Water Loss Management Program
FOR REGIONAL NSW WATER UTILITIES

Tweed Shire Council
Leakage Report

July 2009

TWEED SHIRE COUNCIL

Australian Government
Water for the Future

WATER DIRECTORATE

Local Government Association of NSW
Shires Association of NSW

A joint initiative of the Water Directorate and the Local Government and Shires Associations
Funded by the Australian Government's Water for the Future program

Contents

1 Summary

This report details the findings from night testing undertaken in Tweed Heads and Tweed Heads West in April and May 2009.

Drop tests were carried out in the zones fed by Razorback and Walmsleys reservoirs. The reservoir levels were measured using a pressure transducer. Overnight meter readings of large users were taken to identify exceptional night usage.

No significant leakage was identified as occurring in the area served by Walmsleys reservoir.

The estimated losses in Tweed Heads which could be recovered via an active leakage control program are 61 ML/year. The estimated cost of the leak detection survey would be $10,000 with a further $20-30,000 required in repair costs, depending on the findings of the leak detection survey. The total cost for active leakage control (ALC) is therefore in the order of $30-40,000.

It should be noted that leakage will return to the system over time and continuous monitoring of nightflows will allow informed decision-making on future leakage management work. The size and complexity of the Tweed Heads & Tweed Heads West systems means that permanent metering of nightflows would cost in the order of $50-60,000, if the zones were to be split permanently. Council have indicated this is not going to happen in the immediate future but it should be considered in the longer term.

Once a desired path forward has been determined, we recommend that Council submit a funding application for a leakage project in Tweed Heads. Financial assistance under the Water Loss Management Program is available for water saving projects which target leakage. The amount of assistance depends on the total cost and the amount of water saving predicted and is generally 33% of the total project costs.

If leakage alone were to be pursued in Tweed Heads, for a project cost of $30,000 this would equate to funding of $10,000, with the remaining $20,000 to be covered by Council.

2 General

This report follows meetings and night testing undertaken by representatives of the Water Loss Management program (WLMP) and Tweed Shire Council (TSC) in February, April and May 2009.

It outlines the results of night testing and options for a funding project as part of the WLMP.

2.1 WLMP Strategy

The WLMP aims to reduce leakage from reticulation systems run by local water utilities (LWUs) in NSW using guidelines established by international best practice. The process of leakage reduction can be summarised as follows:

- Understand water loss management principles and methodology specifically the WLMP Awareness and Education Guidelines
- Understand the physical location of key mains and interconnections within the network. If the network is understood properly it should be possible to create a schematic that accurately captures the keys mains, meters and valves within the network.
- Identify a way of measuring demand for parts of the reticulated area at a supply zone level. The preferred methodology for this step is the installation of permanent flow meters, which will serve as an ongoing measurement tool for Council.
- Sectorise the reticulation system in order to create discrete District Metering Areas (DMAs, typically with 500 – 5,000 connections). In conjunction with Council, these sectors should be designed as a permanent arrangement with a view to ongoing monitoring and possibly pressure management in the future.
- Demands in the DMAs and pressures (if necessary) should be measured to quantify leakage levels and give an indication of the long term success of operating the network with the proposed sectorisation scheme. Any significant commercial usage within the system should also be measured.
- Perform Active Leakage Control (ALC) if logged data indicates that this will be economically viable.
- Once sectors have been established and shown to operate successfully then design and install pressure reduction equipment if the gathered data shows this to be operationally and economically viable.

3 The Tweed System

A previous WLMP report by Michael Barratt describes the whole of the Tweed system and sectorisation opportunities in detail. The focus of this report are the areas served by Razorback and Walmsleys reservoirs, as these were identified by Council as being the most straightforward opportunities for night drop tests. Both of these reservoirs are part of the Banora Point water supply system shown below in Figure 1.

