

Smart Ways to Manage Non-Revenue Water

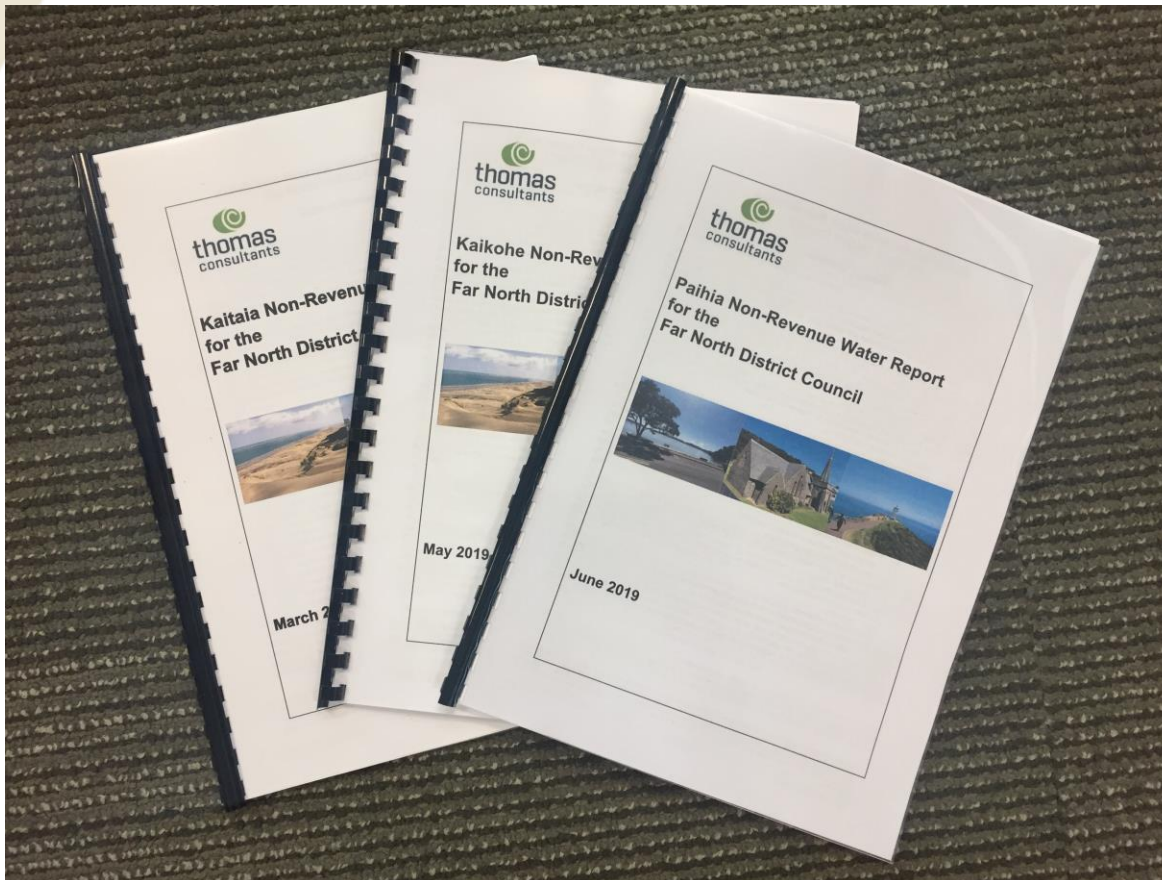


PWC'19 Vanuatu - August 2019

**Presentation by Richard Taylor,
Thomas Consultants, Auckland**

Non-Revenue Water (NRW)

