTS

In order to assess the practicality of applying each of the short listed measures, the cost of implementation was estimated for each measure. Costs considered include:

- **Setup Costs** – the cost of developing and initiating the demand management program (such as costs associated with developing policies and/or strategies, developing program materials, etc);
- **Annual Costs** – ongoing annual costs associated with the continued support of demand management programs (such as administration costs); and
- **Account Costs** – one-off costs associated with the implementation of demand management measures for each participating account (such as labour and material costs).

The basis for cost assessment was previous work undertaken for clients such as Gold Coast Water, Queensland Water Commission, Department of Environment and Resource Management (DERM) and overseas projects.

4.3 BENEFITS FROM MEASURES

In order to provide a basis for comparison of the cost effectiveness of each option, the costs avoided through reduced water use and wastewater discharge have also been taken into account. Calculation of avoided costs was performed assuming the following:

- **Cost of water**: $220/ML – the marginal cost of treatment and distribution of potable water supply. Based on the energy and chemical cost per ML for 2008 (Performance Indicators (2009)). The cost per ML was assumed to double from $110/ML to $220/ML after taking into account the future upgrade of the Bray Park WTP to a membrane filtration plant. This was based on best available information at the time of report preparation.

- **Cost of sewage**: $150/ML – the marginal cost associated with the pumping, treatment and disposal of sewage. Based on the energy and chemical cost per ML discharged (TSC Performance Indicators (2009));

- **Industrial and Commercial Sewage Discharge Rate**: 80% - the percentage of water used by the Industrial and Commercial sectors which is converted to sewage; and

- **Public Sewage Discharge Rate**: 10% - the percentage of water used by the Public sector which is converted to sewerage. The low percentage is due to the high use of irrigation in this sector.

4.4 SELECTION OF PREFERRED MEASURES

A water conservation measure is deemed to be feasible where the benefits of the measure outweigh the costs of implementing and maintaining the measure. Benefit cost analysis was used to identify the most cost effective demand management options of the short listed measures.

Benefit/cost analysis can be carried out from several different perspectives i.e. from the viewpoint of the party (or parties) that are affected by the implementation of a measure. When conservation measures are being analysed, the perspectives most commonly used include:

- Participant – Person or account affected by the water conservation measures

- Utility – The supplier of water to the customer

- Community – The entire group of consumers and suppliers

The proposed measures for implementation are analysed from the utilities (TSC) perspective, as they are responsible for developing the most beneficial conservation plan for the region. The costs in this analysis are the actual costs incurred by the TSC (in conjunction with other parties) to assist in the conservation of water. The costs would include the following:

- Incentives

- Measure administration

- Marketing

- Customer surveys

- Customer audits

- Any other costs previously mentioned

When taking the utility perspective for benefit/cost analysis, two advantages are presented:

- Only direct costs of the water saving measures to TSC are considered. This enables TSC to have an equity when comparing potential investments for saving and the supply of water to customers

- Changes in revenue are treated as transfer payments, the analysis is not complicated with uncertainties associated with long-term rate projections and rates design assumptions.

For any analysis perspective that is taken, it is expected that some disadvantages will be encountered. Benefits that are accrued, or cost incurred outside the utility are not taken into account when taking the utility perspective:

- Any costs that may be incurred by customers striving to conserve water are not considered.

- Other factors external to the utility, such as environmental effects, are not taken into consideration. It is difficult to quantify these sorts of external factors, and because of this fact, any effect these factors would have on an economic analysis are excluded.

The effect of time on the value of costs and benefits in this study are not ignored. All values represented in the analyses are presented in present value terms, therefore equating all future values to their worth in 2008, using an effective return rate of 7%. The analysis was conducted between 2008 and 2036. The baseline year has moved forward by 2 years compared to the Stage 1 DMS assessment to allow for inclusion of the most recent customer water consumption data.

All parameters assumed in calculation are outlined in Table 4-1.

Assumptions used in program costs:

- These customer costs do not include implementation costs for customers resulting from audit.

- These audit cost assumes that the costs will be split evenly between TSC and the customer.

Table 4-1: Summary of Forecasting Assumptions

NO	MEASURE	END USE TARGETED	NUMBER OF ACCOUNTS (2008)	UPTAKE RATE	ESTIMATED SAVINGS	COSTS TO COUNCIL			COSTS TO CUSTOMER
					%	SETUP	ANNUAL	PER ACCOUNT	PER ACCOUNT
1	Major Users Audit (>20 ML/year)	All commercial, industrial and public end uses	21	All existing plus any new accounts	18% of each end use	$50,000	$5,000	3,400	$3,400
2	**Commercial Business Water Audit**								
2.1	- Caravan Parks (Top 100)	All commercial (caravan park) end uses	20	All existing plus any new accounts	22.5% of each end use	$25,000	$2,500	$1,700	$1,700
2.2	- Clubs (Top 100)	All commercial (clubs) end uses	9	All existing plus any new accounts	19.8% of each end use	$15,000	$1,500	$2,040	$2,040
2.3	- Shopping Centres (Top 100)	All commercial (shopping centre) end uses	7	All existing plus any new accounts	23.4% of each end use	$15,000	$1,500	$2,380	$2,380
3	Aged Care Audit (Top 100)	All public (aged care) end uses	10	All existing plus any new accounts	23.4% of each end use	$15,000	$1,500	$2,040	$2,040

NO	MEASURE	END USE TARGETED	NUMBER OF ACCOUNTS (2008)	UPTAKE RATE	ESTIMATED SAVINGS	COSTS TO COUNCIL			COSTS TO CUSTOMER
					%	SETUP	ANNUAL	PER ACCOUNT	PER ACCOUNT
4	Public Building Retrofit (all)	All public (public buildings) bathroom end uses	23	10% per year, up to 90% of public buildings	10% of bathroom end uses	$10,000	-	$3,200	-
5	TSC Open Space Irrigation Audit (Top 100)	All public (open space) end uses	12	All existing plus any new accounts	21.6% of each end use	$15,000	-	$5,080	-
6	Shower Regulation	All commercial, public and industrial shower use	-	All new accounts	30% of shower end use	$10,000	-	-	$90
7	TSC Facilities Audit (Top 100)	All industrial (TSC) facilities end uses	9	All existing plus any new accounts	13.5% of each end use	$10,000	-	$12,800	-
8	Open Space Irrigation Guidelines	All public (open space) end uses	216	All new, 10% of existing up to 50%	5% of each end use	$30,000	$2,500	-	$500
9	Tap Regulation	Commercial, public and industrial tap use	-	All new accounts	10% of tap end use	$10,000	-	-	$60
10.1	Water Management Plan as part of DA (Commercial and Public)	All commercial, public and industrial end uses	-	All new accounts with	10% of each end use	$10,000	$2,500	$1,000	$3,000

NO	MEASURE	END USE TARGETED	NUMBER OF ACCOUNTS (2008)	UPTAKE RATE	ESTIMATED SAVINGS	COSTS TO COUNCIL			COSTS TO CUSTOMER
					%	SETUP	ANNUAL	PER ACCOUNT	PER ACCOUNT
10.2	Water Management Plan as part of DA (Industrial)	All commercial, public and industrial end uses	-	estimated demand > 5 ML/year					$12,000
11	Leakage Audit for Top 100 users	Commercial, public and industrial leakage	100	20 per year up to 100, plus any new accounts	4.5% of each end use	$30,000	$3,000	$1,500	$1,500
12	Waterwise Non-residential Education (all accounts)	All commercial, industrial and public toilet end uses	1,404	All existing and new accounts	1% of each end use	$25,000	$3 per account		-
13	Water Efficient Toilet Regulation	All commercial, industrial and public toilet end uses	-	All new accounts	25% of toilet end use	$15,000	-	-	$1,000
14	Specific Recycled Water Projects	Need to considered on a case-by-case basis							
15	Awards Program	All commercial, industrial and public end uses	1,404	All existing and new accounts	1% of each end use	$15,000	$5,000	$5	-
16	Train landscape managers (all open space irrigation accounts)	All public (open space) end uses	216	1% of accounts up to 10%	10% of each end use	$5,000	-	$50 per account	$800

NO	MEASURE	END USE TARGETED	NUMBER OF ACCOUNTS (2008)	UPTAKE RATE	ESTIMATED SAVINGS	COSTS TO COUNCIL			COSTS TO CUSTOMER
					%	SETUP	ANNUAL	PER ACCOUNT	PER ACCOUNT
17	Water Management Audit for Major Users (>20 ML/year)	All commercial, industrial and public end uses	21	All existing plus any new accounts	3% of each end use	$50,000	$2,500	$3,000 per account	$3,000
18	Audit of Top Industrial Water Users	All industrial end uses	4	All existing plus any new accounts	13.5% of each end use	$20,000		$7,200	$7,200
19	Landscape Water Budgets (all open space irrigation accounts)	Public open space irrigation	216	80% of accounts at 10% per year	15% of each end use	$15,000	$2,000	$500	$1,000

4.5 DISCUSSION OF RESULTS

A summary of the results from the analyses described in Sections 4.1 to 4.4 is presented in Table 4-2.

Eight of the analysed measures were shown to be cost effective, having a benefit/cost ratio greater than 1.0 (i.e. the 'break even' point). Cost effective measures comprised (benefit/cost ratio in brackets):

- Measure 1 - Major users water audit;
- Measure 2 - Individual commercial business water auditing programs
  - Measure 2.1 - caravan parks;
  - Measure 2.2 - clubs; and
  - Measure 2.3 - shopping centres.
- Measure 3 - Aged Care Audits;
- Measure 5 - TSC Open Space Irrigation Audit;
- Measure 6,9 & 13 - Water Efficient Fixture Regulation;
- Measure 12 - Waterwise non-residential education program;
- Measure 16 - Train landscape managers.

Cost-effective measures identified were the auditing programs for major users (>20 ML/year) and commercial businesses (caravan parks, clubs and shopping centres). Option viability in this case can be attributed to the high potential for water savings within each of these sub sectors, justifying and reinforcing the recommendation that there is substantial benefit to be gained through targeting high water using accounts within the commercial sector.

Within the public sector, the most cost-effective measures are the auditing of aged care facilities and major parks and gardens as well as providing training of TSC parks and garden staff in efficient irrigation and turf management practices (Measure 16). In time, these measures could also be complemented by the development of Open Space Irrigation Guidelines (Measure 8).

In terms of regulation, the requirement for water efficient taps, showers and toilets (Measures 6, 9 and 13) in all new developments was identified as being cost-effective.

From an education perspective, the most cost effective measure identified was the introduction of a Waterwise non-residential education program. The high viability of this option is a result of the low setup and unit costs associated with the program. These low costs come hand in hand with broad application across all sectors and end uses, providing potential for significant savings.

4.5.1 SENSITIVITY ANALYSIS

There are a number of marginally cost-effective measures. A sensitivity analysis has been conducted based on the cost associated with the treatment and supply of water as well as the collection, treatment and discharge of sewage. Over the past 5 years, the energy and chemical costs associated with the treatment and pumping of water and sewage has increased by an average of 14% per year. An assessment of the impact of similar increases over the next two years has been undertaken to determine which, if any, of the other measures may become cost-effective.

Assuming a 14% increase in costs, *Measure 11 – Leakage Audit* becomes costs effective. At a 30% increase in cost (cumulative increase in cost over 2 years), *Measure 17 – Water Management Audit* and *Measure 18 – Audit of Top Industrial Water Users* becomes cost effective.

Leakage Auditing of the Top 100 is a marginally cost-effective measure. However, rather than being a standalone measure it should be conducted as part of water audit. Given this, Measure 11 has been included as a component of the water auditing measures (e.g. Measures 1, 2, 3 and 5).

Measure 17 could be implemented in conjunction with a water audit as part of gaining management commitment to water efficiency. It is recommended that this measure be considered for inclusion when developing the auditing programs.

Measures 18 should only be considered once the priority measures have been successfully implemented by TSC.

A sensitivity analysis has also conducted based on the current cost of water ($110/ML). In this instance, four of the marginally cost effective measures no longer have a positive cost benefit, these are:

- Measure 3 - Aged Care Audits;
- Measure 5 - TSC Open Space Irrigation Audit;
- Measure 16 - Train landscape managers.

The sensitivity of the measures has been mitigated by adopting the following strategies:

- Measure 16 has a low overall cost which can potentially be reduced further by combining it with the Open Space Irrigation Audit.
- In terms of priorities, Aged Care Audits should only be considered after the Major Users Audit and Commercial Auditing Programs have been completed. At this time, a reassessment of the viability of this measure and the potential savings can be made.
- The Open Space Irrigation audit is relatively expensive because the entire cost is borne by the Council itself. However, this extra cost is considered worthwhile to set an example to other users and as a means of demonstrating Council's commitment to water efficiency and the DMS.

Table 4-2: Summary of Measure Performance

NO	MEASURE	AVERAGE WATER SAVING (ML/YR)	COUNCIL BENEFITS NPV ($)	COUNCIL COSTS NPV ($)	COUNCIL BENEFIT/COST	PREFERRED MEASURE?
1	Major Users Audit	198.0	$717,831.5	$199,520	3.60	✓
2	**Commercial Business Water Audit Program**					
2.1	- Caravan Parks	101.6	$361,468.6	$100,142	3.61	✓
2.2	- Clubs	66.3	$246,113.4	$58,778	4.19	✓
2.3	- Shopping Centres	38.6	$143,858.1	$56,572	2.54	✓
3	Aged Care Audit	29.9	$78,334.3	$60,524	1.29	✓
4	Public Building Retrofit	3.3	$7,803.1	$74,891	0.10	
5	TSC Open Space Irrigation Audit	38.3	$99,276.0	$95,535	1.04	✓
6	Shower Regulation	10.9	$31,173.8	$10,000	3.12	✓
7	TSC Facilities Audit	13.3	$53,167.5	$128,201	0.41	
8	Open Space Irrigation Guidelines	7.9	$19,214.2	$60,343	0.32	
9	Tap Regulation	18.2	$51,956.3	$10,000	5.20	✓
10	Water Management Plan as part of DA	19.8	$54,474.0	$74,385	0.73	
11	Leakage Audit	80.0	$286,436.3	$300,553	0.95	
12	Waterwise Non-residential Education	28.3	$102,937.3	$93,933	1.10	✓
13	Water Efficient Toilet Regulation	60.4	$172,105.3	$15,000	11.47	✓
14	Specific Industrial Reuse Projects	-	-	-		
15	Awards Program	28.3	$102,937.3	$190,574	0.54	
16	Train landscape managers	2.1	$5,131.6	$5,088	1.01	✓
17	Water Management Audit	36.8	$140,925.2	$162,109	0.87	
18	Audit of Top Industrial Water Users	15.3	$62,820.0	$75,036	0.84	
19	Landscape Water Budgets	20.0	$51,478.5	$112,679	0.46	

Table 4-3: Sensitivity of Benefit Cost to Increases in Water and Sewage Costs

			INCREASE OF 14%		INCREASE OF 30%	
NO	MEASURE	AVERAGE WATER SAVING (ML/YR)	COUNCIL BENEFIT/COST	PREFERRED MEASURE?	COUNCIL BENEFIT/COST	PREFERRED MEASURE?
1	Major Users Audit	198.0	4.10	✓	4.68	✓
2	**Commercial Business Water Audit Program**					
2.1	- Caravan Parks	101.6	4.11	✓	4.69	✓
2.2	- Clubs	66.3	4.77	✓	5.44	✓
2.3	- Shopping Centres	38.6	2.90	✓	3.31	✓
3	Aged Care Audit	29.9	1.48	✓	1.68	✓
4	Public Building Retrofit	3.3	0.12		0.14	
5	TSC Open Space Irrigation Audit	38.3	1.18	✓	1.35	✓
6	Shower Regulation	10.9	3.55	✓	4.05	✓
7	TSC Facilities Audit	13.3	0.47		0.54	
8	Open Space Irrigation Guidelines	7.9	0.36		0.41	
9	Tap Regulation	18.2	5.92	✓	6.75	✓
10	Water Management Plan as part of DA	19.8	0.83		0.95	
11	Leakage Audit	80.0	1.09	✓	1.24	✓
12	Waterwise Non-residential Education	28.3	1.25	✓	1.42	✓
13	Water Efficient Toilet Regulation	60.4	13.08	✓	14.92	✓
14	Specific Industrial Reuse Projects	-				
15	Awards Program	28.3	0.62		0.70	
16	Train landscape managers	2.1	1.15	✓	1.31	✓
17	Water Management Audit	36.8	0.99		1.13	✓
18	Audit of Top Industrial Water Users	15.3	0.95		1.09	✓
19	Landscape Water Budgets	20.0	0.52		0.59	

4.6 EVALUATION OF PREFERRED MEASURES

In performing the total water demand forecasts, interaction between individual measures was taken into account. As several of the preferred measures target a similar customer base, interaction is a critical consideration to avoid double accounting of savings possible through demand management programs.

Interaction between non-residential measures was taken into account by assuming that the major users water audit (targeting the 21 highest users) would be undertaken as a first priority. Savings potentials for the individual commercial business water auditing program were then estimated after removing from the target group those customers already involved in the major users audit. A similar process was used to interact the aged care auditing program and the TSC open space irrigation audit program. Fixture regulation and waterwise education were then assumed as a further percentage reduction on the already reduced baseline demand.

The cost-effectiveness and annual average water savings for each of the preferred measures are shown below in Table 4-1. Table 4-1 also takes into account the customer side costs.

Table 4-4: Cost Effectiveness and Water Savings for Non-residential Program (2008-2036)

SECTOR	COUNCIL NPV ($)	CUSTOMER NPV ($)	TOTAL NPV ($)	AVERAGE ANNUAL POTABLE SAVINGS (ML/YEAR)	ANNUALISED COST ($/KL)
Major Users Audit	$199,520	$88,834	$288,354	198	$0.12
Commercial Business Water Audit Program	$187,864	$66,119	$253,983	87	$0.24
Aged Care Audit	$60,524	$27,319	$87,843	30	$0.24
TSC Open Space Irrigation Audit	$82,855	$0	$82,855	24	$0.28
Waterwise Non-residential Education	$93,933	$10,779	$104,712	28	$0.30
Training Landscape Managers	$5,088	$14,147	$19,235	2	$0.75
Non-res Efficient Fittings Regulation and Management	$109,385	$765,559	$874,944	113	$0.64
Total	**$739,170**	**$972,756**	**$1,711,926**	**483**	**$0.29**

4.7 DEMAND FORECAST WITH IMPLEMENTATION OF PREFERRED MEASURES

Water demand forecasts for TSC were developed assuming the adoption of the measures recommended in Section 4.6. Figure 4-1 and Table 4-5 below outline the water demand management forecast outcomes.

Figure 4-1: Non-residential Managed Demand Forecast

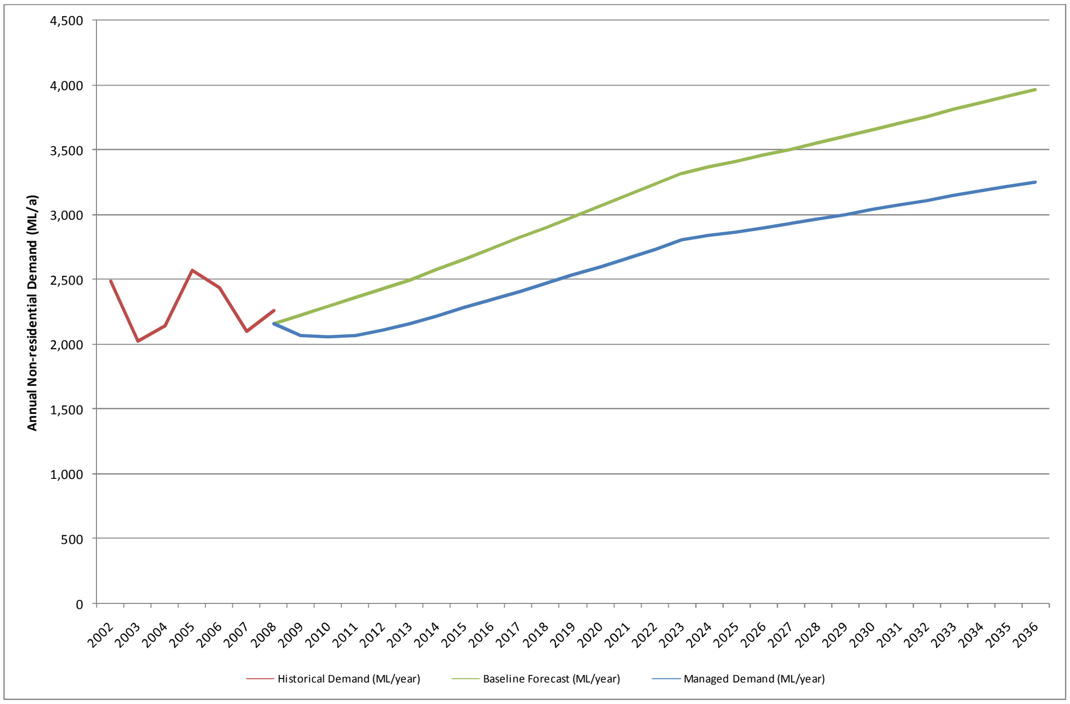


Table 4-5: Non-residential Managed Demand Forecast

	2008	2013	2018	2023	2028	2033	2038
Managed Demand (ML/year)	2,162	2,161	2,471	2,803	2,964	3,144	3,329
Savings (ML/year)	-	338	432	517	590	667	741
Savings (%)	-	14%	15%	16%	17%	18%	18%

4.8 INCENTIVES FOR IMPLEMENTATION OF DEMAND MANAGEMENT

There exist several existing incentives for the implementation of demand management programs within the Tweed Shire Council non-residential sector. These include:

- The potential for multiple economic benefit to accrue due to savings in water supply charges coupled with reduced costs in wastewater disposal and trade waste charges;
- Marketing potential associated with water efficiency programs, as water scarcity gains increasing media attention and public interest;
- The high proportion of water use among a relatively smaller customer base (5% of customers are responsible for 70% of town water consumption). This means that specific customers can be targeted and significant savings can be achieved; and
- The high proportion of water use within the commercial sector. The commercial sector has a high homogeneity of end uses and there is information widely available on how to increase the water efficiency of this sector through the implementation of low cost measures.

4.9 BARRIERS TO IMPLEMENTATION OF DEMAND MANAGEMENT

Barriers to the implementation of demand management measures include:

- Insufficient knowledge of water saving technology and the associated benefits (in local governments, public and private organisations)
- A lack of financial or regulatory incentives for consumers to save on water use;
- Lack of credible published data on existing and new technologies;
- Lack of well developed programs containing incentives;
- Lack of a legislative driver to ensure efficiency in new development; and
- Limited (and passive) legislative drivers for efficiency gains in existing development.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The following conclusions can be drawn based on the assessment of water demand management measures for the Tweed Shire Demand Management Strategy Stage 2:

1. The non-residential sector accounts for an average of 28% of customer water use in TSC.

2. The top 100 water using non-residential accounts (which represent approximately 5% of all non-residential accounts) are responsible for 70% of non-residential use.

3. The commercial sector is the highest non-residential water user at 60% of the total use. Homogeneity of end uses and the large number of commercial customers in the top 100 make this sector attractive for achieving significant, long-term water savings at a reasonable cost. High water using sub-sectors include caravan parks, clubs, shopping centres and mobile home parks.

4. The public sector includes aged care facilities, schools, TSC buildings, TSC open space (e.g. sports grounds and parks and gardens) and hospitals, and constitutes 19% of non-residential consumption. The high water using sub-sectors include aged care facilities, TSC open space irrigation and, to a lesser extent, hospitals.

5. The diversity of water usage within the industrial sector is the highest of that in any sector due to the specific nature of manufacturing processes employed in each business. This sector makes up 13% of the total water demand in TSC, however, nearly 70% of this is consumed by just 5 users.

6. Sewer, Bulk Sales and Rural contribute a total of 8% of the non-residential demand, which is less than 3% of the total TSC water demand.

7. To identify global opportunities for demand management in the non-residential sector, a review of successful water conservation measures in NSW, interstate, nationally and internationally was undertaken. The review revealed both common attributes and innovative approaches to non-residential demand management.

8. A long list of demand management measures was created for TSC based on:

    - An assessment of non-residential demand including a detailed assessment of top water users and sub-sectors;

    - An assessment of end uses within each of the targeted sub-sectors;

    - A review of non-residential demand management programs and measures adopted in NSW, interstate and overseas; and

    - Consideration of future growth in the non-residential sector.

9. A qualitative assessment was undertaken of the long list of measures for the sector based on a triple bottom line multi-criteria assessment. The assessment reduced the number of measures to 23 which were then considered in detail.

10. The short listed options were evaluated in detail based on their water savings and costs from both a customer and council perspective. For each measure an annualised $/kL value and cost-benefit from the TSC perspective was calculated.

11. Seven measures have been recommended for implementation by TSC in the short term, this includes audits of major users (>20 ML/year), audit of caravan parks, clubs and shopping centres, and the development of a non-residential education program.

12. Measures that may become viable in the future include audits of large industrial facilities and the requirement for new large users to develop a water management plan at the DA stage.

13. The implementation of the recommended measures could potentially reduce non-residential use by 18% in 2038.

5.2 RECOMMENDATIONS

Based on the assessment of non-residential demand management for TSC, it is recommended that:

- TSC develop an auditing program targeting the major users (>20 ML/year). Following the marketing and successful implementation of this program it is recommended that that the balance of the caravan parks, shopping centres, clubs and aged care facilities within the top 100 be targeted. Auditing programs should include the requirement to conduct a leakage assessment using data-loggers.

- The auditing of major water using parks and gardens should be undertaken and reinforced by training for TSC parks and gardens staff. Ideally, this should be complemented by the development of Open Space Irrigation Guidelines which would govern how parks and gardens and sports grounds within TSC are irrigated and managed in the future.

- TSC consider the introduction of regulations to control non-residential internal fitting and fixtures including taps, showers, toilets and possibly urinals. This should be complemented by the requirement for any new major user (e.g. 5 ML/year) to complete a water management plan at the DA stage. The Plan may include the provision that customers must use of an alternative water source e.g. rainwater, stormwater, recycled water etc, for non-potable water uses on-site.

- A non-residential education program be developed targeting the key sub-sectors identified. This could involve the preparation of fact sheets targeting water use efficiency within each of the targeted sectors e.g. caravan parks, clubs. There is significant amount of resources available on the internet relating to these sectors, including guidelines and check lists, which can be adapted and used by TSC as part of the education program.

- As part of the overall communications strategy, council liaise with key state government departments regarding the implementation of water efficiency programs (i.e. audits, retrofits) for state government buildings, such as hospitals and schools. It is also recommended that TSC organise workshops with Chamber of Commerce as well as other industry and commercial representatives to form relationships and disseminate key information regarding conservation programs to target sectors.

Further discussion on the implementation of these recommended programs will be provided in the Final DMS.

APPENDIX A

REVIEW OF NON-RESIDENTIAL DEMAND MANAGEMENT

6. REVIEW OF NON-RESIDENTIAL DEMAND MANAGEMENT

6.1 INTERSTATE AUTHORITIES

Interstate approaches to water conservation in the commercial sector through improved efficiency vary from a minimalist to a proactive approach incorporating active programs involving water audits and incentives. The approaches adopted by several interstate agencies were investigated including Sydney Water, Water Corporation (Western Australia), Yarra Valley Water and Hobart City Council.

6.1.1 SYDNEY WATER CORPORATION (SWC)

Aggressive water conservation targets are imposed on SWC as part of its Water License. In addition, the Sydney basin is currently facing a serious water crisis. In response, a range of demand management initiatives have been developed targeting all sectors including the commercial and public sectors. The ‘Every Drop Counts Business Program’ has been operating since around 1999, targeting large non-residential water users. In October 2004, the NSW Government announced the Metropolitan Water Plan for the Sydney region, which includes mandatory Water Management Plans for major users.

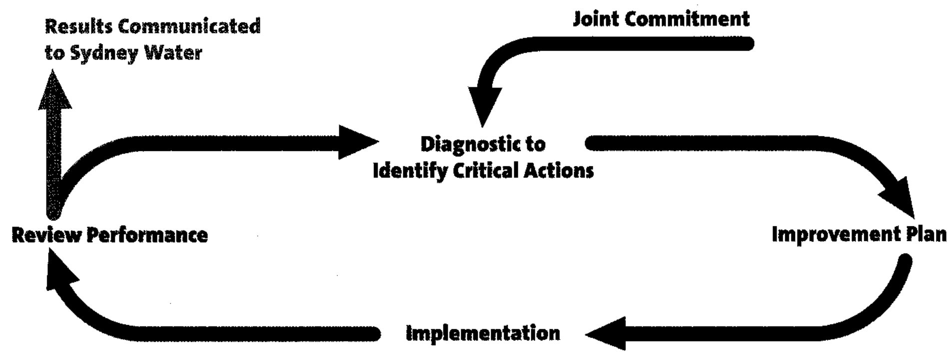
6.1.1.1 EVERY DROP COUNTS BUSINESS PROGRAM

The ‘Every Drop Counts’ Business Program’ (EDCBP) is designed to target large non-residential water users. The program involves a business or government agency entering into a voluntary water saving agreement with SWC. The target customers are those with water bills greater than $70,000 per annum. The EDCP relies on a range of marketing tactics to target selected large water users.

Since the inception of the program, approximately 270 businesses have participated, contributing to an estimated saving in water of 11 ML/d (when compared to the pre-program water consumption).

The EDCBP is designed to integrate water conservation practices into everyday management and business operations, as well as at a strategic level. Figure 6-1 shows the Every Drop Counts Process from a conceptual level.

Figure 6-1: Sydney Water's Every Drop Counts Program[5]



In order to address water efficiency in the non-residential sector, SWC has also developed a diagnostic tool called "One-to-Five". The process is designed as a holistic approach to water management at a business level, rather than at an engineering level. The goal is to assist business to achieve water savings and to continually improve their water efficiency. The tool ranks users from one star (basic understanding of water management) through to five stars (best practice).

The One-to-Five tool is designed to help measure and rate water management performance, reduce costs and improve environmental performance, build management systems for water, use resources efficiently and to promote good corporate citizens. This tool includes a self assessment program, which involves answering a series of questions to ascertain the star rating as shown in Figure 6-2.

[5] Sydney Water, Mohan Seneviratne, Sydney Water, Interview November 2005.

Figure 6-2: 'One-to-Five' Diagnostics Tool

Sample of diagnostic results

ELEMENT	LEVEL OF DEVELOPMENT 1Star	2Star	3Star	4Star	5Star	Critical Action Items
1.1 Demonstrated corporate commitment		★				
2.1 Understanding of performance and opportunities			★			Critical
3.1 Targets, performance indicators (KPI) and motivation		★				
3.2 Plans					★	
4.1 Accountabilities		★				
4.2 Awareness and training	★					Critical
4.3 Resourcing		★				
5.1 Criteria/budgets for capital expenditure (CAPEX)		★				
5.2 Operating budgets		★				
6.1 Water supply, quality & reliability					★	
6.2 Compliance with legal and other requirements				★		
7.1 Operating procedures		★				
7.2 Maintenance procedures		★				
8.1 Efficiency of existing plant design			★			
8.2 Innovation and new technology			★			
9.1 Metering and monitoring		★				Critical
9.2 Reporting, feedback and control systems		★				Critical
9.3 Documentation and records	★					Critical
10.1 Water cost performance in the past 12 months		★				

Overall Ranking : 2 Star % Achievement : 38% % Achievement to reach next level : +8%

6.1.1.2 WATER AUDITING

Of critical importance to the EDCBP is the auditing process. Water audits are used to determine where and how much water can be saved, and are critical for conservation planning. SWC employs a number of contractors to carry out audits, which are funded either by the business, SWC or in some cases co-funded. In brief, the auditing process has proven to be flexible and concise, and often results in the installation of useful sub-metering. This has additional benefits in terms the ongoing monitoring and maintenance of water savings.

6.1.1.3 WATER SAVING FACT SHEETS

In conjunction with the EDCBP, SWC has also developed a number of fact sheets to assist commercial businesses reduce water consumption. Included in these fact sheets are:

- Best Practice Guidelines for Cooling Towers in Commercial Buildings
- Best Practice Guidelines for Clubs and Hotels
- A range of fact sheets relating to water conservation in generic commercial areas such as for kitchens, laundries, outdoor areas, guest rooms, public amenities and general maintenance.

These fact sheets and guidelines are available on SWC's website.

6.1.1.4 PRIVATE FINANCE

SWC has also entered into an agreement with Macquarie Bank to provide private finance for conservation projects. According to SWC, this service has proved to be extremely popular amongst EDCBP participants, as it levels the outlay by the business and pays for retrofitting without increasing operating costs.

6.1.1.5 PROGRAM SUCCESS

SWC's programs have demonstrated that individual business water demand can be reduced by between 10 and 30% depending on investment levels. Most often businesses will invest in those measures that provide a 3 to 4 year payback.

Despite these successes, the program has not provided significant demand reduction, because the EDCBP is a voluntary program, and the program requires significant resourcing levels. In addition, it is understood that any retrofitting work is undertaken by the business adding to the administrative cost.

6.1.2 SYDNEY METROPOLITAN WATER PLAN

Sydney's water shortage has taken centre stage in recent years as it has become increasingly public that, despite demand management programs, demand is outgrowing supply. In response, the NSW Government has developed the Metropolitan Water Plan, which was released in October 2004. Included in this plan are a number of initiatives aimed at achieving more rapid and concrete water savings in the Sydney metropolitan area[6].

6.1.2.1 WATER SAVINGS ACTION PLANS

As part of the Metropolitan Water Plan, businesses consuming more than 50 ML/a, councils and state government agencies are required to prepare water savings action plans before the 31st of March 2006. The structure of these action plans have been outlined by the Department of Energy Utilities and Sustainability (DEUS) in the 'Guidelines for Water Savings Action Plans'. These guidelines include a 12 month baseline monitoring process to ensure rigour is maintained in the assessment process, as well as guidance on developing water conservation programs.

Once the action plan and monitoring has been completed, the business / council / agency must implement cost effective measures to improve water efficiency by September 2007[7].

6.1.2.2 DEMAND MANAGEMENT FUND

To encourage businesses and councils to implement water conservation projects, the government has established a $30m per annum fund (lasting 4 years) for demand management projects. DEUS will allocate funding to projects based on cost / benefit ratio of water savings.

The Demand Management Fund and Water Savings Action Plans are both being managed by DEUS. The intention being that funds are directed to large water users to finance programs, which would otherwise be uneconomical. It has been estimated that a reduction in business consumption of 20% can be achieved through these approaches (29).

6.1.2.3 WATER PRICING REVIEW

The Metropolitan Water Plan is also looking at reviewing water pricing. A report has been prepared by the Independent Pricing and Regulatory Tribunal that recommends the following changes to household billing structures:

- Introduction of a two-tier price structure in Sydney, so that households will be charged a higher price for the water they use above a certain reasonable volume.

---

[6] DIPNR 2005, 'Metropolitan Water Plan', Department of Infrastructure, Natural Resources, Mines and Water, 2004.

[7] DEUS, www.deus.nsw.gov.au, 8/11/2005.

- Reduction of the fixed component of household water bills, so that consumers are likely to have a stronger motivation to reduce the variable part of the water bill which is directly related to the volume of water they use.

The Government has also recognised that a change in the pricing structure of water supplied to businesses may assist in reduction of demand. At present these changes are still being considered by the NSW Government[8].

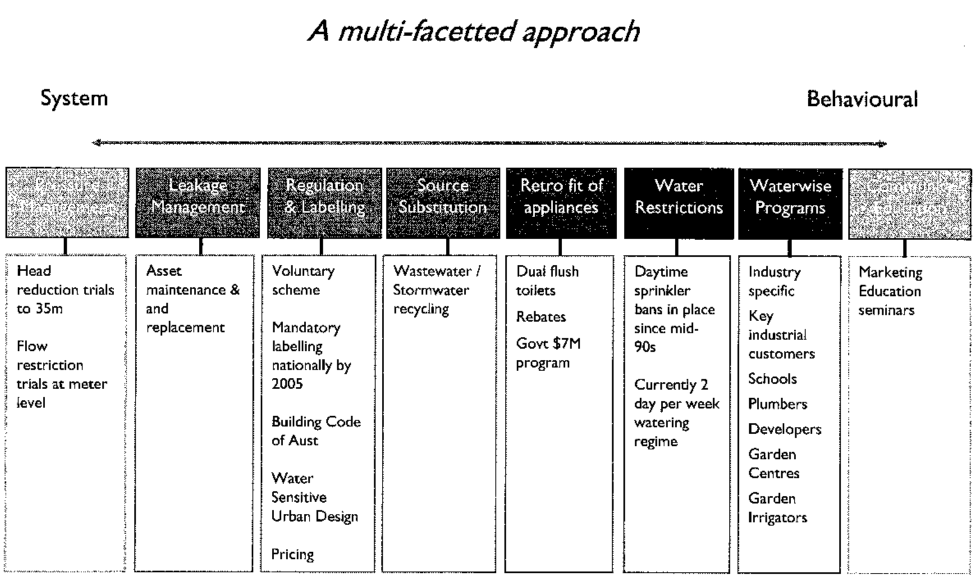
6.1.3 WATER CORPORATION (WC)

The Water Corporation's (WC) sustainable water supply initiatives fall under the Water Cycle Project which was created in 2003 to aid the implementation of the State Water Strategy, an initiative of the Western Australian State Government. The State Water Strategy is a comprehensive approach to water management aimed at critical issues, including:

- Water conservation and efficiency
- Water recycling
- New supplies and total water cycle management
- Innovation research and education
- Resource protection and management.

WC is developing water efficiency and demand management programs aimed at system and behavioural change. Figure 6-3 shows the multi-facetted approach being adopted for water efficiency and demand management.

Figure 6-3 : WAWC's Multi-facetted Approach to Demand Management[9]



---

8 IPART, www.iprt.net , 8/11/2005.

9 Water Corporation, 'Water Corporation -Water Cycle Project – Water Efficiency', http://www.watercorporation.com.au/watercycle/watercycle_efficiency.cfm, 7/11/2005.

6.1.3.1 RETROFIT INITIATIVES

WC offers a number of rebates for domestic water efficient improvements, but currently does not offer any financial assistance for the non-residential sectors. The focus has been directed towards residential, as this sector accounts for 70% of water consumption compared to the top 200 non-residential customers, which account for less than 15% of total water consumption.

The non-residential approach has been to work closely with the top 200 non-residential customers using the 'One-to-Five' program, which is similar to the SWC approach. The majority of the top 200 non-residential customers have participated in a basic water audit under the 'One-to-Five' program, however, WC has not gauged implementation actions. The process adopted requires the initial audit to be conducted with a follow up review after 12 months. As no financial assistance is provided, the onus is on the customer to arrange for and fund retrofits.

WC emphasises the importance of involving a customer's senior management in the 'One-to-Five' process to gain real corporate support prior to implementation.

6.1.3.2 WATERWISE PROGRAMS

The WC has developed a family of WaterWise programs with the aim to encourage behavioural change in the community through industry alliance and partnerships to provide consumers with a water efficient choice. The programs include:

- Waterwise Garden Centres
- Waterwise Landscapers
- Waterwise Plumbers
- Waterwise Garden Irrigators
- Waterwise Display Villages
- Waterwise Landscape Designers.

In general, each program has specific criteria for a business to qualify as being a WaterWise program member.

The WaterWise initiative provide further assistance to business by providing information fact sheets, checklists and a list of recommended WaterWise auditors.

6.1.4 YARRA VALLEY WATER

Yarra Valley Water (YVW) commenced the development of their commercial water conservation program in 2000 and at the time made a strategic decision to steer away from heavily funded incentive based programs to a user pays system. The 'Save Water Efficiency Service' developed by YVW has a major emphasis on marketing by initiating contact with a customer and then demonstrating the possible savings incurred as a result of increased water efficiency.

According to program administrators, the concept of a user pays scheme has inspired a cultural change in commercial organisations by allowing the customer to realise the savings solely from their own resources. The change has, in some cases, encouraged the adoption of further measures outside the initial water audit report and also promoted the extension of measure implementation to other facilities under a common ownership i.e. shopping centres.

Since the beginnings of the 'Save Water Efficiency Service', up to 300 commercial and industrial customers have participated as well as up to 100 schools. The service has an annual turnover of $1.5million a year, which comprises of water audits and retrofits. At anyone time the service has up to 12 water auditors actively carrying out water conservation activities in the field.

The 'Save Water Efficiency Service' is licensed by YVW and is now utilised by other water service providers in Victoria including the Melbourne metropolitan authorities and other regional service providers such as Geelong and Gippsland. The licensing and distribution of the program is an example of coordination between multiple water service providers.