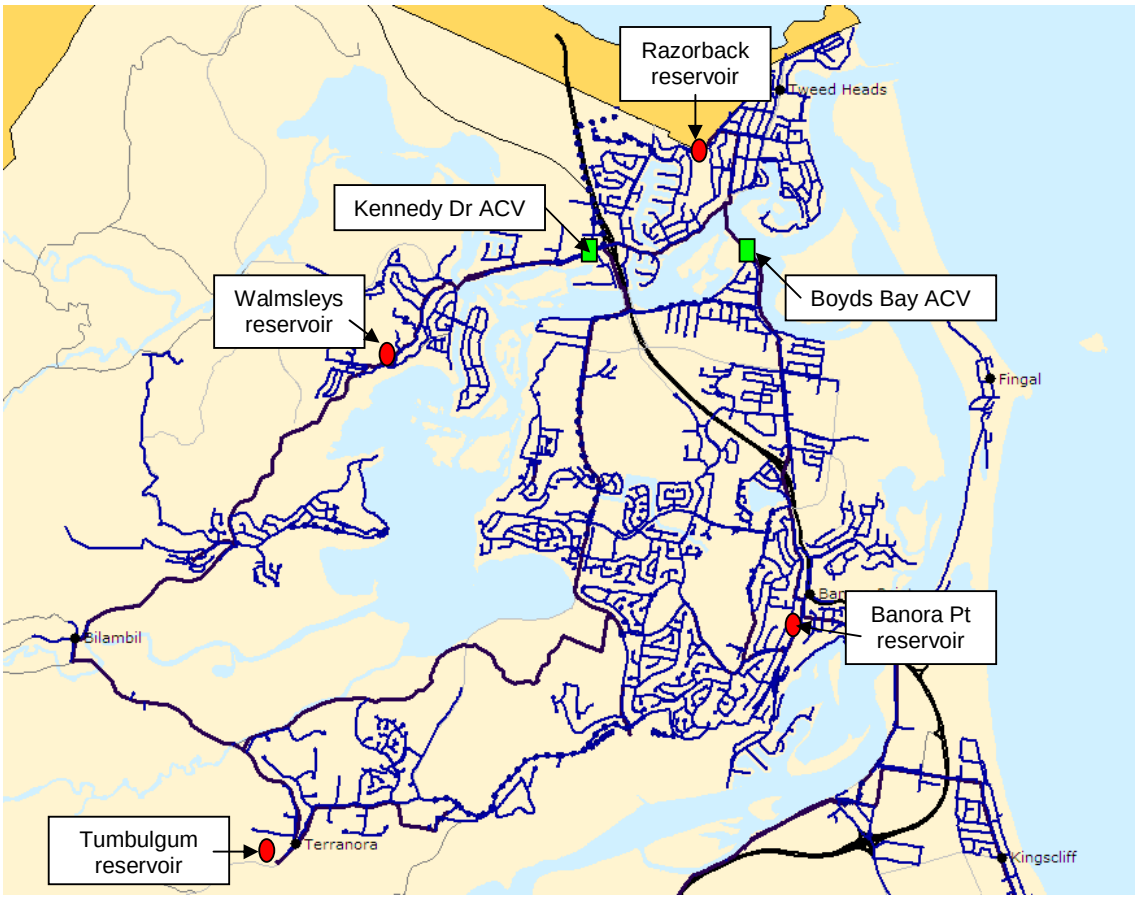


Figure 1. Simplified schematic of the Banora Pt water supply system

3.1 Razorback

Razorback reservoir (TWL 69m) can be filled from Banora Point reservoir (TWL 78.5m) or Tumbulgum reservoir (TWL 114m). The feed into the reservoir is controlled by the Boyds Bay and Kennedy Drive actuator valves. Boyds Bay actuator control valve (ACV) opens when the level in Razorback reservoir falls below 80% and the level in Banora Point is greater than 60%. Kennedy Drive ACV opens when Banora Point cannot cope and the level in Razorback falls below 60%. There is a PRV at Kennedy Drive to prevent the full pressure from Tumbulgum reservoir getting into the Tweed Head mains.

The Razorback reservoir typically supplies the central Tweed Heads area. This area has a number of large users such as the hospital, hotels, bowling club and Twin Towns club and accommodation.

When separated from the area fed by Walmsleys reservoir, this DMA has 2,107 connections and 44km of mains. It borders the Queensland town of Coolangatta. There are two points at which water pipes cross into Queensland, with both lines end-capped on the QLD side of the border. There is also a meter on one of the lines.

Figure 2. View of central Tweed Heads from Razorback lookout

3.2 Walmsleys

Walmsleys reservoir is connected to the Razorback system and has a TWL of 69.5m. The two reservoirs are interconnected and usually balance each other out.

Walmsleys reservoir supplies to Tweed Heads West, which is a largely residential area. The large users in this area are retirement homes and complexes, as well as the Seagulls Club. When separated from Razorback this DMA has 1,472 connections and 26km of mains.

The houses adjacent to Walmsleys reservoir and nearby high areas are served by Marana St reservoir in Belambil Heights, which is at an elevation of close to 150m. There are pressure reducing valves (PRVs) to ensure that the pressures to the houses around Walmsleys reservoir are reduced.

Figure 3. Walmsleys Reservoir

4 Night Flow Measurement

Extract from WLMP Awareness and Education Guidelines Manual - Night Flow Method:
During the night, consumption drops to a minimum and the majority of the minimum night flow is leakage on the distribution system and pipework of customers. An estimate of night consumption (night use plus leakage on pipes of customers) is deducted from the minimum night flow to obtain the assessed night leakage rate for the distribution system, in m^3/hour or similar.