Is an issue for ALL Water Utilities



Case Study

Current Level of NRW

34%



consultants

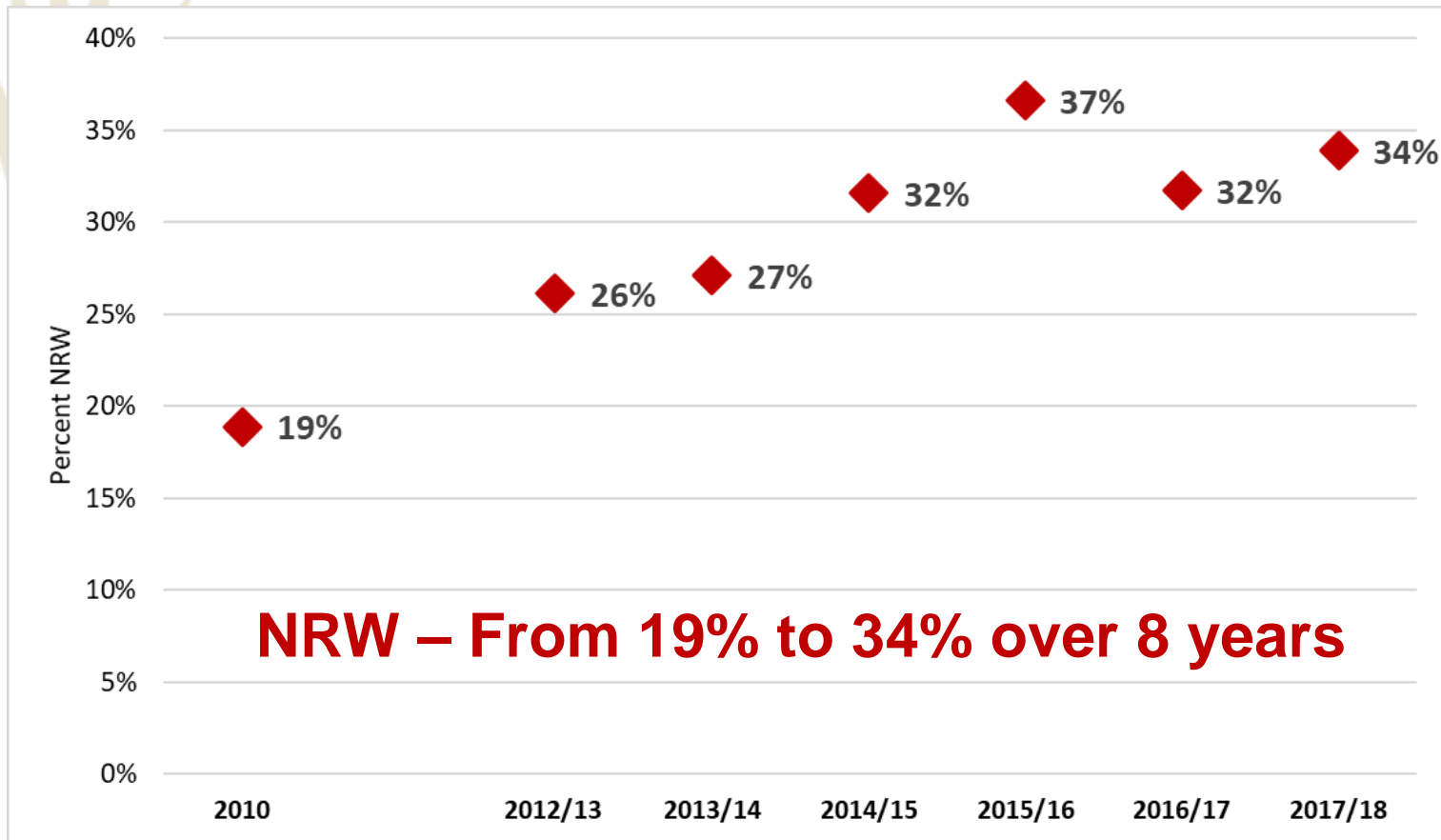
What is Non-Revenue Water?