The program involves conducting a basic water audit at the customer's expense. To encourage the use of the 'Save Water Efficiency Service', a money back guarantee is given should the audit fail to identify a minimum of 5% in possible water savings. The aims of the water audit report include:

- to quantify savings for recommended efficiency measures
- to identify pay back periods of each recommendation based on water and wastewater charges as well as electricity costs
- to supply a quotation for implementing the recommendations.

A further extension of the program is the provision of finance for the implementation of recommendations. The financier, Melbourne City Council has provided $10m towards a sustainability fund, which is used to fund water conservation measures recommended in water audits. The repayment of finance is made through a pay-by-savings model and incorporates a cost of finance component. In the case of non-profit organisations, YVW finances any required works with the cost of finance component excluded from repayments. The cost of water audits is included in the overall costs of implementation.

The program is implemented and managed by YVW using 12 field auditors. Steps in the program are as follows:

- Sub-sectors and specific end uses identified as targets for programs, e.g. hygiene in the hotels, clubs sub-sector
- Program promoted to targeted customers
- Audits arranged and undertaken using contractors
- Costs and benefits identified for the customer. Actions prioritised on payback period basis.
- Funding agreement with customer – either "pay by savings" or once off payment
- Retrofit undertaken by either YVW contractor or customer contractor
- Review of savings after 12 months (providing an opportunity to adjust or expand program)

Based on the program to date, YVW has identified actions that are most common and these have been prioritised on a cost effectiveness basis as follows (36):

<u>Priority 1 Actions (short payback)</u>

- Install flow control valves
- Install restrictors
- Repair leaks
- Adjust toilet cistern
- Install hose nozzles and pressure cleaners.

Priority 2 Actions (medium payback)

- Fine tune cooling tower performance
- Adjust urinal flush volume to Australian Standard
- Install 6/3 L dual flush toilets if cisterns and pans require replacement
- Install auto sensors for urinals.

Priority 3 Actions (long payback)

- Rainwater harvesting and connect to toilet where feasible
- Stormwater harvesting with tank to toilet and garden and lawn watering options
- Upgrade cooling systems (replace once through systems) when economically justifiable
- Other cooling system upgrades.

As shown above the prioritised actions recommended by YVW are generally restricted to proven, low cost water conservation measures with paybacks of less then 2 years. This normally excludes recommending upgrades of cooling towers, due to the operational sensitivity and complexity of these units. It was also found that customers will avoid changing toilets due to cost and extended payback periods.

Initial results of the 'Save Water Efficiency Service' indicate water savings between 22 and 30% for various commercial categories. Table 6-1 shows an example of savings for a sample of 10 audits for schools, shopping centres, swim centres and commercial offices.

Table 6-1 : Examples of Identified Savings under the 'Save Water Efficiency Service'

CATEGORY	WATER SAVINGS (%)	WATER SAVINGS ($)	SEWERAGE SAVINGS ($)	ELECTRICITY SAVINGS ($)	AVERAGE PAYBACK (MONTHS)
School	30	795	925	8,600	14
Shopping Centre	22	7,750	8,795	12,890	6
Swim Centre	22	3,245	3,245	14,100	2
Commercial Offices	23	1,030	1,200	1,600	9

Notes: - Based on 10 customer water audits.

- Energy cost based on hot water savings.

6.1.5 AUSTRALIAN CAPITAL TERRITORY (ACT)

The ACT has developed a strategy for sustainable water resources management titled 'Think Water, Act Water'[10]. The major objectives of the strategy include:

- Improve water use efficiency
- Ensure long term reliability of water resources
- Establish regional approach to ACT/NSW cross-border water supply
- Protect riverine water quality
- Direct water sensitive urban design principles into new development
- Promote community involvement in the management of the ACT Resource Strategy.

A major component of the strategy is the participation of the ACT in the Murray-Darling cap on water diversions, which aims to limit the amount of water resources extracted from the Murray-Darling Basin to a 1993-94 development level[11]. To achieve the proposed cap the ACT government aims to reduce per capita consumption by 12% by 2013 and 25% by 2023 (47).

To enable per capita consumption targets to be achieved the ACT Office of Sustainability has initiated a water efficiency and rebates program. The rebates forming part of the program are aimed at the residential sector, while a water audit program is aimed at the commercial sector.

6.1.6 HOBART CITY COUNCIL

Hobart City Council has set a target of reducing the City's water consumption by 10%, equating to around 3 ML/d. To encourage water conservation a rebate scheme for residential and non-residential customers has been developed. Table 6-2 summarises the rebates provided for non-residential customers.

Table 6-2 : Hobart City Council - Non-residential Rebate Scheme

ITEM	REBATE	OTHER ADVICE
Water audit on whole property	$50	Performed by accredited GreenCity Service™ provider
Replacement of single flush with dual flush toilet	$10	
Rainwater storage	$320	Greater than 25,000 litres only
Waterless urinal	$50	Must be 'WaterMark' authorised

[10] Office of Sustainability – ACT, http://www.sustainability.act.gov.au/water/waterefficiencyrebates.html, 9/01/2006.

[11] ACT Government, Think Water, Act Water : Volume 1 – Strategy for Sustainable Water Resource Management in the ACT, http://www.thinkwater.act.gov.au/documents/Vol1screen_000.pdf, 9/1/2006.

The rebates offered by Hobart City Council are low compared to the cost of installing water conservation fittings and fixtures. As a result, the exercise of offering such rebates generally act as a marketing exercise aimed at providing water conservation knowledge to non-residential customers towards particular end uses. The uptake of the non-residential rebate scheme has been insignificant.

6.2 FEDERAL GOVERNMENT

Initiatives and regulation relating to the Federal Government are centralised around the National Water Initiative (NWI). In conjunction with the NWI the Federal Government has, to date, introduced the Australian Government Water Fund (AGWF) and regulation for the Water Efficiency Labelling and Standards scheme (WELS).

In addition, legislation outlining water management requirements for federally controlled airports has been enacted to achieve efficiency.

6.2.1 NATIONAL WATER INITIATIVE (NWI)

The Council of Australian Governments (COAG) agreed in June 2004 to the National Water Initiative (NWI), which provides a platform for ongoing national water reform. Under the initiative a number of key elements have been outlined, including:

- Water access entitlements and planning framework
- Water markets and trading
- Best practice water pricing
- Integrated management of water for environmental and other public benefit outcomes
- Water resource accounting
- Urban water reform
- Knowledge and capacity building
- Community partnerships and adjustment.

In the context of commercial water conservation through improved water efficiency, the key element of interest is urban water reform, which has the following objectives:

- ensure healthy, safe and reliable water supplies
- increase water use efficiency in domestic and commercial settings
- encourage the re-use and recycling of wastewater
- facilitate water trading between and within the urban and rural sectors
- encourage innovation in water supply sourcing, treatment, storage and discharge
- achieve improved pricing.

A major element of the NWI was the creation of the National Water Commission (NWC), which is an independent statutory body in the Prime Minister's portfolio. The Commission's role includes advancing the national water reform agenda, providing advice to the Australian Government and COAG on national water issues and assisting in the implementation of the NWI. The NWC also administers the $2 billion in funding under the AGWF.

6.2.2 AUSTRALIAN GOVERNMENT WATER FUND (AGWF)

The Australian Federal Government, within the context of the NWI, established the AGWF with $2 billion in funding over five years. The objective of the fund is to invest in water infrastructure, improve water management and generally improve practices to increase Australia's water efficiency and provide enhanced environmental outcomes.

The funding under the AGWF is to be directed towards projects that help to achieve the objectives, outcomes and actions of the NWI. The AGWF consists of three programs including:

- Water Smart Australia Programme
    - Consists of $1.6 billion in funding over five years.
- Raising National Water Standards Programme
    - Consists of $200 million in funding over five years.
- Community Water Grants Programme
    - Consists of $200 million in funding over five years
- Administered by the Departments of the Environment & Heritage and Agriculture, Fisheries & Forestry.

The Community Water Grants Programme has recently made available funding for schools. Under the program, grants of up to $50,000 per project can be provided. In Queensland, it is understood that at least 30 schools have applied through the Green Plumbers Associations 'Schools Water Audit Campaign'.

6.2.3 WATER EFFICIENCY LABELLING AND STANDARDS (WELS)

The WELS Scheme provides a national approach to water efficiency information to assist consumers and encourages manufacturers to improve the efficiency of their products. The objective of the scheme is to promote water efficient products and appliances to provide long term water savings while maintaining individual choice.

The Department of the Environment and Heritage is responsible for the WELS Scheme. The scheme is governed by the *Water Efficiency Labelling and Standards Act 2005*.

The regulatory area of WELS includes the following products and appliances:

- Clothes washing machines
- Dishwashers
- Flow controllers

- Toilet (Lavatory) equipment
- Showers
- Tap equipment (Kitchen, bathroom, laundry & ablution trough use)
- Urinal equipment

The WELS will be implemented over a period of time with full compliance required by the 1 January 2008. Table 6-3 outlines the critical dates for WELS compliance.

Table 6-3 : WELS Implementation Timetable

CRITICAL DATES	PRODUCTS
1 July 2005	Products may be voluntarily registered and labelled.
1 July 2006	New retail stock must be registered and labelled. Toilet (lavatory) equipment subject to minimum water efficiency requirements.
1 January 2007	Pre-existing retail stock including tap equipment, showers, toilet equipment and urinal equipment must be labelled.
1 January 2008	Pre-existing retail stock including washing machines and dishwashers must be labelled.
Flow controllers are only included in the scheme on a voluntary basis. They can be voluntarily registered at any time, but are subject to compliance requirements when registered.	

The Regulator, Australian Minister for the Environment and Heritage, has the capacity under the Act to make determinations on the products covered by the scheme and the standards that apply. The application of standards to WELS products may include a minimum water efficiency requirement. Currently, the only product with a minimum water efficiency provision is lavatory equipment, requiring the water consumption per average flush to be no greater than 5.5 L. An average flush of 5.5 L is based on one full flush to four half flushes correlating to a dual 9/ 4.5 L toilet.

Each state government has the responsibility to develop supporting legislation for the federal WELS project. Queensland legislation was passed by parliament in October 2005 and is titled the *Water Efficiency Labelling and Standards Act 2005.*

6.2.4 AIRPORTS ACT

The *Airports Act 1996* requires applicable airports to have an environment strategy to prevent, control and reduce the environmental impact associated with their operations[12]. An environmental strategy is valid for a 5 year period, prior to requiring a revision.

[12] Commonwealth Consolidated Acts,http://www.austlii.edu.au/au/legis/cth/consol_act/aa1996129/s116.html', 14/11/2005

As an example, the Brisbane Airport Corporation (BAC) has an environmental strategy to satisfy the requirements of the *Airports Act 1996*. The current environment strategy incorporates the following actions relating to water conservation (58):

- Inventory of all major water consumers on airport site
- Water conservation program (based on water audit program)
- Investigate feasibility of:
  - onsite recycling of sewerage effluent and greywater for irrigation purposes
  - stormwater harvesting for irrigation use
- Continued investigation of water conservation technology for future application at Brisbane Airport.

It is clear that this regulation has been effective in creating awareness of end use behaviour and has resulted in the implementation of viable measures to reduce water consumption.

6.3 INTERNATIONAL

Activity in water conservation overseas is varied, with the United States and Singapore having well established mature programs, while the United Kingdom and Europe are in the development phase. The degree of involvement in water conservation is dependent on the importance of water as a resource and the coordination between organisations of interest. In Singapore and the United States, water shortages have inspired significant effort and innovation in water conservation and coordination between government bodies.

6.3.1 UNITED STATES (US)

Water conservation in the United States (US) has been developing over a 20 year period. During this time, effective programs incorporating multiple water utilities have been developed. An excellent example of coordination between water utilities on a statewide basis is in California, where water conservation programs are coordinated through a voluntary group called the California Urban Water Conservation Council (CUWCC).

Part of the success of the CUWCC coordinated programs is due to the implied pressure on water service providers to reduce potable water demand by state authorities to halt the environmental degradation of waterways. The failure to reduce demand could lead to regulated reductions in the raw water entitlements of service providers.

6.3.1.1 CALIFORNIA MOU APPROACH

The California Urban Water Conservation Council (CUWCC) is an organisation formed by water utilities to coordinate water conservation measures. The CUWCC developed the *Memorandum of Understanding Regarding Urban Water Conservation in California* (MOU), which is the central coordinating document required to be signed to enable participation in the CUWCC conservation programs. The programs encompass all facets of water conservation and include residential and non-residential customers. The purpose of the MOU is[13]:

[13] California Urban Water Conservation Council, 'Memorandum of Understanding Regarding Urban Water Conservation in California', March 1994.

- to accelerate the implementation of water conservation measures
- outline measures to gauge the degree of savings associated with water conservation programs.

The MOU defines a water conservation program as a 'Best Management Practice' (BMP). The BMP's that apply to the commercial sector are:

- BMP 4 Metering with commodity rates for all new connections and retrofit of existing connections
- BMP 5 Large landscape conservation programs and incentives
- BMP 6 High efficiency washing machine rebate programs
- BMP 9 Conservation programs for commercial, industrial and institutional accounts
- BMP 11 Conservation pricing.

Benefits associated with the MOU agreement include:

- An implementation strategy, with limited allowances to rearrange and modify the timetable (34). Despite allowances to modify the implementation timetable, BMP's are to be undertaken and completed within the initial term (10 year period)
- A continual improvement process, which is designed to review BMP's as a result of updated information. The continual improvement process includes:
- Reviewing the predicted savings assumptions every 3 years
- Assessing the economic reasonableness of BMP's against specified economic principles
- Removal of BMP's that the CUWCC determines cannot be made economically reasonable or otherwise fails to conforms to the definition of a BMP
- Addition of new BMP's and or modification of existing BMP's after review of research data and or demonstration projects, provided economic principles are upheld and the BMP's conform to the definition
- Favourable treatment for signatories that participate in the CUWCC water conservation programs by government authorities.

6.3.1.2 SURVEY OF COMMERCIAL PROGRAMS

A survey of 29 water utilities was conducted in 2004 by Maddaus Water Management to assess the participation of utilities in various incentive schemes[14]. Table 6-4 provides a summary of the participation rates in various incentive schemes.

[14] Maddaus Water Management, "Recommended Program for CII Water Conservation for Solano County Water Agency Urban Water Conservation Committee, July 2005

Table 6-4 : Survey on US Commercial Sector Water Conservation Programs

CONSERVATION MEASURE	COOLING TOWER PROGRAM	AUDITS	TOILET REBATE	WASHING MACHINE REBATE	LANDSCAPE PROGRAM
Total Number of Programs	5	10	11	14	25
Percentage of Water Utility Participation (%)	17%	34%	38%	48%	86%

To establish the scope and depth of incentive programs offered in the US, the following examples of incentives offered by water utilities are provided below:

- San Diego Water Authority, California:
    - A $500 rebate for the installation of a conductivity controller in cooling towers
    - Commercial washing machines replacement can receive a $275 to $300 rebate
    - The installation of a water efficient x-ray device receives a $2,000 rebate
- Costra Costa Water District, California will provide a free water efficient toilet to commercial organisations as part of its incentive program
- City of Albuquerque, New Mexico offers commercial customers a rebate up to $5,000 on water efficient landscaping
- Seattle Public Utilities, Washington provide rebates of between $200 to $1,000 for the replacement of water cooled to air cooled ice machines
- A large number of water authorities in the US offer free water audits as part of their incentive program.

In addition to the survey of incentives, the authorities surveyed were asked to provide comments on issues relating to the success of commercial demand management programs. The top relevant responses were as follows:

- Gaining Participation – Most agencies agreed that this is the most challenging issue in commencing and maintaining a commercial program. Getting the time and interest of management is difficult as water bills are low and therefore impact on the bottom line is small.
- Program Promotion – Marketing programs need to be well planned, and simply providing a letter offering an incentive will not get the attention of the business. The most successful approach is direct contact and relationship building. This can be achieved through a visit to the business, attendance at commerce group meetings and working with industry associations.
- Target Top Users – Commonly the top 10 % of users will be responsible for more than 50% of the use.

- Conducting Surveys – Water use surveys should be kept as simple as possible to achieve the outcome required. If the program is targeting bathroom use then a detailed assessment of cooling tower efficiency is not warranted. Use of students is a good option to reduce costs.

- Implementation of Survey Recommendations – Water authorities were concerned that their programs were not designed to follow through the survey recommendations.

- Data Management – Data is generally managed using an Access database to provide standard reports for regulating agencies.

- Selling Conservation Measures – Business owners are not interested in the water savings, they are interested in how much it will cost and the payback period.

- Combine Surveys and Incentive Programs – The aim of commercial water conservation is to get participation and encourage implementation. If the recommendations are not implemented then both parties lose and no savings occur. As both parties will benefit from efficient use of water, incentives are a way of improving success. Such incentives may be free surveys, rebates to improve payback periods or payment options such as low interest loans or pay by savings options.

6.3.1.3 LANDSCAPE PROGRAMS – XERISCAPE

XERISCAPE™

A landscape program implemented by water utilities in the US, known as Xeriscape, has been successful in reducing water consumption in outdoor areas. The program consists of a seven step process, which includes:

Plan and Design – By properly planning the area to be landscaped, consideration can be given to aesthetics, water usage through plant selection (specie), plant location, lawn type and dimension

- Create Practical Turf Areas – Turf areas must be a manageable size and shape with the application of appropriate water efficient grass species

- Select Low Water Plants – Select plants that are water efficient, group plants with similar requirements and choose the most appropriate microclimate location. Most gardens have multiple microclimates, which can include for example sunny dry and shaded moist areas

- Use Soil Amendments – The addition of organic material to the soil profile aids water retention is sandy soils and water absorption in clay thus reducing runoff

- Use Mulches – Mulching of garden beds is essential to reduce evaporation and reduces the temperature in the plant root zone resulting in lower evapotranpiration

- Irrigate Efficiently – Irrigation methods must be designed to increase water efficiency. Measure should include:

    - Water close to the ground with drip, micro-sprays or bubbler emitters being the most efficient for watering flowers, shrubs and trees

    - Design irrigation systems to water plants with similar water requirements at the same time (e.g. create watering zones) otherwise some plants will be over watered while other could be under watered

    - Understand the water consumption of sprinklers to establish irrigation times for watering zones

    - Monitor for and repair leaks in irrigation systems

- Maintain Landscape – Landscapes should be maintained by doing the following:
    - Pruning keeps plants looking good and promotes plant vigour
    - Aerating the soil regularly promotes root growth and allows water to progress into the root zone effectively
    - When mowing, ensure the grass remains at between 4 to 6 cm in height and mowe frequently to ensure that no more then one third the length of the grass is removed at once
    - Control pests as weeds will increase the water requirements in gardens

The Southern Nevada Water Agency estimates that 1.7 million square meters of grass has been replaced with xeriscape landscaping under their landscaping program, equating to a 5,300 ML per annum in water savings.

6.3.1.4 COMMERCIAL APPROACH

US agencies have been developing, trialling and refining approaches to water conservation in the commercial sector since the late 1980's. Development has resulted in what may be considered as a 'best practice' approach to the sector. The Californian Department of Water Resources developed a seven step process in 1996, which is currently adopted by most authorities. The seven steps are:

- Step 1 – Line up Support and Resources
- Step 2 – Take Immediate Action : Do the Obvious First
- Step 3 – Conduct a Water Survey (Assess current use and costs)
- Step 4 – Identify Water Management Opportunities (plant and equipment)
- Step 5 – Prepare an Action Plan
- Step 6 – Implement Measures
- Step 7 – Publicise Success.

The CUWCC has drafted a different approach in their BMP 9 – Guide to CII Conservation Programs[15]. This approach suggests the following steps be implemented:

- Step 1 – Identify CII Customers
- Step 2 – Target Survey Customers
- Step 3 – Market Survey Program

[15] California Urban Water Conservation Council, 'Handbook BMP 9 – A Guide to Implementing Commercial Industrial Institutional Conservation Programs', June 2001.

- Step 4 – Conduct Site Visits and Surveys
- Step 5 – Follow Up with Customers
- Step 6 – Monitor and Track Data.

The guide suggests that paybacks for commercial customers should be less than 2 – 3 years and all benefits (water, wastewater and energy) should be considered. As well as cost savings, positive publicity for the business may be an incentive to participate.

A paper published by Jane Plosser[16] of the City of Phoenix proposed that successful commercial conservation programs have two parts:

1. Sound economic and technical information
2. An implementation strategy that fits the company's decision making process.
   - Marketing of commercial programs should therefore include the following concepts:
     - Make cost savings the primary focus bearing in mind that water costs are a low priority in most businesses
     - Conservation messages must reach the management level
     - Recognise that most conservation technology is complex and expensive
     - Employees control many end uses and must be included in the process through education
     - Specific uses of water in a business will dictate the appropriate conservation actions
   - Water utility staff must embrace three tenets in promoting water conservation:
     - *Credibility* – of the authority representative (must have some technical knowledge)
     - *Reliability* – what is promised *must* be delivered
     - *Confidentiality* – of water use and proprietary information must be respected
   - Progress is only possible once the customer trusts and respects the authority's representative.

6.3.1.5 EFFICIENCY OPPORTUNITIES

A number of new initiatives have been implemented over the past 5 years in the US that may have application in Australia. These are:

- The replacement of continuously running taps and high rate rinse valves with low flow rate models. These units cost approximately US$60 and are easily installed. Flow reduction is a minimum of 50% over the older units

[16] Jane Plosser, "Conservation and the Commercial Customer" Journal American Water Works Association, January 1996

- X-Ray water recycling units can save 95% of the water used with the traditional approach. The cost of the units is around US$2400 with a US$100 installation cost and fortnightly service fee of US$100. An alternative is the replacement of older x-ray film processing units with digital technology at a cost of US$30,000, providing a 100% water saving

- WaterMizers to reduce the cost of water used for cooling steam from autoclaves.

- Centrally controlled irrigation systems advise when to water based on the climate conditions

- Replacement of water cooled ice making machines with air cooled units

- Water recycling units for commercial laundries

- Low water food steamers

- Low water use Asian woks.

6.3.1.6 REGULATIONS

Water use in the commercial sector in the US is largely unregulated with state based legislation applied in some states where water shortage has been a perennial issue. Examples of regulations are as follows:

- In California, state grants and subsidies for capital projects are linked to the implementation of Best Management Practices as developed by the CUWCC

- In Arizona, an attempt was made to mandate water efficiency using per capita targets. This approach failed due to the difficulty in measuring change in per capita use. The state has now adopted the California system of undertaking an agreed action plan using a standardised set of activities (BMPs)

- In Washington State and Texas, utilities are required to evaluate water efficient options and undertake specific agreed measures to obtain water resource licenses and grants.

A number of cities across the US have local laws and policies that require commercial businesses to undertake certain water conservation actions. Examples of these laws are:

- Cooling tower blowdown water quality (TDS of 2,000 mg/L)

- Banning once through cooling systems and conservation devices for evaporative systems

- Mandated fixtures such as toilets (note low flow showerheads are federally regulated)

- Landscape controls and points programs

- Mandated recycled water for golf courses

- Building retrofits by specified date

- Government building retrofits by specified date

- Requiring large irrigation areas to be controlled by rain sensors or moisture sensors

- Sub-metering in multi-unit developments
- Offset programs for new buildings.

6.3.2 SINGAPORE

The country of Singapore with a population of 4 million people is a water stressed nation despite the region receiving more than 2,500 mm of rainfall annually[17]. A major cause of Singapore's water shortages is caused by the limited amount of land for the storage of surface water. As a result, the majority (50%) of the Singapore's fresh water is sourced from Malaysia based on a 1961 agreement between the two countries, which is set to expire in 2011. The sourcing of water from Malaysia by Singapore has been a point of contention between the two nations.

The Singapore government has been investigating alternative sources of water to supplement existing supplies in an attempt to lessen their reliance on Malaysian sources. The result of using alternative water sources will be higher water charges, highlighting the importance of water demand management through water efficiency to control demand and prolong the useful life of existing sources.

The Public Utility Board (PUB) implemented a water conservation plan in 1981 to enhance water efficiency. The main components of the water conservation plan include:

- Public Education and Publicity Programme
- Fiscal Policy - Water Tariff
- Legislative Measures
- Mandatory Installation of Water Saving Devices
- Water Recycling and Substitution
- Water Audits
- Offering Incentives for Water Conservation Projects.

6.3.2.1 PUBLIC EDUCATION AND PUBLICITY PROGRAMME

The Public Education and Publicity Programme was designed to educate the public on the need for water conservation with the aim to effect behavioural change. The programme generally consisted of a mass marketing and advertising campaigns and includes the following elements involving the commercial sector:

- Advertising campaigns via television commercials on prime time slots, media advertisements, electronic billboard and publishing articles on innovative water conservation efforts by the public and the industries in local papers to facilitate the sharing of ideas
- Water interruption exercises where water supply is randomly shut-off to residents without notice to illustrate life without water and reinforce the requirement for water conservation

---

[17] National Institute of Education Singapore, http://www.greenleaf-publishing.com/gmi/abstracts42/goh.html, 10/1/2006.

- Save water exhibitions are placed at major public areas, hospitals, community centres, schools, shopping centres and hotels to increase the customers water conservation awareness

The PUB website is also used to inform customers on the water saving appliances, fixtures and technology. The website also provided a mechanism for appointment requests to undertake water audits.

A component of the program was specifically aimed at educational institutions including the following measures:

- Water conservation talks are conducted regularly by PUB officers for students in their respective schools

- Visits to waterworks are conducted as part of the National Education Programme for students, the objective of which is to develop national cohesion, the instinct for survival and confidence in the future

- Teachers' seminars on water conservation were held so that they could, on returning to their respective schools, disseminate the water conservation message to their pupils and fellow teachers.

Surveys are used to gauge the effectiveness of the Public Education and Publicity Programme. The most recent survey conducted in 1999 found that 93% of people surveyed were encouraged to conserve water while 84% had actively participated in water conservation.

6.3.2.2 FISCAL POLICY - WATER TARIFF

The Singapore Government has water pricing policy that requires the full cost recovery of production and supply costs as well as being reflective of the high cost of developing new water sources. In 1991, the Government implemented a conservation tax with the objective of encouraging water conservation. The tax is designed to reflect the scarcity of water.

6.3.2.3 LEGISLATIVE MEASURES & MANDATORY INSTALLATION OF WATER SAVING DEVICES

Legislative measures are designed to deter water wastage and unauthorised usage. Legislation provides minimum standards for water pipes and fittings as well as requiring a high standard of plumbing work by requiring licensed water service workers to perform any water service work.

The Singapore Government has introduced mandatory installation requirements for certain water saving devices. The mandatory measures include:

- Constant flow regulators

- Self-closing delayed action taps

- Dual flush cisterns

- All boilers used in non-residential premises shall include a pre-treatment facility to reduce blowdown losses

- Cooling system water required to be recycled and once through systems are banned

- Restriction on bath capacity to a maximum of 250L

- Sprinklers using potable water are not allowed.

6.3.2.4 WATER RECYCLING AND SUBSTITUTION

Water recycling is encouraged in Singapore, with 60 companies consuming an average of 44 ML/d of recycled water in their operations alone. As part of the assessment for new water connection applications, the PUB advises applicants to adopt water conservation measures, which include the use of recycled water, rainwater and seawater to substitute potable water. The NEWater program produces recycled water for direct potable reuse in the non-residential sector as well as indirect potable reuse for all sectors.

For existing customers, a close working relationship has been established to promote water recycling and the use of non-potable water. Internal water recycling is common particularly in the electronic and electroplating industries.

The Singaporean authorities have noted that the water conservation program has changed customer attitudes to water. With business supporting the national water conservation policy, awareness has increased acceptance that water conservation measures can reduce costs, and therefore increase competitiveness. Importantly NEWater does not attract Singapore's conservation tax making the water source cost effective compared to existing potable supplies.

6.3.2.5 WATER AUDIT & INCENTIVE PROGRAMS

The PUB carries out regular water audits for large customers. Audits allow the PUB to work with customers on the implementation of water conservation measures. Customers are advised during audits to monitor water consumption and regularly check for leaks.

In conjunction with water audits, the Economic Development Board administers three incentive schemes to promote water conservation. The three schemes include:

- Investment Allowances Scheme on Water Conservation Projects – Tax incentive scheme providing tax breaks to business for water conservation projects.

- Resource Productivity Feasibility Study Scheme – Is a grant scheme designed to reduce the cost of feasibility studies design to identify areas of potential conservation. The grants cover 50% of the cost associated with a feasibility study.

- Resource Productivity Scheme – Provides loans to companies based in Singapore at a fixed interest rate of 6% pa over a seven year period for machinery and equipment purchases that will either provide substantial productivity improvements or substantial resource savings

6.3.3 UNITED KINGDOM

Water conservation in the United Kingdom is not as advanced as other countries investigated as part of this study. The Environment Agency (EA) has responsibility for improving and protecting the environment in England and Wales. A key area of the EAs agenda is the sustainability of water resources. The agency's water demand management activities fall under four broad categories - advice, promotion, technical development and research.

Water supply utilities in the UK are privatised, which creates barriers, as the economic case for water efficiency needs to be proven to shareholders and the economic regulator before implementation.

Due to the focus on asset performance and water quality over the past 15 years, progress in water conservation has been slow. The one exception is leakage reduction where the UK is an acknowledged leader. Existing approaches to development of water conservation programs has been piecemeal, with a focus on short term measures rather than coordinating more substantial long term programs.

To provide coordination the UK water supply utilities formed, in September 2005, a central body known as “Waterwise”. This group is sponsored by the utilities and will focus on behavioural change as well as water conservation technology. The aims are to:

- Develop an economic case for water efficiency as a realistic, large scale contributor to sustainable water resources

- Demonstrate the affordability of water efficiency

- Promote the social and environmental benefits of water conservation.

APPENDIX B

MEASURES SCREENING MATRIX

				Environmental			Social			Economic			
Number	**Measure**	**Implementation Methods**	**Applicable Sub-sectors**	**Significant Water Saving**	**Sustainability of Water Savings**	**Energy Savings**	**Positive public awareness**	**Customer Acceptance / Equity**	**No Regulatory Obstacles**	**Likely Payback**	**Local Business Benefit**	**Average**	**Pass**
11	Major Users Water Audit	Council Audit	Major Users (>20 ML/year)	5	4	3	5	5	5	4	5	**4.50**	Y
12	Commercial Business Water Audit	Council Audit	Caravan Parks Aged Care Shopping Centres Clubs	4	4	3	5	4	5	4	5	**4.28**	Y
35	Public Building Retrofit	Council Regulation	Public Buildings	2	4	3	5	5	4	4	5	**4.06**	Y
30	TSC Open Space Irrigation Audit	Council audit; Education	Open Space Irrigation	3	3	1	5	5	5	4	5	**3.94**	Y
13	Bathroom Audit - Shower - Toilets - Taps - Urinals	Council Audit; Plumber	Caravan Parks Aged Care Shopping Centres Clubs Motels Hospitals Industrial	2	4	3	4	4	5	4	5	**3.94**	Y

Number	Measure	Implementation Methods	Applicable Sub-sectors	Environmental			Social			Economic		Average	Pass
				Significant Water Saving	Sustainability of Water Savings	Energy Savings	Positive public awareness	Customer Acceptance / Equity	No Regulatory Obstacles	Likely Payback	Local Business Benefit		
1	Shower Regulation	Council Regulation	All new non-residential	1	4	3	4	4	4	5	5	**3.89**	Y
23	TSC Facilities Audit	Council Audit; Education	Public Buildings	2	4	2	5	5	5	3	5	**3.89**	Y
31	Open Space Irrigation Guidelines	Council Regulation	Open Space Irrigation	2	5	1	5	5	5	4	4	**3.89**	Y
4	Tap Regulation	Council Regulation	All new non-residential	2	4	3	4	4	4	5	4	**3.83**	Y
8	Water Management Plan	Council Regulation	All new non-residential	2	5	2	5	3	4	4	5	**3.83**	Y
25	Leakage Assessment Audit	Council Audit; Education	Caravan Parks Aged Care Shopping Centres Clubs Motels/Hotels Hospitals Industrial Open Space Irrigation	3	3	2	4	4	5	5	4	**3.83**	Y
36	WaterWise program	Council Promotion; Education	All existing non-residential	2	2	2	5	5	5	5	4	**3.83**	Y

Number	Measure	Implementation Methods	Applicable Sub-sectors	Environmental			Social			Economic		Average	Pass
				Significant Water Saving	Sustainability of Water Savings	Energy Savings	Positive public awareness	Customer Acceptance / Equity	No Regulatory Obstacles	Likely Payback	Local Business Benefit		
2	Toilet Regulation	Council Regulation	All new non-residential	2	4	1	4	4	4	5	5	3.78	Y
28	Specific Recycled Water Projects	Council Promotion	Public	2	4	2	5	5	4	3	5	3.78	Y
41	Council promotion of Federal and State Programs	Education	All non-residential	1	2	1	5	5	5	5	5	3.78	Y
38	Awards Programs	Council to supply	All non-residential	1	1	1	5	5	5	5	5	3.67	Y
42	Workshops with Chamber of Commerce as well as other industry and commercial representatives	Education (workshop)	All non-residential	1	2	1	5	4	5	5	5	3.67	Y
32	Train landscape managers	Education (workshop)	Open Space Irrigation	2	3	1	3	5	5	4	5	3.61	Y

Number	Measure	Implementation Methods	Applicable Sub-sectors	Environmental			Social			Economic			
				Significant Water Saving	Sustainability of Water Savings	Energy Savings	Positive public awareness	Customer Acceptance / Equity	No Regulatory Obstacles	Likely Payback	Local Business Benefit	Average	Pass
39	Waterwise Schools Program	Council to supply training materials; Encourage schools to participate	Schools	1	2	1	5	5	5	4	5	**3.61**	Y
40	Liasion with NSW Health and Department of Education and Training	Council to engage	Schools Hospitals	1	2	1	5	4	4	5	5	**3.56**	Y
10	Water Management Audit/Diagnostic	Council/customer agreement	Caravan Parks Aged Care Shopping Centres Clubs Hospitals Industrial	2	3	1	5	5	5	4	3	**3.50**	Y
27	Audit of Top Industrial Water Users	Council Audit; Education	Industrial	2	4	2	4	4	5	3	4	**3.50**	Y

Number	Measure	Implementation Methods	Applicable Sub-sectors	Environmental			Social			Economic		Average	Pass
				Significant Water Saving	Sustainability of Water Savings	Energy Savings	Positive public awareness	Customer Acceptance / Equity	No Regulatory Obstacles	Likely Payback	Local Business Benefit		
34	Landscape Water Budgets	Council to provide	Sports Clubs	2	4	1	5	4	5	3	4	**3.50**	Y
24	Self-Closing Taps	Education; Customer purchase	Caravan Parks Aged Care Shopping Centres Clubs Motels Hospitals	1	4	2	4	3	5	4	4	**3.44**	N
26	Audit of Hospital Process Use	Council Audit; Education	Hospitals	1	4	2	4	5	3	4	4	**3.44**	N
18	Cooling Tower Audit	Council Audit	Shopping Centres Clubs Motels/Hotels Hospitals Aged Care	2	4	3	4	4	5	3	3	**3.44**	N

Number	Measure	Implementation Methods	Applicable Sub-sectors	Environmental			Social			Economic		Average	Pass
				Significant Water Saving	Sustainability of Water Savings	Energy Savings	Positive public awareness	Customer Acceptance / Equity	No Regulatory Obstacles	Likely Payback	Local Business Benefit		
9	Efficient Irrigation System	Regulations, Education	All non-residential irrigation	2	4	1	4	3	4	4	4	**3.33**	N
14	Pool Audit (cover, filter backwash)	Council Audit	Caravan Parks Aged Care Clubs Motels/Hotels Hospitals Schools	2	3	2	4	3	4	4	4	**3.33**	N
17	Pre-rinse Spray Valves Retro-fit	Council Audit; Education	Shopping Centres Clubs Large restaurants	1	4	2	4	3	4	5	3	**3.33**	N
16	Restaurant Audit	Council Audit	Shopping Centres Clubs Motels/Hotels Hospitals Aged Care	2	3	2	4	3	5	4	3	**3.28**	N
3	Urinal Regulation	Council Regulation	All new non-residential	2	5	1	4	3	4	3	4	**3.28**	N

				Environmental			Social			Economic			
Number	**Measure**	**Implementation Methods**	**Applicable Sub-sectors**	**Significant Water Saving**	**Sustainability of Water Savings**	**Energy Savings**	**Positive public awareness**	**Customer Acceptance / Equity**	**No Regulatory Obstacles**	**Likely Payback**	**Local Business Benefit**	**Average**	**Pass**
37	Plumber Training	Council provided	All non-residential	1	1	1	5	4	5	3	5	**3.22**	N
21	Waterless Woks Promotion and Rebate	Council Audit; Education	Shopping Centres Clubs Hotels Large restaurants	1	5	2	4	3	5	4	2	**3.22**	N
29	Capacity Buy-back Program	Council Promotion	All large non-residential users i.e. greater than 10 ML/day	2	4	2	4	3	3	4	3	**3.17**	N
15	Laundry Audit	Council Audit	Aged Care Motels Hospitals	1	4	2	4	3	5	3	3	**3.11**	N
7	Alternative water source	Council Regulation	All new non-residential	2	4	2	5	3	3	2	4	**3.11**	N
5	Washing Machine Regulation	Council Regulation	All new non-residential	2	4	2	4	3	2	3	4	**3.06**	N
6	Sub-metering	Council Regulation	All new non-residential	2	4	2	3	3	3	3	4	**3.06**	N

Number	Measure	Implementation Methods	Applicable Sub-sectors	Environmental			Social			Economic		Average	Pass
				Significant Water Saving	Sustainability of Water Savings	Energy Savings	Positive public awareness	Customer Acceptance / Equity	No Regulatory Obstacles	Likely Payback	Local Business Benefit		
20	Optimisation of Cooling Tower Operation (Cycles of Concentration)	Regulation; Education	Shopping Centres Clubs Motels Hospitals Aged Care	2	5	2	3	3	2	4	3	**3.06**	N
22	Replacement of Water-cooled Ice Machines	Council Audit; Education	Clubs Motels Large restaurants	1	5	1	2	3	5	3	3	**2.89**	N
33	Recycled Water Use	Regulations; Education	Open Space Irrigation Sports Clubs	2	4	1	3	2	2	4	3	**2.72**	N
19	Cooling tower sub-meter rebate	Council Audit; Education	Shopping Centres Clubs Motels Hospitals Aged Care	1	3	2	3	3	5	2	2	**2.56**	N

APPENDIX C

MEASURES ASSESSMENT ASSUMPTIONS

Estimating Water Savings Potential from Audits

Sydney Water's Every Drop Business Program has found that the average water savings based on water audits in commercial and institutional sectors range from 20-40%[17]. Similar to the findings of the Pacific Institute study, industrial facilities can save from 20% to 80% through water efficiency, reuse and recycling.

A general rule of thumb:

- If no water savings measures have so far been implemented, savings could be 20-50% or more of water related costs.
- If some water saving projects have been implemented but not applied using a systematic approach, the potential savings could be at least 20% of water related costs.[17]

Potential savings from on-site water audit as reported by Seneviratne (2007)[18] is provided in the table below.

Table 6-5 : Potential Savings from On-site Water Audits

BUSINESS TYPE	NUMBER OF AUDITS	AVERAGE (%)
Education	168	20
Healthcare	90	25
Laundries	22	15
Hospitality	222	22
Offices	19	28
Hotels and accommodation	120	17
Landscape Irrigation	6	26

Initial results Yarra Vallet Water's 'Save Water Efficiency Service' indicate water savings between 22 and 30% for various commercial categories. Table 6-1 shows an example of savings for a sample of 10 audits for schools, shopping centres, swim centres and commercial offices.

Table 6-6 : Examples of Identified Savings under the 'Save Water Efficiency Service'

CATEGORY	WATER SAVINGS (%)	WATER SAVINGS ($)	SEWERAGE SAVINGS ($)	ELECTRICITY SAVINGS ($)	AVERAGE PAYBACK (MONTHS)
School	30	795	925	8,600	14
Shopping Centre	22	7,750	8,795	12,890	6
Swim Centre	22	3,245	3,245	14,100	2
Commercial Offices	23	1,030	1,200	1,600	9

[18] Seneviratne, M (2007) *A Practical Approach to Water Conservation for Commercial and Industrial Facilities,* p60

Notes: - Based on 10 customer water audits.

Assumptions used to estimate reductions in water use and the cost of an audit are shown below. These are sourced from "Business Water Efficiency Program – Major User Demand Assessment and Cost Analysis" (MWH, 2006).