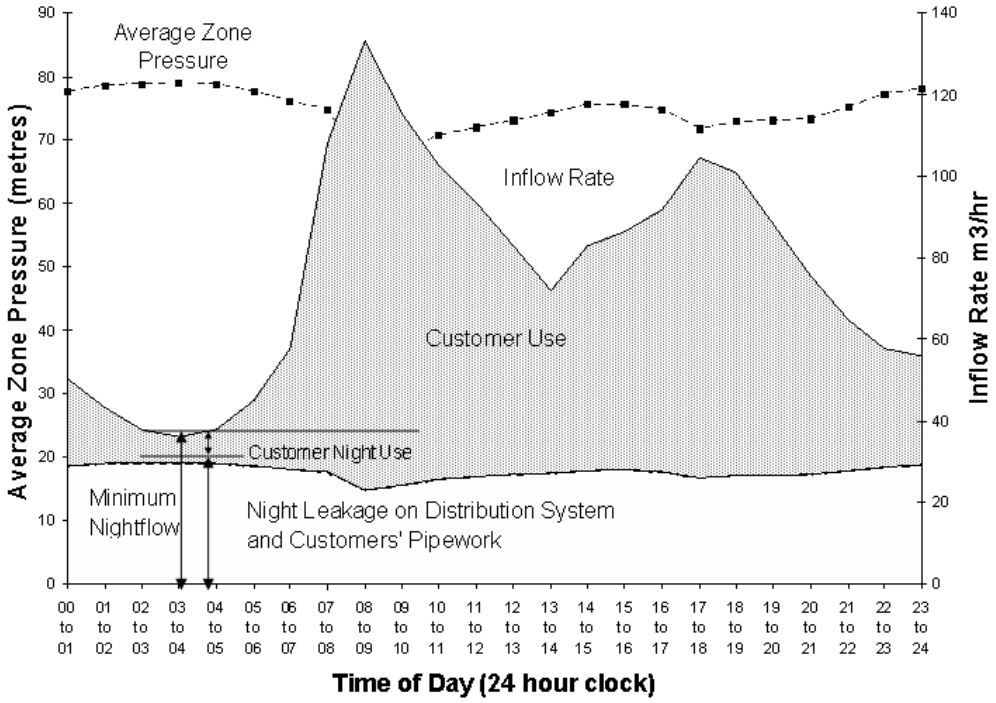


Figure 4. Typical flow pattern and pressure in a 24 hour period

Meter readings of consumers known to be large overnight users (such as hospitals, caravan parks etc) are also undertaken to quantify any exceptional night usage (ENU).

The night flow measurement procedure used for the two zones is outlined below. The following valves were closed when the night test was undertaken to ensure that no water was entering the zones and that the zones were separated from each other:

- Boyds Bay actuator
- Kennedy Drive actuator
- Gate valves along Kennedy Drive

4.1 Razorback

A pressure transducer was installed in the Razorback reservoir on Monday, April 20th. Drop tests were undertaken on the following nights:

- Tuesday April 21st
- Tuesday May 19th (check of valves closures – effectively an additional drop test)
- Monday May 25th
- Monday June 22nd

On April 21st and May 25th overnight meter readings were taken of known large consumers in the Tweed Heads area. The consumption of large users is shown in Table 1, and equates to

usage of 5kL/hr. No consumption was identified at the Hospital, and this was believed to be due to a faulty meter. An allowance of 2kL/hr has been made to cover Hospital use. A total of 7kL/hr of 'exceptional' night use has therefore been input into the analysis in Section 5.

Table 1. Night consumption (kL) of large users in Tweed Heads

User	21-Apr	25-May
Hospital	0	0
Tulip Gate	1	1
Centro	6	3
Twin Towns	18	11
SCU	0	0
Amaroo	2	3
Bowling Club	1	3
Kirra Grove	Not read	15
Total	**28**	**36**
Hrs overnight	6	7
Avg kL/hr	**4.7**	**5.1**

The night consumption for both Kirra Grove and the Twin Towns Club is considered to be high, and may be indicative of leakage occurring downstream of the meters at these sites.

The next graph shows the drop in water level as measured by the pressure transducer on each of the nights for which Razorback was isolated. The drop in level between the hours of 23:30 and 4:30 was between 504 and 536mm.