The International Water Association's (IWA) Standard Water Balance

Own Sources	System Input	Water Exported			Billed Water Exported to other Systems	Revenue Water
		Water Supplied	Authorised Consumption	Billed Authorised Consumption	Billed Metered Consumption by Registered Customers	
Water Imported	(allow for bulk meter errors)				Billed Unmetered Consumption by Registered Customers	Non-Revenue Water
			Unbilled Authorised Consumption	Metered		
				Unmetered		
				Unauthorised Consumption		
			Customer Metering Under-registration			
		Water Losses	Apparent Losses		Leakage on Mains	
			Real Losses		Leakage and Overflows at Service Reservoirs	
					Leakage on Service Connections up to the street/property boundary	

Case Study – Increased NRW

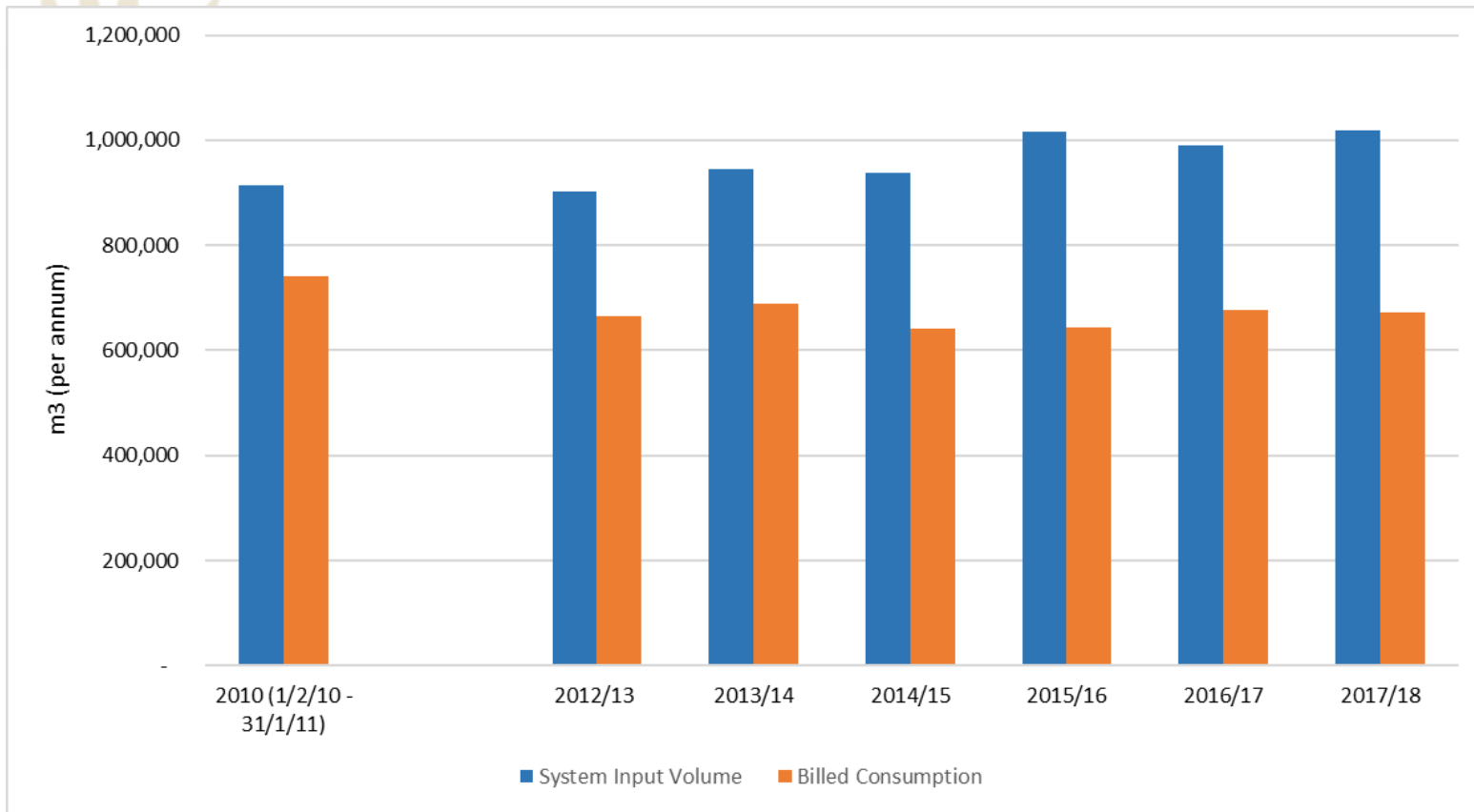
Let's look at the past



WHAT HAS CHANGED?