SECTOR	SUB-SECTOR	ESTIMATED REDUCTION IN WATER USE
Commercial	Commercial	25%
	Clubs	22%
	Shopping Centres	26%
	Aged Care	26%
	Caravan Park	25%
Public	Education	25%
	Government	25%
	Public open spaces	24%
Industry	Industry - Light	15%
	Industry - General	15%
	Industry - Noxious	15%
	Industry - Extractive	15%
Total for Major Users		**20%**

CUSTOMER CATEGORY	ESTIMATED AVERAGE TIME (DAYS)				AVERAGE AUDIT COST
	AUDIT / WATER BALANCE	CONSUMPTION ANALYSIS	DEVELOP SOLUTIONS	TOTAL TIME	
Caravan Park	2	1	2	5	$3,400
Clubs	3	1	2	6	$4,080
Commercial	3	1	2	6	$4,080
Education	4	1	2	7	$4,760
Government	5	1	3	9	$6,120
Hospitals	6	1	3	10	$12,000
Hotels	4	1	2	7	$4,760
Industry - Extractive	5	1	2	8	$5,440
Industry – General	7	1	4	12	$14,400
Industry – Light	5	1	3	9	$10,800
Industry – Noxious	7	1	4	12	$14,400
Shopping Centres	4	1	2	7	$4,760
Aged Care	3	1	2	6	$4,080
Offices/shops < 3 levels	2	1	1	4	$2,720
Public open spaces	3	1	2	6	$4,080
Resort Complexes	5	1	3	9	$6,120
Sporting complexes	4	1	2	7	$4,760
Taverns/Motels	3	1	2	6	$4,080

Community Submissions Report

Demand Management Strategy

August 2010

THIS PAGE IS BLANK

Table of Contents

Executive Summary

Aim of this Report

This report consolidates all feedback on the Demand Management Strategy (DMS) received by Council from the Tweed community between October 2009 and May 2010.

Background

Tweed Shire Council is proposing to implement a range of demand management actions recommended in the Tweed District Demand Management Strategy (DMS).

The first stage of the DMS, focussing on residential water use, was adopted by Council in its meeting of 17 February 2009. It had been placed on public exhibition for a period of eight (8) weeks closing 1 August 2008 with only one late submission received. The report included demand-managed-water-use-projections for the entire shire to enable the continuation of ongoing planning, with a proviso that these estimates would be reviewed once the Stage 2 report was completed.

In January 2009 the Stage 2 report focussing on non-residential water use and a combined summary report to coordinate the recommendations from the two stages were placed on public exhibition. The Stage 1 report was also updated and corrected as required to improve consistency between the three documents. All three documents were placed on public exhibition for a period of twelve (12) weeks closing 30 April 2010:

Demand Management Strategy (Summary Combined Report)

Demand Management Strategy – Stage 1 (focus on Residential water use)

Demand Management Strategy – Stage 2 (focus on Non-Residential water use)

In parallel to the exhibition period, Council has promoted the proposed demand management actions through Tweed Link and the media, and has utilised the publicity generated by the community consultation for the Water Augmentation project to promote the Demand Management Strategy recommendations.

Activities conducted

The community was informed about the proposal and their feedback sought through the following avenues:

- Daily News advertisement on 28 January 2010, Tweed Link advertisements and articles on 26 January, 9 February and 16 February 2010, and media releases 12 January, 2 February 2010 inviting comments from the community and inviting the community to attend information days at Tweed Heads, Murwillumbah and Pottsville.
- Three Community Information Sessions were held from 2pm to 7pm at:
  - Tweed Heads, Wednesday 10 February 2010
  - Murwillumbah, Thursday 18 February 2010
  - Pottsville, Tuesday 23 February 2010
- Free call 1800 telephone line enabling the public to have their questions answered and to take the effort out of writing a submission by making a 30 second verbal submission.

- Designated email address WaterTSC@tweed.nsw.gov.au to enable the community to contact Council's Water Unit directly.
- An Interested Parties Register to keep people and organisations informed of developments either by email or regular post. Over 100 people are registered and 13 circulars have been sent over the last sixth months.
- Multiple factsheets and reports made available to inform the community
- All factsheets and reports available online and at Council offices and libraries
- The date for submissions was extended by eight (8) weeks following a request by the Community Working Group (CWG) to allow additional time for the community to make submissions

Public feedback

The initial public exhibition of the first stage of the DMS in August 2008 resulted in only one late submission received.

There has been far more public interest and feedback during this second phase of community consultation and public exhibition, although compared to the overall populace the response is still low, and it is unclear whether responses are representative of the views of the entire Shire community.

Council has received community feedback from:

- A total of 83 submissions were received. Seventy-seven (79) of these were received by 30 April 2010 and another four (4) submissions were accepted as late submissions.
- A total of approximately 40 members of the community who attended the three information sessions (Tweed Heads, Murwillumbah and Pottsville) to discuss water issues including demand management.
- The Community Working Group provided recommendations for Council's demand management approach, and in particular suggested improvements in the way the community is informed about demand management.
- A number of phone calls were received by the 1800 Freecall telephone service centre relating to demand management issues.

Responses to issues raised

Many of the submissions repeated or raised similar issues. Council received 83 submissions, containing over 600 individual matters or issues. The CWG report and the Community Information Sessions also raised a number of similar matters for consideration.

Due to the volume of issues raised, they were paraphrased and grouped for presentation purposes. In many instances the text is a combination of the most representative and significant wording from individual submissions. The name of entities that raised the same or similar issue were recorded next to the paraphrased text. This produced a list of some 200 issues which are contained in Appendix A.

These issues were then grouped further under header issues according to content (header issues are in grey in Appendix A). The full list of 56 header issues is contained in the discussion section of this report.

Upon review of the complete list of issues raised, the major issues of significance have been consolidated in the table below. High level responses and discussion to these issues are also provided.

Issue		Response
Issues 2 - 3	Population Issues - population restrictions / carrying capacity - population projections used - population is pushing augmentation	A number of population planning issues outside of the scope of the DMS were raised, including determining the region's carrying capacity and restricting population growth. These would need to be addressed by the relevant local, state and federal planning instruments. The accuracy of population projections was questioned. Council's projections were based on the sum of development area staging over the next 30 years and is considered more reliable than using annual percentage growth rates. Augmentation is required due to population growth. Council has a responsibility to provide an ongoing water supply and to ensure it gains approvals for a preferred augmentation option before more water is needed. It should be noted that the timing of the implementation will be based on monitoring of actual future population and water demand.
Issues 4 - 10.	Sustainability of new developments	Current planning and competition laws may serve to limit a councils' ability to mandate self sustaining communities or development. These issues would not preclude an individual developer from making a voluntary decision to build a self sustaining development, however Council can only work with developers to pursue options over and above the regulations in an opportunistic way.
Issues 11- 24 and 36 - 44	Mixed response to recommended DM actions, and interest for water substitution / alternative sources: - dual reticulation (third pipe) water recycling - high volume rainwater tanks - indirect potable water recycling - stormwater reuse - greywater reuse	The DMS assessed the feasibility of each of these alternatives plus grey/blackwater (4^{th} pipe) and decentralised sewerage, and found they are impractical or provided no additional advantage over the proposed implementation of BASIX, with 5,000 L water tanks and reduced infiltration gravity sewers (RIGS). Notwithstanding, the DMS recommends Council pursue opportunistic prospects where possible. Opportunities will depend on developments proposed and will be assessed by Council.

	Issue	Response
Issues 25 - 34	Use of education, promotion, pricing signals and rebates. More user-friendly format.	Education and promoting water savings and restrictions are key recommendations from the DMS. An "inclining block tariff" approach to pricing is recommended in the DMS and is in line with Council policy and best practice. Rebates for rainwater tanks were considered non cost-effective. Shower head rebates and home water audits are proposed as part of the DMS.
Issues 41-44 and 50 - 56	Independent review of Council's position, particularly: - population projections - climate change considerations - range of options - consideration of external environmental impacts	Given that all work to date has been carried out and cross-checked by a range of service providers recognised as experts in the water field, it is difficult for Council to justify further significant expenditure to have reviews carried out by additional experts. The approach to population projections is described above. Climate change modelling was taken into account to determine the Tweed's water supply capacity. Namely, modelling carried out by SE QLD and Rous Water which show that the secure yield in those adjacent regions could be reduced by between 7-15%. A number of independent experts and government authorities were involved in determining the maximum possible range of options for consideration. Alternatives were assessed on an industry standard approach using Triple Bottom Line approach taking into consideration non-economic factors such as environmental benefits and impacts.
25 - 34	Council water use (particularly parks and gardens) to lead by example	Implementation of new Council policies and procedures to reduce the organisation's water use and to set an example to the community are some of the are key recommendations from the DMS.
Issues 48 - 49	Community consultation good, but could be broader and more meaningful	The consultation process represented a major undertaking for Council, both in terms of time and resources. Feedback has been forwarded to Council's Marketing and Communication section for consideration in Council's Community Engagement Strategy. An observer from Southern Cross University provided an independent viewpoint of the process, and was generally supportive of Council's approach..

Aim of this Report

This report consolidates all feedback on the Demand Management Strategy (DMS) received by Council from the Tweed community between October 2009 and May 2010.

The report:

- describes the historical context to Council's DMS
- lists the issues raised by the Tweed community regarding the DMS
- combines related issues in a summary table
- outlines how these will be / have been addressed in the DMS
- provides responses to issues where appropriate

Background

History

Council's approach to water management has included focussed demand management actions for some time. The success of previous actions can be seen from the 40% reduction in total daily per capita consumption since 1992. In 1992 the total daily consumption was 491 litres per person. By 2009 this had dropped to 292 litres per person. This marked reduction in per capita water use can be attributed to various programs implemented during this time aimed at educating and assisting residents and businesses to reduce their water use.

Water efficient retro-fits

Between November 2005 and December 2008 Tweed Shire Council hosted a number of product giveaways and installations that resulted in nearly 50 per cent of the Shire's homes being fitted with energy and water saving devices resulting in 827 million litres of water savings to the town water supply annually. Program achievements include:

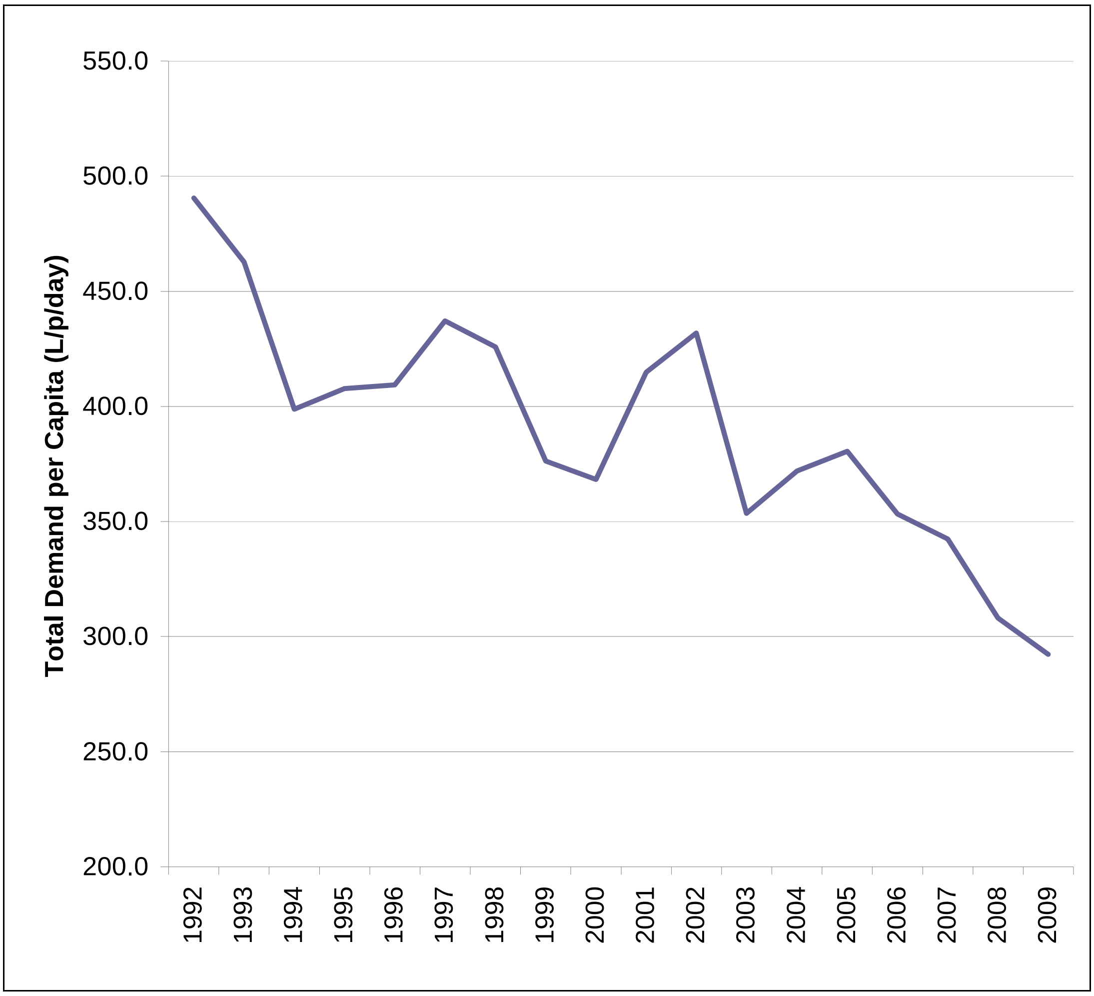
- 18,250 households have been retrofitted
- 16,560 3-star showerheads have been installed
- 2,607 tap aerators have been installed on sinks
- 960 single flush toilets have been converted to dual flush

Recycled water

Council has been recycling small quantities of water since the 1980s, and over the last decade has increased the amount of water recycled throughout the Shire. This process is ongoing and Council undertook a Recycled Water Options Report in 2006 which identified several potential water reuse options for the Tweed. One of these, at Chinderah Golf Course, has already been implemented and added to the existing water recycling schemes. Others, such as water recycling on the Les Burger Field at Bogangar are in various stages of implementation or investigation.

Education

Demand Management actions by their very nature require time for implementation. Many of the potential savings require the education of people and organisations to alter the way in which they use water. Council has recognised this and has invested in the waterwise education of school children for some 15 years. Education facilities have been built at the Environment Centre at Kingscliff Wastewater Treatment plant and at the new Bray Park Water treatment plant.



Historical Total Water Demand per capita for Tweed Shire

The per capita reduction in water use has been so significant that the Shire's overall water consumption has actually been reduced during the period between 1992 and 2009 despite the population growing from 49,000 to 80,000 over the same period.

Given that future reductions in water use will require significantly more effort for each litre of water saved, Council commissioned consultants Montgomery Watson Harza (MWH) to undertake a Demand Management Strategy to guide the future focus of water use reduction.

Demand Management Strategy

That Tweed District Demand Management Strategy (DMS) has now been completed and Tweed Shire Council is proposing to implement a range of demand management actions recommended in the strategy. The Demand Management Strategy (DMS) was prepared in two (2) stages.

The first stage of the DMS, focussing on residential water use, was adopted by Council in its meeting of 17 February 2009. It had been placed on public exhibition for a period of eight (8) weeks closing 1 August 2008 with only one late submission received. The report included demand-managed-water-use-projections for the entire shire to enable the continuation of ongoing planning, with a proviso that these estimates would be reviewed once the Stage 2 report was completed.

The consultants Montgomery Watson Harza (MWH) produced the Stage 2 report focussing on non-residential water use and a combined summary report to coordinate the recommendations from the two stages. In December 2009 the Stage 2 report focussing on non-residential water use and a combined summary report to coordinate the recommendations from the two stages were completed. The Stage 1 report was also updated and corrected as required to improve consistency between the three documents.

Council at its meeting 19 January 2010 resolved to place all three documents on public exhibition for a period of six (6) weeks. Due to a request from the Community Working Group, Council resolved in its 16 March 2010 meeting to extend the exhibition period by a further eight weeks. Submissions closed 30 April 2010. This report relates to these three documents:

- Demand Management Strategy (Summary Combined Report)
- Demand Management Strategy – Stage 1 (focus on Residential water use)
- Demand Management Strategy – Stage 2 (focus on Non-Residential water use)

In parallel to the exhibition period, Council has promoted the proposed demand management actions through Tweed Link and the media, and has utilised the publicity generated by the community consultation for the Water Augmentation project to promote the Demand Management Strategy recommendations.

Community consultation conducted

Council has informed the community about the recommendations of the DMS and feedback has been sought through the following avenues:

- Daily News advertisement on 28 January 2010, Tweed Link advertisements and articles on 26 January, 9 February and 16 February 2010, and media releases 12 January, 2 February 2010 inviting comments from the community and inviting the community to attend information days at Tweed Heads, Murwillumbah and Pottsville.
- Three Community Information Sessions were held from 2pm to 7pm at:
  - Tweed Heads, Wednesday 10 February 2010
  - Murwillumbah, Thursday 18 February 2010
  - Pottsville, Tuesday 23 February 2010
- Free call 1800 telephone line enabling the public to have their questions answered and to take the effort out of writing a submission by making a 30 second verbal submission.
- Designated email address WaterTSC@tweed.nsw.gov.au to enable the community to contact Council's Water Unit directly.
- An Interested Parties Register to keep people and organisations informed of developments either by email or regular post. Over 100 people are registered and 13 circulars have been sent over the last sixth months.
- Multiple factsheets and reports made available to inform the community
- All factsheets and reports available online and at Council offices and libraries
- The date for submissions was extended by eight (8) weeks following a request by the Community Working Group (CWG) to allow additional time for the community to make submissions

Public Participation

The initial public exhibition of the first stage of the DMS in August 2008 resulted in only one late submission received. This submission has been dealt with at that time when Council adopted the DMS Stage 1 at its meeting of 17 February 2009.

There has been far more public interest and feedback during this second phase of community consultation and public exhibition, although compared to the overall populace the response is still very low, and it is unclear whether responses are representative of the views of the entire Shire community.

Council has received community feedback from:

- A total of 83 submissions were received. Seventy-seven (79) of these were received by 30 April 2010 and another four (4) submissions were accepted as late submissions.
- A total of approximately 40 members of the community who attended the three information sessions (Tweed Heads, Murwillumbah and Pottsville) to discuss water issues including demand management.
- The Community Working Group provided recommendations for Council's demand management approach, and in particular suggested improvements in the way the community is informed about demand management.
- A number of phone calls were received by the 1800 Freecall telephone service centre relating to demand management issues.

A number of submissions related to water augmentation issues, and the issues raised are referred to and dealt with within the Water Augmentation Submissions Report.

Submissions

Submissions received

Submissions were received from various sectors and geographical locations within the community as shown in the table below.

AREA	NUMBER
Murwillumbah, Burringbar, Stokers Siding, Tumbulgum, Reserve Crk, Farrants Hill	21
Uki, Byangum	18
Commissioners Creek, Doon Doon	-
Byrrill Creek, Mt Burrell, Kunghur	2
Limpinwood, Pumpenbil, Tyalgum, Chillingham, Nobbys Creek	9
Fingal Head, Hastings Point, Kingscliff, Cudgera	7
Tweed Heads, Banora Point, Bilambil Heights, Terranora, Carool	5
Submission from address outside of Tweed Shire	8
Email only (no address given)	4
CWG members (Individual comments from CWG Report)	6
CWG Report	1
TOTAL	**83**

Submissions were received from the following groups and individuals:

No.	Date	Surname	Corresp	ECM
1	05/03/2010	Murwillumbah Ratepayers Assoc	Letter	13730120
2	05/03/2010	Pearson, Rifello	Email	13741755
3	05/03/2010	Pearson, Rifello, Rothwell	Email	13771843
4	05/03/2010	Summers - 1st	Email	13771839
5	07/03/2010	Maher	Email	13772859
6	07/03/2010	Prince - 1st submission	Email	13775029
7	07/03/2010	Summers - 2nd	Email	14989681
8	08/03/2010	Caldera Environment Centre, Hopkins	Email	13740719
9	08/03/2010	Fingal Head Coastcare Inc., Bolton	Email	13784721
10	08/03/2010	Gill	Email	13776054
11	08/03/2010	Peacock	Email	13776060
12	08/03/2010	Sledge	Email	13778318
13	08/03/2010	Smith	Email	13778286
14	08/03/2010	Symons	Email	13772855
15	09/03/2010	Costello	Email	13790171
16	09/03/2010	Ehrlich	Email	13778283
17	09/03/2010	Gray	Email	13779428
18	09/03/2010	Hill	Email	13784716
19	09/03/2010	Ipsen	Email	13868335
20	09/03/2010	Jacobi	Email	13874632
21	09/03/2010	James	Email	15740195
22	09/03/2010	Lewin	Email	13783627
23	09/03/2010	Mackay	Email	13779433
24	09/03/2010	Malecki	Email	13779417
25	09/03/2010	Mason	Email	13790167
26	09/03/2010	Masters	Email	13868332
27	09/03/2010	McCormick	Email	13779412
28	09/03/2010	McNamara	Email	13874636
29	09/03/2010	Moore	Email	14480908
30	09/03/2010	Murray	Email	13777132
31	09/03/2010	Prince - 2nd submission	Email	13778321
32	09/03/2010	Van Steenwyk	Email	13790120
33	09/03/2010	Wilkins-Russell	Email	13782536
34	09/03/2010	Yeomans	Email	13790164
35	12/03/2010	DECCW, NSW Office of Water - Hennessy	Email	14167425
36	15/03/2010	Caldera Environment Centre, Hopkins	Email	14117340
37	17/03/2010	Caldera Environment Centre, Dawson	Email	14178878
38	19/04/2010	Tweed District Residents & Ratepayers	Letter	15922994
39	24/04/2010	Townsend	Letter	15922995
40	26/04/2010	Baker	Email	15679879
41	26/04/2010	Prince - 3rd submission	Email	15679880
42	26/04/2010	Wood	Letter	15676673
43	27/04/2010	Lemaire	Letter	15676676
44	27/04/2010	Mann	Email	15679893
45	27/04/2010	Sledge and Vionot	Email	15679888
46	29/04/2010	Hastings Point Progress Association	Email	15690635
47	29/04/2010	Chadwick	Email	15691747
48	29/04/2010	Jack	Email	15729572

No.	Date	Surname	Corresp	ECM
49	29/04/2010	Kaye	Letter	15922999
50	29/04/2010	Rifello	Email	15684208
51	29/04/2010	Rifello	Email	15684215
52	29/04/2010	Watsford	Letter	15923001
53	30/04/2010	Blackwell	Email	15878843
54	30/04/2010	Dawe	Letter	15923002
55	30/04/2010	Dawson	Email	15723970
56	30/04/2010	Caldera Environment Centre, Hopkins	Email	15922992
57	30/04/2010	Ehrlich	Email	15878844
58	30/04/2010	Gardner	Email	15878839
59	30/04/2010	Graf	Email	15741468
60	30/04/2010	Havier and Addis	Email	15733798
61	30/04/2010	Hearder	Email	15733815
62	30/04/2010	Hollingsworth (letter dated 27 April)	Email	15741465
63	30/04/2010	Mayfield	Email	15730610
64	30/04/2010	Munz and Maher (letter dated 29 April)	Email	15740193
65	30/04/2010	Outridge - Margo	Letter	15934282
66	30/04/2010	Outridge - Mary Blane	Letter	15934283
67	30/04/2010	Outridge - Mary Lou	Letter	15934281
68	30/04/2010	Pearson	Letter	15934284
69	30/04/2010	Riordan (letter dated 28/4)	Email	15723898
70	30/04/2010	Bonar	Email	15730617
71	30/04/2010	Robertson, Lovegrove and Dundee	Email	15738042
72	30/04/2010	Stuart	Email	15723903
73	03/05/2010	Caldera Environment Centre	Letter	15934285
74	03/05/2010	Caldera Environment Centre, Hopkins	Letter	15934286
75	03/05/2010	Hersovitch	Email	15934280
76	03/05/2010	Turner	Email	15938493
77	10/03/2010	Dawson (CWG)	CWG report	13828670
78	10/03/2010	Eberhard (CWG)	CWG report	13828670
79	10/03/2010	Edwards (CWG)	CWG report	13828670
80	10/03/2010	Gardner (CWG)	CWG report	13828670
81	10/03/2010	Murray (CWG)	CWG report	13828670
82	10/03/2010	Thompson (CWG)	CWG report	13828670
83	10/03/2010	Community Working Group (CWG)	CWG report	13828670

The complete set of submissions received is bound under a separate cover "Submissions and feedback received – Demand Management Strategy" and is available upon request. A detailed list of submission issues is contained in Appendix A. A summary of issues and responses follows in the discussion section.

Issues raised

Major issues raised in the submissions are grouped as follows:

1. Questioning the accuracy and sustainability of future population projections
2. New developments should be required to be more sustainable
3. Alternative sources of water and waterwise options should be pursued

4. Better education, higher water pricing, and more water restrictions required
5. Better promotion of demand management actions in more user-friendly format
6. Council water use (particularly parks and gardens) to lead by example
7. Request for an independent review of the DMS
8. Community consultation good, but could be broader and more meaningful

Public information sessions

Tweed Heads Public Information Session

The Public Information Session at Tweed Heads held from 2:00pm – 7:15pm on Wednesday 10 February 2010 at the South Sea Islander Room, Tweed Heads Civic Centre, Brett Street, Tweed Heads. It was attended by CWG members, Tweed Shire Council staff, and approximately 20 members of the public.

Murwillumbah Public Information Session

The Public Information Session at Murwillumbah was held from 2:00pm – 9:00pm on Thursday 18 February 2010, at the Canvas & Kettle Room, Murwillumbah Civic Centre, Murwillumbah. It was attended by CWG members, Tweed Shire Council staff, and approximately 12 members of the public.

Pottsville Public Information Session

The Public Information Session at Pottsville held from 2:00pm – 7:00pm on Tuesday 23 February 2010 at the Pottsville Environment Centre, Centennial Drive, Pottsville. It was attended by CWG members, Tweed Shire Council staff, and approximately 5 members of the public.

Issues raised

Major issues raised during public information sessions are grouped as follows:

1. Council is looking at both demand and supply sides of water.
2. New developments are not sustainable and should be required to be more sustainable
3. Water substitution and alternative water sources should be pursued. Council to support rebates and retrofits.
4. Better education, higher water pricing, and communication of water use required. Meter individual dwellings in Retirement Villages and Multi-Unit Complexes
5. Good that 40% reduction in water use since 1992, understandable that future savings will require more effort per litre saved. What additional regulations would help Council to enforce more demand management actions?
6. Water unit staff have been helpful and information is available and forthcoming.
7. CWG members should “get on with it” and not concentrate on “administrative” issues.
8. There is a need for augmentation. Four options presented are limited. Each of the four options has benefits and disadvantages
9. Options should avoid a dam at Byrrill Creek, reduce extractions and discharges in the river system

10. Compensation commitments were not honoured with original Clarrie Hall Dam
11. Current planning legislation out of step with community wants. Council can't force developers to implement recycled water in new developments. Queensland can, but NSW has BASIX.

Notes from each of the public information sessions are bound under a separate cover "Submissions and feedback received – Demand Management Strategy". A summary of issues and responses follows in the discussion section.

Community Working Group

The Community Working Group (CWG) was primarily formed to provide information to Council regarding four shortlisted water supply augmentation options. The CWG also provided feedback on demand management issues.

CWG Report

The CWG produced a report covering these issues. It presents the views, interests and issues of members together with a summary of group recommendations. Council was presented with the report 5 March 2010. At its meeting of 16 March 2010, Council determined to publically display the report, and the report was placed on public display to provide other members of the community with additional information prior to the close of submission at the end of April. The full report is available on Council's website: http://www.tweed.nsw.gov.au/Water/WaterSupplyAugmentationWorkingGroup.aspx

Issues raised

Major issues relevant to the Demand Management Strategy which the CWG raised in its report:

1. The accuracy and sustainability of future population projections used
2. More focus on demand before supply
3. An independent review required
4. Water substitution and alternative water sources should be pursued.
5. Climate change to be taken into account
6. New developments should be required to be more sustainable and take into account the entire water cycle.
7. Costs have taken finances but not the environment into account

The CWG also made a number of suggestions for future community engagement:

8. Needed a mechanism to better engage the broader community who are generally complacent unless you discuss with them directly.
9. While the CWG has learnt a lot from the process adopted, the CWG felt uncomfortable speaking on behalf of the whole Tweed community, and encourages Council to seek additional ways to engage the whole community in this process in the future.

Discussion of Issues

Summary of issues and responses

Upon review of the complete list of issues raised, the major issues of significance have been consolidated in the table below. High level responses and discussion to these issues are also contained in the table.

	Issue	Response
Issues 2 - 3	Population Issues - population restrictions / carrying capacity - population projections used - population is pushing augmentation	A number of population planning issues outside of the scope of the DMS were raised, including determining the region's carrying capacity and restricting population growth. These would need to be addressed by the relevant local, state and federal planning instruments. The accuracy of population projections was questioned. Council's projections were based on the sum of development area staging over the next 30 years and is considered more reliable than using annual percentage growth rates. Augmentation is required due to population growth. Council has a responsibility to provide an ongoing water supply and to ensure it gains approvals for a preferred augmentation option before more water is needed. It should be noted that the timing of the implementation will be based on monitoring of actual future population and water demand.
Issues 4 - 10	Sustainability of new developments	Current planning and competition laws may serve to limit a councils' ability to mandate self sustaining communities or development. These issues would not preclude an individual developer from making a voluntary decision to build a self sustaining development, however Council can only work with developers to pursue options over and above the regulations in an opportunistic way.
Issues 11- 24 and 36 - 44	Mixed response to recommended DM actions, and interest for water substitution / alternative sources: - dual reticulation (third pipe) water recycling - high volume rainwater tanks - indirect potable water recycling - stormwater reuse - greywater reuse	The DMS assessed the feasibility of each of these alternatives plus grey/blackwater (4^{th} pipe) and decentralised sewerage, and found they are impractical or provided no additional advantage over the proposed implementation of BASIX, with 5,000 L water tanks and reduced infiltration gravity sewers (RIGS). Notwithstanding, the DMS recommends Council pursue opportunistic prospects where possible. Opportunities will depend on developments proposed and will be assessed by Council.

Issue		Response
Issues 25 - 34	Use of education, promotion, pricing signals and rebates. More user-friendly format.	Education and promoting water savings and restrictions are key recommendations from the DMS. An "inclining block tariff" approach to pricing is recommended in the DMS and is in line with Council policy and best practice. Rebates for rainwater tanks were considered non cost-effective. Shower head rebates and home water audits are proposed as part of the DMS.
Issues 41-44 and 50 - 56	Independent review of Council's position, particularly: - population projections - climate change considerations - range of options - consideration of external environmental impacts	Given that all work to date has been carried out and cross-checked by a range of service providers recognised as experts in the water field, it is difficult for Council to justify further significant expenditure to have reviews carried out by additional experts. The approach to population projections is described above. Climate change modelling was taken into account to determine the Tweed's water supply capacity. Namely, modelling carried out by SE QLD and Rous Water which show that the secure yield in those adjacent regions could be reduced by between 7-15%. A number of independent experts and government authorities were involved in determining the maximum possible range of options for consideration. Alternatives were assessed on an industry standard approach using Triple Bottom Line approach taking into consideration non-economic factors such as environmental benefits and impacts.
25 - 34	Council water use (particularly parks and gardens) to lead by example	Implementation of new Council policies and procedures to reduce the organisation's water use and to set an example to the community are some of the are key recommendations from the DMS.
Issues 48 - 49	Community consultation good, but could be broader and more meaningful	The consultation process represented a major undertaking for Council, both in terms of time and resources. Feedback has been forwarded to Council's Marketing and Communication section for consideration in Council's Community Engagement Strategy. An observer from Southern Cross University provided an independent viewpoint of the process, and was generally supportive of Council's approach..

Detailed issues and responses

Review of the complete list of issues found that many issues were referred to by multiple submissions. To enable more efficient review of all issues, these submissions were grouped together under headings based on the issues raised (refer Appendix A).

Methodology

Many of the submissions repeated or raised similar issues. Council received 83 submissions, containing over 600 individual matters or issues. The CWG report and the Community Information Sessions also raised a number of similar matters for consideration.

Due to the volume of issues raised, they were paraphrased and grouped for presentation purposes. In many instances the text is a combination of the most representative and significant wording from individual submissions. The name of entities that raised the same or similar issue were recorded next to the paraphrased text. This produced a list of some 200 issues.

These issues were then grouped further under header issues according to content (header issues are in grey in Appendix A). The full list of 56 header issues is contained in the table below, together with detailed responses to each one.

Thus it should be noted that issues listed are not an attempt to record individual submissions word-for-word but are Council's best attempt to consolidate the number of issues, record those raising a similar issue, and enable responses to be drafted effectively.

Appendix A shows which individual comments on related topics have been grouped into header issues.

The complete set of submissions received is bound together in a "Submissions Received" report and is available upon request.

Issues and responses table

Responses and discussion to heading issues are contained in the table below.

No.	ISSUE	RESPONSE
	Historical water use	
1	Council has achieved a lot (reducing daily per capita consumption by more than 40%), and is planning to do a lot more (save another 40% from daily per capita consumption), but still more can be done and it can be done sooner.	Historical figures show daily per capita has decreased from 500 L/cap/day in 1992 to around 300 L/cap/day in 2009 - a 40% decrease. Planned reduction under the preferred DMS scenario is actually in the order of 25%. This is based on a starting daily per capita of 370 L/cap/day (in 2006) reducing to 260 L/cap/day in 2036. Overall reduction from 1992 to 2036 is therefore 500 L/cap/day to 260 L/cap/day - a 48% decrease. Demand management requires time to produce results, and the DMS recommends an implementation plan over a number of years. The cost-effectiveness of further demand management would need to be assessed at that point in time. It is worth noting that there is a need to take a conservative approach when dealing with water reduction targets as we are dealing with water security.
	Planning Issues	
-	***Population issues***	
2	Population projections used in the DMS are considered too high for the Tweed's future sustainability and are not supported by the majority of residents. The assumption that the population needs to double is flawed. Population should be based on the carrying capacity of the region.	This is a regional planning and infrastructure issue, rather than an isolated water demand and supply issue. Council has determined the potential population yield from the current LEP zonings (which have not significantly changed since the first LEP revision under the EP&A Act in the late 1980's). Urban land release sites already zoned for development mean that the population of the Tweed is allowed to double in the future. The rate of growth was based on the characteristics of each development area and its likely staging over the next 30 years. This was considered a more reliable population projection than to simply apply a per centage growth rate each year. Population growth figures are confirmed in the "Tweed Urban and Employment Lands Release Strategy" (GHD, 2009) which was released in 2009. Appendix A of the Stage 1 DMS report provides a detailed explanation of how population growth was determined.

No.	ISSUE	RESPONSE
3	If Council's population estimates are overestimated, then augmentation could be delayed and allow development of better water saving programs in the five new major developments and infill areas.	Acknowledged, population growth will be monitored and projections will be updated as required. Council has a responsibility to provide an ongoing water supply. To this end Council needs to ensure it gains approvals for a preferred augmentation option in advance, however the timing and implementation of the preferred scheme will be dependent on actual population growth and actual water demand.
-	***<u>Sustainability of new housing developments</u>***	
4	New developments should be permitted only if they are sustainable, self-sufficient and are not dependent on the Shire's water grid.	Current planning and competition laws may serve to limit a councils' ability to mandate self sustaining communities or development. - There is legislation that describe requirements for provision of water supply and sewer services for urban development - Council must operate within requirements of this legislation - BASIX stipulates minimum requirements for a development but restricts what additional requirements Council can mandate. - In areas currently zoned for urban development, the existing approval processes do not practically permit developments to be independent of the public water supply. These issues would not preclude an individual developer from making a voluntary decision to build a self sustaining development, however Council can only work with developers to pursue options over and above the regulations in an opportunistic way. The Stage 1 Demand Management Strategy assessed options for dual reticulation and decentralised sewerage. It was found that in general dual reticulation and decentralised sewerage provided no advantage or additional advantage over the proposed implementation of BASIX, with 5,000 L water tanks and reduced infiltration gravity sewers (RIGS). Notwithstanding opportunities may arise for sewer mining in such greenfield areas. Such opportunities will be dependent on the style of the development proposed and the willingness of the developer. Where opportunities are identified by the developer Council will assess the proposals put forward.

No.	ISSUE	RESPONSE
5	New developments should be permitted only if they are sustainable and their demand on the Shire's water grid can be limited via sustainable design.	Refer to response to Issue 4
6	There is a once only opportunity for Council and the Dept of Planning to endorse the Water Sensitive Cities concept and apply water saving strategies to new developments such as Cobaki Lakes, Bilambil and Terranora.	Refer to response to Issue 15.
7	The proponents of Cobaki and Kings Forest initially proposed greywater recycling and dual reticulation but this was not supported by Council. Why didn't Council meet part of the costs with Leda?	The proponents of Cobaki Lakes proposed an alternative system with the objective of reducing the cost to sewer their development. A "four-pipe" system was proposed to collect and send "greywater" and "blackwater" to separate treatment plants. Treated greywater was to be returned to properties for non-potable residential reuse for external, toilet and cold water laundry. Treated blackwater was to irrigate public open space areas during dry periods. The proposal did not adequately consider: - wet weather flows and the regulatory ramifications of this - water balances to ensure the long-term sustainability of water recycling on the site - the need for discharge/disposal of treatment by-products - access to treatment plants for operation, maintenance and odour control - contingencies should the relatively untested blackwater system prove ineffective - that the fourth pipe system would substantially increase Council's operating costs - that excessive satellite treatment plants substantially increase Council's operating costs Council has an obligation to ensure developments meet all regulatory requirements, and a sustainable sewerage management system is implemented. As with any development, the proponents had the opportunity to revise their proposal to meet these requirements but did not do so.

No.	ISSUE	RESPONSE
8	Existing residents should not be made to pay for augmentation of the water supply through greater taxes, environmental degradation or reduced living standards due to poorer river health.	A separate charge is levied on all new development to pay for the additional costs associated with providing new or upgraded infrastructure to meet the requirements of the development. Council levels charges for the cost of augmenting the water supply on all new developments. These charges are based on the estimated future capital cost and projected population, and are reviewed every five years. In this way augmentation is paid for by the new developments that produce the additional demand. To ensure an ongoing water supply, Council will need to augment the system prior to the construction of the all new developments (and prior to receiving the full amount of developer charges). Council would then borrow a portion of the capital costs which would incur financing costs (loan costs). These are not fully recuperated from developer charges and under the LGA Act Council is not permitted to include the cost of financing. This additional cost is met by the entire rate payer base. Depending on the timing of the infrastructure, the amount borrowed and the financing conditions, the increased cost to ratepayers is estimated at between 0.5-1.5 cents per kL.
	Demand Management – infrastructure issues	
-	***Infrastructure Upgrades***	
9	That Council should allocate funding and focus actions on improving infrastructure works to reduce water use and losses. In particular, infrastructure leakage programmes should be further investigated.	Agreed. Further improvements in leakage reduction is one of the recommendations of the DMS.

No.	ISSUE	RESPONSE
10	Tweed's water reticulation is energy and cost inefficient and should not be exacerbated with new developments based on a similar approach. Full ecological costs associated with new developments should be factored into government planning including s94 and s64 developer contributions.	Tweed's water reticulation system is operated as efficiently as possible. Assessment of options (both in the Demand Management Strategy and the Water Augmentation Options) has taken into account the ecological costs through the TBL assessment, which is normal industry practice for these types of studies. The s64 developer contribution plans were revised by council in 2007 and were prepared in accordance with the Guidelines for Developer Charges for Water Supply, Sewerage and Stormwater issued by the Minister for Land and Water Conservation (now Department of Water and Energy) in December 2002. The s94 are not related to water and sewerage supply. These guidelines were based on a Determination issued by the Independent Pricing and Regulatory Tribunal (IPART) in September 2000.
-	***High volume rainwater collection***	
11	That Council should make high volume rainwater collection for whole of home use compulsory in all new developments. Rainwater tanks should be supplied free of charge.	Sizing of the tank depends on the rainfall distribution, roof size and pattern of uses and end use. This has been analysed for greenfield areas in TSC and the recommendation is for 5,000 L tank - which are larger than the minimum BASIX requirements. A study examining the feasibility of using rainwater tanks for whole of home was conducted by MWH . Rainwater tank systems do not provide the same levels of service as town water supply. There are issues associated with water quality, energy consumption and footprint. In urban areas NSW Health supports the use of rainwater tanks for non-drinking uses. NSW Health recommends that people use the public water supply for drinking and cooking because it is filtered, disinfected and generally fluoridated. Refer to response to Issue 12.