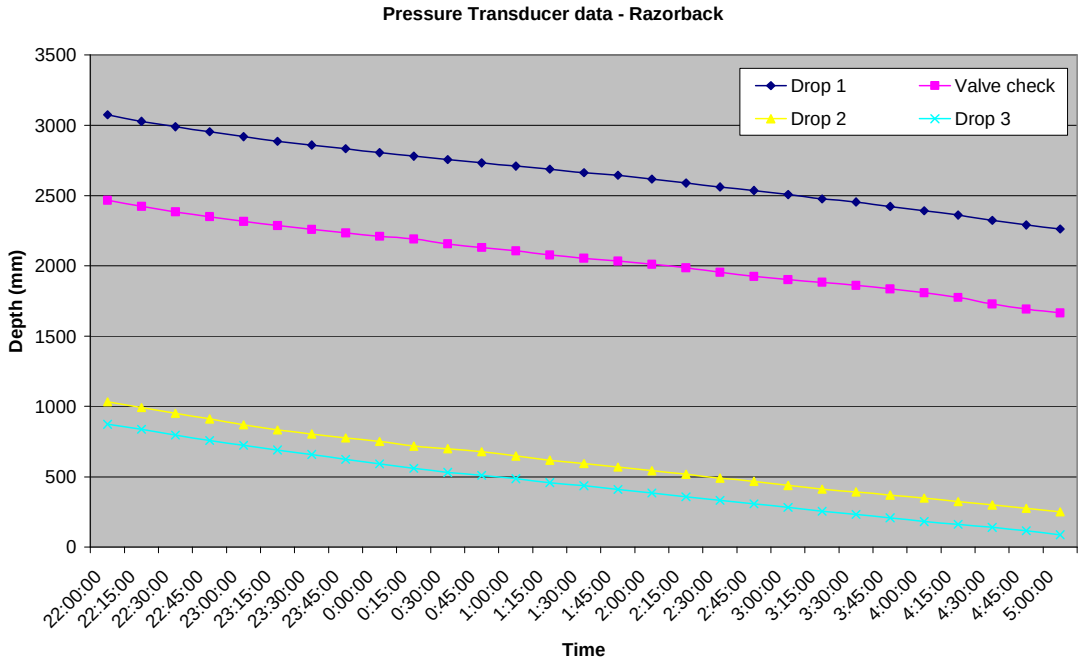


Figure 5. Level drop in Razorback Reservoir

This data has been multiplied by the surface area of the reservoir to determine the average minimum hourly flow rate out of the reservoir when drop testing was underway. The lowest rate recorded was 11.7L/s with good repeatable data between 12 and 15L/s.

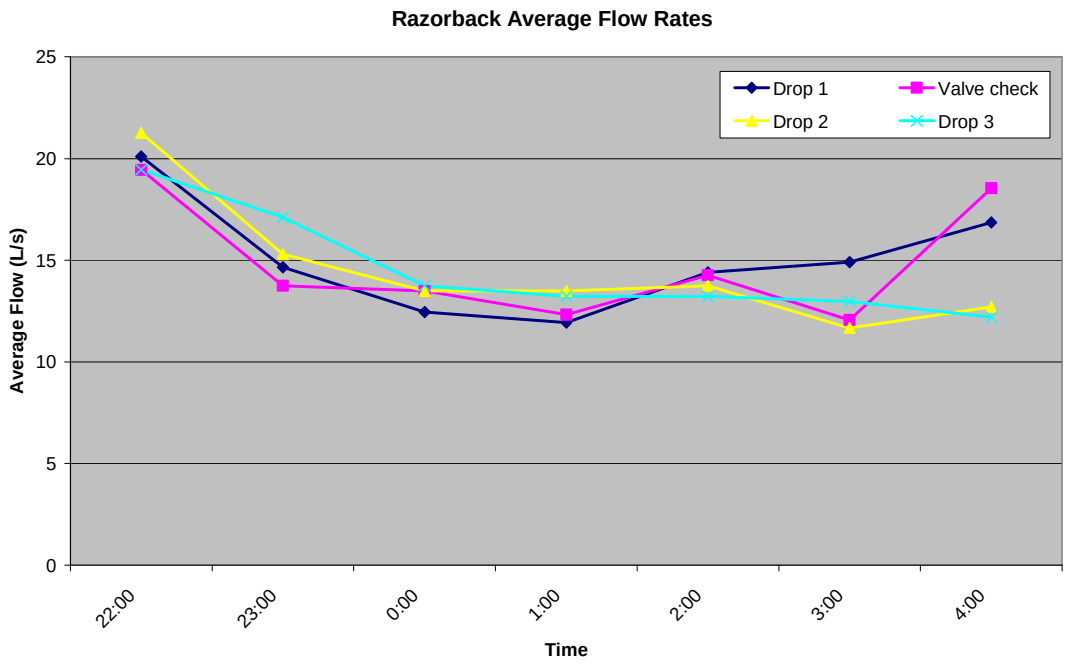


Figure 6. Night flow rates (L/s) out of Razorback Reservoir

The average zonal night pressure (AZNP) was not measured but based on the elevation of the reservoir and average elevation of hydrants in the zone has been calculated at 59m head throughout the zone.

4.2 Walmsleys

A pressure transducer was installed in Walmsleys reservoir on Monday, April 20th. When the initial night test was performed, the water level in Walmsleys rose rather than falling as expected. This indicated that the zone was not isolated as planned. Investigations were undertaken to determine where the zone was being breached and this was rectified by Council.

A check of the isolation of this zone was then undertaken on the night of Tuesday May 19th. The level in the reservoir fell, confirming that the zone was now operating as it should.

Drop tests were undertaken on the following nights:

- Monday May 25th
- Monday June 22nd

On April 21st and May 25th overnight meter readings were taken of known large consumers in the Tweed Heads West area. The meter readings of large users are shown in Table 2. These showed usage of 3.5kL/hr which has been input as 'exceptional' night use into the analysis in Section 5.