Case Study – Increased NRW

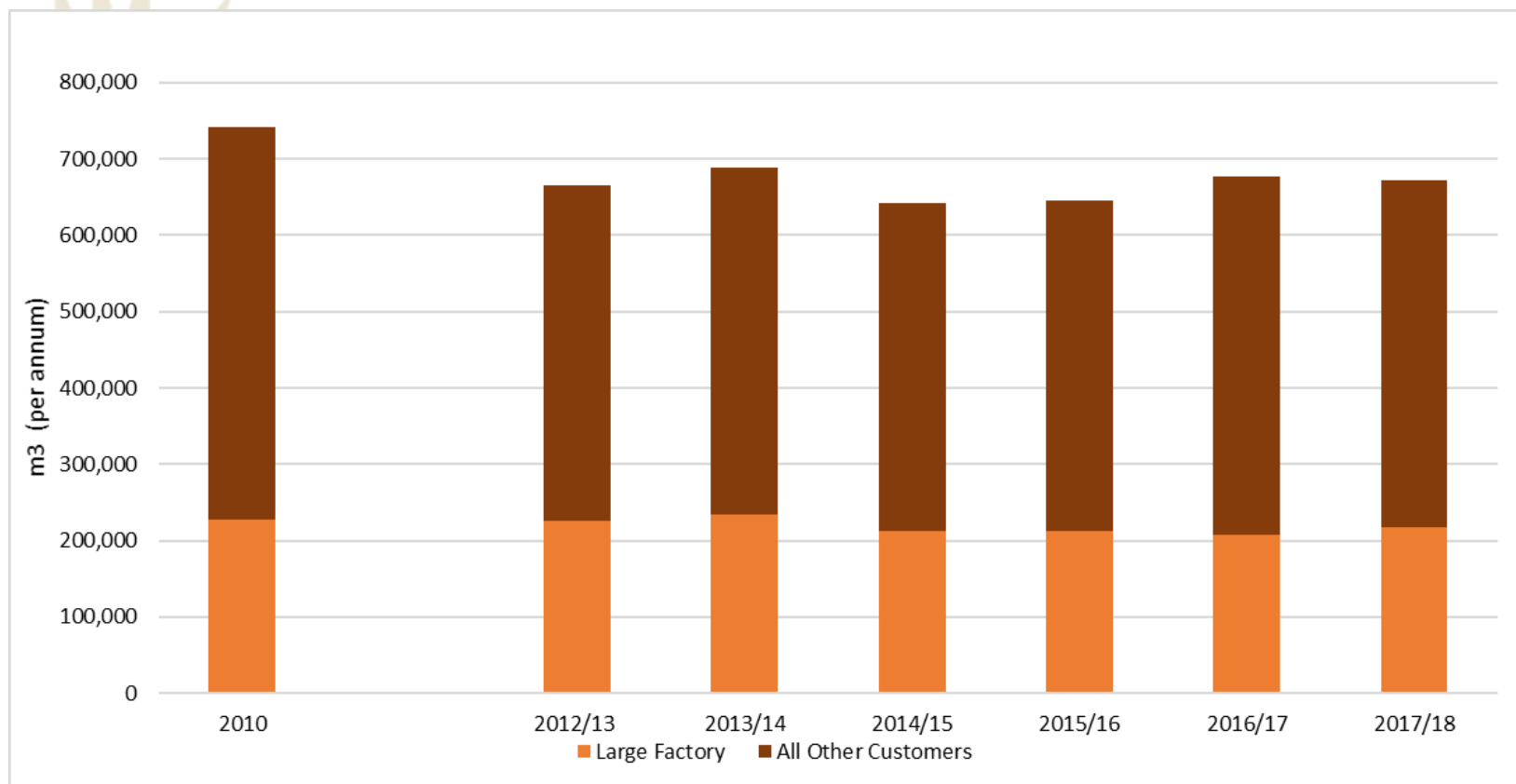
Let's look at some data



System Input Volume and