No.	ISSUE	RESPONSE
12	That Council should make high volume rainwater collection for primary source of water compulsory in all new developments. A minimum of 10,000-20,000L tanks should be required in residential and 40,000L for non-residential. This would instantly relieve the pressure on our water supply, would help reduce demand on water during drier months. Country people are able to live off rainwater tanks by being careful with their water use. It is achievable and should be enforced on all.	10 - 20 kL would not provide a reliable supply. For a Greenfield single family residential property, a 100 kL tank or greater connected to 300 m2 of roof area would be required to meet 100% of the family's demand. A rural property may have the space for numerous tanks and connected roof area (eg large sheds) but this is not feasible on a suburban block. Currently the disadvantages of using rainwater tanks to supply all of a household's demand far outweigh the advantages due to the lack of water security (much higher probability of running dry than the existing reticulated system) and economics of large stand alone rainwater tanks in areas where potable supply is available.
13	That Council should make high volume rainwater collection for primary source of water compulsory in all (new and existing) developments.	Refer to response to Issue 12.
14	High volume rainwater collection (self-sufficiency) can be accommodated by ensuring the size of blocks of land is large enough and by using space saver tanks and bladders.	Refer to responses to Issues 7 and 8. Space-saver devices can maximise the volume of water that can be stored in available areas, however they do not change the volume of water required to be stored, and so there is a limit to how much additional water can be stored on an average suburban block. Depending on the type of system used and its accessibility, space-saver storages can also create issues in terms of cost, system longevity, and ease of installation and maintenance.
	Water substitution	
15	That Council should make water substitution methods compulsory in all new developments, in particular recycling water (effluent reuse) through dual reticulation, greywater reuse, and stormwater harvesting as they are in Pimpama/Coomera and Ballina.	Council needed to have a full commitment in place to recycle water prior to conditioning developments accordingly. Such a commitment would require not only changes in policies and standards but an approved financial commitment to providing the necessary infrastructure when required. Otherwise Council could be challenged in the Land and Environment Court. Options such as these were examined in detail as part of the Demand Management Stage 1 report. It found that these options did not score well in the Triple Bottom Line assessment. Their capital and operation costs were also high. For these reasons, Council has not committed to implementing these options at this point in time. However the DMS recommended they be pursued on an opportunistic basis where possible.

No.	ISSUE	RESPONSE
16	Greywater currently produced in the Shire could be reclaimed to provide up to 9635ML/yr.	Grey water reuse was considered and discarded under Greenfield Scenario 5 (refer to DMS Stage 1 section 5.2.6)
17	Around Australia, new technologies are allowing local reuse of bulk harvested stormwater. The South Australian government, and Marion and Salisbury Councils will implement projects that utilise 1200ML of stormwater for reuse. The Stormwater Association of Qld advocates stormwater harvesting for non-potable uses as a cost effective alternative to the Traveston Dam.	It should be noted that the Stormwater Industry reference has been taken out of context. The press release of Nov 09 stated that water supply should not only be the choice between Traveston dam and desalination, and a balanced solution is needed with fit for purpose solutions. SIA do not suggest that that stormwater harvesting could replace Traveston or other water supply dams, simply that stormwater reuse can be an alternative and can be cost-effective in certain situations. Tweed's IWCM takes this approach. MWH conducted an investigation into Stormwater Harvesting and Reuse. It found that: - The Salisbury project uses Aquifer Storage & Recovery (ASR) technology. Although aquifers do exist in the Tweed area, BlighTanner in a 2004 study have said that there are no known aquifers in the Tweed Area that would be suitable for ASR. - Substantial funding has been provided by the federal government to undertake stormwater harvesting projects, unclear whether these projects would be cost-effective without this funding. The investigation stated stormwater appropriate for non-potable uses such as open space irrigation, active playing surfaces provided issues such as reliability and storage requirements could be met. Council has committed to opportunistic investigation of stormwater opportunities with developers.

No.	ISSUE	RESPONSE
18	That Council should make water substitution methods compulsory in all (new and existing) developments. In England and Singapore they recycle water and provide water through dual reticulation, greywater reuse, stormwater harvesting, rainwater tanks and desalination without needing dams.	Recycling in England, in much of Europe, and even along our longer river systems in Australia (eg the Murray-Darling) is by default rather than by intention. This type of Indirect Recycling of water has come about through a historical context and was not planned. SEQ has planned and constructed a system to provide indirect recycled water to Wivenhoe dam, however to date no recycled water has been returned to the dam for potable use. Singapore is severely water restricted and has limited options for new water supply. Implementation of these measures has had social, environmental and economic impacts such as: - conversion of large natural estuarine water bodies to freshwater in order to store the city's stormwater runoff for reuse - construction of a desalination plant - construction of a pipeline to receive water from Thailand - educating the population about water use includes cutting-off residential water use for several hours at random and without warning. Council has taken an open approach to water substitution and each of these options were examined as part of the Stage 1 report. Water substitution through rainwater collection is the focus of the DMS and is required under BASIX.
19	End users will pay lower water bills wherever large scale stormwater harvesting, greywater reuse, and dual reticulation water reuse are implemented.	This is not true. These schemes can often be more expensive than traditional water supply schemes. Detailed costings were completed in both the DMS and WSA reports.
20	Water recycling has not been fully considered. It seems to only be given peripheral consideration. Tweed had a 2006 Recycled Water Options Report - but was this used ? That study should have been used in the DMS and they should complement each other.	Water recycling has been given in depth consideration; to suggest it has not been fully considered is incorrect. Water recycling has been practiced in the shire since the 1980's, and a number of additional recycled water options have been identified by TSC: http://www.tweed.nsw.gov.au/Water/WastewaterRecycledWater.aspx Council's Demand Management Strategy utilised work carried out in the Recycled Water Options report, and these reports complement each other. Both documents consider recycled water use and both form part of the overall Integrated Water Cycle Management Plan which was adopted by Council in 2006 to ensure a consistent and complimentary approach to water management.

No.	ISSUE	RESPONSE
		Council has investigated alternative supply schemes (such as reuse schemes) before embarking on this Water Supply Augmentation project. Reuse in particular has been investigated in detail in the Stage 1 Demand Management Strategy which went on public exhibition in 2008. The Stage 1 report looked at the possibility of introducing recycled water in a 'three-pipe system' to supplement 'future major greenfield development sites' at Cobaki, Bilambil heights, Area E (Terranora), Kings Forest and West Kingscliff. A three-pipe system would include a pipe for drinking water, one for sewage and the third to transport recycled water from wastewater treatment plants. The study concluded that although this system would save the equivalent amount of water as the 'rainwater tank' option, both the upfront and ongoing costs of providing a three-pipe network and establishing membrane treatment was significantly higher. These overall combined costs to the community, home owners and council were approximately twice that of the rainwater tank option from a long-term financial perspective - in excess of $30 million over a period of 20 years. A further two major options considered included the combination of rainwater tanks and recycled water, and an indirect potable re-use option (which would involve returning recycled water to the Clarrie Hall Dam to be collected and re-treated as part of normal drinking water). Indirect potable reuse was also considered under the Water Supply Augmentation Options report. All of these options were ruled out based on low scores in Triple and Quadruple Bottom Line analyses and due to prohibitive costs. (The total cost involved with implementing the indirect potable re-use option was found to be in excess of $184 million). From an environmental perspective, both recycled water options reduced effluent flows to the waterways but only by about 10 per cent and a considerable amount of energy would be required to treat and transport the water. The membrane treatment processes and pumping systems consume enormous amounts of energy which in turn produce significant greenhouse emissions.
21	Water recycling should be implemented. At present 92% of reclaimed water is discharged into the Lower Tweed Estuary. By 2036 the population of 157,000 will generate 14,330ML/yr wastewater which should be utilised to reduce the demand on potable supplies.	This was considered in the DMS. Refer to responses to Issues 15 to 20.
	Alternative water sources	

No.	ISSUE	RESPONSE
22	That Council should procure alternative water sources such as indirect potable reuse (ie returning highly treated sewage effluent to Clarrie Hall Dam or Bray Park Weir for all uses including drinking)? Direct Potable reuse (which returns highly treated water directly to local reservoirs) would be even better.	These were explored as options in both the WSA and DMS reports.
	Other technologies	
23	Sewage effluent can be dumped vertically to generate hydro-electricity. This power, along with methane generated in digesters, can be used to pump effluent through filtration and UV and other purifying systems to produce water for re-use.	Council's sewage treatment plants are situated approximately at sea level, and there are few opportunities for hydro-electricity generation using this method. Council's current treatment plants are all based on aerobic treatment processes.
24	The existing water supply is adequate for our current and projected population for at least 20 years, especially if 22,500L rainwater tanks and other on-site recycling systems including simple low-cost filters for drinking water were used.	Refer to responses to Issues 11 to 14. Simple filters can be utilised to remove some contaminants, but these require on-going maintenance, need to be disposed of once used, and may not be so cost effective. One alternative (although often used after filtering) is to disinfect with UV, however this is expensive and requires specialist on-going maintenance.
	Demand Management – pricing issues	
	Rebates	
25	That Council should provide rebates for installation of rainwater tanks and retro-fitting of water efficient appliances, particularly for those who were told to remove their tanks many years ago	Rebates for rainwater tanks was considered in the Stage 1 DMS but was deemed not to be cost-effective. Shower head rebates and home water audits are proposed as part of the DMS.

No.	ISSUE	RESPONSE
26	Instead of spending $75M at Bray Park and $35M on a dam ($110M total), Council could provide $500 rebates for rainwater tanks to all the houses projected to be in the shire in 2036.	The $110M referred to provides a secure water supply (through water treatment and the dam) for an estimated population in 2036 of 157,000. The increase in population from today is approximately 80,000, which roughly equates to 30,000 new houses. To install equivalent self-sufficient rainwater tanks would cost over $20,000 per residence. If the $110M was divided amongst residences, the equivalent rebate would be only $3700 per dwelling (assuming no rebates to commercial and industrial customers). For comparison, the shire-wide cost to make all new developments self-sufficient on rainwater tanks would be at least 30,000 x $20,000 = $600M.
	<u>Price of water</u>	
27	Council should increase the base price of water and decrease the water volumes which trigger the step price increase for excess consumption. Council should also target water use of 150L/p/d or lower (such as in SEQ and Melbourne). Why is Tweed aiming at only 205L/p/d water usage	This "inclining block tariff" approach is recommended in the DMS and is in line with Council policy and what is considered best practice. From TSC web-site: "To encourage water conservation, high residential consumers are subject to a 50% step price increase for consumption in excess of 450 kL per year. From July 2010, it is proposed to implement this 50% step price increase for consumption in excess of 350 kL per year. " http://www.tweed.nsw.gov.au/Water/WaterPricing.aspx 205 L/p/day is a short term target (2012), ultimate average shire-wide target in 2036 is 170 L/p/day. The target set in Melbourne and SEQ (155 L/p/day target and 140 L/p/day, respectively) are targets set under severe drought restrictions - not long term conservation goals. The long term planning target for SEQ is for 230 L/p/day.

No.	ISSUE	RESPONSE
28	Council should vary the price of water according to its availability (eg linked to the level of water in Clarrie Hall dam).	In the USA, most droughts are managed in this way. This approach is a short-term approach for managing drought conditions. It does not improve the reliability of the supply source. In Australia, we have relied on a restrictions based approach to. TSC has developed a Drought Management Plan with drought response triggers linked to the water level in Clarrie Hill Dam. TSC has adopted a best practice approach to water pricing, which promotes conservation through a user pays system.
	Demand Management – management issues	
	Water reduction initiatives	
29	The DMS should encourage water savings through community education (including personal water usage and garden design). Imagine the savings if the DMS proposed allocation of the dam budget from water engineering to water education.	Education and promoting water savings and restrictions are some of the key recommendations from Council's Demand Management Strategy and the Drought Management Strategy to encourage water savings. The Drought Management Plan proposes that permanent restrictions will be implemented in July 2012. Low level permanent restrictions may include the following: • Watering on alternate days (3 days per week) for odd and even house numbers • External water use only during the hours of 6am to 9am and 5pm to 8pm • No runoff allowed from watering into gutters and stormwater systems • Vehicles not to be washed on hard surfaces and trigger sprays to be used.

No.	ISSUE	RESPONSE
30	Compulsory use of large rainwater tanks and decentralised systems would encourage people to use water more responsibly.	Agreed, however, this would need to be supported through on-going education. Public health risks associated with rainwater tanks were highlighted in Technical Note 2: Large Stand Alone Rainwater Tanks (MWH, Feb 2010) prepared for the CWG. On this basis TSC recommends that rainwater is used for non-potable applications such as toilet flushing, outdoor use and cold water use in washing machines where potable water supply is available.
31	Council should encourage water savings through permanent water restrictions.	Refer to response to Issue 29.
32	Council should audit all major non-residential (top 100) users.	Top 100 users are the priority targets identified in the Stage 2 (non-residential) DMS. Water auditing of these users is recommended as part of the DMS.
33	Council to immediately implement waterwise and native garden initiatives in TSC outdoor operations, residential and commercial users.	Waterwise, native garden and targeting TSC Outdoor users are priority targets identified in the Stage 1 and Stage 2 sections of the DMS. Refer to response to Issue 32.
34	Council is yet to retrofit the remaining houses in the Shire (approx 50%) and carry out an audit of other high use water items (dual flushed toilets, washing machines, hoses without trigger control). A retrofit of existing homes could result in a further saving of 600ML/yr.	The value quoted of "50% remaining" is inaccurate for the following reasons: - Houses built after 1982 already have dual flush toilets. - Houses built on the Tweed after the introduction of BASIX (2005) have waterwise showers, dual flush toilets, tap aerators, rainwater tanks, etc. Council estimates that approximately 35% of the current housing stock might remain to be retrofitted. A retrofit of these homes would deliver approximate water savings of 250ML/yr. It should be noted that this figure of 35% will gradually fall as BASIX requirements are implemented in older housing stock which are renovated or replaced. Furthermore, experience from other areas shows that ongoing water education, water pricing reforms and wider acceptance of water saving appliances results in further ongoing retrofits by homeowners. Refer to website: http://www.tweed.nsw.gov.au/Sustainability/RetrofitProgram.aspx
	Ongoing planning and monitoring	
35	The reduction from 292L/p/day (current) to 169L/p/day (future shire-wide average) seems steep (42% reduction). Over what period is this reduction proposed to be implemented?	Numbers are not correct. Residential per capita demand is projected to reduce from 240 L/p/day to 170 L/p/day - representing a 26% decrease. This is over a 30 year timeframe (2006-2036). The reduction is steep, however, this is attributed to the high number of Greenfield developments in the next 30 years.

No.	ISSUE	RESPONSE
	Issues with the report and approach	
	The Scenarios	
36	In new greenfield developments Scenario 4 (which includes BASIX provisions, 5000L rainwater tanks, and indirect potable reuse) is seen as a more sustainable approach. In particular due to reduced discharges to areas such as receiving waters at Cobaki. It could be more cost effective if decentralised plants at Cobaki and Kingsforest were constructed and piping costs were reduced by returning the water just upstream of Bray Park weir WTP.	Decentralised plants have their place especially when it comes to their proximity to sites for recycled water opportunities. A decentralised system was considered for Cobaki Lakes. It was concluded that although the capital and operating costs of the decentralised treatment option are lower than the option of treating all water at Banora Point, the overall cost of providing recycled water are substantially higher than for potable water. The overall cost to the community is higher than for potable water and these costs would need to be passed on through the price of recycled water. These higher costs are balanced in some way by the reduction in nutrients and greenhouse gas generation for the business as usual option of centralised sewage treatment without recycling. Decentralised options will be considered by Council if proposed by a developer.
37	The most sustainable option Scenario 3 (combining BASIX, Rainwater tanks and Dual reticulation) brings consumption down to 95L/p/d but is incorrectly discarded and considered too costly by Council.	Each of the Scenarios and assessed in accordance with the TBL Assessment.
38	Why was Scenario 5 which includes Direct potable reuse discarded when it is used or being planned for Rous Hill in Sydney, Coomera and Pimpana in Qld, Ballina Heights, and Adelaide?	Direct potable reuse is not currently planned for any water supply in Australia. These other schemes are dual reticulation schemes where recycled water is not for potable use.

No.	ISSUE	RESPONSE
39	BASIX measures are minimalistic and uninspiring.	BASIX was designed to address water conservation in a cost-effective manner. It addresses the major water opportunities for water conservation in the home. BASIX requires all new homes in NSW to use up to 40% less potable water than the average home. BASIX does limit Council's ability to mandate some actions that are more stringent than the BASIX requirements (eg larger rainwater tanks). Refer to response to Issue 4.
40	Why does the study discount Scenarios 3 and 5 which reduce water use to 95L/p/d and less?	Scenarios 3 and 5 were discarded based cost effectiveness and other factors which were assessed in the TBL assessment.
	External and flow-on effects	
41	External factors such as environmental costs and benefits have not been directly included in the economic and comparative analysis. The analysis should have included items such as reduced water discharges to sensitive receiving waters, reduced storm surcharges, creation of habitat through reedbeds, etc.	They have been qualitatively considered in the TBL assessment The benefits of rainwater tanks in terms of stormwater management was considered.
42	Climate change and sea level effects have not been considered.	Climate change was indirectly considered through an increase in discretionary demand. Sea level impacts are not directly relevant to the DMS study. Refer to responses to the Water Augmentation Project for more information on where climate change has been considered.

No.	ISSUE	RESPONSE
43	Flowchart on page 14 mentions stormwater and wastewater, after which no mentions seems to be made of maximising reuse of these two crucial sources of water.	Action 13 of the revised Tweed Shire Integrated Water Cycle Management Strategy identifies the need to assess opportunities for recycled water use within the shire. Council undertook a Recycled Water Options Report in 2006 which proposed the investigation of several practical water reuse options for the Tweed. One of these, at Chinderah Golf Course, has already been implemented and added to the existing water recycling schemes. Others, such as water recycling on the Les Burger Field at Bogangar are in various stages of implementation or investigation. A report investigating the feasibility of stormwater harvesting within the TSC area has also been prepared by MWH. http://www.tweed.nsw.gov.au/Water/WaterSupplyAugmentation.aspx (under Downloads)
44	Perception that the conclusions of the Demand Management Strategy are weighted specifically to create the promise that the Shire has no option other than to undertake some massive centralised water infrastructure project. There should be a shift from hard infrastructure towards decentralised supplies which cause less devastation.	As part of the Stage 1 Demand Management Strategy options for dual reticulation and decentralised sewerage were assessed. It was found that in general dual reticulation and decentralised sewerage provided no advantage or additional advantage over the proposed implementation of BASIX, with 5,000 L water tanks and reduced infiltration gravity sewers (RIGS). Notwithstanding opportunities may arise for sewer mining in such greenfield areas. Such opportunities will be dependent on the style of the development proposed and the willingness of the developer. Where opportunities are identified by the developer Council will assess the proposals put forward.
	Review of data	
45	Council's 2006 IWCM Strategy noted a target of 12% unaccounted for water (UFW). It appears that a new, more stringent target of 10% has been set in the DMS, however there is no discussion as to why this has occurred or what the achievements to date are.	This is a more stringent target based on the adoption of an active leakage plan which was recommended as part of the DMS. Status: At this stage Council does not have the resources available to develop and implement the program. Further consideration will be given to obtaining suitable support to implement the program.
46	A more detailed analysis connecting water restrictions in 2002-2003 to water savings during and since (using a cause – effect equation) would be valuable.	Impacts from restrictions reflect short-term drought impacts, rather than impacts from long term conservation measures. The relationship is complex, and a direct comparison is not possible. The impact of the 2002-2003 drought was considered in the development of the Drought Management Plan.

No.	ISSUE	RESPONSE
47	A better breakdown of information for retro-fitted homes and businesses would be valuable. It would provide useful data on take-up rates for different appliances: for instance almost 50% of all homes have been retrofitted, of which 5% had existing toilets replaced with dual flush toilets.	Previous programs have not been directly managed by TSC, as such this information may not be freely available. In the future, TSC will set up a program monitoring success of the demand management measures. This will include assessment of take up rates, with statistics similar to those used in the example.
	Consultation with the community	
48A	Majority of Community only speak out when there is something to complain about - So just implement radical water saving devices in each new development and rebate incentives for retrofitters	Council takes a balanced approach to consultation by consulting as much as possible with the community, but recognising there are constraints on people's time and Council's resources. Feedback from the community can assist Council in determining the best ways to manage water resources within the shire.
48B	For a document put out for public submission, the sheer size and complexity of the DMS information is daunting. Better marketing of Council's IWCM strategy as a holistic package are required for the community to understand the steps being taken to conserve, protect and augment the future of water in the Shire.	Acknowledged. The issue is complex and the amount of detail in the Stage 1 and 2 reports reflect this. The third document was a summary document intended for public information. In the interests of transparency, and for those wanting more detailed information, Council has made all three parts of the report publically available. More education and promotion of Council's IWCM approach is one of the priorities identified.
49	When Council fails to provide information about the low Tweed River historic flows at Bray Park Weir, how can residents adequately respond on water supply issues in the Demand Management Strategy?	It is in Council and the community's interest to provide information that enables the public to make submissions to the water projects. To this end, Council has provided significant quantities of summary and detailed information over a prolonged period of time (since mid 2009). Some data can be more difficult to source and present than other data, however Council is committed to responding to data requests that are permitted to be in the public sphere.

No.	ISSUE	RESPONSE
	Community Working Group (CWG)	
	Forward thinking Council	
50	TSC is not serious about reducing water demand and needs to acknowledge that there are solutions to demand management that are not considered in the report [and which are] not dealt with in sufficient detail and result in the perpetuation of an unsustainable economic and social system.	MWH has completed the reports in accordance with the "Best-Practice Management of Water Supply and Sewerage Guidelines". Economic and social considerations were accounted for in the assessment of options.
51	Best practice seems to dictate the recycling of water (eg Sydney Water). Are there health risks or Dept Health restrictions which mean these options are not being seriously considered? Are there other State and Federal regulatory impediments to the enforcement of more stringent and sustainable water management?	Recycle water options were considered in detail in both the DMS and WSA reports. There are regulatory requirements for recycled water schemes, as opposed to impediment. These are in place to ensure that public health and environmental risks are properly managed and mitigated.
52	The Demand Management, Drought Management and Supply Augmentation strategies were all produced by MWH, resulting in little opportunity for peer input or review. The recommendations in these strategies result in a mostly “business as usual”, “dollar focussed” approach. MWH was involved with the background studies for the Traveston Dam which were disputed, and their studies on the Tweed may also be disputed. Council should follow the CWG’s recommendation for an independent expert review of the proposed demand management and water augmentation approaches.	Members of the CWG have written to Council’s General Manager to request an independent expert review of the three studies in which MWH has been involved. One of these studies is a collaborative effort between MWH, NSW Public Works (Dams and Civil) and Environmental Hydrogeologists Associates, all of which contributed in the areas of their respective expertise, and thereby provided opportunity for peer review. Furthermore, this work has been based on previous studies by acknowledged specialists such as GHD and Hunter Water. All work to date has been carried out by independent experts. The variety of reports used on this project show the breadth and depth of that independent expertise and have included information from all of the following experts: Montgomery Watson Harza, NSW Public Works, Hunter Water, SunWater, Water Solutions, GHD, Southern Cross University, Converge Heritage & Community, Greenloaning Biostudies, Eco-sure Environmental Consultants, Tweed Landcare Inc., and Peter Parker Environmental Consultants.

No.	ISSUE	RESPONSE
		In addition Council and its consultants are continuing to work with independent relevant government agencies, particularly licensing authorities, to ensure their requirements are met through this ongoing review process. Council has requested feedback and advice from the following licensing and regulatory authorities during this process: NSW Office of Water, NSW Fisheries, National Parks, NSW Forestry, NSW Health, Department of Planning and Northern Rivers Catchment Management. Given that each of the participants are recognised experts in the water field, it is difficult for Council to justify further significant expenditure on expert reviews of the work already undertaken by experts. Given that Council would need to engage the said independent reviewer, there are also questions as to whether the community would accept the independence of the process. Finally, MWH was not involved in any studies concerning the Traveston Crossing Dam project. MWH reported to the Queensland Water Commission on the SEQ Water Strategy in relation to demand management strategies in face of the millennium drought.
	<u>Global best-practice water management</u>	
53	Best practices result from a combination of water tanks, stormwater harvesting, recycling water and desalination.	Best practice is the use of a balanced integrated water management approach which considered both supply side options and demand management options.
54	Composting Toilets have not been given enough attention and Council should have designs which are approved and can implemented available for new and retro-fitted constructions. Household by-products should be composted on-site.	There a number of benefits from composting toilets, however, successful operation of composting toilets may require intensive user intervention and understanding of various issues relating to ongoing maintenance: insects/flies (e.g. disease vectors for pathogens), odours, mechanical or electrical failures, or inappropriate use of toilets (i.e. addition of chemicals). Other issues of concern may arise due to possible contamination of adjacent soils and waterways as a result of the excess liquid (or leachate) disposal, use of compost prior to pathogen die-off, and poor environmental conditions required for composting (C/N, moisture, temperature). NSW Health regulations require both liquid and solid waste material to be removed and disposed of adequately.

No.	ISSUE	RESPONSE
		Cost effective disposal is usually on site, however the buffers required to neighbouring land will preclude most areas in urban environments. Alternatively, liquid (urine) could be diverted directly to the sewer and a registered waste collector could be contracted to collect and dispose of solid waste external to the block. Given these issues, the use of composting toilets is not recommended for wide scale adoption. Council encourages it in unsewered areas, and while it does not prohibit the installation of composting toilets in urban areas, it is not recommended.
55	By varying the price of water according to its availability, residents will be encouraged to store water when the price is low to use when water price is high.	A restrictions regime has been developed which is tied to water availability (refer to the Drought Management Plan). It should be noted that the storage of water has associated health issues, which is unlikely to be supported by council or government agencies. Refer also to response to Issue 28.
-	***Environmental flows***	
56	At its meeting 17 November 2009, Council approved further environmental flow restrictions on the Tweed River at Bray Park Weir: "The cessation level for flow bypass requirements at Bray park Weir be set at a level of 50% of the capacity of the Clarrie Hall Dam".	Council is not able to approve or alter environmental flow requirements which fall under the jurisdiction of the NSW Office of Water. At its meeting 17 November 2009, Council adopted the Drought Management Strategy which included a recommendation to approach the NSW Office of Water to determine appropriate flows during periods of serious drought. Based on the recommendations from the Drought Management Strategy, Council requested the cessation of flows at Bray Park Weir when the capacity of Clarrie Hall Dam drops below 50%. However, in July 2010 the Office of Water imposed the following license conditions on Council: "*(9iii) [That there must be a flow equivalent or greater to the] 100th percentile flow at Bray Park Weir when Clarrie Hall Dam capacity is 50% or less and 2 weeks after the imposition of Level 6 water restrictions by Council."* A further relief clause was also provided for more extreme drought events: *"(10) If the storage level of Clarrie Hall Dam falls below 50% and an approved demand management strategy has been introduced the licensee may apply to the Office of Water for modification of the discharge requirements in subsection iii of condition 9."*

Appendices

Appendix A – Detailed Issues Table

Individual topics or issues are listed against the entity making the submission. Related topics have been grouped into grey header issues that have been addressed in the Discussion Section of the report.

It should be noted that the issues paraphrase comments from individual submissions. In many instances the text is a combination of the most representative and significant wording from individual submissions. Issues listed are not an attempt to record individual submissions word-for-word but are Council's best attempt to consolidate the number of issues, record those raising a similar issue, and enable responses to be drafted effectively.

The complete set of submissions received is bound together in a "Submissions Received" report and is available upon request.

No.	ISSUE	RAISED BY:	REFER TO
	Historical water use		
1	Council has achieved a lot (reducing daily per capita consumption by more than 40%), and is planning to do a lot more (save another 40% from daily per capita consumption), but still more can be done and it can be done sooner.		See response in Discussion Section
1.1	Tweed has done a brilliant job reducing daily per capita consumption by more than 40%. The water Tweed saved with the incentives between 2005 – 2009 was equivalent to the water saved from 1995-2005 without incentives. It is impressive Tweed is aiming to again save another 40% from daily per capita consumption in this latest forward plan.	NSW Office of Water, DECCW - Hennessy	issue grouped for combined response
1.2	Appreciates what Council is doing and is planning to do, but more can be done and it can be done sooner.	Masters	issue grouped for combined response
	Planning Issues	-	-
-	***Population issues***		

No.	ISSUE	RAISED BY:	REFER TO
2	Population projections used in the DMS are considered too high for the Tweed's future sustainability and are not supported by the majority of residents. The assumption that the population needs to double is flawed. Population should be based on the carrying capacity of the region.		See response in Discussion Section
2.1	The CWG is concerned that the water supply augmentation options process is premised on population growth predictions that the CWG is not able to assess the validity of.	Community Working Group Report (March 2010)	issue grouped for combined response
2.2	Population expectations and projections used in the DMS are considered too high for the Tweed's future sustainability. The assumption that the population needs to double is flawed.	Murwillumbah Ratepayers Assoc; Summers; Maher; Prince; Gill; Peacock; Sledge; Symons; Gray; Hill; Ipsen; James; Lewin; McCormick; McNamara; Wilkens-Russel; Yeomans; Caldera Environment Centre – Dawson; Tweed District Residents & Ratepayers; Townsend; Lemaire; Mann; Sledge and Vionot; Riordan; Hastings Point Progress Association; Chadwick; Jack; Rifello; Watsford; Robertson, Lovegrove and Dundee; Gardner; Graf; Havier and Addis; Hearder; Mayfield; Munz and Maher; Outridge - Margo; Outridge - Mary Lou; Pearson; Stuart; Caldera Environment Centre; Caldera Environment Centre – Hopkins; Turner; Eberhard (CWG)	issue grouped for combined response
2.3	Population is predicted based on recent historic population growth rates which are clearly ecologically unsustainable. Council shows no sign of questioning the trends which depend on Commonwealth Government policies. Recent media surveys in SEQ indicated two-thirds of residendts reject continual exponential growth which are effectively promoted by the Demand Management Strategy.	Caldera Environment Centre - Hopkins	issue grouped for combined response

No.	ISSUE	RAISED BY:	REFER TO
2.4	A Community Water Survey which compiled responses from approx 150 people reflected that the majority (greater than 80% of respondents) did not want this growth.	Gardner; Gardner (CWG); Thompson (CWG)	issue grouped for combined response
2.5	Council should allow developments only if it is sustainable within the present infrastructure and is mainly self-sufficient in water usage. Limit growth to negate the need for augmentation of the water supply. Link to the availability.	Fingal Head Coastcare Inc.; Lewin; McCormick; McNamara; Caldera Environment Centre – Dawson; Dawson	issue grouped for combined response
2.6	Council should look at the most sustainable and efficient use of existing water resources.	Jacobi; James	issue grouped for combined response
2.7	It is one thing to cater for population needs, and another to plan overdevelopment and doubling of the population. The availability of resources should determine population, not the other way round.	James; Lewin; Mason; Caldera Environment Centre - Dawson	issue grouped for combined response
2.8	Max Boyd had a study done which suggested the Shire could sustain a population of 80,000. Current plans exceed this. Council must not continue to exceed nature's ability to sustain us naturally.	Malecki	issue grouped for combined response
2.9	Water and population need to be linked. Without considering population growth in the context of ultimate resource scarcity, that is acknowledging there is a finite limit of water available to be trapped in the system (which can support a fixed number of people). Population growth at current levels is unsustainable. The current urban model is flawed. With controlled land release, money could be set aside for the best long term option rather than expediency.	Community Working Group Report (March 2010)	issue grouped for combined response

No.	ISSUE	RAISED BY:	REFER TO
2.10	The best elements of urban planning need to be adopted by TSC (why can't TSC be leading edge?) in tandem with maintaining and enhancing the environmental values of the region. Enlightened LEP addressing the future needs of community and the environment. The Tweed Shire LEP should address the issue of preserving why people live or would wish to live in the Tweed. This includes those values, both environmentally and socially, which will be destroyed for future generations through a develop or bust approach, filling the pockets of a parochial few at the detriment of the greater good to meet their demands.	Community Working Group Report (March 2010)	issue grouped for combined response
3	If Council's population estimates are overestimated, then augmentation could be delayed and allow development of better water saving programs in the five new major developments and infill areas.		See response in Discussion Section
3.1	Australia's population growth is 2.1% p.a., which applied to the Tweed's 2008 population would result in 114,000 residents by 2036. This corresponds to 12,642ML/year which is well below the secure yield of 13,750ML/year. If Council's assumptions are incorrect, there is no need to rush ahead with unsustainable options and alternatives can be implemented in the five new major development areas.	Hastings Point Progress Association	issue grouped for combined response

No.	ISSUE	RAISED BY:	REFER TO
3.2	Council should recheck the predicted population for 2021. Based on annual increase of 2.97% there should be 129,284 people, the DMS quotes 119,446 people, and Council cycleway Section 94 Plan No22 quotes 105,183 people in 2021.	Murray	issue grouped for combined response
3.3	If Council's population estimates are overestimated, then augmentation could be delayed and allow development of better water saving programs in the five new major developments and infill areas.	Gardner; Graf; Havier and Addis; Hollingsworth; Munz and Maher; Pearson; Murray	issue grouped for combined response
3.4	Growth that develops ahead of infrastructure is reckless.	Fingal Head Coastcare Inc.	issue grouped for combined response
-	***Sustainability of new housing developments***		
4	New developments should be permitted only if they are sustainable, self-sufficent and are not dependent on the Shire's water grid.		See response in Discussion Section
4.1	New developments should not be allowed to be dependent on the Shire's water grid by being able to collect, treat, re-circulate and reuse waste water to supply their own needs.	Symons; Ehrlich; Turner	issue grouped for combined response
5	New developments should be permitted only if they are sustainable and their demand on the Shire's water grid can be limited via sustainable design.		See response in Discussion Section
5.1	The designs of Cobaki and Kings Forest are unsustainable and are pushing the requirement for a new source of water supply. Water demand should be limited via sustainable design.	Summers; Prince; Fingal Head Coastcare Inc.; Gill; Peacock; Sledge; Symons; Gray; Hill; Ipsen; Malecki; Mason; McNamara, van Steenwyk, Yeomans; Tweed District Residents & Ratepayers; Riordan; Hastings Point Progress Association; Chadwick; Rifello; Watsford; Gardner; Graf; Havier and Addis; Hearder; Hollingsworth; Munz and Maher; Outridge - Margo; Outridge - Mary Lou; Pearson; Caldera Environment Centre; Turner	issue grouped for combined response

No.	ISSUE	RAISED BY:	REFER TO
5.2	The designs of Cobaki and Kings Forest should incorporate porous surfaces to improve stormwater run-off quality and quantity.	Yeomans	issue grouped for combined response
5.3	The Tweed community is concerned that council is taking too little action in the total water cycle of new satellite cities which are expected to accommodate a predicted 76198 persons by 2036.	Community Working Group Report (March 2010)	issue grouped for combined response
6	There is a once only opportunity for Council and the Dept of Planning to endorse the Water Sensitive Cities concept and apply water saving strategies to new developments such as Cobaki Lakes, Bilambil and Terranora.	Murray	See response in Discussion Section
7	The proponents of Cobaki and Kings Forest initially proposed greywater recycling and dual reticulation but this was not supported by Council. Why didn't Council meet part of the costs with Leda?		See response in Discussion Section
7.1	The proponents of Cobaki and Kings Forest initially proposed greywater recycling and dual reticulation but this was not supported by Council. Why didn't Council meet part of the costs with Leda?	Gill; Peacock; Sledge; Gray; Hill; Ipsen; Malecki; McCormick; McNamara; Prince; Wilkens-Russel; Yeomans; Tweed District Residents & Ratepayers; Townsend; Gardner; Munz and Maher; Pearson	issue grouped for combined response
8	Existing residents should not be made to pay for augmentation of the water supply through greater taxes, environmental degradation or reduced living standards due to poorer river health.		See response in Discussion Section
8.1	Existing residents should not be made to pay for augmentation of the water supply through greater taxes, environmental degradation or reduced living standards due to poorer river health.	Turner	issue grouped for combined response
	Demand Management – infrastructure issues	-	

No.	ISSUE	RAISED BY:	REFER TO
-	***Infrastructure Upgrades***		
9	That Council should allocate funding and focus actions on improving infrastructure works to reduce water use and losses. In particular, infrastructure leakage programmes should be further investigated.	Murwillumbah Ratepayers Assoc; Lemaire	See response in Discussion Section
9.1	Non-revenue water was 1274ML in 2006 and is forecast at 2735ML/yr in 2036.	Murray	issue grouped for combined response
10	Tweed's water reticulation is energy and cost inefficient and should not be exacerbated with new developments based on a similar approach. Full ecological costs associated with new developments should be factored into government planning including s94 and s64 developer contributions.	Turner, Caldera Environment Centre - Hopkins	See response in Discussion Section
-	***High volume rainwater collection***		
11	That Council should make high volume rainwater collection for whole of home use compulsory in all new developments. Rainwater tanks should be supplied free of charge.		See response in Discussion Section
11.1	That Council should make high volume rainwater collection for whole of home use compulsory in all new developments. Rainwater tanks should be supplied free of charge.	Summers; Prince; Wilkens-Russel; Caldera Environment Centre – Dawson; Townsend; Rifello; Pearson; Caldera Environment Centre; Turner	issue grouped for combined response

No.	ISSUE	RAISED BY:	REFER TO
12	That Council should make high volume rainwater collection for primary source of water compulsory in all new developments. A minimum of 10,000-20,000L tanks should be required in residential and 40,000L for non-residential. This would instantly relieve the pressure on our water supply, would help reduce demand on water during drier months. Country people are able to live off rainwater tanks by being careful with their water use. It is achievable and should be enforced on all.		See response in Discussion Section
12.1	That Council should make high volume rainwater collection for primary source of water compulsory in all new developments. A minimum of 10,000-20,000L tanks should be required in residential and 40,000L for non-residential.	Summers; Maher; Prince; Gill; Peacock; Sledge; Gray; Hill; Ipsen; James; Lewin; Mason, Masters; McCormick; McNamara; Moore, Wilkens-Russel, Yeomans; Caldera Environment Centre – Dawson; Tweed District Residents & Ratepayers; Townsend; Baker; Hersovitch; Riordan; Hastings Point Progress Association; Chadwick; Kaye; Watsford; Robertson, Lovegrove and Dundee; Blackwell; Gardner; Graf; Havier and Addis; Hearder; Hollingsworth; Munz and Maher; Outridge - Margo; Outridge - Mary Lou; Stuart; Turner; Dawson (CWG); Edwards (CWG)	issue grouped for combined response
12.2	A 20,000 gallon rainwater tank with every new home would instantly relive the pressure on our water supply, and would help reduce demand on water during drier months.	Moore; Caldera Environment Centre - Dawson	issue grouped for combined response
12.3	Country people are able to live off rainwater tanks by being careful with their water use. It is achievable and should be enforced on all.	Prince; Hill; Jacobi; McCormick; Townsend; Rifello; Gardner; Hearder; Hollingsworth; Pearson; Caldera Environment Centre; Turner	issue grouped for combined response

No.	ISSUE	RAISED BY:	REFER TO
12.4	Council should ensure 5000L rainwater tanks are mandated for all 16,000 new dwellings planned in the major development areas. This could save 80,000L annually. SEQ has installed 236,000 rainwater tanks (almost 1 in 4 penetration rate) while Tweed has installed only 117 tanks over the same period.	Murray	issue grouped for combined response
13	That Council should make high volume rainwater collection for primary source of water compulsory in all (new and existing) developments.		See response in Discussion Section
13.1	That Council should make high volume rainwater collection for primary source of water compulsory in all new and existing developments.	Fingal Head Coastcare Inc.; Hersovitch; Dawe	issue grouped for combined response
14	High volume rainwater collection (self-suffiency) can be accomodated by ensuring the size of blocks of land is large enough and by using space saver tanks and bladders.		See response in Discussion Section
14.1	Blocks in new developments should be large enough to accommodate high volume rainwater tanks.	Symons	issue grouped for combined response
14.2	Rainwater could easily be accommodated and stored on site in space saving bladders, slim line tanks, or underground storages.	Turner (and others)	issue grouped for combined response
	Water substitution		