Table 2. Night consumption of large users in Tweed Heads West

User	21-Apr	25-May
Cobaki Broadwater	4	8
Nursing Home	1	1
Retirement Village	Not read	4
Seagulls Club	5	4
Pyramid	6	7
Sports Oval	0	1
Total	**16**	**25**
Hrs overnight	5.5	7
Avg kL/hr	**2.9**	**3.5**

Again, some of these sites have high usage between the hours of 10pm and 5am when the readings were taken and when consumption would be expected to be low. Leakage may be occurring downstream of the meter at sites such as Seagulls and the Pyramid Holiday Park.

The next graph shows the drop in water level as measured by the pressure transducer on each of the nights for which Walmsleys was isolated. This graph shows some slight increases in level on the night when the isolation of the reservoir was being checked. However, on the two drop test nights the reservoir decreased in level by 102 and 108mm respectively.

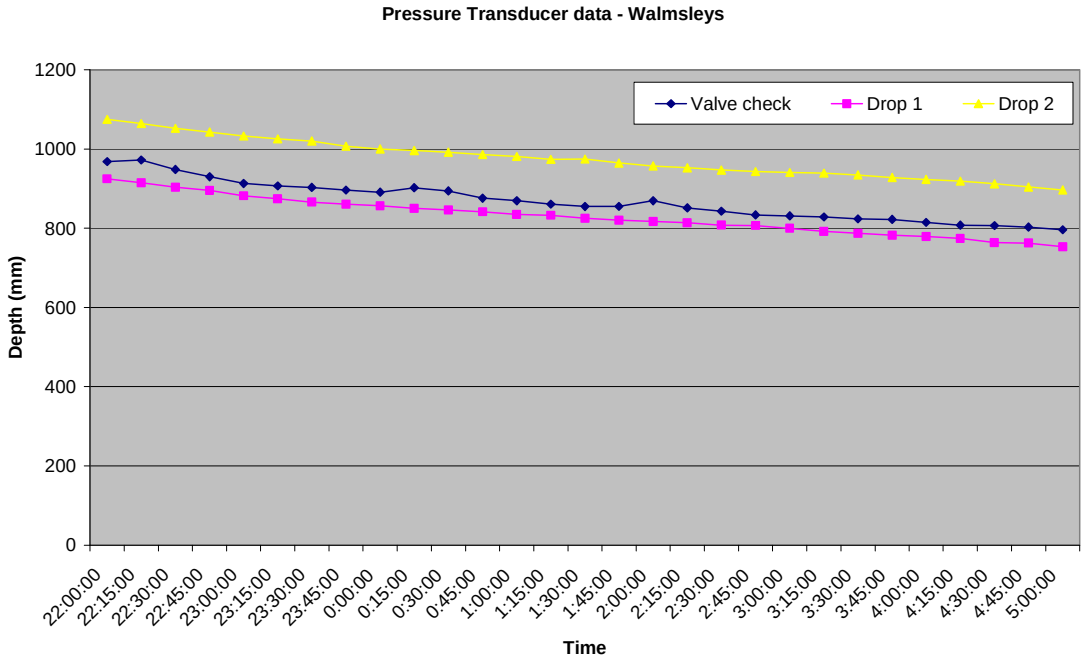
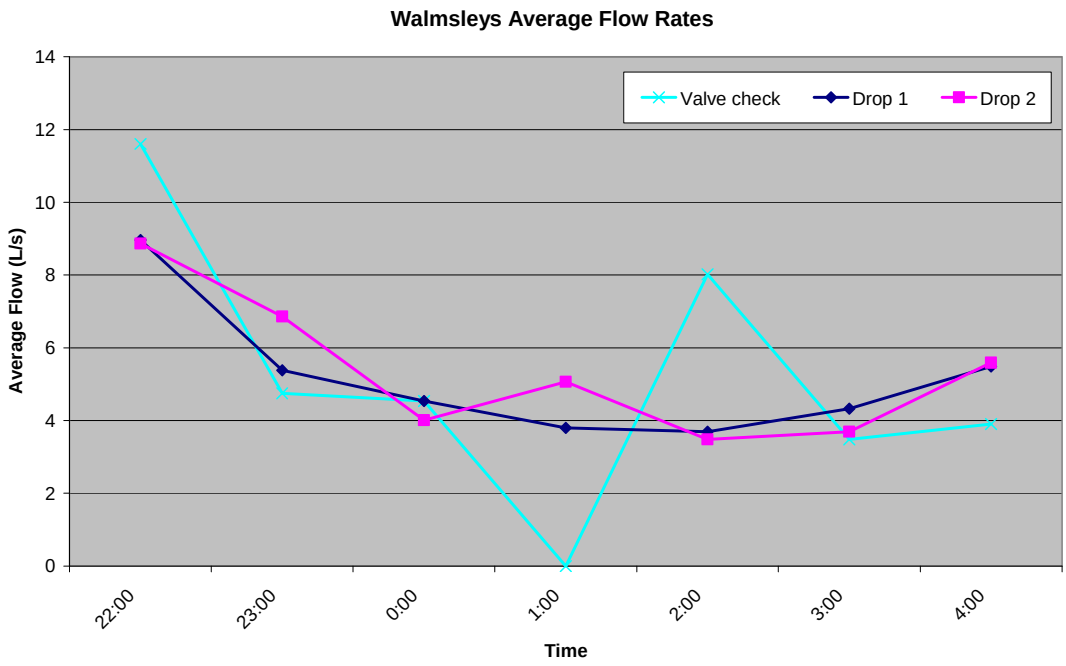