Billed Consumption

Case Study – Increased NRW

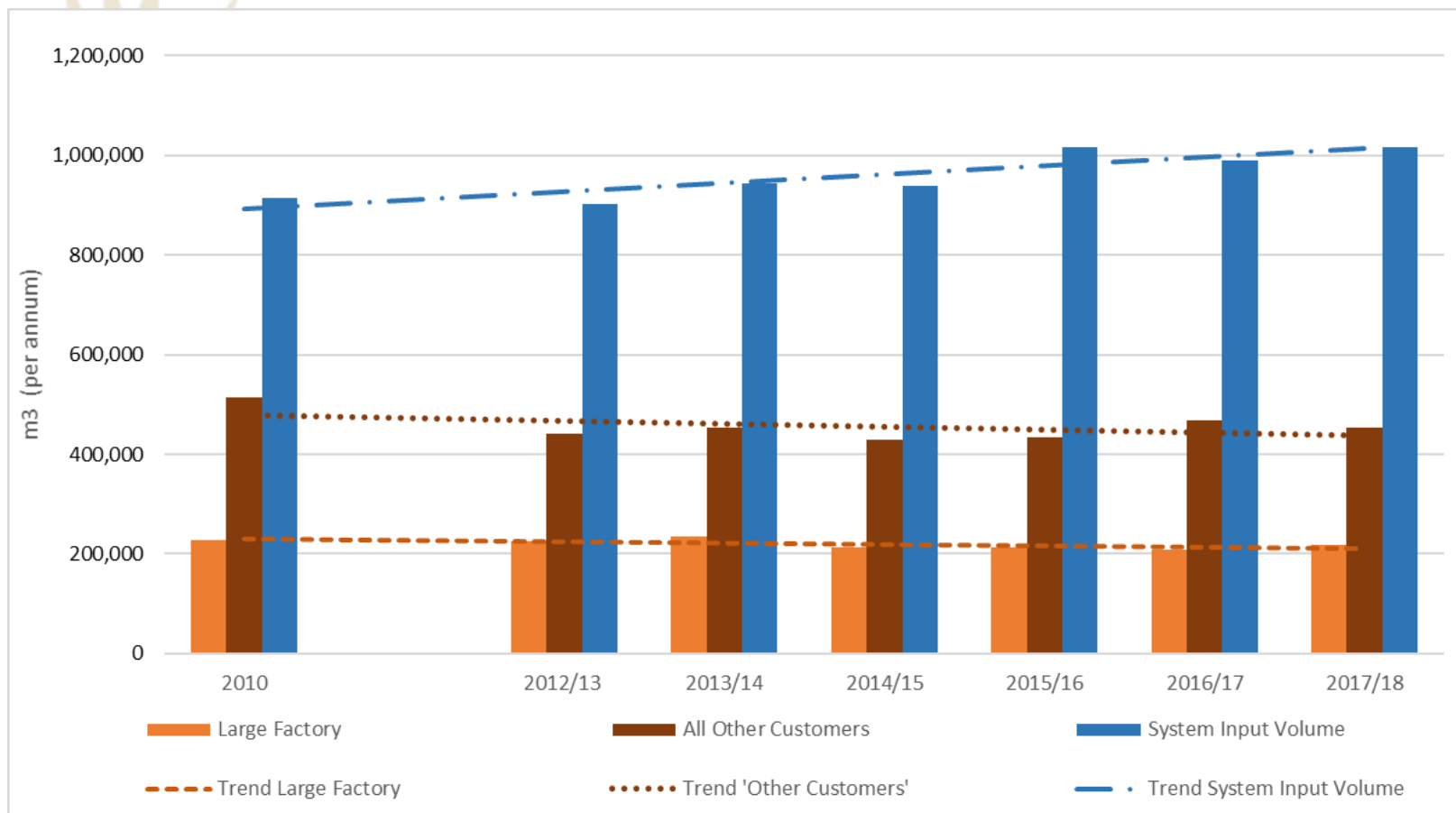
Let's look closer at Billed Consumption