No.	ISSUE	RAISED BY:	REFER TO
15	That Council should make water substitution methods compulsory in all new developments, in particular recycling water (effluent reuse) through dual reticulation, greywater reuse, and stormwater harvesting as they are in Pimpama/Coomera and Ballina.		See response in Discussion Section
15.1	That Council should make water substitution methods compulsory in all new developments, in particular recycling water (effluent reuse) through dual reticulation, greywater reuse, and stormwater harvesting.	Murwillumbah Ratepayers Assoc; Summers; Maher; Prince; Gill; Peacock; Sledge; Symons; Ipsen; Malecki; Masters; McCormick; McNamara; Wilkens-Russel, Yeomans; Townsend; Baker; Hersovitch; Lemaire; Mann; Riordan; Hastings Point Progress Association; Chadwick; Jack; Rifello; Kaye; Robertson, Lovegrove and Dundee; Dawe; Dawson; Blackwell; Gardner; Graf; Havier and Addis; Hearder; Hollingsworth; Munz and Maher; Outridge - Margo; Outridge - Mary Lou; Pearson; Stuart; Caldera Environment Centre; Caldera Environment Centre – Hopkins; Turner; Murray	issue grouped for combined response
15.2	Pimpama/Coomera and Ballina are implementing bulk stormwater harvesting, greywater reuse and on-site recycled water with a dual pipe system. Makes financial sense at Tweed for new large urban development from the outset (eg Kings Forest and Cobaki Lakes)?	Townsend; Riordan; Hastings Point Progress Association; Chadwick; Gardner; Graf; Caldera Environment Centre - Hopkins	issue grouped for combined response
15.3	Why has Council discounted Scenario 5 from future consideration?	Caldera Environment Centre - Dawson	issue grouped for combined response
15.4	Why has Council discounted Scenario 3 which reduces water use to 95L/p/d from future consideration?	Riordan; Hastings Point Progress Association; Gardner; Hollingsworth; Munz and Maher	issue grouped for combined response
15.5	Large scale Recycling, Storm Water Harvesting & Large Water tanks are the only environmentally & socially sustainable way forward for Tweed Shires	Community Working Group Report (March 2010)	issue grouped for combined response

No.	ISSUE	RAISED BY:	REFER TO
	Water Management		
15.6	Council needs to meet the NSW govs BEST PRACTICE GUIDELINES for sewage and water management	Dawson	issue grouped for combined response
16	Greywater currently produced in the Shire could be reclaimed to provide up to 9635ML/yr.	Murray	See response in Discussion Section
17	Around Australia, new technologies are allowing local reuse of bulk harvested stormwater. The South Australian government, and Marion and Salisbury Councils will implement projects that utilise 1200ML of stormwater for reuse. The Stormwater Association of Qld advocates stormwater harvesting for non-potable uses as a cost effective alternative to the Traveston Dam.	Murray	See response in Discussion Section
18	That Council should make water substitution methods compulsory in all (new and existing) developments. In England and Singapore they recycle water and provide water through dual reticulation, greywater reuse, stormwater harvesting, rainwater tanks and desalination without needing dams.		See response in Discussion Section
18.1	That Council should make water substitution methods compulsory in all new and existing developments, in particular recycling water (effluent reuse) through dual reticulation, greywater reuse, and stormwater harvesting.	Fingal Head Coastcare Inc.; Hill; James; Mason; Caldera Environment Centre - Dawson	issue grouped for combined response

No.	ISSUE	RAISED BY:	REFER TO
18.2	Developments should capture and store rainwater on a large scale and have dual reticulation of greywater and harvested stormwater so that no demands are put on the current water supply infrastructure.	Fingal Head Coastcare Inc.; Townsend; Gardner; Hearder; Turner	issue grouped for combined response
18.3	Singapore and England and others use a combination of rainwater tanks, stormwater harvesting, recycling and desalination without using dams. Why can't the Tweed?	Prince	issue grouped for combined response
18.4	Promotion of independence and self-reliance, through on-site water collection and recycling, would help foster a sense of attachment to place and a feeling of unity to others in the community.	Caldera Environment Centre – Dawson; Caldera Environment Centre	issue grouped for combined response
19	End users will pay lower water bills wherever large scale stormwater harvesting, greywater reuse, and dual reticulation water reuse are implemented.		See response in Discussion Section
19.1	End users will pay lower water bills wherever large scale stormwater harvesting, greywater reuse, and dual reticulation water reuse are implemented.	Fingal Head Coastcare Inc.	issue grouped for combined response
20	Water recycling has not been fully considered. It seems to only be given peripheral consideration. Tweed had a 2006 Recycled Water Options Report - but was this used ? That study should have been used in the DMS and they should complement each other.		See response in Discussion Section
20.1	Water recycling has not been fully considered. It seems to only be given peripheral consideration. Has Tweed updated its 2006 Recycled Water Options Report – these two studies should complement each other.	NSW Office of Water, DECCW - Hennessy	issue grouped for combined response

No.	ISSUE	RAISED BY:	REFER TO
20.2	Other options beside dam construction have been inadequately addressed and show a lack of willingness/innovation to adopt other water saving and storage issues (storm water retention, recycling).	Community Working Group Report (March 2010)	issue grouped for combined response
21	Water recycling should be implemented. At present 92% of reclaimed water is discharged into the Lower Tweed Estuary. By 2036 the population of 157,000 will generate 14,330ML/yr wastewater which should be utilised to reduce the demand on potable supplies.	Murray	See response in Discussion Section
	Alternative water sources		
22	That Council should procure alternative water sources such as indirect potable reuse (ie returning highly treated sewage effluent to Clarrie Hall Dam or Bray Park Weir for all uses including drinking)? Direct Potable reuse (which returns highly treated water directly to local reservoirs) would be even better.		See response in Discussion Section
22.1	Why did the report discount alternative water sources such as indirect potable reuse (ie returning highly treated sewage effluent to the water supply system for all uses including drinking).	Murwillumbah Ratepayers Assoc; Symons; Caldera Environment Centre – Dawson; Lemaire; Dawson; Gardner	issue grouped for combined response
22.2	Direct Potable reuse would be even better.	Caldera Environment Centre – Dawson; Dawson; Gardner; Turner	issue grouped for combined response
22.3	Large scale Recycling, Storm Water Harvesting & Large Water tanks are the only environmentally & socially sustainable way forward for Tweed Shires Water Management	Community Working Group Report (March 2010)	issue grouped for combined response
	Other technologies		

No.	ISSUE	RAISED BY:	REFER TO
23	Sewage effluent can be dumped vertically to generate hydro-electricity. This power, along with methane generated in digesters, can be used to pump effluent through filtration and UV and other purifying systems to produce water for re-use.	Caldera Environment Centre	See response in Discussion Section
24	The existing water supply is adequate for our current and projected population for at least 20 years, especially if 22,500L rainwater tanks and other on-site recycling systems including simple lowcost filters for drinking water were used.	Caldera Environment Centre	See response in Discussion Section
	Demand Management – pricing issues	-	
	Rebates		
25	That Council should provide rebates for installation of rainwater tanks and retro-fitting of water efficient appliances, particularly for those who were told to remove their tanks many years ago		See response in Discussion Section
25.1	That Council should provide rebates for installation of rainwater tanks to those who were told to remove their tanks many years ago.	Murwillumbah Ratepayers Assoc; Lemaire	issue grouped for combined response
25.2	That Council should provide rebates for installation of rainwater tanks and retro-fitting of water efficient appliances.	Maher; McCormick; Tweed District Residents & Ratepayers; Townsend; Prince; Hersovitch; Riordan; Chadwick; Gardner; Graf; Havier and Addis; Hearder; Hollingsworth; Munz and Maher; Pearson; Murray; Edwards (CWG)	issue grouped for combined response
26	Instead of spending $75M at Bray Park and $35M on a dam ($110M total), Council could provide $500 rebates for rainwater tanks to all the houses projected to be in the shire in 2036.		See response in Discussion Section

No.	ISSUE	RAISED BY:	REFER TO
26.1	Instead of spending $75M at Bray Park and $35M on a dam ($110M total), Council could provide $500 rebates for rainwater tanks to all the houses projected to be in the shire in 2036.	Caldera Environment Centre	issue grouped for combined response
	Price of water		
27	Council should increase the base price of water and decrease the water volumes which trigger the step price increase for excess consumption. Council should also target water use of 150L/p/d or lower (such as in SEQ and Melbourne). Why is Tweed aiming at only 205L/p/d water usage		See response in Discussion Section
27.1	Council should decrease the water volumes which trigger the step price increase for excess consumption, and increase excessive usage charges.	Pearson and Rifello; Pearson, Rifello and Rothwell; Fingal Head Coastcare Inc. Peacock; Sledge; Symons; Gray; Hill; Ipsen; James; Lewin; Masters, Yeomans; Tweed District Residents & Ratepayers; Townsend; Prince; Hersovitch; Hastings Point Progress Association; Chadwick; Gardner; Graf; Havier and Addis; Hollingsworth; Munz and Maher; Pearson; Murray; Edwards (CWG)	issue grouped for combined response
27.2	Council should increase the base price rate for water to encourage more frugal water use.	Pearson and Rifello; Pearson, Rifello and Rothwell; Peacock; Sledge; Symons; Gray; Hill; Ipsen; James; Lewin; Masters; McNamara; Prince, van Steenwyk, Wilkens-Russel, Yeomans; Tweed District Residents & Ratepayers; Townsend; Prince; Hersovitch; Sledge and Vionot; Hastings Point Progress Association; Chadwick; Gardner; Graf; Havier and Addis; Hearder; Hollingsworth; Munz and Maher; Outridge - Margo; Outridge - Mary Lou; Pearson; Edwards (CWG)	issue grouped for combined response

No.	ISSUE	RAISED BY:	REFER TO
27.3	Council should target a per capita water use of 150 litres per day or lower.	Peacock; Sledge; Hill; Ipsen; Lewin; McNamara; Prince, Wilkens-Russel; Tweed District Residents & Ratepayers; Prince; Hersovitch; Hastings Point Progress Association; Chadwick; Gardner; Graf; Havier and Addis; Hollingsworth; Mayfield; Munz and Maher; Outridge - Margo; Outridge - Mary Lou; Pearson; Caldera Environment Centre; Edwards (CWG)	issue grouped for combined response
27.4	Tweed aims at 205L/p/d water usage. SEQ and Melbourne are aiming at 12 and 155ML/p/d respectively.	Hersovitch; Watsford; Gardner	issue grouped for combined response
28	Council should vary the price of water according to its availability (eg linked to the level of water in Clarrie Hall dam).		See response in Discussion Section
28.1	Council should vary the price of water according to its availability (eg linked to the level of water in Clarrie Hall dam.	van Steenwyk	issue grouped for combined response
	Demand Management – management issues	-	
	Water reduction initiatives		
29	The DMS should encourage water savings through community education (including personal water usage and garden design). Imagine the savings if the DMS proposed allocation of the dam budget from water engineering to water education.		See response in Discussion Section
29.1	Council should encourage water savings through community education.	Murwillumbah Ratepayers Assoc; Symons; Mason; Tweed District Residents & Ratepayers; Townsend; Hersovitch; Lemaire; Watsford; Gardner; Graf; Hearder; Hollingsworth; Mayfield; Munz and Maher; Pearson; Murray	issue grouped for combined response

No.	ISSUE	RAISED BY:	REFER TO
29.2	Council should encourage water savings through community education focussing on personal water usage and garden design.	Fingal Head Coastcare Inc.	issue grouped for combined response
29.3	Council should allocate the dam budget from water engineering to water education.	Mason	issue grouped for combined response
30	Compulsory use of large rainwater tanks and decentralised systems would encourage people to use water more responsibly.		See response in Discussion Section
30.1	Compulsory use of large rainwater tanks and decentralised systems would encourage people to use water more responsibly.	Caldera Environment Centre – Dawson; Mayfield; Caldera Environment Centre; Turner	issue grouped for combined response
30.2	Most important that Council does focus on and carry out the Demand Management it says it will. More aggressive Water Demand Management should accompany whichever option becomes the preferred option.	Edwards (CWG)	issue grouped for combined response
30.3	Considerable expenditure is required to reverse Tweed's wastefulness and carelessness of the Tweed River environment.	Murray (CWG)	issue grouped for combined response
31	Council should encourage water savings through permanent water restrictions.		See response in Discussion Section
31.1	Council should encourage water savings through permanent water restrictions.	Maher; Masters; Hersovitch	issue grouped for combined response
32	Council should audit all major non-residential (top 100) users.		See response in Discussion Section
32.1	Council should audit all major non-residential (top 100) users.	Symons; Townsend; Gardner	issue grouped for combined response
33	Council to immediately implement waterwise and native garden initiatives in TSC outdoor operations, residential and commercial users.		See response in Discussion Section

No.	ISSUE	RAISED BY:	REFER TO
33.1	Council to immediately implement waterwise and native garden initiatives in TSC outdoor operations, residential and commercial users.	Masters; Baker; Hersovitch; Watsford	issue grouped for combined response
34	Council is yet to retrofit the remaining houses in the Shire (approx 50%) and carry out an audit of other high use water items (dual flushed toilets, washing machines, hoses without trigger control). A retrofit of existing homes could result in a further saving of 600ML/yr.	Murray	See response in Discussion Section
	<u>Ongoing planning and monitoring</u>		
35	The reduction from 292L/p/day (current) to 169L/p/day (future shire-wide average) seems steep (42% reduction). Over what period is this reduction proposed to be implemented?		See response in Discussion Section
35.1	The reduction from 292L/p/day to 169L/p/day seems steep (42% reduction). Over what period is this reduction proposed to be implemented?	NSW Office of Water, DECCW - Hennessy	issue grouped for combined response
35.2	Council should ensure performance plans are developed, implemented and monitored, based on specific measurable objectives.	Murwillumbah Ratepayers Assoc; Lemaire	issue grouped for combined response
	Issues with the report and approach	-	
	<u>The Scenarios</u>		

No.	ISSUE	RAISED BY:	REFER TO
36	In new greenfield developments Scenario 4 (which includes BASIX provisions, 5000L rainwater tanks, and indirect potable reuse) is seen as a more sustainable approach. In particular due to reduced discharges to areas such as receiving waters at Cobaki. It could be more cost effective if decentralised plants at Cobaki and Kingsforest were constructed and piping costs were reduced by returning the water just upstream of Bray Park weir WTP.	Murwillumbah Ratepayers Assoc; Lemaire; Gardner	See response in Discussion Section
37	The most sustainable option Scenario 3 (combining BASIX, Rainwater tanks and Dual reticulation) brings consumption down to 95L/p/d but is incorrectly discarded and considered too costly by Council.	Gardner; Graf; Outridge - Margo; Outridge - Mary Lou; Pearson	See response in Discussion Section
38	Why was Scenario 5 which includes Direct potable reuse discarded when it is used or being planned for Rous Hill in Sydney, Coomera and Pimpana in Qld, Ballina Heights, and Adelaide?	Gardner, Caldera Environment Centre – Hopkins	See response in Discussion Section
39	BASIX measures are minimalistic and uninspiring.	Caldera Environment Centre – Hopkins (and others)	See response in Discussion Section
40	Why does the study discount Scenarios 3 and 5 which reduce water use to 95L/p/d and less?		See response in Discussion Section
	External and flow-on effects		
41	External factors such as environmental costs and benefits have not been directly included in the economic and comparative analysis. The analysis should have included items such as reduced water discharges to sensitive receiving waters, reduced storm surcharges, creation of habitat through		See response in Discussion Section

No.	ISSUE	RAISED BY:	REFER TO
	reedbeds, etc.		
41.1	Stormwater harvesting and reuse of water would reduce discharges to estuaries, and in some instances flood surge damage.	Gill; Peacock; Sledge; Gray; Hill; Ipsen; McCormick, Yeomans; Caldera Environment Centre – Dawson; Tweed District Residents & Ratepayers; Hersovitch; Mann; Riordan; Hastings Point Progress Association; Robertson, Lovegrove and Dundee; Gardner; Graf; Hollingsworth; Murray	issue grouped for combined response
41.2	External factors such as environmental costs and benefits have not been directly included in the economic and comparative analysis……such as reduced water discharges to sensitive receiving waters, creation of habitat through reedbeds, …..etc	Murwillumbah Ratepayers Assoc; Mason; McCormick; McNamara; Prince, Wilkens-Russel; Lemaire; Turner	issue grouped for combined response
41.3	There are no figures on environmental cost. The cost of water recycling and dam construction cannot be fairly compared until environmental costs are incorporated into the overall dam costs.	Community Working Group Report (March 2010)	issue grouped for combined response
42	Climate change and sea level effects have not been considered.		See response in Discussion Section
42.1	Climate change and sea level effects have not been considered.	Peacock; Gray; Hill; Lewin; McNamara, Wilkens-Russel; Caldera Environment Centre – Dawson; Tweed District Residents & Ratepayers; Mann; Riordan; Gardner; Graf; Hollingsworth; Pearson; Stuart	issue grouped for combined response
42.2	The CWG has not seen any evidence of how Tweed SC has considered climate change scenarios and impacts in their decision-making process.	Community Working Group Report (March 2010)	issue grouped for combined response

No.	ISSUE	RAISED BY:	REFER TO
43	Flowchart on page 14 mentions stormwater and wastewater, after which no mentions seems to be made of maximising reuse of these two crucial sources of water.		See response in Discussion Section
43.1	Flowchart on page 14 mentions stormwater and wastewater, after which no mentions seems to be made of maximising reuse of these two crucial sources of water.	Townsend	issue grouped for combined response
44	Perception that the conclusions of the Demand Management Strategy are weighted specifically to create the promise that the Shire has no option other than to undertake some massive centralised water infrastructure project. There should be a shift from hard infrastructure towards decentralised supplies which cause less devastation.		See response in Discussion Section
44.1	Perception that the conclusions of the Demand Management Strategy are weighted specifically to create the promise that the Shire has no option other than to undertake some massive centralised water infrastructure project. There should be a shift from hard infrastructure towards decentralised supplies which cause less devastation.	Mayfield; Turner	issue grouped for combined response
	Review of data		
45	Council's 2006 IWCM Strategy noted a target of 12% unaccounted for water (UFW). It appears that a new, more stringent target of 10% has been set in the DMS, however there is no discussion as to why this has occurred or what the achievements to date are.	NSW Office of Water, DECCW - Hennessy	See response in Discussion Section

No.	ISSUE	RAISED BY:	REFER TO
46	A more detailed analysis connecting water restrictions in 2002-2003 to water savings during and since (using a cause – effect equation) would be valuable.	NSW Office of Water, DECCW - Hennessy	See response in Discussion Section
47	A better breakdown of information for retro-fitted homes and businesses would be valuable. It would provide useful data on take-up rates for different appliances: for instance almost 50% of all homes have been retrofitted, of which 5% had existing toilets replaced with dual flush toilets.	NSW Office of Water, DECCW - Hennessy	See response in Discussion Section
	Consultation with the community		
-	Council pushed through four shortlisted options without consulting the community about what those options should be.	Prince; Fingal Head Coastcare Inc.; Jacobi; Mason; Prince; Tweed District Residents & Ratepayers; Hersovitch; Jack; Rifello; Ehrlich; Hearder; Pearson	refer to Water Augmentation Submission Report
-	Community consultation was inadequate.	Stuart; Caldera Environment Centre - Hopkins	refer to Water Augmentation Submission Report
-	It would appear that Council has deliberately failed to inform the CWG that one of the options they have been given to consider is in fact specifically prohibited. This makes a mockery of the entire community consultation process regarding our future water supply options. I have written to the Minister about this serious breach of transparency.	McCormick; Jack; Murray	refer to Water Augmentation Submission Report
48A	Majority of Community only speak out when there is something to complain about - So just implement radical water saving devices in each new development and rebate incentives for retrofitters	Community Working Group Report (March 2010)	See response in Discussion Section

No.	ISSUE	RAISED BY:	REFER TO
48B	For a document put out for public submission, the sheer size and complexity of the DMS information is daunting. Better marketing of Council's IWCM strategy as a holistic package are required for the community to understand the steps being taken to conserve, protect and augment the future of water in the Shire.		See response in Discussion Section
48.1	For a document put out for public submission, the sheer size and complexity of [the DMS] information is daunting.	Caldera Environment Centre - Dawson	issue grouped for combined response
48.2	Better marketing of the TSC Integrated water management strategy as a holistic package, and reducing the dominance of technical literature, are required so the Tweed community better understand the steps being taken to conserve, protect and augment the future needs of the Shire.	Community Working Group Report (March 2010)	issue grouped for combined response
49	When Council fails to provide information about the low Tweed River historic flows at Bray Park Weir, how can residents adequately respond on water supply issues in the Demand Management Strategy?	Murray	See response in Discussion Section
	Community Working Group (CWG)		
-	Two unpopular, pro-development councillors were inappropriately included on the CWG when they do not represent the environmentally conscious population.	Jack	refer to Water Augmentation Submission Report
	Forward thinking Council		

No.	ISSUE	RAISED BY:	REFER TO
50	TSC is not serious about reducing water demand and needs to acknowledge that there are solutions to demand management that are not considered in the report [and which are] not dealt with in sufficient detail and result in the perpetuation of an unsustainable economic and social system.		See response in Discussion Section
50.1	If Council officers are so old-minded they should be fired.	Summers	issue grouped for combined response
50.2	Outdated unsustainable solutions of damming should not be pursued. Why doesn't Council lead the way with sustainable solutions?	Mason; Dawe; Stuart	refer to Water Augmentation Submission Report
50.3	TSC is not serious about reducing water demand and needs to acknowledge that there are solutions to demand management that are not considered in the report [and which are] not dealt with in sufficient detail and result in the perpetuation of an unsustainable economic and social system. Perhaps [TSC] has a hidden agenda of water augmentation.	Caldera Environment Centre - Dawson	issue grouped for combined response
50.4	The significant cost of the Bray Park WTP means that Council is not prepared to support alternative water supply options that will not utilise (and pay for) water from the new plant.	Symons; Gardner; Graf; Hollingsworth; Munz and Maher; Pearson	refer to Water Augmentation Submission Report
51	Best practice seems to dictate the recycling of water (eg Sydney Water). Are there health risks or Dept Health restrictions which mean these options are not being seriously considered? Are there other State and Federal regulatory impediments to the enforcement of more stringent and sustainable water management?		See response in Discussion Section
51.1	If Health Department regulations are restricting the use of rainwater, then these must be updated to	Jacobi	issue grouped for combined response

No.	ISSUE	RAISED BY:	REFER TO
	reflect current technological developments.		
51.2	Not enough known about the long term health risks of water recycling seems to be ignoring current best practice (see Sydney Water attachments)	McCormick	issue grouped for combined response
51.3	Regulatory impediments to the enforcement of more stringent and sustainable water management must be removed.	Turner	issue grouped for combined response
52	The Demand Management, Drought Management and Supply Augmentation strategies were all produced by MWH, resulting in little opportunity for peer input or review. The recommendations in these strategies result in a mostly “business as usual”, “dollar focussed” approach. MWH was involved with the background studies for the Traveston Dam which were disputed, and their studies on the Tweed may also be disputed. Council should follow the CWG’s recommendation for an independent expert review of the proposed demand management and water augmentation approaches.	Turner	See response in Discussion Section
52.1	The CWG would like assurance that Tweed SC's demand management strategy is benchmarked against national and international standards, and undergoes independent assessment to demonstrate this, otherwise a needless Dam option could proceed.	Community Working Group Report (March 2010); Bonar	issue grouped for combined response
	Extension of time for submissions		
-	Community groups are under much pressure to respond within the scheduled timeframe.	Caldera Environment Centre - Hopkins; Ehrlich	refer to Water Augmentation Submission Report

No.	ISSUE	RAISED BY:	REFER TO
	Global best-practice water management		
53	Best practices result from a combination of water tanks, stormwater harvesting, recycling water and desalination.	Prince; Robertson, Lovegrove and Dundee	See response in Discussion Section
54	Composting Toilets have not been given enough attention and Council should have designs which are approved and can implemented available for new and retro-fitted constructions. Household by-products should be composted on-site.	Symons; Dawe; Havier and Addis; Caldera Environment Centre; Caldera Environment Centre - Hopkins	See response in Discussion Section
55	By varying the price of water according to its availability, residents will be encouraged to store water when the price is low to use when water price is high.	van Steenwyk	See response in Discussion Section
	Draft Water Sharing Plan		
-	The draft Tweed River Area unregulated and alluvial Water Sharing Plan prohibits the damming of Byrrill Creek and therefore Byrrill Creek should not even be considered as an option.	Pearson and Rifello; Pearson, Rifello and Rothwell; Peacock; Ehrlich; Gray; Hill; James; Lewin; McCormick; McNamara; Prince, Wilkens-Russel; Prince; Jack; Turner; Murray	refer to Water Augmentation Submission Report
	Water Augmentation Options		
-	No EIS has been carried out on any of the options.	Jack	refer to Water Augmentation Submission Report
-	Only the four options were considered but other simpler/cheaper/common sense sustainability options were not considered as a whole/part solution to the problem.	Stuart; Caldera Environment Centre - Hopkins	refer to Water Augmentation Submission Report

No.	ISSUE	RAISED BY:	REFER TO
-	Dams are outdated technology. Only the fastest/cheapest/easiest engineering solutions have been considered. London is an example of sustainability where the Tahmes River is its main water source and there is not dam supply.	Dawson; Stuart (and others); Turner; Murray	refer to Water Augmentation Submission Report
-	The four options presented are contrary to NSW State Government policy and will cause unacceptable environmental and ecological damage.	Caldera Environment Centre	refer to Water Augmentation Submission Report
-	Government policies and legislation (Northern Rivers Catchment Management Plan, Tweed Macro Water Sharing Plan, National Water Sensitive Cities Strategy) disqualify Council's preferred options due to the need for environmental flows, ecological damage to Byrrill Creek & National Parks, unsustainable & unapproved inter-catchment transfer of water, ignoring alternative sources used by other regions.	Caldera Environment Centre	refer to Water Augmentation Submission Report
-	Those in the community who are self-sufficient (particularly rural allotments) pay rates which unfairly subsidise the capital works spending by Council for the benefit of new and future residents who are responsible for the environmental impacts of these options.	Caldera Environment Centre	refer to Water Augmentation Submission Report
-	Option 9 (Direct Potable Reuse) is the least environmentally damaging, but even this relies on fossil fuels for pumping and purification.	Caldera Environment Centre - Hopkins	refer to Water Augmentation Submission Report
	Raising Clarrie Hall Dam		
-	Is unacceptable as it will flood significant areas of native forest, farmland and residential land.	Fingal Head Coastcare Inc.; Lewin; Prince, van Steenwyk, Yeomans; Baker; Hersovitch; Sledge and Vionot; Chadwick; Jack; Dawe	refer to Water Augmentation Submission Report

No.	ISSUE	RAISED BY:	REFER TO
-	Given that Clarrie Hall dam contains 16,000ML, the weir at Bray Park is able to supply 13,750ML/annum, and only 3250ML/annum additional supply is required until 2036 it would appear that we have enough water for a population of 500,000.	Smith	refer to Water Augmentation Submission Report
-	To increase the water Clarrie Hall dam can supply, Council should construct a holding pond on the Tweed River and pump water (run on solar energy) from this to the dam during periods of high flow.	Smith	refer to Water Augmentation Submission Report
-	In addition to demand management measures, Council should also raise the wall at Clarrie Hall Dam.	Wood	refer to Water Augmentation Submission Report
-	Dams are unsustainable, deplete our waterways and result in a decline of water quality. For these reasons dams are being dismantled around the world wherever possible.	Turner	refer to Water Augmentation Submission Report
	Byrrill Creek Dam		
-	Object as it will flood some of the highest conservation value land in the Tweed, is a regionally significant biodiversity hotspot adjacent to the Mt. Warning World Heritage National Park. Major drawcard for tourism.	Fingal Head Coastcare Inc.; Peacock; Sledge; Symons; Costello; Ehrlich; Gray; James; Lewin; Malecki; Mason; McCormick; McNamara; Moore; Prince, : van Steenwyk, Wilkens-Russel, Yeomans; Baker; Hersovitch; Sledge and Vionot; Chadwick; Jack; Kaye; Dawe; Blackwell; Outridge – Mary Blane; Turner	refer to Water Augmentation Submission Report
-	Are we damming our hinterland valleys to provide for coastal development that will ultimately be lost to the sea due to future climate change?	Gardner	refer to Water Augmentation Submission Report

No.	ISSUE	RAISED BY:	REFER TO
-	A dam at Byrrill Creek is unacceptable regardless of any demand management strategy or secure yield scenarios. The Tweed Riparian Restoration Prioritisation Report 2003 looked at 86 riparian sites within 6 sub catchments and ranked each according to their relative conservation and regeneration potentials. Byrrill Creek was ranked the highest of all the sub catchments and 10 of the top 30 highest priority sites of all the 6 sub catchments were located within the Byrrill Creek catchment. The total funding to date for riparian projects at Byrrill Creek amounts to $ 416.264 plus in kind labour contributions of $154.324 by Landcare members.	Symons; McCormick; Turner	refer to Water Augmentation Submission Report
-	Council purchased land at Byrrill Creek 25 years ago under very different circumstances. Building a dam may have been an acceptable position back then but it is not now.	Symons	refer to Water Augmentation Submission Report
-	Remove Byrrill Creek from the options for augmentation of the water supply.	McCormick	refer to Water Augmentation Submission Report
-	In addition to demand management measures, Council should also approach State Government to ensure restrictions are not placed on building a new dam at Byrrill Creek which has been planned for and land acquired since the 1960s.	Wood	refer to Water Augmentation Submission Report
	Pipeline to SEQ Water grid		
-	Unsatisfactory as selling water to the Gold Coast robs the Tweed of needed water and promotes unsustainable development on the Gold Coast without them providing the necessary infrastructure. Desalination has large energy	Fingal Head Coastcare Inc.; Prince; Sledge and Vionot; Jack; Dawe; Stuart; Turner	refer to Water Augmentation Submission Report

No.	ISSUE	RAISED BY:	REFER TO
	requirements. SEQ has even less water than the Tweed.		
-	In addition to demand management measures, Council should investigate connection to South East Queensland water grid.	Wood	refer to Water Augmentation Submission Report
	<u>Contingency Option</u>		
-	Unsatisfactory information to comment.	Fingal Head Coastcare Inc.	refer to Water Augmentation Submission Report
-	Use of groundwater would deplete finite supplies necessary for agriculture.	Prince	refer to Water Augmentation Submission Report
-	Objection against the Contingency Option.	Sledge and Vionot; Jack	refer to Water Augmentation Submission Report
-	Pipeline options or localised groundwater extraction in urbanising areas would be preferable to inundating irreplaceable rural areas that are currently subsidising the growth of coastal fringes.	Dawson	refer to Water Augmentation Submission Report
	<u>Water-wise options</u>		
-	Council should include the “water wise option” within the short-listed options.	Prince; Fingal Head Coastcare Inc.	refer to Water Augmentation Submission Report
-	Given time, the population can adjust to any situation but the rush to overdevelop the Shire at this time is unsustainable.	Symons	refer to Water Augmentation Submission Report
	<u>Sale of Tweed water</u>		

No.	ISSUE	RAISED BY:	REFER TO
-	Council wants to sell water to the Gold Coast or bottled "Coca-cola style".	Murwillumbah Ratepayers Assoc; Gill; Lemaire	refer to Water Augmentation Submission Report
-	***Environmental flows***		
56	At its meeting 17 November 2009, Council approved further environmental flow restrictions on the Tweed River at Bray Park Weir: "The cessation level for flow bypass requirements at Bray park Weir be set at a level of 50% of the capacity of the Clarrie Hall Dam".	Murray	See response in Discussion Section

Appendix B –Notes from Public Information Sessions

Tweed District Water – Demand Management and Water Supply Augmentation

Public Information Session

Wednesday 10 February 2010
South Sea Islander Room, Tweed Heads Civic Centre, Brett Street, Tweed Heads
2:00pm – 7:15pm

CWG members and Tweed Shire Council staff in attendance:

CWG
Richard Murray
Don Beck
Cr Holdom

TSC
Anthony Burnham
Tim Mackney
Dan Walton
Sascha Piotrkowski
Marion Martin

The information session was attended by approximately 20 members of the public who were interested in discussing the Shire's Demand Management actions and strategy, and the approach to augmentation of the Water Supply.

Some of the topics discussed and opinions raised by individuals were:

1. Conservation focus, concerned about dam environmental impacts, population growth is ok, concern with current planning legislation being out of step with community direction – ie restrictive on both community and Council.

2. Tweed needs to develop water resources and hydro-electricity options.

3. Astonishment that Council might have difficulty gaining approval to construct Byrrill Creek Dam

4. Understanding and supportive of the need for augmentation

5. Concerns that population predictions are driving the need for a second dam. The person was opposed to Byrrill Creek on two fronts – environmental (obvious reasons) and social (if Council had the political strength to put a cap on population we wouldn't need a second dam).

6. Environmental and recycled water focus is wanted, but need to balance with costs and legislative constraints. Concerned that Council should not ultimately be shackled by these constraints

7. Particularly interested in the environmental issues. Has been following the process with interest, especially the CWG through the minutes and question register. Wants CWG to “get on with it” and not concentrate on “administrative” issues.

Three attendees placed their names on the Interested Parties Register, with several other attendees indicating that they were already on the register.

The following brochures and reports were available as handouts:

- Recycled Water
  - Tweed Shire Council Recycled Water Initiative – Fact Sheet No. 1
  - Tweed Shire Council Recycled Water Initiative – Case Study 1
  - Tweed Shire Council Recycled Water Initiative – Case Study 2

- Demand Management
  - Water Demand Management – Tweed Shire Demand Management Strategy
  - Water Demand Management – Progress to Date
  - Water Demand Management – Reducing Water Usage
  - Water Demand Management – User Pays Water Pricing 2009 – 2010
  - Integrated Water Cycle Management – Household Retrofit Program
  - Integrated Water Cycle Management – Water Modelling Activities

  - REPORT: Demand Management Strategy – Dec. 2009 – by MWH
  - REPORT: Demand Management Strategy – Stage 1 – by MWH
  - REPORT: Demand Management Strategy – Stage 2 – by MWH

- Water Supply Augmentation
  - Tweed District Water Supply Augmentation Factsheet 1 – Why does the Tweed need more water?
  - TSC Fact Sheet 1 – Why does the Tweed need more water?
  - TSC Fact Sheet 2 – Water Supply Augmentation to 2036
  - TSC Fact Sheet 3 – Community consultation to determine a preferred option
  - TSC Fact Sheet 4 – Community Working Group nominations
  - TSC Fact Sheet 5 – Water Supply Options
  - TSC Fact Sheet 6 – Short-listed Option 1: Raise Clarrie Hall Dam
  - TSC Fact Sheet 7 – Short-listed Option 2: Construct Byrrill Creek Dam
  - TSC Fact Sheet 8 – Short-listed Option 3: Pipeline connection to SE QLD
  - TSC Fact Sheet – Questions and answers to the Project

  - REPORT: Tweed District Water Supply Augmentation Options Study
    Stages 1 & 2 – by MWH

- Water Savings and Education
    - Tweed Shire Council – Water Wise Fact Sheet 1
    - Tweed Shire Council – Water Wise Fact Sheet 2
    - Tweed Shire Council – Recycled Water Initiative Fact Sheet 2
    - Tweed Shire Council – Water Wise Fact Sheet 6
    - Tweed Shire Council Fact sheet 3 – Rebates
    - Tweed Shire Council – Water Wise Fact Sheet 10 – Rainwater tanks
    - NSW Government - How Can Greywater be used?

- Joanna Gardner's (CWG member) Byrrill Creek Landowners Information
  Three (3) handouts
    - Environmental Effects and Considerations for the Proposed Byrrill Creek Dam
    - An Overview of the Byrrill Creek Dam Area
    - Byrrill Creek Dam Newsletter – February 3rd 2010

Tweed District Water – Demand Management and Water Supply Augmentation

Public Information Session

Thursday 18 February 2010
Canvas & Kettle Room, Murwillumbah Civic Centre, Murwillumbah
2:00pm – 9:00pm

CWG members and Tweed Shire Council staff in attendance:

CWG	***TSC***
Tony Thompson	Anthony Burnham
Colleen Edwards	Tim Mackney
Don Beck	Dan Walton
Cr Holdom	
Robyn Lemaire	
Joanna Gardner	

The information session was attended by approximately 12 members of the public who were interested in discussing the Shire's Demand Management actions and strategy, and the approach to augmentation of the Water Supply.

Colleen Edwards:

- Why 40m wide spillway on 70m CHD? Can it be larger?
- Blasting issues
- Dam compensation
- $ per kL

Jim Warburton:

- Rocky cutting – community consultation – no dams. Wave of community consultation. Water SE. Catchment Management Authority.
- Tweed River – mid estuary and fresh water in poor condition – stressed.
- Office of Water – presentation. Catchment management.
- Mandatory tanks.
- Top 5 – broad consultation as part rocky cutting.
- Community – NO DAMS.
- River already unhealthy. Fresh. E.g. red alert nutrients.
- Does the fish ladder work?
- Take rocky cutting dam off the list.
- Byrrill Creek Dam take off the list and sell land.
- Forest Plantation – reduces biodiversity.
- CAP – need to work to it. Policy Statement – no cross catchment.
- Need high flows for down stream area.
- Disconnect between the coastal and upper catchment values.
- Existing system struggling.

- Further population should not degrade the area further e.g. have 25 x nightcap villages (vs) standard development.
- Standard development not sustainable.
- Need big RWT. 22,500 L
- Dam – release temperature pollution.
- No more extraction from river.
- No more discharge to river.
- More recycling is preferred option.

<u>Ron Duckworth</u>:

- If CHD went ahead – road alignment at McCabbes Bridge is by far the preferred alignment.
- Extra length approximately 6 – 7 km plus 3 crossings.
- Noting trades change travel and hours making grazing and the like unuseable.
- Recommend to spread risk e.g. water quality.
- All other alternatives.
- CHD all farming country U/S.
- BCD – less developed catchment. Better water quality.
- CHD 27 properties affected approximately 18 cattle.
- Commercial impact
- Fencing required.
- Impoundment opportunity in CHD catchment at higher level but adjacent.
- Scaling of roads in Doon Doon Road and Commissioner Creek Roads to minimise sediment run off.
- Some commitments never followed through with PWD and Council.

<u>Lady</u>

- Appalled at only 4 options.
- Suspicious of process – just a way of building Byrrill Creek Dam.
- Commitment not to build BCD.
- Use $56mil to assist farmers and invest in other measures.
- TSC lagging behind
    - Grey water – facilitate this process. Minimise cost.
- Any saving water to reduce extraction.
- Storm water harvesting. Town areas recycling.
- Tweed Heads, Murwillumbah areas.
- Big buildings – capture as much as possible.
- RW Tanks. Retrofit. Assistance.
- Michael Mobbs.
- Avoid supply side.
- Pipeline SEQ grid. GHG emission. High rating given desalinisation.
- BCD.

<u>Joanna – requested information for future Uki Meeting</u>
Why nine options? Why some not proceeded with.
Demand Management – what are Council doing? What's still to be done?

Other notes

- Individual meters for each dwelling in:
- Retirement Villages and Multi-Unit Complexes.

- Tanks compulsory for industrial.
- Tighten up “step charge”.
- Encourage greywater use with reduction in sewer levy.
- Tank size based on no. of bedrooms, floor area of the house ie. not a blanket 5000L size.
- Water bills – make them like energy bills i.e. water meter challenge competition to encourage water saving reductions.

- Glad to see 40% reduction in water use since 1992
- Understands future savings will require more effort per litre saved (low-hanging fruit has been “picked” to some extent)

- Surprised that Council can’t force developers to implement recycled water in new developments. Queensland can do it – NSW push based around BASIX
- Rainwater is the best water in the world despite what NSW Health and Australian drinking guidelines say.

- Simple DIY greywater reuse at home – flexible hose attached to T-piece under laundry sink and runs out onto back lawn / garden. Changes position of hose every few days. Lawn is green as green all year round. When raining, turns valve so that water goes to sewer rather than water log yard.