Figure 7. Level drop in Walmsleys Reservoir

This data has been multiplied by the surface area of the reservoir to determine the average minimum hourly flow rate out of the reservoir when drop testing was underway. The lowest rate recorded was 3.5L/s with good repeatable data between 3.5 and 4.5L/s.

NB The light blue line is from the isolation check night and therefore contains some discrepancies (such as the 0L/s flow) which have been excluded from the analysis.



The AZNP was not measured, but based on the elevation of the reservoir and average elevation of hydrants has been estimated at 49m head throughout the zone.

5 Analysis and Results Summary

The night flow rates measured as described above have been input into the WLMP's DMA Analysis spreadsheet. The results are shown on the next two pages.

In Tweed Heads/Razorback, the minimum night flow of 11.7L/s is believed to be made up of:

- Typical consumer & business night usage (estimated at 2.5L/conn/hr): 5.1L/s
- Exceptional night consumption at large users: 2L/s
- Unavoidable background leakage (on mains and service connection points): 1.1L/s
- Night leakage: 3.5L/s

This equates to estimated water savings of around 60ML/year.

NB. The night usage rates in a sector such as Tweed Heads have been estimated based on typical usage per connection and the mix of properties in the zone.

Table 3. Estimate of typical night usage by connection type in Tweed Heads

Connections	No.	Typical Units / Rooms	Connections	Occupancy	Usage L/conn/hr	Usage L/hr	Usage L/s
Apartment Block - Large (>20 units)	25	50	1250	90%	2.5	2813	0.78
Apartment Block - Medium to Small	400	10	4000	95%	2.5	9500	2.64
Motel	10	20	200	70%	2.5	350	0.10
Park or Garden	40	1	40	100%	5	200	0.06
House - standalone	970	1	970	100%	2.5	2425	0.67
Semi / Townhouse / Villa	500	1	500	95%	2.5	1187.5	0.33
Business	160	1	160	90%	15	2160	0.60
Sub-total	**2105**					**18635**	**5.18**
Exceptional night use						7000	1.94
TOTAL NIGHT USAGE						**25635**	**7.12**

In Tweed Heads West / Walmsleys, the possible water savings appear to be minimal. The minimum night flow rate of 3.5L/s which was observed can be explained by:

- Typical consumer & business night usage (estimated at 2.5L/conn/hr): 1.6L/s
- Exceptional night consumption at large users: 1L/s
- Unavoidable background leakage (on mains and service connection points): 0.8L/s
- Night leakage: 0.1L/s.

The estimated savings in this zone are 3ML/year, which are not considered to be worthwhile pursuing.

5.1 Razorback

DMA Analysis for Water Loss Management Program

1. Data Entry Worksheet

Water Loss Management Program FOR REGIONAL NSW WATER UTILITIES

Enter all required data below

Calculations carried out by	**Melanie Werner**
Date of analysis	**6/07/2009**
Project Number	**IP11**
Council Name	**Tweed Shire**
Sector (DMA) to be analysed	**Razorback - Tweed Heads**

Length of mains	Lm	**44**	***km***
Average Zone Night Pressure	AZNP	**59**	***metres***
No of residential Connections	RC	**1298**	***conn***
No of non residential connections	NRC	**809**	***conn***
Total Connections	TC	**2107**	***conn***
Average persons per connection	PpC	**2.5**	***person***
No of metered connections	MC	**2107**	***conn***
Average Minimum Night Flow	AMNF	**11.7**	***l/s***
Flowmeter Accuracy at this flow	Fmacc	**10%**	***percent***
Dates of night flow measurement	**21/4/2009**	***to***	**22/4/2009**
Exceptional Night Use (see ExcNightUse Sheet)	ENU	**7**	***KL/h***
Water Cost	$KL	**1.36**	***$/KL***
Estimated Leak Detection Cost	$Km	**220**	***$/Km***
Estimated Metering Cost	Mcost	**0**	***$***

Calculated Night Day Factor	NDF	**22**	Default =	24
Goto Night Day Factor Worksheet				

Note: Using the default may overestimate annualised savings in a gravity fed system and underestimate savings in a pumped system.