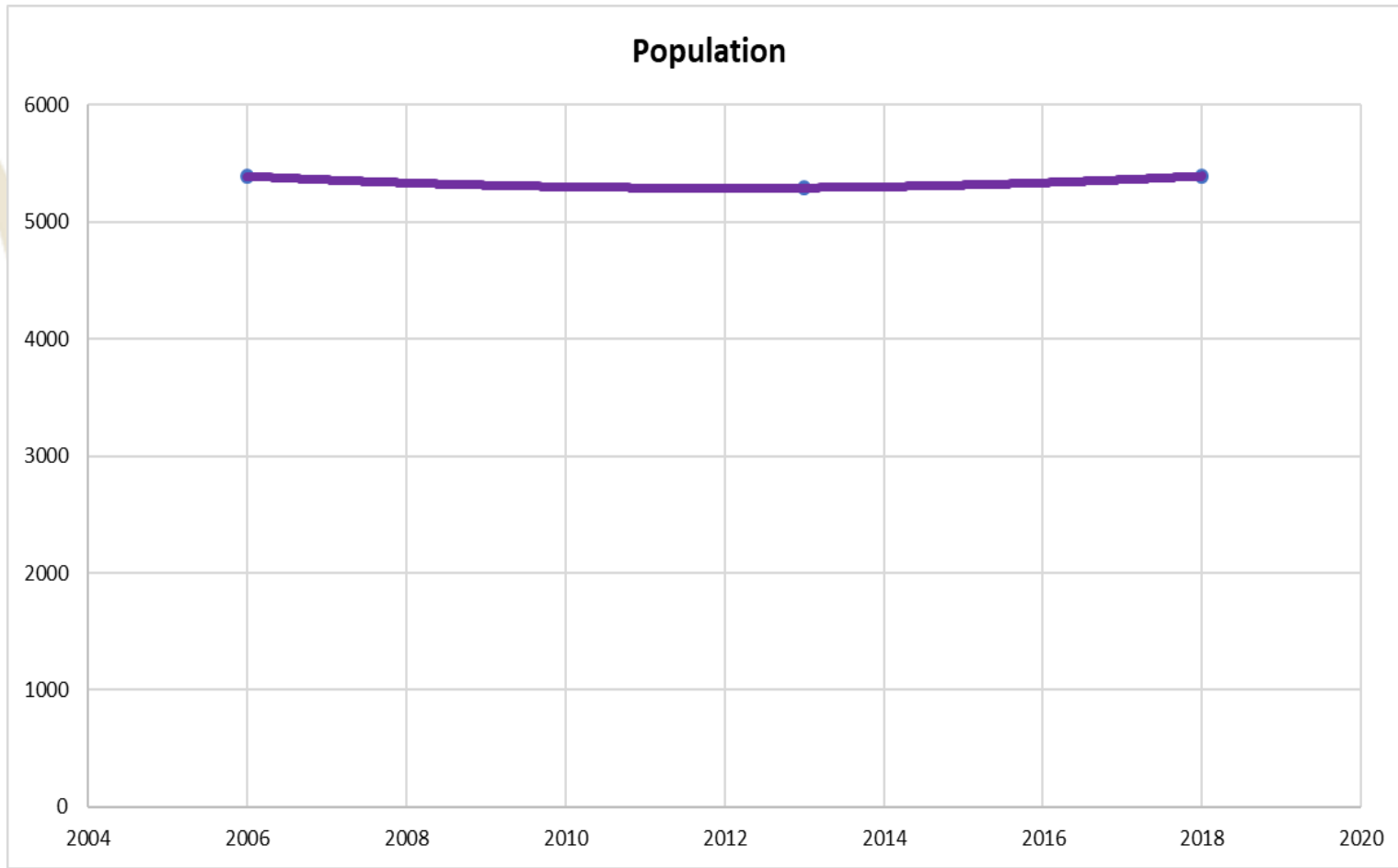
Billed Consumption (Large Factory and 'All Other Customers')