The following brochures and reports were available as handouts:

- Demand Management
  - Water Demand Management – Tweed Shire Demand Management Strategy
  - Water Demand Management – Progress to Date
  - Water Demand Management – Reducing Water Usage
  - Water Demand Management – User Pays Water Pricing 2009 – 2010
  - Integrated Water Cycle Management – Household Retrofit Program
  - Integrated Water Cycle Management – Water Modelling Activities

  - REPORT: Demand Management Strategy – Dec. 2009 – by MWH
  - REPORT: Demand Management Strategy – Stage 1 – by MWH
  - REPORT: Demand Management Strategy – Stage 2 – by MWH

- Recycled Water
  - Tweed Shire Council Recycled Water Initiative – Fact Sheet No. 1
  - Tweed Shire Council Recycled Water Initiative – Case Study 1
  - Tweed Shire Council Recycled Water Initiative – Case Study 2

- Water Supply Augmentation

- Tweed District Water Supply Augmentation Factsheet 1 – Why does the Tweed need more water?
- TSC Fact Sheet 1 – Why does the Tweed need more water?
- TSC Fact Sheet 2 – Water Supply Augmentation to 2036
- TSC Fact Sheet 3 – Community consultation to determine a preferred option
- TSC Fact Sheet 4 – Community Working Group nominations
- TSC Fact Sheet 5 – Water Supply Options
- TSC Fact Sheet 6 – Short-listed Option 1: Raise Clarrie Hall Dam
- TSC Fact Sheet 7 – Short-listed Option 2: Construct Byrrill Creek Dam
- TSC Fact Sheet 8 – Short-listed Option 3: Pipeline connection to SE QLD
- TSC Fact Sheet – Questions and answers to the Project

- REPORT: Tweed District Water Supply Augmentation Options Study Stages 1 & 2 – by MWH

- <u>Water Savings and Education</u>
  - Tweed Shire Council – Water Wise Fact Sheet 1
  - Tweed Shire Council – Water Wise Fact Sheet 2
  - Tweed Shire Council – Recycled Water Initiative Fact Sheet 2
  - Tweed Shire Council – Water Wise Fact Sheet 6
  - Tweed Shire Council Fact sheet 3 – Rebates
  - Tweed Shire Council – Water Wise Fact Sheet 10 – Rainwater tanks
  - NSW Government - How Can Greywater be used?

- <u>Joanna Gardner's (CWG member) Byrrill Creek Landowners Information</u>
  Three (3) handouts
  - Environmental Effects and Considerations for the Proposed Byrrill Creek Dam
  - An Overview of the Byrrill Creek Dam Area
  - Byrrill Creek Dam Newsletter – February 3rd 2010

- <u>Colleen Gardner's (CWG member) Clarrie Hall Dam Landowners Information</u>
  One (1) handout
  - Impacts on the Community of Clarrie Hall Dam (Social, Commercial and Cultural)

Tweed District Water – Demand Management and Water Supply Augmentation

Public Information Session

Tuesday 23 February 2010
Pottsville Environment Centre, Centennial Drive, Pottsville
2:00pm – 7:00pm

CWG members and Tweed Shire Council staff in attendance:

CWG	*TSC*
Don Beck	Anthony Burnham
Rob Learmonth	Tim Mackney

The information session was attended by 5 members of the public who were interested in discussing the Shire's Demand Management actions and strategy, and the approach to augmentation of the Water Supply.

- Why lock yourself into a major option when in the near future say 5 – 10 years legislation etc may change to make currently ruled out or unconsidered options more feasible?
- Great that Council is looking at both demand and supply sides of water.
- Council engineers were at WUSD conference in QLD and are proactive – that's great.
- What additional regulations would help Council to enforce more demand management actions?
- The community has to hear more about WUSD
- Are the options really limited to the four?

<u>The following brochures and reports were available as handouts</u>:

- <u>Recycled Water</u>
  - Tweed Shire Council Recycled Water Initiative – Fact Sheet No. 1
  - Tweed Shire Council Recycled Water Initiative – Case Study 1
  - Tweed Shire Council Recycled Water Initiative – Case Study 2

- <u>Demand Management</u>
  - Water Demand Management – Tweed Shire Demand Management Strategy
  - Water Demand Management – Progress to Date
  - Water Demand Management – Reducing Water Usage

- Water Demand Management – User Pays Water Pricing 2009 – 2010
- Integrated Water Cycle Management – Household Retrofit Program
- Integrated Water Cycle Management – Water Modelling Activities

- REPORT: Demand Management Strategy – Dec. 2009 – by MWH
- REPORT: Demand Management Strategy – Stage 1 – by MWH
- REPORT: Demand Management Strategy – Stage 2 – by MWH

- Water Supply Augmentation
  - Tweed District Water Supply Augmentation Factsheet 1 – Why does the Tweed need more water?
  - TSC Fact Sheet 1 – Why does the Tweed need more water?
  - TSC Fact Sheet 2 – Water Supply Augmentation to 2036
  - TSC Fact Sheet 3 – Community consultation to determine a preferred option
  - TSC Fact Sheet 4 – Community Working Group nominations
  - TSC Fact Sheet 5 – Water Supply Options
  - TSC Fact Sheet 6 – Short-listed Option 1: Raise Clarrie Hall Dam
  - TSC Fact Sheet 7 – Short-listed Option 2: Construct Byrrill Creek Dam
  - TSC Fact Sheet 8 – Short-listed Option 3: Pipeline connection to SE QLD
  - TSC Fact Sheet – Questions and answers to the Project

  - REPORT: Tweed District Water Supply Augmentation Options Study Stages 1 & 2 – by MWH

- Water Savings and Education
  - Tweed Shire Council – Water Wise Fact Sheet 1
  - Tweed Shire Council – Water Wise Fact Sheet 2
  - Tweed Shire Council – Recycled Water Initiative Fact Sheet 2
  - Tweed Shire Council – Water Wise Fact Sheet 6
  - Tweed Shire Council Fact sheet 3 – Rebates
  - Tweed Shire Council – Water Wise Fact Sheet 10 – Rainwater tanks
  - NSW Government - How Can Greywater be used?

- Joanna Gardner's (CWG member) Byrrill Creek Landowners Information
  Three (3) handouts
  - Environmental Effects and Considerations for the Proposed Byrrill Creek Dam
  - An Overview of the Byrrill Creek Dam Area
  - Byrrill Creek Dam Newsletter – February 3rd 2010

- Colleen Gardner's (CWG member) Clarrie Hall Dam Landowners Information
  One (1) handout
  - Impacts on the Community of Clarrie Hall Dam (Social, Commercial and Cultural)

THIS PAGE IS BLANK

TWEED SHIRE COUNCIL

Customer Service | 1300 292 872 | (02) 6670 2400

tsc@tweed.nsw.gov.au
www.tweed.nsw.gov.au

Fax (02) 6670 2429
PO Box 816
Murwillumbah NSW 2484

MWH

BUILDING A BETTER WORLD

Technical Note 2: Large Stand Alone Rainwater Tanks

Prepared for Tweed Shire Council

October 2010

CONTENTS

Tweed Shire Council

Technical Note 2: Large Stand Alone Rainwater Tanks

In line with our Quality System, this document has been prepared by Kelly Devrell and reviewed by Shane O'Brien and signed off by Mark Hunting.

BRISBANE Level 3, 35 Boundary Street, PO Box 3602, South Brisbane, QLD 4101

p +61 7 3029 5000, f +61 7 3029 5050

Figures

Tables

In line with our Quality System, this document has been prepared by Kelly Devrell and reviewed by Shane O'Brien and signed off by Mark Hunting.

BRISBANE Level 3, 35 Boundary Street, PO Box 3602, South Brisbane, QLD 4101
p +61 7 3029 5000, f +61 7 3029 5050

MWH

This document contains information about MWH, particularly about the culture of our organisation and our approach to business, which would be of value to our competitors. We respectfully request, therefore, that it be considered commercially sensitive.

In line with our Quality System, this document has been prepared by Kelly Devrell and reviewed by Shane O'Brien and signed off by Mark Hunting.

BRISBANE Level 3, 35 Boundary Street, PO Box 3602, South Brisbane, QLD 4101

p +61 7 3029 5000, f +61 7 3029 5050

1 Introduction

MWH was commissioned by Tweed Shire Council (TSC) in January 2010 to investigate the environmental benefits, and technical and legislative factors for a property to disconnect from the water supply network and rely solely on rainwater.

Rainwater tanks have a long history of use in Australia, predominantly in rural areas (farms and towns) which often depend upon them for household water. More recently the use of tanks has grown in urban areas, driven by State or local government policies or programs (i.e. rebates) to encourage their use and by home owners' personal choice.

The general public perception is that rainwater is safe to drink. In most areas of Australia, the risk of illness arising from consumption is low, providing it is visually clear, has little taste or smell and, importantly, the storage and collection of rainwater is via a well maintained tank and roof catchment system. While the risk from consuming rainwater is low in most areas of Australia, the water from domestic tanks is not as well treated or managed as the major urban water supplies. The microbial quality of water collected in tanks is not as good as the urban supplies. In a limited number of areas, specific industries or very heavy traffic emissions may affect the chemical quality of rainwater.

Rainwater can be used as a source for hot water services, bathing, laundry, toilet flushing, or gardening. These uses represent lower risks to public health than drinking rainwater.
Irrespective of how tank rainwater is used, water quality is dependent on implementing a sensible maintenance program. However, while maintenance requirements are not particularly onerous, in practice most roof catchments and rainwater tanks are poorly maintained. This may reflect the notion that rain is a relatively pure source of water and it may be related to the fact that in many rural areas, the availability of water is a bigger issue than quality. (enHealth, 2004)

The environmental advantages of using rainwater tanks include reduced stormwater flow and pollution which has water quality benefits for the receiving waters and reduced potential for wet weather sewage overflows due to reduced ingress of rainwater into the sewerage network.

This document investigates the feasibility of using large stand alone rainwater tanks as a sole supply and includes the current use of rainwater tanks in Australia, the size of tank required in Tweed to be independent of the reticulated water supply network, the water quality issues associated with rainwater, costs involved and the necessary operation and maintenance.

2 Current Position

TSC currently has a rainwater tank policy requiring dual supply rainwater tanks to have a minimum storage capacity of 4.5 kL and a minimum roof area catchment of 50 m^2. The Demand Management Strategy - Stage 1, recommends Council adopt requirements in excess of NSW Government's Building and Sustainable Building Index (BASIX). Through agreement, new developments would install dual flush toilets, 3 star showerheads and 5 kL rainwater tanks with a minimum roof catchment area of 160 m^2, connected to external, toilet flushing and cold water to washing machines.

Shown below are a number of case studies showing how large rainwater tanks are currently being used in Australia. The case studies use an integrated approach combining groundwater, greywater, recycled water and rainwater to augment their supply, and are thus not completely self-reliant on rainwater tanks.

In addition to these case studies there is also the town of Miriam Vale in Queensland which relies on rainwater tanks for internal uses due to the very poor quality of the potable supply and Marion Bay in South Australia which switched to desalinated water in 2007 as a better quality more reliable water source after being reliant on rainwater for years.

There are also projects which capture rainwater runoff from a number of properties and divert this into either a communal rainwater tank or into the raw water supply. Again, this rainwater is used to augment other water sources and not as the sole water supply.

2.1 Case Studies

2.1.1 Healthy Home – Gold Coast

The Healthy Home Project brought together Queensland's leading Universities and Government Departments in a joint venture with industry partners.

Driver: Environmental showcase building

Rainwater End-Use: Laundry, kitchen, bathrooms and garden sub-surface watering system.

Recycled/ Grey Water End-Use: The house also contains a greywater system and a water flow control system which reduces water use by up to 50 per cent.

Time in Operation: Unknown

Rainwater Tank Size: 22.5 kL

Rainwater Tank Treatment: First flush device, filters, Ultraviolet (UV) disinfection

Issues / Key Elements: There is also a manually controlled mains refill capacity for when the stored rainwater runs low.

2.1.2 Living Laboratory – Currumbin Ecovillage

The Living Laboratory, as with all homes in The Currumbin Ecovillage, is completely water self-sufficient.

Driver: Environmental showcase building, opted not to connect to reticulated water and sewer supply

Rainwater End-Use: Potable water supply utilised for drinking, cooking, washing up, bathing / showering.

Recycled/ Grey Water End-Use: Toilet flushing, gardens / lawn, clothes washing, car washing supplied by recycled water from the Ecovillage Water Reclamation Plant

Time in Operation: Since November 2007

Rainwater Tank Size: 22.5 kL above ground tank + 4 x 2.16 kL concrete water tanks embedded in ground and used as thermal mass[1] / water storage

Rainwater Tank Treatment: Unknown

2.1.3 Healthy Home – Canberra

The Canberra Healthy Home is in a rural location 30 km west of Canberra. The objective for the design of this house was to construct a building with the highest possible environmental credentials, it is constructed of mud brick and recycled timber construction, is independent of the electricity grid, and self-sufficient for water.

Driver: Environmental building

Rainwater End-Use: All internal.

Recycled/ Grey Water End-Use: The house also contains a greywater and sewage treatment plant which produces water of a suitable quality to use in gardening.

Time in Operation: Unknown

Rainwater Tank Size: 20 kL

Rainwater Tank Treatment: Unknown

[1] Heavyweight building materials store a lot of heat so are said to have high thermal mass, as opposed to lightweight materials that do not store much heat and have low thermal mass. Adding thermal mass within a home helps reduce the extremes in temperature experienced, making the average internal temperature more moderate year-round.

2.1.4 Capo Di Monte – Mount Tamborine

Capo Di Monte is a 46-residence (maximum equivalent population[2] of 100) leisure village catering for 'over-50's' on Tamborine Mountain. Each residence is self-contained with 1 or 2 bedrooms, and the development also has a community centre with swimming pool and activities rooms.

Water self sufficiency is achieved through two large community tanks with an effective rainwater storage of only 6.5 kL per residence and is made possible through using water-efficient fittings in the houses, an emphasis on sensible and conservative water use by residents, and by recycling of treated wastewater for non-potable purposes. There is also an on-site water bore to augment supply.

Driver: Sole water supply as there is no reticulated water supply or sewerage network on Tamborine Mountain, environmentally sustainable development

Rainwater End-Use: All internal except toilet flushing

Recycled/ Grey Water End-Use: Class A+ recycled water from the on-site treatment plant is used for toilet flushing and garden watering.

Time in Operation: Stage 1 completed in 2006

Rainwater Tank Size: Two 200 kL community tanks

Rainwater Tank Treatment: Pressure media filter, UV disinfection and dosed with sodium hypochlorite to provide a residual chlorine concentration.

Issues / Key Elements: An on-site water bore provides a back-up supply. An estimated 72% of internal water requirements except toilet flushing will be supplied by rainwater, with the remaining 28% from the existing on-site bore.

Other: Capital cost for the potable water supply $312,109, with headworks charges of $274,121 and an estimated O&M cost of $5,110 per year ($1.57 / kL produced).

2.2 Discussion

From the case studies it can be seen that none of the houses/developments are solely reliant on rainwater to provide their water supply with all using an integrated approach combining groundwater, greywater, recycled water and/or rainwater to augment their supply.

The highlighted projects also contain water efficient devices including flow control systems and water sensitive landscaping. These would reduce the demand significantly when compared to the demands from an existing house in Tweed that does not have water efficient devices and has an established garden. The estimated demands at the Capo Di Monte 'over 50's' village are 89 L per person per day for the potable supply and 21 L/person/day for the recycled water supply giving a total water demand of 110 L/person/day for all household houses. This is slightly less than the amount of water used per person in South East Queensland at the highest level of drought restrictions and less than half the 254 L/person/day used by existing single family residential properties in Tweed.

The Capo Di Monte village is a medium density village with small gardens and 110 L/person/day is not a realistic water demand target for existing houses in the Tweed area to achieve.

---

[2] Equivalent Population is a common way of expressing non residential water demands in terms of residential demands i.e. if the community centre has a demand ten times greater than the per person demand it will have an Equivalent Population (EP) of 10..

2.3 Current Funding Arrangements

As part of the NSW Government's $700 Climate Change Fund, established to help business, households, schools, communities and government save energy, water and greenhouse gas emissions, the NSW rainwater tank rebate provides up to $1500 cash back for the installation of any new rainwater storage system in residential properties in NSW.

The Australian Government is also providing Rebates of up to $500 for households to install rainwater tanks or greywater systems. Residents in NSW are eligible for both rebates provided the sum of received payments does not exceed the total cost of the tank. A reduced payment for the NSW rebate can be requested if the total payments would exceed the cost if it were paid in full.

Table 2-1: Available rebates

Rainwater tank capacity	NSW Home Saver Rebate (maximum)	Criteria	Federal Rebate – National Rainwater and Greywater Initiative	Criteria
2,000 litres – 3,999 litres	Tank Rebate – $150 Connection to toilet(s) – $500 Connection to washing machine(s) – $500 Maximum total –$1,150	Households **not connected to the mains supply** are eligible for a rebate for the purchase of the **tank only**. Rainwater tanks installed to comply with BASIX for new homes, major renovations or a pool installation are not eligible for a rebate. There is a limit of one rainwater tank per property. Connection to toilet and/or washing machine	$400	Internal reuse of the water for toilet and/or laundry use
4,000 – 6,999 litres	Tank Rebate – $400 Connection to toilet(s) – $500 Connection to washing machine(s) – $500 Maximum total –$1,400		$500	
7,000 litres and above	Tank Rebate – $500 Connection to toilet(s) – $500 Connection to washing machine(s) – $500 Maximum total –$1,500		$500	

3 Reliable Yield of Rainwater Tanks

3.1 Methodology

To determine the potential rainwater yields for a range of tank sizes and roof areas an analysis was undertaken using MWH's Residential Source Substitution model. The model is a daily water balance model, utilising historic climate data, annual demand and assumptions around the size and end uses connected to the rainwater tanks.

3.2 Modelling Assumptions

The models used were modified from those developed for the Demand Management Strategy and use Bray Park climate data from 1970 to 2007. Assumptions used in the model were taken from the Demand Management Strategy and are outlined below in Table 3-1.

Existing refers to existing single family residential houses in the Tweed area whereas Greenfield refers to new residential developments. Greenfield accounts generally use less water internally due to more efficient water fixtures.

Table 3-1: Residential Water Use in Tweed Shire

	Internal Use (L/day)	External Use (L/day)	Total Use (L/day)	Total Use (kL/year)
Existing per account	549	161	710	259
Existing per person[1]	196	58	254	93
Greenfield per account	493	161	654	239
Greenfield per person[1]	176	58	234	85

1 L/person/day calculated using 2.8 people per account for single family residential from the Demand Management Strategy

3.3 Tweed Climate

The Bureau of Meteorology classifies Tweed Shire Council as being in a summer rainfall zone of Australia. This rainfall zone is denoted by wet summers and low winter rainfall. This has an impact on rainfall tank sizing because the tank has to be large enough to capture the wet summer rainfall and store it to cater for the winter demand.

The majority of NSW, and some areas in Victoria and Tasmania are classified as being in an uniform rainfall zone whereby a smaller tank could cater for the demand as it is being topped up relatively uniformly throughout the year.

The annual and average monthly rainfalls at Bray Park for the period 1970 – 2007 are shown below in Figure 3-1 and Figure 3-2 respectively. The seasonal fluctuation described above can be seen in Figure 3-2 while significant yearly variations in total rainfall are shown in Figure 3-1.

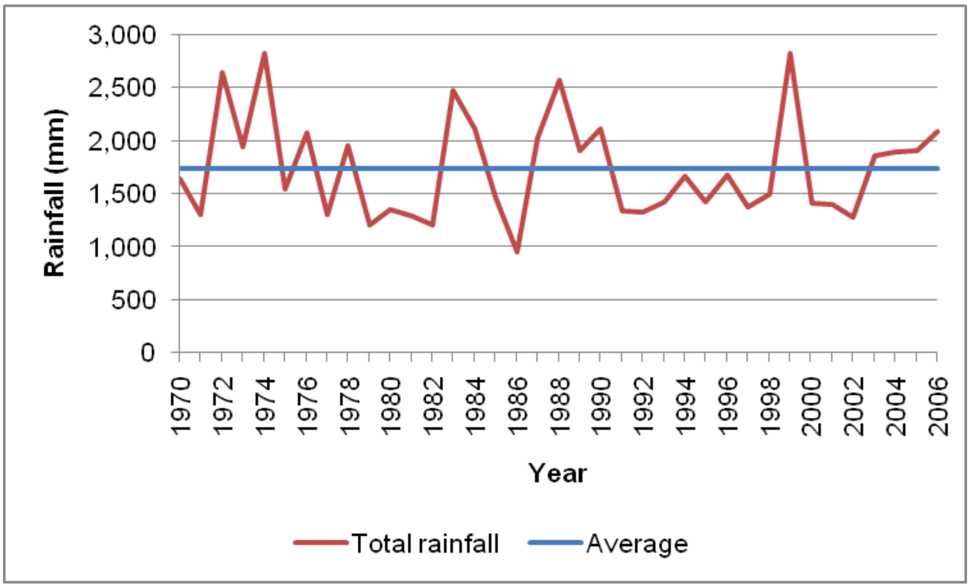


Figure 3-1: Annual Rainfall

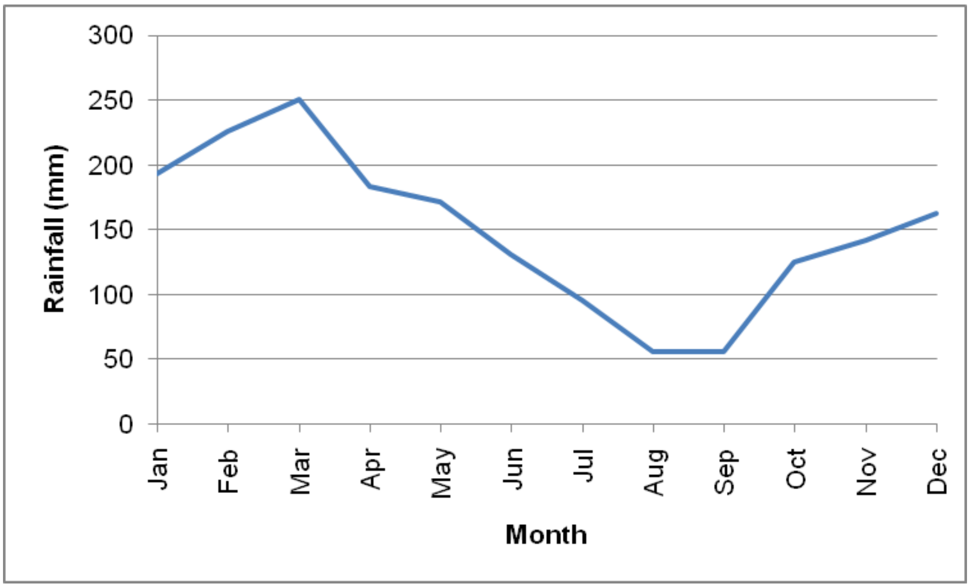


Figure 3-2: Average Monthly Rainfall

3.4 Yield Assessment Results

Rainwater tanks of various sizes were simulated for roof areas of 100, 200 and 300 m^2 connected roof area. The results of these simulations are shown in Figure 3-3.

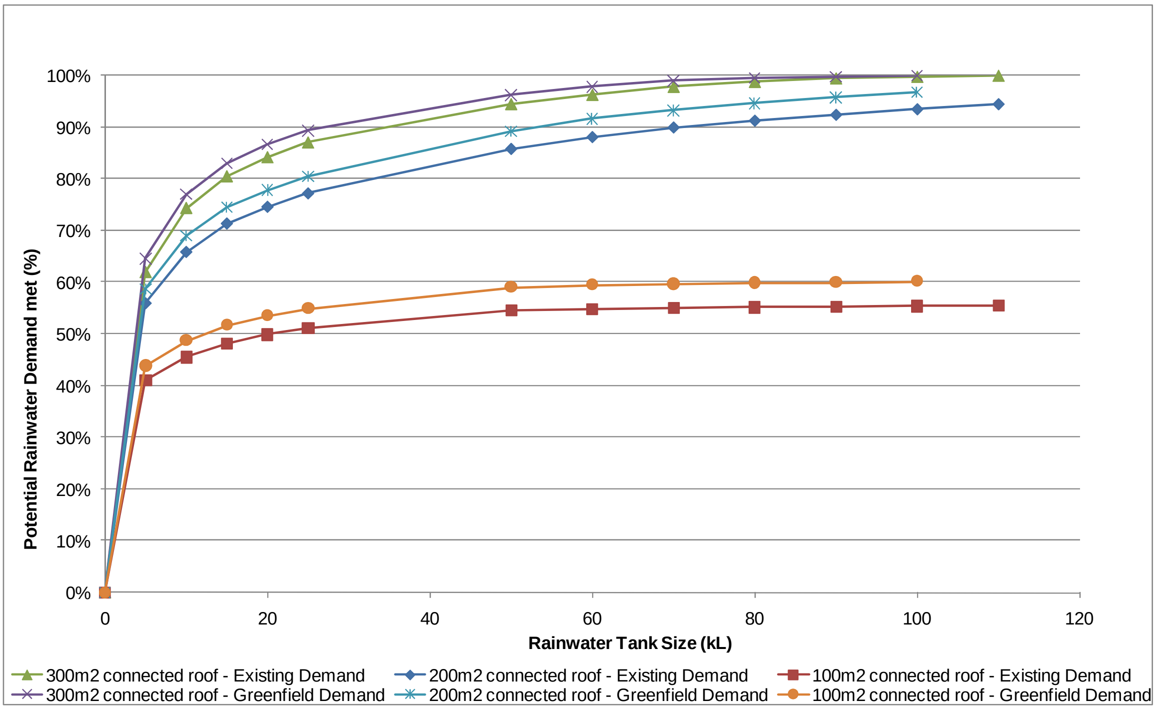


Figure 3-3: Average Annual Yield Analysis for Rainwater Tanks

It can be seen that for a Greenfield single family residential property a 100 kL tank connected to 300 m^2 of roof area would be required to meet 100% of the family's demand. A slightly larger volume tank of 110 kL would be required to take account of the less water efficient fixtures in an existing property compared to a new Greenfield property. Although there are larger industrial size rainwater tanks available, 110 kL is approximately equivalent to five 22.5 kL tanks, (one commercially available 22.5 kL tank has a diameter of 3.73 m)and would be extremely difficult to locate on an average suburban block.

The figure also illustrates that for a given roof area and demand, there is a 'point of diminishing returns' in tank size, where increasing the size further does not provide a significant increase in yield.

The tank volume over the period 1970 – 2007 for a 110 kL tank connected to 300 m^2 of roof area supplying 100% of demand for an existing single family residential property is shown in Figure 3-4. It can be seen that the tank runs out of water once during this period and is frequently full and overflowing. The rainwater tank model assumes a fixed internal demand and a seasonal demand based on irrigation requirements, it does not assume any self-imposed restrictions or changes to those demands whereas in reality, if there is a period of reduced rainfall and the volume in the tank is getting low householders would most likely manage their demands more carefully in order to preserve their only water supply source. The consequence of failure of a large stand alone rainwater tank is however very minimal as water carting is always available although this will be at an additional cost.

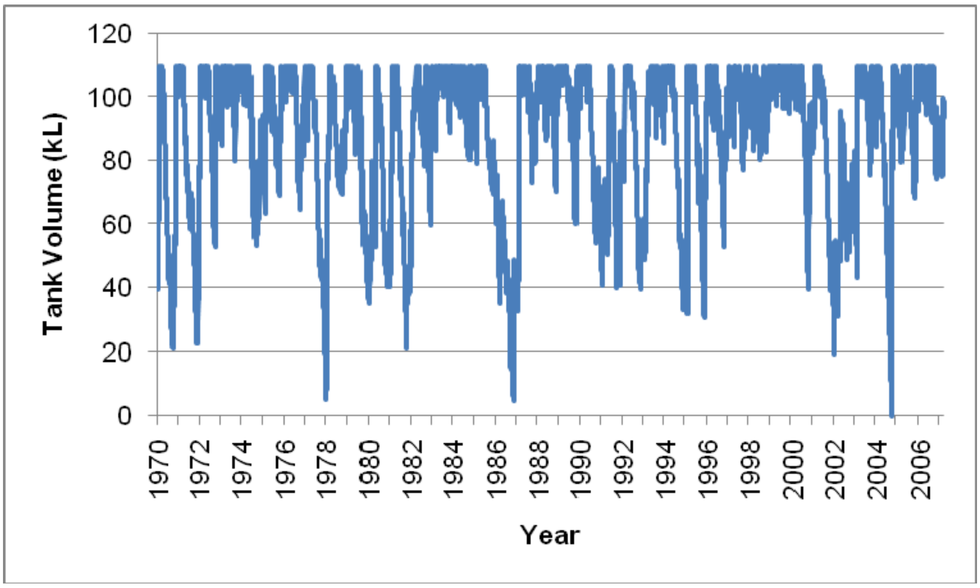


Figure 3-4: Tank Volume over time for 110kL tank using existing demand

In comparison to the Levels of Service for the reticulated water supply from Clarrie Hall Dam, Department of Water and Energy (DWE) guidelines in respect to levels of service for water supplies and water restrictions due to drought are described by the 5/10/20 rule.
This rule underpins the reasonableness of drought restrictions. Levels of Service under this rule are defined as follows:

- Restrictions implemented no more than 5% of the time, on average;
- Restrictions imposed no more than once every 10 years on average; and
- Demand reductions during drought restrictions should be 20%.

From the 2009 Tweed Shire Council Drought Management Strategy, which analysed the performance of Clarrie Hall Dam from 1986 to 2007, it is clear that the carting ban (imposed when the dam falls to 90%) will occur regularly (approximately once every two years). Water restrictions however have occurred only once in the past 20 years, during the drought of 2002, which is the worst on record and brought Clarrie Hall Dam down to its lowest level of 35% capacity. It is therefore believed that the level of service will meet the 5/10/20 rule for the foreseeable future. During the period 1986 – 2007, Clarrie Hall Dam fell below 40% only once in early 2003.

Assuming no flow in the system, Clarrie Hall Dam would fail in 14 to 15 months at 2008 demand levels and in around 12 months under 2018 demands. This case assumes zero inflow to Clarrie Hall dam and zero flow in the Tweed and Oxley Rivers. This is the worst case scenario and the probability of occurrence is very low as there has always been some level of flow in the Tweed system based on the available records spanning around 120 years. Compared to a large stand alone rainwater tank, the consequences of failure of Clarrie Hall Dam are major and contingency options to supply customers under a total failure scenario or to provide a back up supply if the dam reaches critical levels were also reviewed as part of the study.

If the period of 1986 – 2007 is examined, it can be seen that as long as appropriate restrictions are implemented, both Clarrie Hall Dam and a large stand alone rainwater tank have the capacity to continue to supply water throughout the modelling period. However, during this period, Clarrie Hall Dam only fell below 40% capacity once and restrictions were only applied once. The large tank however, failed once and almost failed on one other occasion. It is likely that the household would need to restrict their water use on these occasions. The large stand alone rainwater tank also fell below 40% capacity on 10 occasions during the period 1986 – 2007.

In 2006, SunWater analysed the security of the Tweed River water supply system using climate data from 1890 to 2004. This was a theoretical historic no failure yield analysis which determines the annual volume of water (in ML/year) that can be supplied, without failure for every year of the analysis. This analysis showed that using DWE criteria and assuming 20% demand reduction during drought restrictions the level of Clarrie Hall Dam would have dropped below 40% on only two occasions, once during the 1902/03 drought and again during the 2002/03 drought. Compared to the Drought Management Strategy the probability of Clarrie Hall Dam falling below 40% capacity is reduced to 1 in 100 years.

Therefore, although water restrictions would be required for both systems, the probability of failure of a large stand alone rainwater tank as the sole supply is far higher than for the reticulated water network supplied by Clarrie Hall Dam.

4 Water Quality Issues

4.1 Regulatory Requirements

While no specific legislation regulates rainwater harvesting and reuse, a large stand alone rainwater tank will be required to comply with a number of relevant legislative and non-legislative regulatory requirements. These along with other relevant reference documents are listed in Table 4-1.

Table 4-1: Regulatory Requirements and Reference Documents

Type of Document	Name	Key Issues
Legislation	*Water Management Act 2000*	Entitles householders to capture rainwater i.e. the States rights to water do not extend to private roofs. This is a NSW Act and this right is not the same in all States.
Standards	AS/NZS 3500 *Plumbing and drainage*	Technical standards for installation
Guidelines	*Guidance on Use of Rainwater Tanks* (enHealth, 2004)	Information is provided on the range of potential hazards that can threaten water quality, preventive measures that can be used to prevent these hazards from contaminating rainwater, straightforward monitoring and maintenance activities, and, where necessary, corrective actions.
	Australian Drinking Water Guidelines (NHMRC & NRMMC, 2004)	The ADWG provide a Framework for management of drinking water quality based on a preventive, risk management approach.
	Rainwater Tanks Where a Public Water Supply is Available - Use of (NSW Health, 2007)	In urban areas NSW Health supports the use of rainwater tanks for non-drinking uses. NSW Health recommends that people use the public water supply for drinking and cooking because it is filtered, disinfected and generally fluoridated.
Other Reference Documents	*NSW Code of Practice for Plumbing and Drainage* (CUPDR, 2006)	
	Rainwater Tank Design and Installation Handbook (MPMSAA, 2008)	
	Research Report 39: Guidance Manual for the Design and Installation of Urban Roofwater Harvesting Systems in Australia (Edition 1) (Chapman et al., 2008a)	
	Research Report 42: Water Quality and Health Risk from Urban Water Tanks (Chapman et al., 2008b)	

4.2 Tweed Shire Council Requirements for Rainwater Tank Installations

TSC has the following requirements for the installation of rainwater tanks:

- Submit a **Plumbing / Drainage Permit** ($42) to Tweed Shire Council and pay an **Inspection Fee** ($90).
- Clearly label any pipes and taps as ‘rainwater’.

Note: *If the tank capacity is greater than 10,000 litres and you are not in a rural area, you must also submit a Development Application to meet other building requirements.*

4.3 Water Quality / Scheme Requirements

enHealth (2004) identified that collection and storage of rainwater provides the opportunity for a number of microbial (i.e. pathogens), physical (i.e. sediments) and chemical (i.e. heavy metals) contaminants to enter the water, with microbial contaminants being the most prevalent.

Chapman et al. (2008b) reported the following water quality results from a National survey of water quality from 35 rainwater tanks from Adelaide, Brisbane, Broken Hill, Canberra, Sydney and Wollongong:

- *Microbial:* Compared to conventional urban water supplies the water supplied from the rainwater tanks tested provided relatively poor microbial water quality. Pathogens responsible for gastrointestinal infection (*Campylobacter spp* and *Salmonella spp*) were detected in 1 and 2 rainwater tanks respectively.
- *Chemical:* High lead concentrations were detected in six tanks. High zinc concentrations were also detected but high zinc concentrations are more of an aesthetic issue, opposed to a health issue, since it may lead to taste problems. Occasional high levels of plasticisers and herbicides were detected although further investigation is required to ascertain the prevalence in a larger sample and over a longer sample time.

Both the NSW Department of Health and enHealth (2004) advise against drinking rainwater where a reticulated water supply is available as the water quality from a rainwater tank, in particular microbial quality, may not be consistently high quality.

The following measures can be implemented to improve rainwater quality obtained from a rainwater harvesting scheme:

- Prudent scheme design (e.g. rainwater tank location, materials of construction and guttering design can all impact on the water quality);
- Use of treatment processes (e.g. leaf and debris screen); and
- Regular Maintenance (e.g. regular removal of debris and leaves from the roof and guttering).

There are a number of treatment processes that are commonly adopted to improve rainwater quality depending on the particular end use. For a number of rainwater harvesting schemesTable 4-2 compares the end uses the rainwater is used for and the level of treatment adopted for the rainwater.

With the exception of Capo Di Monte, which provides community based water supplies, the examples are for schemes providing rainwater to an individual dwelling.

A rainwater harvesting and reuse scheme may also require additional measures to prevent mosquito breeding in the rainwater tanks.

Table 4-2: Indicative Combinations of Risk Mitigation Measures Requires for Selected End Uses

Example	End Uses	Adopted Rainwater Treatment
Various Locations	Outdoor water uses	None
Gold Coast Water	Outdoor water uses Toilet flushing Laundry (cold tap)	Leaf and Debris Screen First Flush Device
Capo Di Monte (Mt Tamborine, QLD)	All water uses including drinking.	Leaf and Debris Screen Sand Filter UV Chlorine Dosing

5 Capital and Operational Costs

5.1 Capital Costs

A range of capital costs for rainwater tanks, pumps, plumbing and installation is shown below in Table 5-1. This table has been taken from a 2007 National Water Commission report, by Marsden Jacob Associates, "The cost-effectiveness of rainwater tanks in urban Australia". The results were relatively consistent for the tank itself, but the estimates of installation and plumbing costs were far more variable. In some cases, indoor plumbing is inaccessible or encased within the concrete slab of the house, making plumbing to some areas of the house cost prohibitive which explains the variability of plumbing costs shown in Table 5-1.

Table 5-1: Rainwater tank costs provided by suppliers ($)

	2 kL tank	5 kL tank	10 kL tank	20 kL tank	Pump	Plumbing (approx.)	Installation (approx.)
Range	641-922	935-1,349	1,621-1,899	2,618-2,835	240-1,045	300-3,000	300-800
Average	732	1,080	1,656	2,852	622	885	549
Median	721	1,091	1,630	2,835	650	727	548

The Marsden Jacob report also contained a levelised cost analysis which demonstrated that in all of the cases examined, the cost per kilolitre of tank water is greater than the price currently charged by water companies and a "typical" property owner who installs a rainwater tank will, in most cases, face a net financial loss over time. To offset this loss, a rebate in the order of $1,600 to $4,000 would be required depending on tank size and roof size.

Using the average costs shown in Table 5-1 gives an approximate cost of $3,150 for a 5 kL tank and $27,000 for an equivalent 110 kL tank. This gives a capital cost of $3.50 per kL of rainwater supplied for the 5 kL tank based on a demand of 231 L/day over 20 years (outdoor use, toilet flushing and cold water to washing machine as analysed in the Demand Management Strategy). Using the same methodology the capital cost per kL of rainwater supplied for the 110 kL tank is $9.80 based on a demand of 710 L/day which is the existing single family residential demand shown in Section 3.2.

This is a very simplistic calculation; it does not contain any rebates, replacement of pump (expected every 10 years) or any ongoing maintenance. It is shown for comparative purposes only and shows that to supply all internal and external demands with rainwater costs approximately 2.8 times more than supplying the end uses recommended in the Demand Management Strategy with a 5 kL tank. This again highlights the effect of diminishing returns shown in Figure 3-3.

5.2 Operational Costs

Most research on operational costs of rainwater tanks has focussed on the more practical domestic tank sizes ranging from 2,000 litres (2 kL) to 10,000 litres (10 kL), which suggests that

> "*a typical household rainwater system supplying rainwater to the laundry, toilet and garden appears to have an average energy intensity of approximately 1.5 kWh/kL"*. *(Retamal, 2009)*

Using this energy intensity to calculate the energy requirement of a pump to supply all internal/external demand for an existing single family residential property gives:

1.5 kWh/kL x 259 kL/yr x 21.582[3] c/kWh = approximately $85 per year

Other operational costs (both financial and non-financial) include:

- regular checking and cleaning of gutters, roof catchments and tank screens, including removing overhead branches where required;
- potentially installing gutter screens or guards;
- checking the tank for sludge every two to three years and having the tank cleaned if there is a thick layer of sludge at the bottom;
- if the tank owner suspects the tank has been contaminated, the water stored in the tank may require chlorine disinfection; and
- maintenance of the water pump as required.

In contrast to the installation and plumbing for a rainwater tank, the operating and maintenance of a tank can often be undertaken by the home owner and in some cases represents a cost that would have been incurred even without the tank (e.g. cleaning of gutters).

> *Interestingly, the cost of the physical tank itself might account for as little as 30% of the whole of life cost if the tank is plumbed for both indoor and outdoor use. In a "typical" installation, the water pump (including replacement every 10 years) might account for around 35%, installation and plumbing 25% and ongoing operation and maintenance around 10%. (NWC, 2007)*

In 2009, Gold Coast Water implemented an inspection program for registered rainwater tanks in accordance with Queensland Local Government Act 1993. Although the majority of costs associated with rainwater tanks are borne by the customer this is one example of a cost that could be incurred by Council.

[3] TRU Energy NSW Electricity 5700 (peak) rate

6 Operation and Maintenance

Regular maintenance is the key to good water quality. Installing screens, filters and first flush devices will reduce contamination.

Unless adequately treated, rainwater is not as reliably safe to drink as the network water supply. It is almost impossible to completely protect rainwater from bird droppings and other debris containing micro-organisms and particularly in an urban environment, air pollution caused by nearby light / heavy industries and vehicle emissions.

Likely sources of micro-organisms and chemical contaminants that can be controlled are:

- Overhanging branches
- Soil and leaf litter accumulated in gutters – particularly if kept damp for long periods due to poor drainage
- Faecal matter deposited by birds, lizards, small rodents, marsupials etc
- Dead animals and insects either in gutters or in the tank itself

It is important that roofs, gutters, screens and first flush devices be regularly inspected and cleared of leaves and other debris.

To prevent mosquito breeding, and corrosion and metal contamination, guttering and pipework should be self-draining or fitted with drainage points. Water should not be allowed to pool under the overflow outlet or tap, as these can become mosquito-breeding sites.

The tank should be a sealed unit with the lid preventing sunlight from reaching the water. Sunlight encourages the growth of algae that will taint the water. Holes and spaces will allow mosquitoes to enter. The inlet should incorporate a mesh cover and a strainer to keep out leaves and to prevent the access of mosquitoes and other insects. The overflow should also be covered with an insect proof cover such as plastic insect mesh wired around the pipe.