FAVAD N1 Factor	FN1	**0.9**	Default =	1.0
To calculate use N1Calc Worksheet				

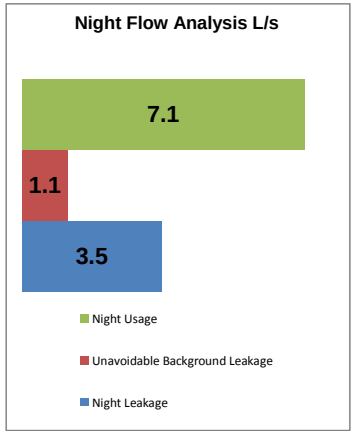
Note: An N1 Factor of 1.0 shows a linear relationship between pressure and leakage.

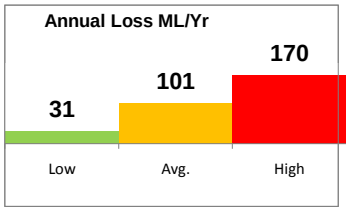
Defaults Used

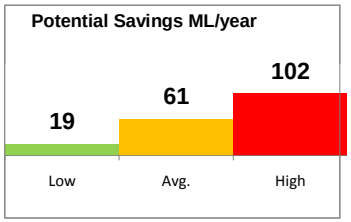
Estimated Residential Night Usage	3.00	3.00	litres/conn/hour
95%confidence limit	50%	50%	percentage
Night use for Non-Residential is	6	6	times that of Residential Properties
95% confidence limit	50%	50%	percentage

Estimated Unavoidable Background Leakage

Km of Mains	20	20	Litres per Km per hour
Metered Service Connections	1.250	1.250	Litres per Connection per hour
Unmetered Service Connections	1.50	1.50	Litres per Connection per hour
Plumbing Systems	0.125	0.125	Litres per Connection per hour







Potential Savings	**79**	**L/conn/day**
Best Estimate	**61**	**ML/Year**

5.2 Walmsleys

DMA Analysis for Water Loss Management Program

1. Data Entry Worksheet

Water Loss Management Program
FOR REGIONAL NSW WATER UTILITIES

Enter all required data below

Calculations carried out by	**Melanie Werner**
Date of analysis	**6/07/2009**
Project Number	**IP11**
Council Name	**Tweed Shire**
Sector (DMA) to be analysed	**Walmsleys - Tweed Heads**

Length of mains	Lm	**26.194**	***km***
Average Zone Night Pressure	AZNP	**49**	***metres***
No of residential Connections	RC	**1707**	***conn***
No of non residential connections	NRC	**100**	***conn***
Total Connections	TC	**1807**	***conn***
Average persons per connection	PpC	**2.5**	***person***
No of metered connections	MC	**1807**	***conn***
Average Minimum Night Flow	AMNF	**3.5**	***l/s***
Flowmeter Accuracy at this flow	Fmacc	**10%**	***percent***
Dates of night flow measurement	**19/5/2009**	***to***	**22/6/2009**
Exceptional Night Use (see ExcNightUse Sheet)	ENU	**3.5**	***KL/h***
Water Cost	$KL	**1.36**	***$/KL***
Estimated Leak Detection Cost	$Km	**220**	***$/Km***
Estimated Metering Cost	Mcost	**0**	***$***

Calculated Night Day Factor	NDF	**22**	Default =	24
Goto Night Day Factor Worksheet				

Note: Using the default may overestimate annualised savings in a gravity fed system and underestimate savings in a pumped system.

FAVAD N1 Factor	FN1	**1.1**	Default =	1.0
To calculate use N1Calc Worksheet				

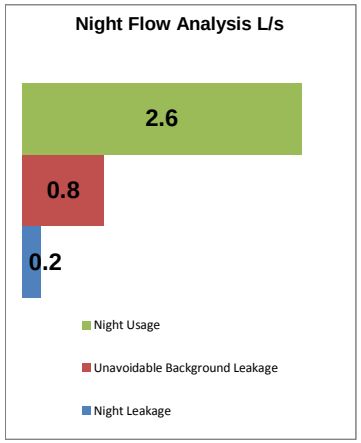
Note: An N1 Factor of 1.0 shows a linear relationship between pressure and leakage.

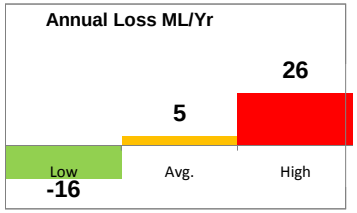
Defaults Used

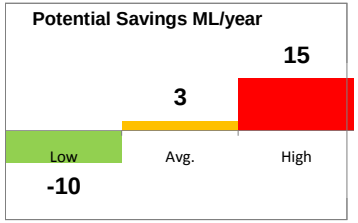
Estimated Residential Night Usage	2.50	3.00	litres/conn/hour
95%confidence limit	50%	50%	percentage
Night use for Non-Residential is	6	6	times that of Residential Properties
95% confidence limit	50%	50%	percentage

Estimated Unavoidable Background Leakage

Km of Mains	20	20	Litres per Km per hour
Metered Service Connections	1.250	1.250	Litres per Connection per hour
Unmetered Service Connections	1.50	1.50	Litres per Connection per hour
Plumbing Systems	0.125	0.125	Litres per Connection per hour







Potential Savings	**4**	**L/conn/day**
Best Estimate	**3**	**ML/Year**

6 Potential Water Savings

6.1 Active Leakage Control

Based on the preceding information it is believed that active leak control (ALC) is only worth pursuing in the Tweed Heads / Razorback system. The Tweed Heads West / Walmsleys system had low levels of observed leakage and it would not be economical to attempt to reduce that leakage.