The most common additional treatment measures utilised in Queensland case studies include:

- Filtering through a 20 micron filter;
- UV disinfection (to ensure all pathogens were eliminated); and
- Carbon filters on cold water taps.

The suggested maintenance procedures shown in Table 5-1 are recommended by Gold Coast Water to ensure risks to water quality are minimised.

It is recommended that the tank is emptied and cleaned once every two years which would require another source of supply during this time, especially if only one large tank is used to supply all internal and external end uses. Therefore, regardless of the size of tank 100% reliability from a large stand alone rainwater tank is impossible as allowance needs to be made for emptying and cleaning once every two years.

Table 6-1: Suggested maintenance procedures

Maintenance Action	Regularity
Check and clean mosquito net on tank overflow	October – March: every month April – September: every three months
Check and clean first flush device	Three months
Check roof and gutters for the presence of accumulated including leaf and other plant material	Three months
Clear accumulated plant material	Three months
Prune overhanging tree branches and foliage	Three months
Check water quality – must be clear with no smell	Six months
Check for evidence of animal, bird or insect access including mosquito larvae; if present locate and close access points	Six months
Check tank for defects and repair	Six months
Check for evidence of algal growth; if present, find and close points of light entry	Six months
Ensure taps have the correct signage installed	Six months
Clean tank to remove accumulated sediment or sludge	Two years

7 Property Development and Water Access Charges

The current Tweed Development Servicing Plan (DSP) for Water Supply Services makes no allowance for properties that are self-sufficient for water requiring *contributions where the anticipated development will or is likely to increase the demand for water supply services*.

As yields from rainwater tanks are susceptible to droughts there is no guarantee that connection to the reticulated water supply will not be necessary in the future to service the property.

The current water access charges from the TSC website (http://www.tweed.nsw.gov.au) are $102 annually for residential customers. This fee applies to all land that is within 225 metres of a water main and able to be connected (whether connected or not).

A similar approach is taken in Section 311 of the *Water Management Act 2000*, which states a water supply authority may only levy water service charges on land:

> (a) to which water is supplied, or
>
> (b) to which, in the opinion of the water supply authority, it is reasonably practicable for water to be supplied, from one of the water supply authority's water mains.

8 Considerations

An evaluation of large stand alone rainwater tanks is shown in Table 8-1 with some identified advantages and disadvantages of this method of source substitution. The reduced stormwater pollutant loads and peak discharge rates can also be achieved through the use of smaller rainwater tanks and these advantages are not solely applicable to large rainwater tanks.

Table 8-1: Large Stand Alone Rainwater Tanks considerations

Advantages	Disadvantages
Reduced potable water demand	Climate dependent – yield reliability calculated for average climate conditions and hence performance will reduce considerably during periods of below average rainfall
Reduced stormwater peak discharge rate and volume which reduces both flooding and erosion downstream	Cost prohibitive to supply entire internal/external demand due to size of infrastructure required to maintain 100% reliability
Reduced pollutant loads in stormwater increase the water quality and health of downstream water bodies	Large connected roof area required – not all roof area is available for use and will depend on the location of downpipes and tank location
New potable water supply sources could potentially be delayed	Required footprint for large rainwater tanks – e.g. one commercially available 22.5 kL rainwater tank has a diameter of 3.73 m and stands 2.44 m high. Existing single family residential property requires five 22.5 kL tanks to be self sufficient. Difficult to locate on an average suburban block.
Reduced potential for wet weather sewage overflows due to reduced ingress of rainwater into the sewerage network	Costs borne by customer not council
Reduced stormwater flow and pollutant loads lead to increased habitat protection for fish and other aquatic animals	Increased energy costs
Ability to be independent of reticulated supply, dams can be depleted over many years of drought and restrictions may still apply to reticulated supply although tanks contain water. Tanks can also be topped up by carting water although this will involve a cost.	May not reduce infrastructure costs if council deem that connection may occur in the future and hence demand is required to be catered for
Rainwater can be lower in salinity and hardness than mains water reducing corrosion and detergent use	Does not reduce developer charges or rates
	Maintenance is the onus of the owner not council
	Potential water quality issues
	May not be able to maintain current garden watering practices and other lifestyle choices i.e. pools/spas
	Alternative source of fluoride needs to be sought

Advantages	Disadvantages
	More expensive to retrofit in existing houses where access issues for installation and roofs/gutter connections may not be suitable

9 Discussion

Rainwater tanks have a long history of use in Australia, predominantly in rural areas (farms and towns) which often depend upon them for household water. More recently the use of tanks has grown in urban areas, driven by State or local government policies or programs (i.e. rebates) to encourage their use and by home owners' personal choice.

TSC currently has a rainwater tank policy requiring dual supply rainwater tanks to have a minimum storage capacity of 4,500 litres and a minimum roof area catchment of 50 m^2. The Demand Management Strategy - Stage 1 recommends for major development that requirements above the NSW Government's Building and Sustainable Building Index (BASIX) be pursued through agreement for dual flush toilets and 3 star shower heads and the provision of 5,000 L rainwater tanks with a minimum connected roof area of 160 m^2, connected to external, toilet flushing and cold water to washing machines.

In addition to the examples and case studies discussed in this report, there are few examples of communities which rely solely on rainwater tanks for their permanent water supply. While none of the examples or case studies are completely self-reliant on rainwater tanks, using an integrated approach combining groundwater, greywater and recycled water to augment their supply, they are examples of how rainwater tanks are currently being used in Australia

To be totally self sufficient for water an existing average single family residential property in the Tweed area would require a 110 kL tank connected to 300m^2 of roof area, and an average Greenfield property with water efficient devices would require a 100 kL tank also connected to 300m^2 of roof area.

Currently the disadvantages of using rainwater tanks to supply all of a households demand far outweigh the advantages due to the lack of water security and economics of large stand alone rainwater tanks in areas where potable supply is available.

The Bureau of Meteorology classifies Tweed Shire Council as being in a summer rainfall zone of Australia. This rainfall zone is denoted by wet summers and low winter rainfall. This has an impact on rainfall tank sizing because the tank has to be large enough to capture the wet summer rainfall and store it to cater for the winter demand. Yield reliability is calculated for average climate conditions and hence will fluctuate during periods of below average rainfall.

A large connected roof area is required which may not be feasible on typical urban blocks that do not have large sheds or outbuildings like rural areas. Large rainwater tanks also have a large footprint (a 110 kL tank equates to five 22.5 kL tanks, which are 3.7 m in diameter and 2.4 m high) which again may not be feasible in urban areas where land availability is limited.

It is important to realise that rainwater tank cost, both capital / operating, and maintenance time are borne by the customer not the council; there are also increased energy costs associated with pump operation.

Because large rainwater tanks are susceptible to drought and not a reliable source of supply, water infrastructure will still need to be sized to cater for peak demand with no reduction due to rainwater tank usage. This also means there will be no reduction in developer charges or rates.

There are also water quality issues associated with exposure to rainwater, which require treatment and increase the capital and operating costs. Rainwater does not contain fluoride and if used as the sole source of drinking water, an alternative source of fluoride will need to be sought.

Finally, demands in this study have been taken from average demands for Single Family Residential properties contained in the Demand Management Study. If individual property demands are significantly higher than average, then current garden watering practices and other lifestyle choices may not be able to be maintained.

10 Conclusions

- In urban areas NSW Health supports the use of rainwater tanks for non-drinking uses. NSW Health recommends that people use the public water supply for drinking and cooking because it is filtered, disinfected and generally fluoridated.
- To be totally self sufficient for water an existing average single family residential property in the Tweed area would require a 110 kL tank connected to 300m^2 of roof area, and an average Greenfield property with water efficient devices would require a 100 kL tank also connected to 300m^2 of roof area.
- Although there are larger industrial size rainwater tanks available, 110 kL is approximately equivalent to five 22.5 kL tanks, which have a diameter of 3.73m each and would be extremely difficult to locate on an average suburban block.
- Yield reliability is calculated for average climate conditions and hence will fluctuate during periods of below average rainfall.
- Although water restrictions do occur in the reticulated water supply network the probability of failure of the Clarrie Hall Dam is very low compared to using a large stand alone rainwater tank as the sole supply.
- The cost per kilolitre of tank water is greater than the price of water from the reticulated water supply.
- To supply all internal and external demands with rainwater costs approximately 2.8 times more than supplying the end uses recommended in the Demand Management Strategy with a 5 kL tank
- Property development and access charges will still apply.
- Because large rainwater tanks are susceptible to drought and not a reliable source of supply, water infrastructure will still need to be sized to cater for peak demand with no reduction due to rainwater tank usage. This also means there will be no reduction in developer charges or rates.
- Rainwater tank cost, both capital / operating, and maintenance time are borne by the customer not the council; there are also increased energy costs associated with pump operation.
- There are water quality issues associated with exposure to rainwater, which require treatment and increase the capital and operating costs. Rainwater does not contain fluoride and if used as the sole source of drinking water, an alternative source of fluoride will need to be sought.
- There are environmental advantages to using rainwater tanks, however these can also be provided by smaller tanks that are used to augment the existing water supply and not as the sole supply.
- Currently the disadvantages of using rainwater tanks to supply all of a household's demand far outweigh the advantages due to the lack of water security and economics of large stand alone rainwater tanks in areas where potable supply is available.

11 References

Your Home case study, Gold Coast, Queensland http://www.yourhome.gov.au/technical/fs84.html

Your Home case study, Canberra, ACT http://www.yourhome.gov.au/technical/fs814.html

Tweed Shire Council, Development Servicing Plan for Water Supply Services, July 2007

State of New South Wales, Water Management Act 2000

Smart and Sustainable Homes, Currumbin case study, April 2009, http://www.sustainable-homes.org.au/03_projects/currumbin_ll/currumbin_ll.htm

Environment, Climate Change and Water, NSW rainwater tank rebate http://www.environment.nsw.gov.au/rebates/ccfrtw.htm

Australian Government, Department of the Environment, Water, Heritage and the Arts, National Rainwater and Greywater Initiative, http://www.environment.gov.au/water/programs/nrgi/index.html

Bureau of Meteorology, Major seasonal rainfall zones of Australia http://www.bom.gov.au/climate/environ/other/seas_group.shtml

http://www.tweed.nsw.gov.au/Agenda21/pdfs/TSC%20Requirements%20for%20Rainwater%20Tank%20Installations.pdf

ABC News, Marion Bay awaits Desalination Plant http://www.abc.net.au/news/stories/2007/05/31/1938784.htm

Australian Government, National Water Commission, Marsden Jacob Associates, The cost effectiveness of rainwater tanks in urban Australia, March 2007

Retamal, Turner, White, Energy Implications of Household Rainwater Systems, published Water Journal, v36 8 December 2009

Gold Coast Water, FACT SHEET Inspection Program – Rainwater Tanks, http://www.goldcoastwater.com.au/attachment/goldcoastwater/pet_tank_inspection_fs.pdf

Chapman H., Cartwright T. & Tripodi N., 2008a. *Research Report 39: Guidance Manual for the Design and Installation of Urban Roofwater Harvesting Systems in Australia (Edition 1)*, The Cooperative Research Centre for water Quality and Treatment.

Chapman H., Cartwright T., Huston R. and O'Toole J., 2008b. *Research Report 42: Water Quality and Health Risk from Urban Water Tanks*, The Cooperative Research Centre for water Quality and Treatment.

Committee on Uniformity of Plumbing & Drainage Regulations in NSW (CUPDR) 2006. *NSW Code of Practice for Plumbing and Drainage,* Sydney.

enHealth Council, 2004, *Guidance on Use of Rainwater Tanks.* enHealth Council. Australian Government Department of Health and Ageing.

Master Plumbers & Mechanical Services Association of Australia, 2008. *Rainwater Tank Design and Installation Handbook.*

National Health and Medical Research Council & Natural Resources and Management Ministerial Council (NHMRC & NRMMC) 2004. *Australian Drinking Water Guidelines,* Canberra.

NSW Health, Rainwater Tanks Where a Public Water Supply is Available - Use of, June 2007 http://www.health.nsw.gov.au/policies/gl/2007/pdf/GL2007_009.pdf

MWH, Tweed Shire Council Demand Management Strategy, 2009

MWH, Tweed Shire Council Drought Management Strategy, 2009

SunWater, Tweed River System Water Supply Security Review, 2006

MWH

BUILDING A BETTER WORLD

Technical Note 1: Stormwater Harvesting

Prepared for Tweed Shire Council

October 2010

CONTENTS

Tweed Shire Council

Technical Note 1: Stormwater Harvesting

This document contains information about MWH, particularly about the culture of our organisation and our approach to business, which would be of value to our competitors. We respectfully request, therefore, that it be considered commercially sensitive.

In line with our Quality System, this document has been prepared by Kelly Devrell and reviewed by Shane O'Brien and signed off by Mark Hunting.

BRISBANE Level 3, 35 Boundary Street, PO Box 3602, South Brisbane, QLD 4101

p +61 7 3029 5000, f +61 7 3029 5050

Figures

Tables

In line with our Quality System, this document has been prepared by Kelly Devrell and reviewed by Shane O'Brien and signed off by Mark Hunting.

BRISBANE Level 3, 35 Boundary Street, PO Box 3602, South Brisbane, QLD 4101
p +61 7 3029 5000, f +61 7 3029 5050

1 Introduction

MWH was commissioned by Tweed Shire Council (TSC) in January 2010 to investigate the feasibility of stormwater harvesting within the TSC area.

Stormwater is water from rain or runoff that enters the drainage system. Urban areas have expanses of constructed hard and impervious surfaces like roads, driveways, car parks, roofs and paving. When stormwater runoff flows over these hard surfaces, it readily accumulates pollutants. Stormwater pollutants originate from many different sources ranging from fuel and oil from our roads, excess fertilisers and soaps for cleaning, to litter dropped on our streets and sediment from building sites. These pollutants are a major cause of pollution in our rivers, creeks, lakes and bays. In general, stormwater contains many of the hazards found in sewage, but at lower concentrations for microbial hazards and potentially higher concentrations for some chemical hazards (e.g. hydrocarbons and pesticides).

In urban areas, the increase in the number and size of impervious areas has reduced the amount of rain that infiltrates the ground or is retained by vegetation. Consequently, increased quantities of stormwater runoff enter the drainage system and the receiving waterways. Urbanisation has also changed the timing for stormwater discharged into water environments. Traditionally, stormwater drainage systems have been constructed to remove stormwater from urban areas as quickly as possible in order to minimise the risk of flooding and to prevent water from becoming stagnant. The increased volume entering waterways causes scouring (in stream erosion) of waterways. In less modified catchments the runoff water is released over a longer period of time, which maintains healthier water environments. A stormwater harvesting scheme that reduces the amount of stormwater runoff discharging to waterways has the benefits of reducing erosion and pollution downstream thereby increasing the water quality of the receiving waters. Stormwater can also be harvested direct from creeks and ponds although this will have a reduced effect on any water quality improvement to these receiving waters.

Stormwater is an alternative to using mains drinking water for many purposes. However, there are human health and environmental risks that need to be managed as stormwater run-off from urban areas is often contaminated with litter, pathogens, oil and other chemicals. If simple management protocols and good catchment management practices are followed, then stormwater can be used safely for low-risk purposes such as open space irrigation. For higher-risk uses, where people are more likely to be in close contact with the water, more complex management controls are necessary. This document will also examine the current position of stormwater harvesting in Australia and compare stormwater harvesting to other source substitution options like recycled water.

An important distinction between stormwater and wastewater is that the quality of wastewater does not vary as much as the quality of stormwater. The quality of wastewater received at a wastewater treatment plant will not vary significantly day to day as industrial wastewater will be used for approximately the same processes and purposes and the uses of domestic wastewater also will not vary widely on a daily basis. Stormwater however, can vary significantly in quality dependent on the catchment and rainfall.

Stormwater harvesting may be adopted:

- To reduce the adverse impacts (social, economic and environmental) of the pollutant and hydraulic loads associated with wet weather events;
- As a form of source substitution in order to improve water supply security, reduce cost and energy use.

The level of treatment required for a stormwater harvesting and reuse scheme and the feasibility of the scheme for source substitution, will depend on the following factors:

- Catchment;
- Scale;
- Topography;
- Climate; and
- End Use – Desired standards of service in terms of reliability and water quality.

Components of a stormwater harvesting and reuse system are:

- Collection;
- Pre-Treatment;
- Raw Water Storage;
- Treatment – provide fit for purpose;
- Post Treatment Storage;
- Storage above or below ground in tanks, storage basins or aquifers;
- Water Treatment for End Use; and
- Distribution.

The main component in terms of cost is the storage; storage size required is dependant on rainfall pattern, reuse demand, and required level of reliability. Due to the highly seasonal rain in the Tweed region, storages need to be large enough to capture the stormwater during the wet summer months and store it to be available throughout the year. Unlike recycled water, which is a relatively constant source of supply, stormwater is climate dependent and supply is not guaranteed during periods of drought or below average rainfall.

2 Current Position

2.1 Case Studies

Details of five case studies from the local area, Australia and internationally are contained in this section. One case study is a proposed development in Bilambil Heights, which is currently in the planning stage.

The end uses identified in the case studies range from toilet flushing to irrigation to direct to potable water supply. The drivers of these projects can be legislation, water supply security or receiving water quality, which shows that stormwater harvesting, is not a “one size fits all” solution and depends on existing catchment and infrastructure and required outcomes.

2.1.1 Banora Point Golf Course, Tweed Shire Council

The local stormwater system delivers runoff directly and via pipes into a canal storage running along the east, south and west boundaries of the golf course. Overflow from the canal during wet weather overtops weirs at the northern ends of each north-south canal section and re-enters the downstream stormwater system to the north.

This stormwater harvesting scheme has been in operation since 1987 and is an opportunistic stormwater management coordinated between the developer and Council which became part of the strategic stormwater management for the suburb. The 45 ML storage, which includes canal and onsite dam is used for the irrigation of the golf course. The onsite treatment is minimal incorporating sedimentation and treatment for mosquitoes and the scheme is influenced by tides and requires salinity monitoring during extended dry periods at which point extraction must be stopped and only the greens are watered, usually from the reticulated water supply. The operating cost of the scheme is unknown. (pers communication Tim Mackney, TSC 15/1/2010)

2.1.2 RISE Subdivision, Tweed Shire Council

The proposed “RISE” subdivision is currently in the planning stage and comprises a residential, retirement living, retail, commercial, school and open space precinct urban development located at Bilambil Heights catering for a population of approximately 3,000.

The proponent intends to provide two different water supplies to the development; potable water from Council’s reticulated water supply, and non-potable from recycling storm water collected from roofs and from road ways and open space areas. (TSC, 2009)

The non-potable system will supply water for toilet flushing, outdoor uses and irrigation of public open space via a 3 ML Reservoir – the size and extent of any stormwater collection/retention ponds is unknown. The exact treatment is also unknown but will need to be to a level compatible with the proposed end uses of the water.

If the recycled stormwater system does not proceed, BASIX requirements will apply; i.e. 5 kL rainwater tank at each individual and equivalent tanks for multi-dwelling buildings plumbed to supply water for toilet flushing, laundry cold water tap and external uses.

The concept of stormwater recycling and IWCM is generally supported for the development, however the applicant needs to consider whether the nominated system is the most economical and practical for the development. Ultimately this is a commercial decision for the developer, and not Council. (TSC, 2009)

2.1.3 Blackmans Swamp Stormwater Harvesting Project – Orange City Council, New South Wales

The Blackmans Swamp Creek Stormwater Harvesting project represents the first large scale, direct-to-potable stormwater harvesting project in NSW, if not Australia. This project is capable of providing between 1,300-2,100 ML of additional water into the Orange's raw water supply each year from the city's stormwater system, meeting up to 40 per cent of the city's total water needs.

The basic concept of the Blackmans Swamp Creek Stormwater Harvesting Project involves capturing a portion of the high flows in Blackman's Swamp Creek during storm events, and transferring these into the nearby Suma Park Dam to augment the city's bulk water supply. (OCC, 2009)

Blackmans Swamp Creek is the major drainage catchment in the city of Orange. The creek enters the urban area where it is channelised and piped, it also picks up excess treated effluent from the sewerage treatment plant.

The driver for this stormwater harvesting scheme was water supply security with Orange experiencing water storages below 30% and well below average runoff during the recent drought. The first release of harvested stormwater flowed into Suma Park Dam on 21 April 2009 and the scheme includes a weir on Blackmans Swamp Creek, which creates a 3 ML on stream storage and the site for the first pump station, a 200 ML dam and two 17 ML batching ponds.

Treatment before entering the raw water supply includes Gross Pollutant Traps (GPTs) and flocculation to remove suspended solids, next the raw water undergoes a very high level of treatment to ensure it meets all requirements for potable water supply.

This project was successful due to the close proximity of Blackman's Swamp Creek to Suma Park Dam, the availability of key existing infrastructure and the regularity of flows in Blackman's Swamp Creek. The capital cost of the project was $5 million but the operational costs are unknown.

2.1.4 Parafield Stormwater Harvesting Facility, City of Salisbury, South Australia

The Parafield Stormwater Harvesting Facility supplies 1,100 ML per year of treated stormwater to G.H. Michell & Sons, Australia's largest wool processing company through an Aquifer Storage and Recovery (ASR) system. The stormwater is harvested from Parafield Airport, one of Australia's busiest general aviation airports.

The driver for this stormwater harvesting scheme was the quality of the receiving waters and the cost of potable supply to large industrial consumer. The scheme began operation in 2000 and supplies water for wool washing and processing. The cost of the scheme was $3.7 million and includes a 50 ML capacity capture basin, pumped to a similar capacity holding basin, from where the stormwater gravitates to a two hectare bird proofed cleansing reed bed before being injected into two ASR bores (depth 180 metres, T2 Aquifer).

2.1.5 Berlin–Lankwitz stormwater plant, Germany

Although Germany is not considered a water-poor country, rainwater utilisation in households became widespread since the 1980s. Decentralised stormwater retention and infiltration in urban areas has been used in Germany since the beginning of the 1980s as a sustainable and cost-effective alternative to combined and separate sewers. In Germany, all new developments are required by law to retain/infiltrate rainwater on site. Rainwater infiltration in the investigated area has been excluded from the beginning due to unfavourable soil permeability and intensive use of the scarce open space. About 11,770 m^2 of sealed surface area are connected to the rainwater reservoir situated in the cellar of a new building. 63% of the collected surfaces originate from the roof, 35% from courtyards and sidewalks and 12% from traffic surfaces. (Nolde, 2006)

The driver for this stormwater harvesting scheme besides the legislative requirements were protection of receiving waters and security of supply. The stormwater harvesting plant supplies 80 apartments and 6 small trade units (200 persons) with high-quality water for toilet flushing and garden watering and has been in operation since 2000.

The scheme includes 190 m^3 initial collection stormwater reservoir and 6m^3 storage reservoir with a daily treatment capacity of 10m^3 through first flush diversion, sedimentation grit chamber, biological treatment and UV disinfection.

2.2 Discussion

The case studies highlighted above show that there are many applications of stormwater harvesting schemes to meet drivers such as legislation or the protection of downstream water quality. The treatment varies according to the end use of the harvested stormwater with minimal treatment required for irrigation of a golf course compared to Orange where stormwater is being used to augment the citys water supply and requires extensive treatment.

The capital cost of both the Orange and Salisbury schemes are less than $0.50 per kL of harvested stormwater however, it is important to realise that both of these schemes utilised existing infrastructure / natural aquifers located nearby thereby avoiding large capital costs. Suma Park Dam is only 4km from the centre of Orange, which is much closer than Clarrie Hall Dam to the centre of the major Tweed population centres of Murwillumbah and Tweed Heads. Although aquifers do exist in the Tweed area, it was identified that

> *"at this time there are no known aquifers in the Tweed area that would provide an opportunity for either enhanced recharge of an existing supply or an aquifer storage and recovery system" (Bligh Tanner, 2004)*

Available land and topography is also an issue when examining cost effectiveness of stormwater harvesting schemes, in the case of Orange where available land was needed to construct a very large 200 ML dam, if suitable land is not already owned by Council costs will increase further.

The proposed RISE subdivision is an important case study for Council in that it is a developer initiated scheme, the cost benefit analysis of how the stomwater harvesting scheme compares to the BASIX requirements is not known but ultimately is a commercial decision for the developer whether any incurred losses can be recouped later on.

Again, these case studies show that stormwater harvesting is not a "one size fits all" solution and any proposal will need to be examined in detail to determine if it is suitable for application in the Tweed area.

3 Regulatory Requirements

A stormwater water harvesting and reuse scheme will be required to comply with a number of relevant legislative and non-legislative regulatory requirements. Regulatory requirements will depend on a number of factors including:

- Planned end use for the captured stormwater; and
- Potential impacts scheme may have on the environment.

3.1 Guidelines

Although not legally enforceable, at both the State and Federal level, guidelines have been developed specifically for stormwater harvesting and reuse. These guidelines, along with other guidelines that may be relevant to a stormwater harvesting and reuse scheme are listed in Table 3-1.

Table 3-1: Guidelines Relevant to Stormwater Harvesting and Reuse

Planned End Use	Guidelines
All	*Managing Urban Stormwater: Harvesting and Reuse*, DEC
All	*Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Stormwater Harvesting and Reuse (*NRMMC,EPHC & NHMRC, 2009b)
Drinking Water	*Australian Drinking Water Guidelines* (NHMRC & NRMMC, 2004)
Drinking Water	*Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Augmentation of Drinking Water Supplies* (NRMMC,EPHC & NHMRC, 2008)
Managed Aquifer Recharge	*Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Managed Aquifer Recharge* (NRMMC,EPHC & NHMRC, 2009a)
Swimming Pools	*Guidelines for Managing Risks in Recreational Water* (NHMRC, 2008)
Pools/Water Features.	*Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, ARMCANZ, 2000)

3.2 Legislation

There is no specific legislation that regulates stormwater harvesting and reuse in New South Wales, however the following legislation may impact on the requirements and/or feasibility of a stormwater harvesting and reuse scheme:

- *Protection of the Environment Operations Act 1997.*
- *Water Management Act 2000*
- *Fisheries Management Act 1994*
- *Rivers and Foreshores Improvement Act 1948*
- *Threatened Species Conservation Act 1995*
- *Native Vegetation Act 2003*
- *National Parks and Wildlife Act 1974*
- *Dam Safety Act 1978*

4 Water Quality/Scheme Requirements

The relevant guidelines (DSC 2006; NRMMC,EPHC & NHMRC, 2009b) both advocate a risk mitigation approach to the design of stormwater harvesting and reuse schemes, rather than setting prescriptive water quality targets.

The risk based approach involves the following process:

1. Hazard Identification
2. Dose (concentration) – Response (effect) assessment
3. Exposure assessment
4. Risk Characterisation

Based on the risk characterisation, which should take into consideration the entire system associated with the collection, storage, treatment and reuse of the stormwater water, suitable treatment and non-treatment (e.g. the use of a fence to restrict public access while irrigating) mitigation measures are then selected to mitigate the risk to a tolerable level.

Any proposed stormwater harvesting and reuse scheme will be required to adequately mitigate all risks to both humans and the environment.

The risk mitigation is not only incorporated into the design phase of the project but instead the entire life of the project. During the operation phase activities such as regular maintenance, performance monitoring and validation need to be undertaken in order to ensure the desired level of risk mitigation is continually achieved.

4.1 Hazards

Key hazards that may be associated with the implementation of a stormwater harvesting and reuse scheme are listed in Table 4-1.

Table 4-1: Common Potential Hazards Associated with Stormwater Harvesting and Reuse

Area	Hazard
Public Health	Microorganisms (pathogens) in water: • Bacteria, viruses and parasites Chemical toxicants in water: • e.g. metals, nutrients, pesticides, hydrocarbons
Public Safety	Water storage (above ground)
Environmental	Hydraulic Loading Rate Chemical toxicants in water: • e.g. metals, nutrients, pesticides, hydrocarbons

(Adapted from: DCE 2006, NRMMC,EPHC & NHMRC, 2009b)

In general, stormwater contains many of the hazards found in sewage, but at lower concentrations for microbial hazards and potentially higher concentrations for some chemical hazards (e.g. hydrocarbons and pesticides).

For a stormwater harvesting and reuse scheme, unlike a water recycling scheme, the scheme's catchment has a significant impact on the raw stormwater quality, and consequently exposure rate to hazards. The raw water quality will be impacted by factors such as catchment land uses and the proportion of the catchment that is impervious.

In addition, stormwater quality in a particular catchment may vary significantly influenced by rainfall patterns and other events occurring in the catchment (e.g. bushfires or increased erosion and sedimentation due to development).

4.2 Risk Mitigation

The risk associated with exposure to a particular hazard is determined by taking into consideration the consequence of the exposure and the likelihood of the consequence occurring.

In order to reduce a particular risk to a tolerable level, a stormwater harvesting and reuse scheme may incorporate a combination of treatment and non-treatment risk mitigation measures, examples of these are presented in Table 4-2.

Table 4-2: Non-Treatment Based Risk Mitigation Measures

Primary Objective	Types of Processes
Preventing entry of hazard Concentration of hazards in stormwater can be managed by catchment management programs	Protection of stormwater from human and animal waste can prevent the entry of human infectious viruses and greatly reduce the presence of human infectious protozoa. This type of early prevention can greatly reduce the need for downstream treatment (e.g. detention in lagoon or wetland)
Reducing exposure through preventative measures at site Reduce risk by reducing exposure to stormwater.	Restricting uses of stormwater Controlling methods of application Setting withholding periods between application of recycled water and use of irrigated areas or harvesting of produce. Controlling public access during applications or use of recycled water Using signage, labelling and communication to minimise accidental exposure Cross connection controls Using signage, labelling and communication to minimise accidental exposure
Pre-Treatment Remove gross and readily separated contaminants from the harvested stormwater. E.g.: • Litter (man made and natural); • Coarse sediments (gravel, sand and soil); • Other readily separated suspended solids; • Organic, heavy metal and chemical contaminants associated with the sediments; • Hydrocarbons. To help manage contaminant spills within the catchment before they enter the storage and treatment systems where they can create water quality and operational issues.	In-catchment stormwater quality improvement systems including detention storage, swales and bioretention filters. Screening to remove litter and other large debris and objects. Sediment traps to catch the coarse sediment load. Oil and sediment separators to remove finer suspended solids and hydrocarbons. Naturally occurring or constructed natural systems e.g. open water bodies incorporating sedimentation zones and wetlands.

Primary Objective	Types of Processes
Post-Treatment The harvested stormwater is likely to require further treatment so that it is suitable for intended end use. The treatment processes selected will depend on the nature of the intended end use and any water quality requirements.	Flotation if there is a need to remove difficult to filter particles such as algae. Dissolved air flotation is achieved by the use of microscopic air bubbles that become attached to the solid particles in the water. The bubbles then float to the surface of the liquid with the solid particles attached and can be skimmed off. Filtration to reduce suspended solids and turbidity levels and make the water suitable for disinfection (with or without the addition of chemical coagulants and flocculants to enhance efficiency) Activated carbon absorption or advanced oxidation to remove organic chemicals if they are expected in the raw water and if the proposed end use is sensitive to them. Reverse osmosis if dissolved salts are of concern. Disinfection to destroy or inactivate human pathogens and to provide residual protection in the water distribution system.

(Adapted from: NRMMC,EPHC & AHMC, 2006 and Water by Design, 2009)

Treatment based risk mitigation measures will be required to address operational risk as well as environmental and human health risks.

Water quality criteria may also be used to complement the risk mitigation process to enable verification that treatment processes are performing as planned and risk mitigation targets are being met consistently. The level of risk mitigation required for a particular scheme will depend on the catchment's characteristics, raw stormwater quality and the planned end uses for the stormwater.

Some indicative combinations of risk mitigation measures that may be suitable for particular end uses are provided in Table 4-3, although the suitability of these combinations will depend on the scheme's raw water quality. Mitigation measures required to address human health risk were the priority when developing the combinations provided in Table 4-3 so further risk mitigation may be required to address environmental and operational risks.

Storages are included in the indicative treatment process for drinking water augmentation because although storages will form a part of stormwater harvesting schemes which supply other end uses, they are not a treatment component. The greatest advantage provided by detention in storages is time to allow operational monitoring of recycled water treatment processes to be completed and recycled water quality to be assessed before supply of water to downstream drinking water treatment plants and distribution systems. This allows corrective action to be taken or supply to be stopped before unsafe water is provided to consumers.

Table 4-3: Indicative Combinations of Risk Mitigation Measures for Selected End Uses

Use	Indicative Treatment Process	On-site Preventative Measures	Health Based Water Quality Criteria
MUNICIPAL USE / NON FOOD CROPS			
Municipal use with unrestricted access – open spaces, sports grounds, golf courses and non-potable construction uses (e.g. dust suppression) OR Irrigation of non-food crops	Filtration Disinfection	No specific measures	Turbidity: <25 NTU[1] (median) <100 NTU (95th %ile) *E.coli*[2] <10/100mL
Municipal use with restricted access and application	No Treatment	Restricted public access during irrigation Minimum 25 to 30 m buffer to nearest point of public access and spray control	Not applicable
Municipal use with drip irrigation	No Treatment	Drip irrigation of plants	Not applicable
THIRD PIPE / FOOD CROPS			
Dual reticulation with indoor and outdoor use OR Irrigation of commercial food crops	Screening Filtration (if required) Disinfection	Strengthened cross-connection controls required including ongoing education of householders and plumbers (for dual reticulation)	Turbidity: <2 NTU (target) <10 NTU (95th %ile) <25 NTU (maximum) *E.coli* <1/100mL
DIRECT TO POTABLE REUSE			
Drinking Water Augmentation	Diversion Oil & Sediment separator Raw Water Storage Pre-Filtration Ultra filtration Activation Carbon filter UV Treated Water Storage	Catchment management programs applied to prevent animal and human waste entering the stormwater.	Various

(Adapted from: NRMMC,EPHC & NHMRC, 2009b)

---

1 NTU (Nephelometric turbidity units) – measure of how much sediment is suspended in the water
2 E. coli is used as an indicator of faecal pollution

5 Current Funding Arrangements

As part of the Rudd Government's $1 billion National Urban Water and Desalination Plan to help secure the water supplies of Australian cities $200 million will be provided to undertake innovative stormwater capture projects to help secure water supplies for Australian cities.

Support will be available for urban stormwater harvesting and reuse projects in both large cities and smaller towns that contribute to:

- Improving the security of water supplies in Australia, without adding to greenhouse gas emissions;
- Reducing the demand on potable water supplies; and
- Helping to reduce the impact of urban run-off on water quality in receiving waters.

Project funding is available for up to 50 per cent of eligible capital costs. The minimum project size is $4 million (eligible for funding of $2 million). While there is no maximum project size, funding is capped at $20 million (GST exclusive) per project.

Projects will need to source 100 per cent of their energy needs from renewable sources or fully offset the carbon impact of the project's operations.

The successful projects in the first round of funding are shown in Table 5-1 which has been adapted from the "$86 Million for stormwater harvesting and reuse" Media release from Senator the Hon. Penny Wong, 2 November 2009. The second round of funding closes on 10 February 2010.

As mentioned the funding shown in Table 5-1 can be up to 50% of the total project cost, very little information is available about the cost benefit analysis of these projects so it is unclear whether they are cost effective without government funding.

Table 5-1: Funded Projects – National Urban Water and Desalination Plan (first round)

State	Council / Authority	Project Name	End Uses	Funding Received ($000,000)	Potable Demand offset (ML/yr)	Yield (ML/ yr)
Victoria	Ballarat City Council	Harnessing Ballarat's Stormwater	Irrigation	$2.377	189	189
	Yarra Valley Water	Kalkallo Stormwater Harvesting and Reuse	Potable water supply	$9.665	365	365
	Melbourne Water	Clayton South Retarding Basin & Namatjira Park Stormwater Reuse	Irrigation	$2.4275	92	92
	City of Greater Geelong	Stormwater Harvesting - Geelong's Plan	Irrigation	$2.7945	222	222
Queensland	South Bank Corporation	South Bank Stormwater Harvesting and Reuse Centre	Irrigation	$3.3	77	77
South Australia	City of Unley	Stormwater Harvesting and Reuse	Irrigation and environmental flows	$2.558	98	114
	City of Salisbury	Unity Park Biofiltration and Reuse	Unknown	$6.99	400	8,000
	City of Onkaparinga	Water Proofing the South Stage 2	Irrigation	$14.97	1,300	
	City of Playford	Playford Stormwater and Reuse	Irrigation	$9.6	640	
	SA Water	Adelaide Airport Stormwater Scheme	Unknown	$4.864	400	
	Adelaide Botanic Gardens and SA Dept. Environment & Heritage	Botanic Gardens First Creek Wetland ASR	Irrigation	$2.935	100	
	City of Charles Sturt	Water Proofing the West Stage 1	Irrigation and Industrial	$20	555	
	SA Water	Barker Inlet Stormwater Reuse Scheme	Industrial, Commercial and Irrigation	$3.925	170	

6 Considerations

An evaluation of stormwater harvesting is shown in Table 6-1 with some identified advantages and disadvantages of this method of source substitution.

Table 6-1: Stormwater Harvesting considerations

Advantages	Disadvantages
Significant mitigation of post development stormwater runoff rates, minimising potential downstream impacts of the development	Climate dependent
Reduction in potable water demand	Required storage footprint – the storage has to be large enough to capture the wet summer rainfall and store it to cater for the winter demand. Due to the regions strong seasonal variation in rainfall storage requirements will be larger than those in climates with less seasonal variation e.g. Melbourne, Germany
Dual reticulation system based on recycled stormwater is likely to have a higher community acceptance than a recycled sewage effluent system. (RISE Concept Plan, TSC, 2009)	Susceptible to drought and not a reliable source of supply, water infrastructure will still need to be sized to cater for peak demand with no reduction due to stormwater harvesting.
Reduction of stormwater pollution	Likely to have a higher cost per kilolitre of water than rainwater tanks (DEC, 2006)
Reduced potential for wet weather sewage overflows due to reduced ingress of stormwater into the sewerage network	Conservative design required
	Variable quality of stormwater – concentration of pathogens can vary by many orders of magnitude between catchments and storm
	The pathogen reduction achieved by most wastewater treatment systems are expected to be greater and more consistent when treating wastewater than stormwater. This is due largely to the more variable quality
	Environmental impact of storages, environmental flows in creeks and rivers need to be maintained which needs to be balanced with the goal of stormwater harvesting. Storages can also provide potential mosquito habitats and increase the potential for upstream flooding
	High relative unit costs of treated stormwater compared to recycled water, rainwater and potable water (DEC, 2006)

7 Opportunity Assessment

7.1 Methodology

A desktop review exercise was undertaken using GIS data from TSC including aerial photography, stormwater infrastructure, contour information and water infrastructure including water treatment plants and reservoirs.

Suitable sites were identified based on the following criteria:

- Proximity to large external demand;
- Low lying areas; and
- Proximity to existing stormwater infrastructure.

Using this methodology, it was identified that sports fields and other recreation areas are the most suitable typical urban developments for the retrofit of a stormwater harvesting system.

Stormwater harvesting can also be used to supply non-potable water for toilet flushing and garden irrigation direct to properties via a third-pipe system, this is suitable for new Greenfield developments as retrofitting is generally uneconomic except to large users. (KBR, 2004)

The viability of third pipe systems supplied with stormwater have been examined in this document by comparing the requirements and costs of stormwater harvesting for public irrigation with the requirements and costs of third pipe recycled water systems.

Direct to potable use similar to the Blackmans Swamp Creek (Orange) stormwater harvesting case study has not been examined due to this project being the first of its kind in Australia and very limited data being available. The indicative risk mitigation measures for a direct to potable scheme are shown in Table 4-3 and would have a significant impact on the capital and operating costs of the scheme.

7.2 Stormwater Harvesting for Municipal Use

7.2.1 Cost Assessment

A review of 11 case studies was done in New South Wales by the NSW Department of Environment and Conservation (2006) of stormwater harvesting schemes predominately for irrigating public spaces.

The study also identified the capital and operating costs for each project, which are shown per kL of stormwater produced in Figure 7-1 and Figure 7-2 respectively. It can be seen that there are economies of scale with larger projects costing less per kL than projects with smaller reuse volumes. These figures do not account for the additional water quality benefits from the projects.

These case studies were all taken from projects in Sydney, which the Bureau of Meteorology classifies as being in a uniform rainfall zone; storages in Tweed would need to be larger to cater for the same reuse volume due to the highly seasonal Tweed rainfall pattern. As a result, it is expected that capital costs for stormwater harvesting projects in Tweed would be higher on average per ML than those shown in Figure 7-1.

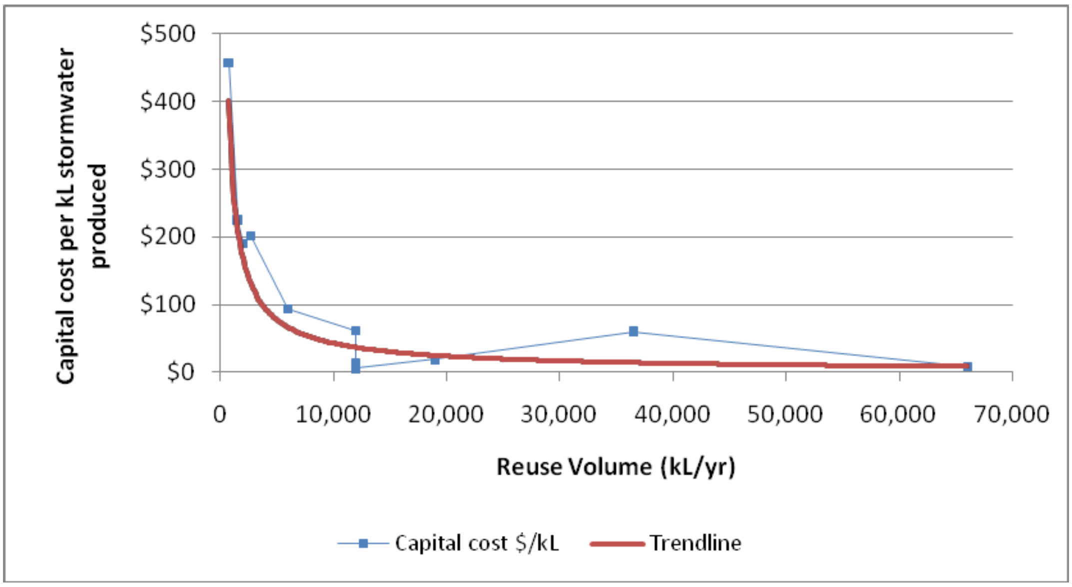


Figure 7-1: Capital cost per kL for stormwater harvesting case studies based predominantly on public space irrigation (DEC, 2006)

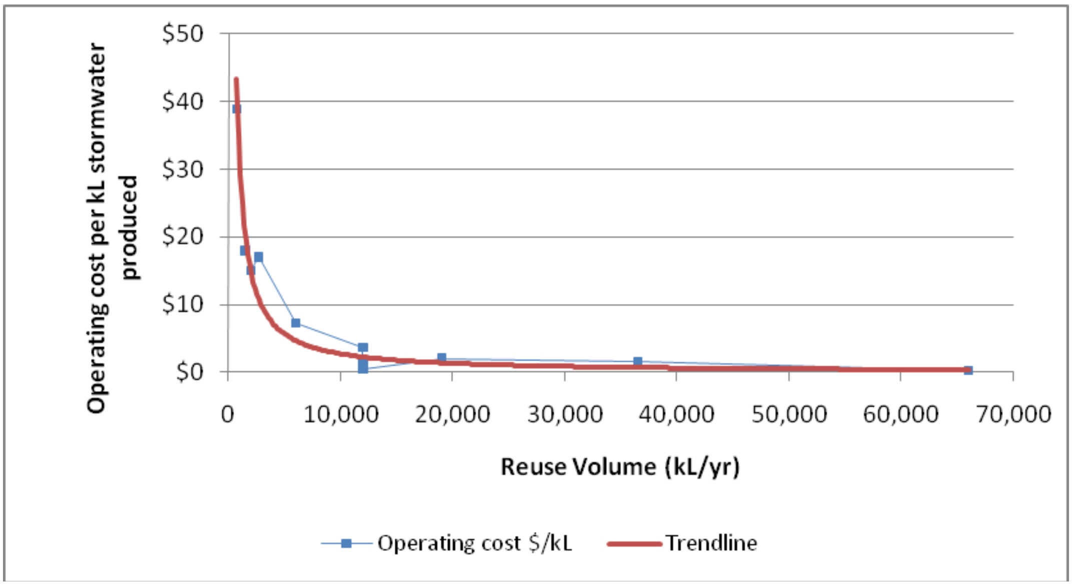


Figure 7-2: Operating cost per kL for stormwater harvesting case studies based predominantly on public space irrigation (DEC, 2006)

In terms of reuse volume, the case studies shown in Figure 7-1 and Figure 7-2 are of a much smaller scale than the Blackmans Swamp Creek (Orange) and the Parafield (Salisbury) case studies, which shows why these two large projects appear to be relatively inexpensive and highlights the economies of scale that can be achieved through large projects.

7.2.2 Identified Sites

The sites shown in Table 7-1 were identified as being suitable for stormwater harvesting based on the criteria in Section 7.1. The indicative capital and operating costs were calculated using the formula of the trendlines shown in Figure 7-1 and Figure 7-2.

The area to be irrigated for each site was assumed to be 2/3 of the total area for parks and fields and 1/4 of the area for golf courses as irrigation is typically focussed at the fairways and greens.

The annualised costs shown in Table 7-1 vary from $1 to $22 per kL with an average value of $5.60 which is higher than mains water price.

Table 7-1: Identified Sites potentially suitable for Stormwater Harvesting (public space irrigation)

Site	Total Area (ha)	Assumed Irrigation Area (ha)	Assumed Demand[1] (kL/yr)	Indicative Capital Cost	Indicative Annual Operating Cost	Annualised cost ($/kL)
Bridge Club Park	3.8	2.5	9,500	$424,200	$27,500	6.9
Banora Green Soccer	6.7	4.5	16,800	$461,600	$26,700	4.0
South Tweed Heads Football Club	8.2	5.5	20,600	$475,700	$26,500	3.4
Arkinstall Park	11.9	7.9	29,800	$502,900	$26,000	2.4
Coolangatta and Tweed Heads Golf Course	84.4	21.1	79,400	$581,800	$24,700	1.0
Murwillumbah Golf Club	44.0	11.0	41,400	$528,000	$25,500	1.8
Jim Devine Soccer Field	1.7	1.1	4,300	$376,300	$28,600	14.7
Knox Park	7.5	5.0	18,800	$469,400	$26,600	3.6
Les Cave Fields	18.4	12.3	46,100	$536,600	$25,400	1.6
Willward Park	3.5	2.3	8,800	$419,000	$27,600	7.4
SDA Primary and High School	12.9	8.6	32,400	$508,900	$25,900	2.2
Murwillumbah Showground	13.0	8.7	32,600	$509,500	$25,900	2.2
Queens Park	1.1	0.7	2,800	$352,700	$29,200	22.1

1 The potential irrigation demand of sports fields/open spaces was determined using MWH's Irrigation Tool for Active Playing Surfaces. Using climate data for Bray Park for the period 1970 – 2007, the irrigation demand was determined to be 3,762 kL/ha/yr.

7.2.3 Storage sizing

Sizing of stormwater storages is dependent on a number of factors:

- Yield and reliability required;
- Contributing catchment area (i.e. how much land drains to the storage);
- Contributing catchment landuse (i.e. how much runoff will the catchment produce, less runoff will occur from permeable surfaces compared to impermeable roads, roofs and paved surfaces);
- Climate (average rainfall and seasonality); and
- Treatment adopted (e.g. an underground aquifer storage will occupy less area than using a wetland for treatment).

All of these factors are site specific and will need to be examined on a case by case basis.

To give an indication of the storage sizes required, details of two of the 11 case studies by the NSW Department of Environment and Conservation (2006) are shown below.

Bexley Municipal Golf Course, Bexley

The contributing catchment area comprises 77 ha of urban landuse and 5 ha of golf course. Stormwater from this catchment flows through the 20 ha golf course in a concrete-lined channel.

No information is known about the reliability of the supply and how much of the total golf course demand is met by the system however the annual stormwater reuse volume is 66 ML and potable water is available as a back-up supply.

The capacity of the stormwater channel is 7 ML, assuming a 2 m deep channel gives a required surface area of 3, 500 m^2 or five 700 m^2 average size house blocks.

Riverside Park, Chipping Norton

The contributing catchment area comprises 47 ha comprising urban landuse and parkland.

This system irrigates an area of 2 ha (baseball fields) and potable water provides a back-up supply for the irrigation system. The estimated annual stormwater reuse volume is 12 ML.

The harvesting system consists of a 2.4 ML storage and sedimentation pond and three treatment wetlands. It is unknown how large the wetlands are but from satellite imagery they appear to be approximately the same size as the two baseball fields that they are used to irrigate (2 ha). This project also has water quality benefits with the treated stormwater not used for irrigation flowing to the Georges River.

These case studies were taken from projects in Sydney, which the Bureau of Meteorology classifies as being in a uniform rainfall zone; storages in Tweed would need to be larger to cater for the same reuse volume due to the highly seasonal Tweed rainfall pattern.

7.3 Comparison of Source Substitution Options

The costs and demands shown in Table 7-2 have been taken from the Demand Management Strategy (MWH, 2009). The average capital and operating cost per kL for the proposed dual reticulation (third pipe) recycled water schemes are $32 and $0.30[3] respectively. These schemes treat water to A+ quality.

Table 7-2: Recycled Water costs

Development	Annual Demand in 2036 (kL/yr)	Total Capital Cost	Capital Cost per kL	Opex Cost/annum at 2036	Opex Cost per kL	Annualised cost ($/kL)
Cobaki Lakes	430,000	$13,490,000	$32	$117,000	$0.30	$7.1
Bilambil Heights	280,000	$10,408,000	$37	$77,000	$0.30	$7.8
Terranora	165,000	$5,910,000	$36	$45,000	$0.30	$7.3
Kingscliff	90,000	$2,433,000	$27	$29,000	$0.30	$6.4
Kings Forest	440,000	$12,825,000	$29	$146,000	$0.30	$6.9

Annualised costs for dual reticulation A+ quality recycled water is approximately $7/kL as shown in Table 7-2 for schemes ranging from 90 to 440 ML/year. By comparison, stormwater harvesting costs for lower quality municipal use water shown in Table 7-1, show that schemes reusing volumes of 10 ML/year also cost approximately $7 per kL. The largest schemes (up to 80 ML/year) may cost as little as $1/kL for the lower quality municipal use water[4].

However, stormwater for municipal use is more practically implemented for small irrigation schemes. The recycled water schemes shown in Table 7-2 are much larger in scale and using stormwater instead of recycled water to service these developments would not be feasible.

Stormwater harvesting for third pipe systems is less cost effective than stormwater harvesting for municipal reuse due to the more stringent and costly treatment requirements as shown in Table 4-3. Similarly harvesting, treatment and storage for third pipe stormwater schemes is more costly than the equivalent recycled water scheme due to stormwater being climate dependent, having a variable quality and requiring larger storages.

Analysis of various development servicing options for a Greenfield site at Kalkallo in Melbourne showed that recycled water supplied by third pipe requires significantly less storage space than stormwater. To supply garden and toilet with 95% reliability and adopting end-use management measures, a 22 ML recycled water storage is required compared to a 1,100 ML stormwater storage. This equates to 0.9 hectares compared to 44 hectares (assuming a uniform 2.5 metre storage depth) or 0.2% of the storage requirement.

[3] This cost aligns to estimates of recycled water system's operational costs investigated for the South East Queensland Water Strategy, which range from $236 to $274 per ML, approximately $0.30 per kL (Cardno, 2006).

[4] As discussed in Section 7.2, the stormwater harvesting costs were taken from Sydney case studies and the costs may be slightly higher in the Tweed area due to the different rainfall pattern.

MWH

8 Discussion

Stormwater harvesting is under review as cities across Australia look for alternate sources of water to ensure reliable water supplies. As part of the Rudd Government's $1 billion National Urban Water and Desalination Plan to help secure the water supplies of Australian cities $200 million will be provided to undertake innovative stormwater capture projects to help secure water supplies for Australian cities.

Unlike recycled water, which is a relatively constant source of supply, stormwater is climate dependent and supply is not guaranteed during periods of drought or below average rainfall. Because this supply is not guaranteed, the size of potable water infrastructure cannot be downsized as it will still need to be able to cater for peak water demand.

Being climate dependent also has implications on the size of storage required for stormwater harvesting schemes, which need to be large enough to capture the wet summer rainfall and store it to cater for the winter demand. The required size and yield of any proposed stormwater harvesting storages will need to be assessed individually to account for connected catchment area and demand. There is also a 'point of diminishing returns' in storage size, where increasing the size further does not provide a significant increase in yield and will determine the most cost-effective storage for a given demand and catchment, this will mean a reliability less than 100% and will require an additional water source to meet the required demand.

Compared to other source substitution options like recycled water and the rainwater tank requirements of BASIX, stormwater harvesting is generally less cost-effective but this is dependent on the size of the scheme and existing infrastructure as there are economies of scale with larger projects. Costs of stormwater harvesting schemes also need to be examined in terms of integrated water cycle management. For example if downstream pollution and waterway health is an issue, the cost of any necessary stormwater treatment should be considered to determine whether stormwater harvesting is a feasible addition. This would need to be examined on a case by case basis.

In general, stormwater contains many of the hazards found in sewage, but concentrations will vary with lower concentrations for microbial hazards and potentially higher concentrations for some chemical hazards (e.g. hydrocarbons and pesticides). For a stormwater harvesting and reuse scheme, unlike a water recycling scheme, the scheme's catchment has a significant impact on the raw stormwater quality, and consequently exposure rate to hazards. The raw water quality will be impacted by factors such as catchment land uses and the proportion of the catchment that is impervious.

In addition, stormwater quality in a particular catchment may vary significantly influenced by rainfall patterns and other events occurring in the catchment (e.g. bushfires or increased erosion and sedimentation due to development). Due to this variable quality, the pathogen reduction achieved by most wastewater treatment systems is expected to be greater and more consistent when treating wastewater than stormwater.

The relevant guidelines both advocate a risk mitigation approach to the design of stormwater harvesting and reuse schemes, opposed to prescriptive water quality targets.

The level of risk mitigation required for a particular scheme will depend on the catchment's characteristics, raw stormwater quality and the planned end uses for the stormwater.

The risk mitigation is not only incorporated into the design phase of the project but instead the entire life of the project. During the operation phase activities such as regular maintenance, performance monitoring and validation need to be undertaken in order to ensure the desired level of risk mitigation is continually achieved.

Stormwater harvesting, is not a “one size fits all” solution and depends on existing catchment, infrastructure and required outcomes. Whilst it is generally considered a less cost-effective method of source substitution compared to recycled water or the rainwater tank requirements of BASIX there can be economies of scale and any proposed stormwater harvesting scheme will need to be analysed on its own merits. From the review of stormwater harvesting case studies, the most cost effective scheme appears to be municipal schemes which are greater than 10 ML and require limited treatment.

9 Conclusions

- Unlike recycled water, which is a relatively constant source of supply, stormwater is climate dependent and supply is not guaranteed during periods of drought or below average rainfall. Because this supply is not guaranteed, the size of potable water infrastructure cannot be downsized as it will still need to be able to cater for peak water demand.
- The pathogen reduction achieved by most wastewater treatment systems is expected to be greater and more consistent when treating wastewater than stormwater.
- 13 sites were identified as being potentially suitable for stormwater harvesting in the Tweed area, however areas of irrigation and demand for these sites have been assumed and these sites would need to be individually assessed. Using a coarse comparison curve based on DEC (NSW) case studies for public irrigation, the indicative annualised costs of these sites vary from $1 to $22 per kL with an average value of $5.60, which is higher than mains water price.
- The required size and yield of any proposed stormwater harvesting storages will need to be assessed individually to account for connected catchment area and demand. There is also a ‘point of diminishing returns’ in storage size, where increasing the size further does not provide a significant increase in yield and will determine the most cost-effective storage for a given demand and catchment, this will mean a reliability less than 100% and will require an additional water source to meet the required demand.
- Stormwater reuse systems are generally most cost effective where treatment requirements are minimal. Other reuse options such as recycled water are generally more cost effective for ‘higher end uses’ such as third pipe or potable systems. There are economies of scale with larger projects and stormwater harvesting schemes reusing greater than 10 ML/year for municipal use can potentially cost less than $7 on an annualised cost per kL basis.
- Stormwater harvesting for third pipe systems will be less cost effective than stormwater harvesting for municipal reuse due to the more stringent and costly treatment requirements. Similarly harvesting, treatment and storage for third pipe stormwater schemes is more costly than the equivalent recycled water scheme due to stormwater being climate dependent, having a variable quality and requiring larger storages.
- Direct to potable use similar to the Blackmans Swamp Creek (Orange) stormwater harvesting case study has not been examined due to this project being the first of its kind in Australia and very limited data being available. This scheme appears relatively cheap as the project utilised existing infrastructure located nearby thereby avoiding large capital costs. Suma Park Dam is only 4km from the centre of Orange, which is much closer than Clarrie Hall Dam to the centre of the major Tweed population centres of Murwillumbah and Tweed Heads.
- At this time there are no known aquifers in the Tweed area that would provide an opportunity for either enhanced recharge of an existing supply or an aquifer storage and recovery system.

10 References

Tweed Shire Council, “RISE” Concept Plan and State Significant Site Application, retrieved January 15, 2010 from http://www.tweed.nsw.gov.au/councilmeetings/pdfs/5%20%5BPR-CM%5D%20DA09_0466%20-%20RISE%20Concept%20Plan%20Bilambil%20Heights.pdf

Orange City Council, Blackmans Swamp Stormwater Harvesting Project, retrieved January 7, 2010 from http://www.orange.nsw.gov.au/go/building-our-city/blackmans-swamp-stormwater-harvesting-project

Australian Government, Department of Climate Change, Senator the Hon. Penny Wong, Media Release, $86 Million for stormwater harvesting and reuse – 02 November 2009, retrieved January 18, 2010 from http://www.climatechange.gov.au/minister/wong/2009/media-releases/November/mr20091101.aspx

Australian Government, Department of Climate Change, Senator the Hon. Penny Wong, Media Release, $200 Million for stormwater capture – 23 March 2009, retrieved January 7, 2010 from http://www.climatechange.gov.au/minister/wong/2009/media-releases/March/mr20090323.aspx

“Possibilities of rainwater utilisation in densely populated areas including precipitation runoffs from traffic surfaces”, Erwin Nolde, published in *Desalination*, *Volume 215, Issues 1-3*, *5 September 2007*, *Pages 1-11* retrieved January 15, 2010 from ScienceDirect http://dx.doi.org/10.1016/j.desal.2006.10.033

City of Salisbury, Parafield Stormwater Harvesting Facility, retrieved January 1, 2010 from http://cweb.salisbury.sa.gov.au/manifest/servlet/page?pg=16065

Department of Environment and Conservation (DEC) NSW, 2006, *Managing urban stormwater: harvesting and reuse*

Australian Government, Department of Environment, Water, Heritage and the Arts, Stormwater harvesting and reuse projects - second round, http://www.environment.gov.au/water/programs/urban/stormwater-harvesting.html

Australian and New Zealand Environmental and conservation Council & Agriculture and Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ) 2000. *National Water Quality Management Strategy Paper No. 4,*

Fletcher T, Duncan H, Poelsman P and Lloyd, 2004. *Stormwater flow and quality, and the effectiveness of non-proprietary stormwater treatment measures – a review and gap analysis. Technical Report 04/8*, Cooperative Research Centre for Catchment Hydrology.

National Health and Medical Research Council (NHMRC) 2008. *Guidelines for Managing Risks in Recreational Water,* Canberra.

National Health and Medical Research Council & Natural Resources and Management Ministerial Council (NHMRC & NRMMC) 2004. *Australian Drinking Water Guidelines,* Canberra.

Natural Resource Management Ministerial Council, Environmental Protection and Heritage Council & Australian Health Ministers’ Conference (NRMMC,EPHC & AHMC) 2006. *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1)*, Canberra.

Natural Resource Management Ministerial Council, Environmental Protection and Heritage Council & National Health and Medical Research Council (NRMMC,EPHC & NHMRC) 2008. *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Augmentation of Drinking Water Supplies,* Canberra.

Natural Resource Management Ministerial Council, Environmental Protection and Heritage Council & National Health and Medical Research Council (NRMMC,EPHC & NHMRC) 2009a. *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Managed Aquifer Recharge*, Canberra.

Natural Resource Management Ministerial Council, Environmental Protection and Heritage Council & National Health and Medical Research Council (NRMMC,EPHC & NHMRC) 2009b. *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Stormwater Harvesting and Reuse,* Canberra.

Water by Design, 2009. *Draft Stormwater Harvesting Guidelines,* South East Queensland Healthy Waterways Partnership.

Queensland Water Commission, South East Queensland Water Strategy – Draft, March 2008

Cardno for the Council of Mayors, *Recycled Water Supply Options – SEQRWSS: Preliminary Cost Estimation for Three Options*, June 2006, http://www.qwc.qld.gov.au/myfiles/uploads/SEQWS/supporting%20docs/Recycled%20water%20supply%20options_Preliminary%20costs%20(June%202006).pdf

Bligh Tanner, *Banora Point and Tweed Heads West STPs Water Recycling Discussion Paper*, November 2004

KBR for Local Government Association and State Government of South Australia, *Metropolitan Adelaide Stormwater Management Study, Part B – Stormwater Harvesting and Use*, July 2004

Grant et al, *Designing for sustainable water and nutrient outcomes in urban developments in Melbourne*, Abstract for presentation at Urban Drainage Modelling and Water Sensitive Urban Design 2006 http://www.icms.com.au/UDMandWSUD/abstract/57.htm

MWH, *Tweed Shire Council Demand Management Strategy*, December 2009 http://www.tweed.nsw.gov.au/Water/DemandManagementStrategy.aspx

TWEED SHIRE COUNCIL

Water Demand Management Strategy

Review and Recommendations

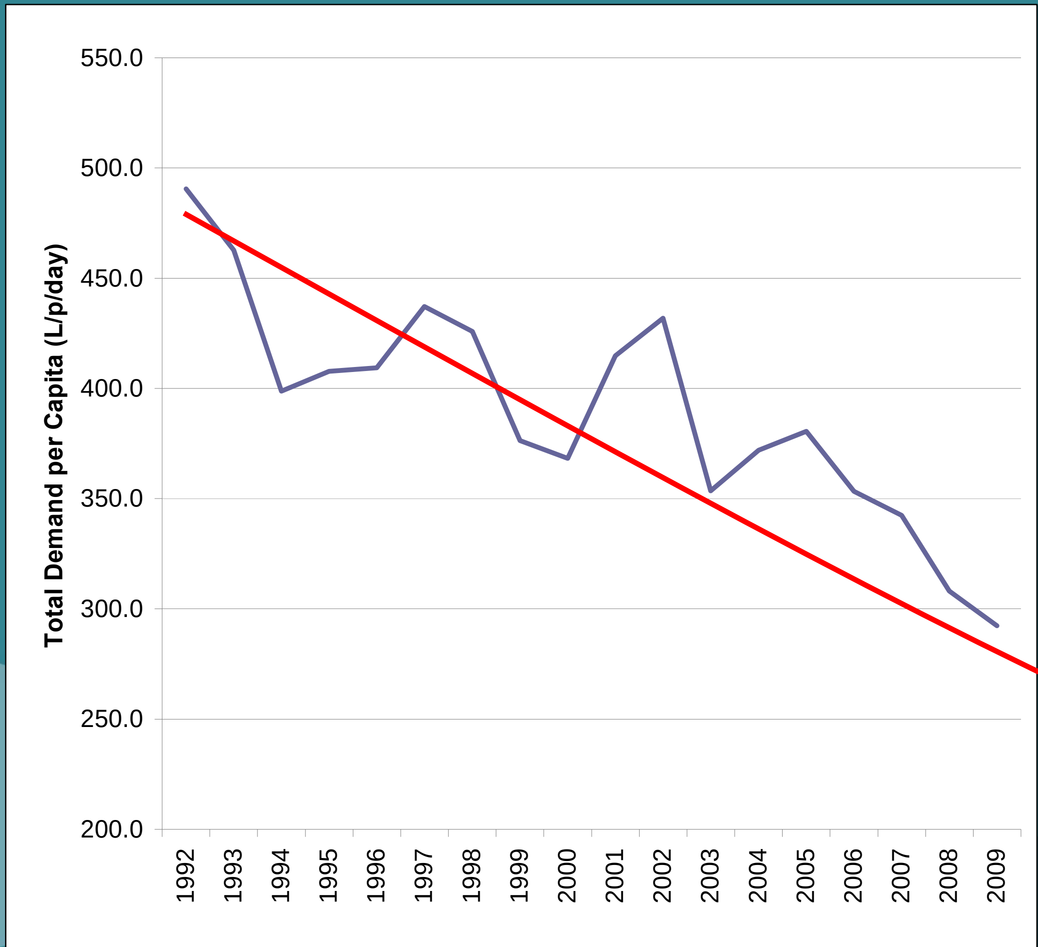
Council Workshop

28th September 2010

Integrated Water Cycle Management (IWCM)

- Adopted by Council in 2006
- Provides overall guidance
- Action 1 → DMS

Historical Demand Management in the Tweed



1. **Water Recycling since 1980's**
2. **Retro-fitting with water-efficient fittings 2005-2008**
3. **School and community education since 1990's**
4. **User-pays pricing**

Future savings will require significantly more effort

→ determine best approach

Demand Management Strategy (DMS)

1. Stage 1 - focus on Residential water (Feb 2008)

   Adopted Feb 2009

2. Stage 2 - focus on Non-residential water (Dec 2009)

3. Summary document – combines stages (Dec 2009)

Placed on public exhibition 28.01.2010 – 30.04.2010

Community feedback sought

Public exhibition:

- Extended exhibition (28.01.2010 – 30.04.2010)
- Ads, Media releases (6 in total)
- Info sessions at TH, M'bah and Pottsville (3 sessions)
- Interested Parties Register (100+ members, 13 circulars)
- Freecall 1800 (62 calls and enquiries)
- Info → email, website, offices

Submissions received:
2008 → 1
2010 → 76

Feedback on the Strategy

Other issues :

1. Land-use Planning controls and strategies
2. Population limits

Feedback on the Strategy

DMS related issues :

1. Approach should be sustainable

2. Mixed & contradictory responses to DM actions

3. Population growth rates

1. Sustainability Assessment

Benefits and impacts to Triple Bottom Line (TBL):

– Environmental issues
– Social issues
1. Economic issues

Options assessed against eight TBL criteria:

- Greenhouse gas emissions
- Pollutants entering waterways
- River extractions

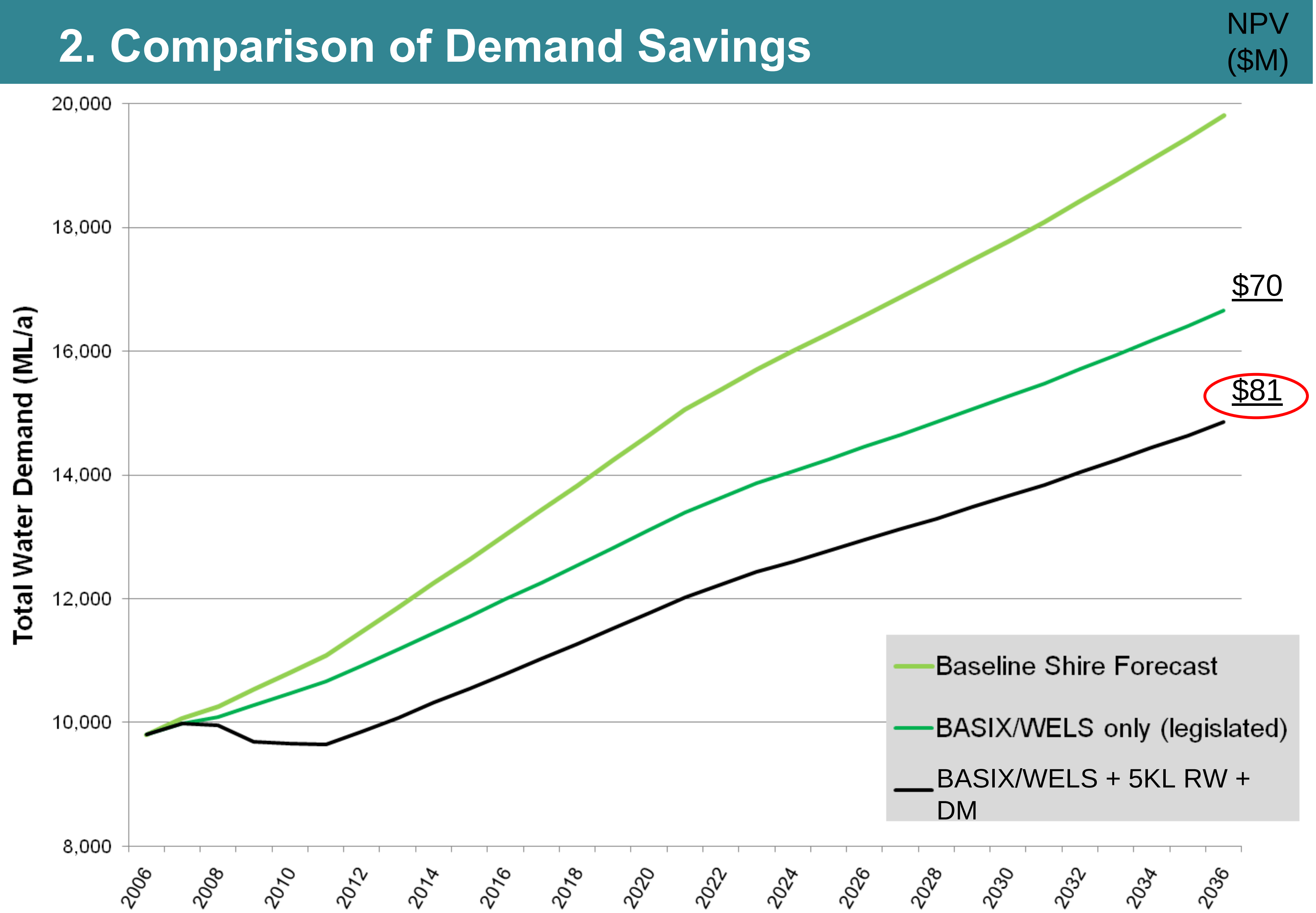
- Community acceptance
- Water security provided
- Level of service

- Life cycle costs
- Impact on access and user charges

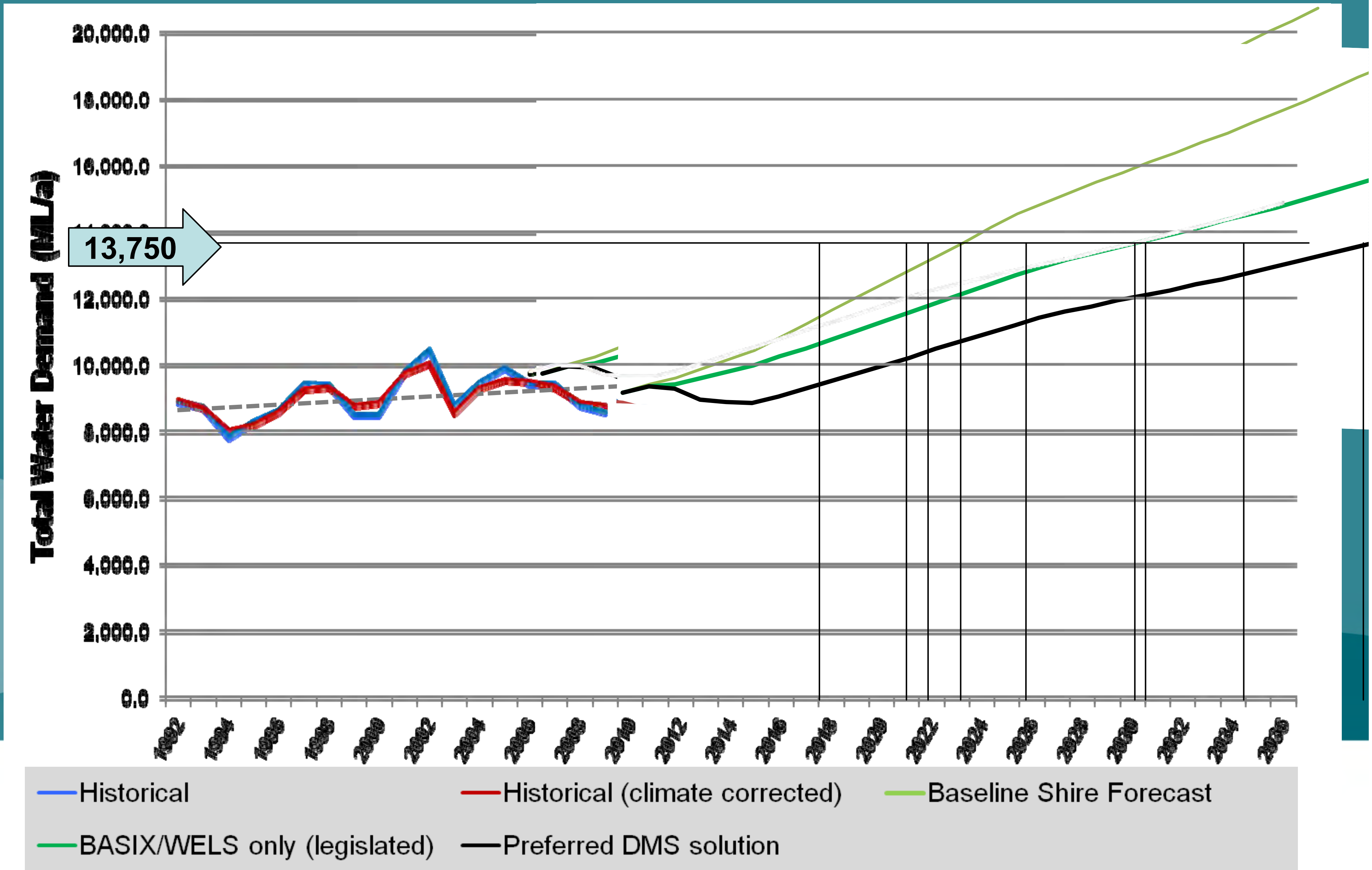
2. What was assessed?

Options	Greenfield areas	Existing areas
BASIX and WELS (legislated)	√	√
RW (rainwater) tanks (1kL-100kL)	√	√
Dual pipe recycling	√	X
RW + Dual pipe recycling	√	X
RW + Indirect potable recycling	√	√
Grey/Blackwater recycling	√	X
Urban stormwater harvesting	√	X
Education and training	√	√
Water tariff review	√	√
Rebates and Retrofits	√	√
Audits (water efficiency)	√	√

2. Comparison of Demand Savings



3. DM assumptions and projections



Feedback on the Strategy

DMS related issues :

1. Approach should be sustainable
   →TBL assessment used
2. Mixed responses to DM actions
   → Long list of options assessed
   → Best option selected based on TBL
3. Population growth rates
   → Strategy flexible enough to accommodate

Recommended Strategy

Actions	Greenfield areas	Existing areas
BASIX and WELS (legislated)	√	√ *
Rainwater tanks (minimum 5kL)	√	√ *
Additional education and training	√	√
Rebates and Retrofits (showers, etc)	√	√
Major user audits (top 20)	√	√
Commercial audits (clubs, tourism, shopping centres)	√	√
Aged-care audits	√	√
Leakage and pressure detection	√	√
Water tariff review	√	√
Opportunistic recycling	√	?

* for developments requiring BASIX assessment

Budget implications

1. Operating budget

Action	10yr budget TSC
Leakage and pressure detection	$4.5M
Residential retrofit	$1.2M
RW tank promo & inspections	$750K
Res & Non-res education	$650K
Non-residential audits	$480K
Landscape efficiency awards	$140K
Other	$80K
Total	**$8M***

* $5M in the first 4 years

2. NPV assessment

Issues

1. **Budget (10yr program) is currently unfunded :**
   - Creates implications for future budgets
   - Staged Implementation required

2. **Successful implementation :**
   - DM must be a condition of Part 3A approvals
   - Negotiate with State Govt to make BASIX more flexible
   - Will have implications on water supply augmentation timing

3. **Progress to date :**
   - BASIX continues
   - Leakage and Pressure program
   - DM Program Leader

Documents provided with Council Business Paper

Document	Contents	Date
Business Paper – DMS	Recommendations to Council	Oct 2010
Demand Management Strategy reports - Summary, Stage 1 and Stage 2	Recommendations to Council Original DMS recommendations Detailed options assessment	Feb 2008 Dec 2009
Community Submissions Report - DMS	Summary of all issues raised in submissions and TSC responses	Aug 2010
Technical Paper – Stormwater Harvesting	Further investigation of the feasibility of urban stormwater harvesting on the Tweed	Mar 2010
Technical Paper – Large Stand Alone Rainwater Tanks	Further investigation of the feasibility of large stand alone rainwater tanks on the Tweed	Feb 2010
Council Workshop Powerpoint Presentation	Overview of DMS review and recommendations	28.09.2010

THANK YOU

Rainwater tank sizing for Tweed

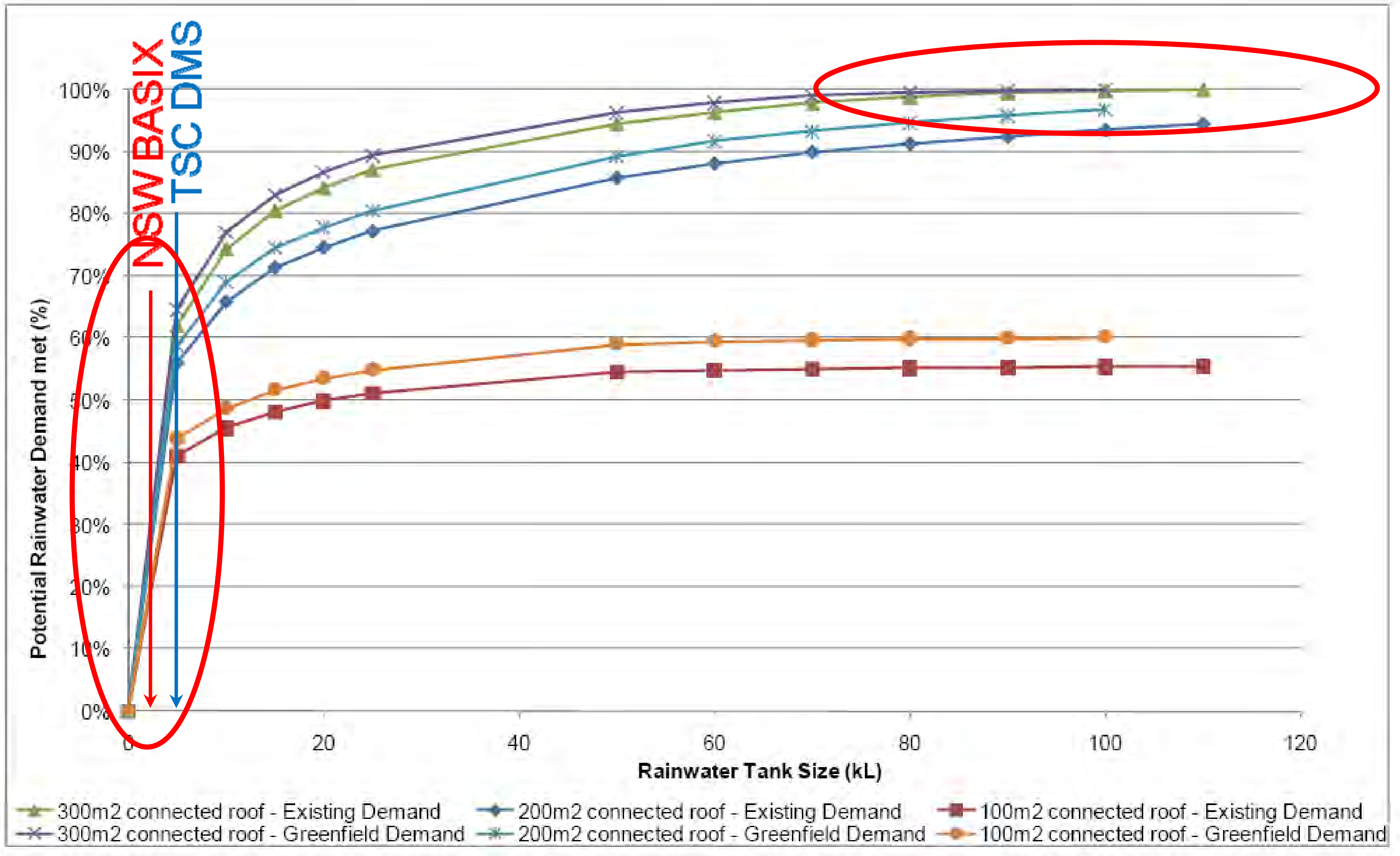


Figure 3-3: Average Annual Yield Analysis for Rainwater Tanks