The assessment of how much water can be recovered through leak detection and repair work has been made using the following basic assumptions:

- Potable water cost to consumers of $1.50/kL (up to 450kL/year) for the 2009-10 financial year. Production costs per kL are not readily available.
- Water savings are estimated to be 60% of the difference between Current Annual Real Losses (CARL) and Unavoidable Annual Real Losses (UARL).
- Leakage Detection Costs of $220/ km (External Contractors), based on tenders submitted to date as part of the WLMP.
- Leakage Repair Costs of $440/ km (Council work teams), based on predicted total repair costs divided by length of mains. The figure of $440/km is from projects completed to date as part of the WLMP. Tweed Heads has a high level of development and density of dwellings, meaning that repair costs could be higher than average, and this will be taken into account if a funding application is submitted.

The UARL calculation includes allowance for both burst and background leakage based on the number of service connections, average pressure and the length of mains. It should be noted that these figures assume a certain number of active leaks in the network and is therefore reflective of how the system would operate in time after the initial leakage survey but with regular leak detection work afterwards. It is anticipated that after a thorough survey that most leaks will be found leaving predominantly background leakage in the system (background leakage is weeping joints etc that are too small to detect).

It should also be noted that for the majority of the water systems there is no demand side metering and so a burst that does not run to the surface could run indefinitely.

A summary of the costs and savings delivered by an active leak control project is given below. The project payback period is a rough guide to how quickly the project costs are “recompensed” by the water savings. NB This is based on water savings at the retail cost of water rather than production cost.

Table 4. Active leak control costs and water savings

Zone	Water saving (ML/yr)	Water Saving ($/yr)[1]	Leak Detect cost ($)	Repairs Cost ($)	Total cost (detect & repair)	Payback period (months)[2]
Razorback	61	82,300	9,680	19,360	29,040	4

From the above figures, it is anticipated that Current Annual Real Losses (leakage) for the water system in Tweed Heads could be reduced by a total of 61ML/y through a thorough active leakage survey with prompt repair work.

[1] Based on retail cost of water
[2] Based on retail cost of water

6.2 Permanent Metering and Monitoring

Leakage will return to the system over time and continuous monitoring of nightflows will allow informed decision making on leakage management work in the future. However, the nature of the reticulation system in Tweed Heads and Tweed Heads West means that permanent metering and monitoring of nightflows in these zones is not straightforward. Additionally, Council has indicated that there is no immediate plan to operate these two zones separately. Therefore, the valves between the two zones would need to be shut on certain nights for testing *or* the areas would need to be treated as a combined large zone.

If the zones were to be separated in the future, the following meters would be required:

- Inflow meter at Boyds Bay ACV (375mm)
- Inflow meter at Kennedy Drive (450mm)
- Reservoir inlet / outlet meter on Razorback reservoir (300mm)
- Meter on pumped line serving high properties from Razorback
- Reservoir inlet / outlet meter on Walmsleys reservoir (300mm)

The estimated cost for permanent metering is in the order of $50-60,000. NB This is an initial estimate only.

6.3 Temporary Monitoring of Large Overnight Users

WLMP can assist with providing logging equipment to monitor the users identified as having high night usage from the overnight meter readings undertaken, such as Kirra Grove, Twin Towns, Seagulls and Pyramid. This temporary datalogging of consumer meters (for say 1 month) will identify any continual use at these sites that indicates leakage downstream of the meter. This information can then be passed to the site owners for action, and will generate further water savings by reduction of consumer demand on the system.

7 Recommendations

Based on the above findings the WLMP recommends the following:

- A thorough leakage detection survey and repairs be undertaken for the Tweed Heads reticulation system. The estimated water savings are 61 ML/year. The project cost is estimated to be **$30-$40,000,** depending on the final cost of repairs that need to be undertaken.

- Council consider in the future the installation of a permanent metering system for measurement of nightflows in the Tweed Heads and Tweed Heads West area. An initial estimate for the installation of meters is $50-60,000.

- Council consider temporary logging of existing meters of large consumers in the Tweed Heads and Tweed Heads West zones as an additional demand management tool.

- Council submit a funding application for a leakage project in Tweed Heads. Financial assistance under the Water Loss Management Program would be available for approximately 33% of the total project costs.

- Further zones in the Tweed Shire Council area are considered for nightflow assessments, via drop tests or permanent metering, with WLMP assistance and possible funding if leakage is identified.