Case Study – Increased NRW

Overall Trends



Case Study – Increased NRW



Population – little change

Case Study – Increased NRW

Let's look at current Customer Water Use 'By Others'

	Split of Detailed 2017-2018 Customer Billed Water Use Report (Excluding Large Factory)		
	Water Use 350 m3 or more	Water Use 30 - 350 m3	Water Use 0 - 30 m3
Billed Volume for 2017-2018	185,704	280,654	1,919
Percentage of Total Billed Volume	27.6%	41.7%	0.3%
Number of Accounts	232	1,866	245
Percentage of Number of Accounts	10%	80%	10%
Average Billed Volume	800	150	8
Average Water Use per day	2.193	0.412	0.021
Average Water Use per day	2,193	412	21
Average water use per person/day - assuming average occupancy of 2.6		158	

Case Study – Increased NRW

With reference to the **Water Balance Diagram –**

Own Sources	System Input	Water Exported	Authorised Consumption	Billed Authorised Consumption	Billed Water Exported to other Systems	Revenue Water
		Water Supplied			Billed Metered Consumption by Registered Customers	
Water Imported	(allow for bulk meter errors)		Unbilled Authorised Consumption	Apparent Losses	Billed Unmetered Consumption by Registered Customers	Non-Revenue Water
					Metered	
					Unmetered	
					Unauthorised Consumption	
Water Losses	Real Losses	Water Losses	Real Losses	Customer Metering Under-registration	Leakage on Mains	
				Leakage and Overflows at Service Reservoirs		
				Leakage on Service Connections up to the street/property boundary		

The **increase** in NRW could be due to any of the following:

- Increase in **Unbilled Authorised Consumption**;
- Increase in the **theft of water**;
- **Customer water meters** becoming more and more inaccurate; and
- Increase in '**Real Water Losses**'

Case Study – Increased NRW

For Unbilled Authorised Consumption

Own Sources	System Input	Water Exported			Billed Water Exported to other Systems	Revenue Water
		Water Supplied	Authorised Consumption	Billed Authorised Consumption	Billed Metered Consumption by Registered Customers	
Billed Unmetered Consumption by Registered Customers						
Unbilled Authorised Consumption	Metered		Non-Revenue Water			
Apparent Losses	Unmetered					
Water Losses	Unauthorised Consumption			Customer Metering Under-registration		
	Real Losses	Leakage on Mains				
Water Imported	(allow for bulk meter errors)		Leakage and Overflows at Service Reservoirs	Leakage on Service Connections up to the street/property boundary		

Over the last 8 years what has changed with:

- Fire Service use?
- System flushing programmes?
- Other authorised use of hydrants?
- Irrigation use? (unmetered, unbilled)

In this case study – nothing significant to our knowledge.

Case Study – Increased NRW

For Customer Meter Under-registration?

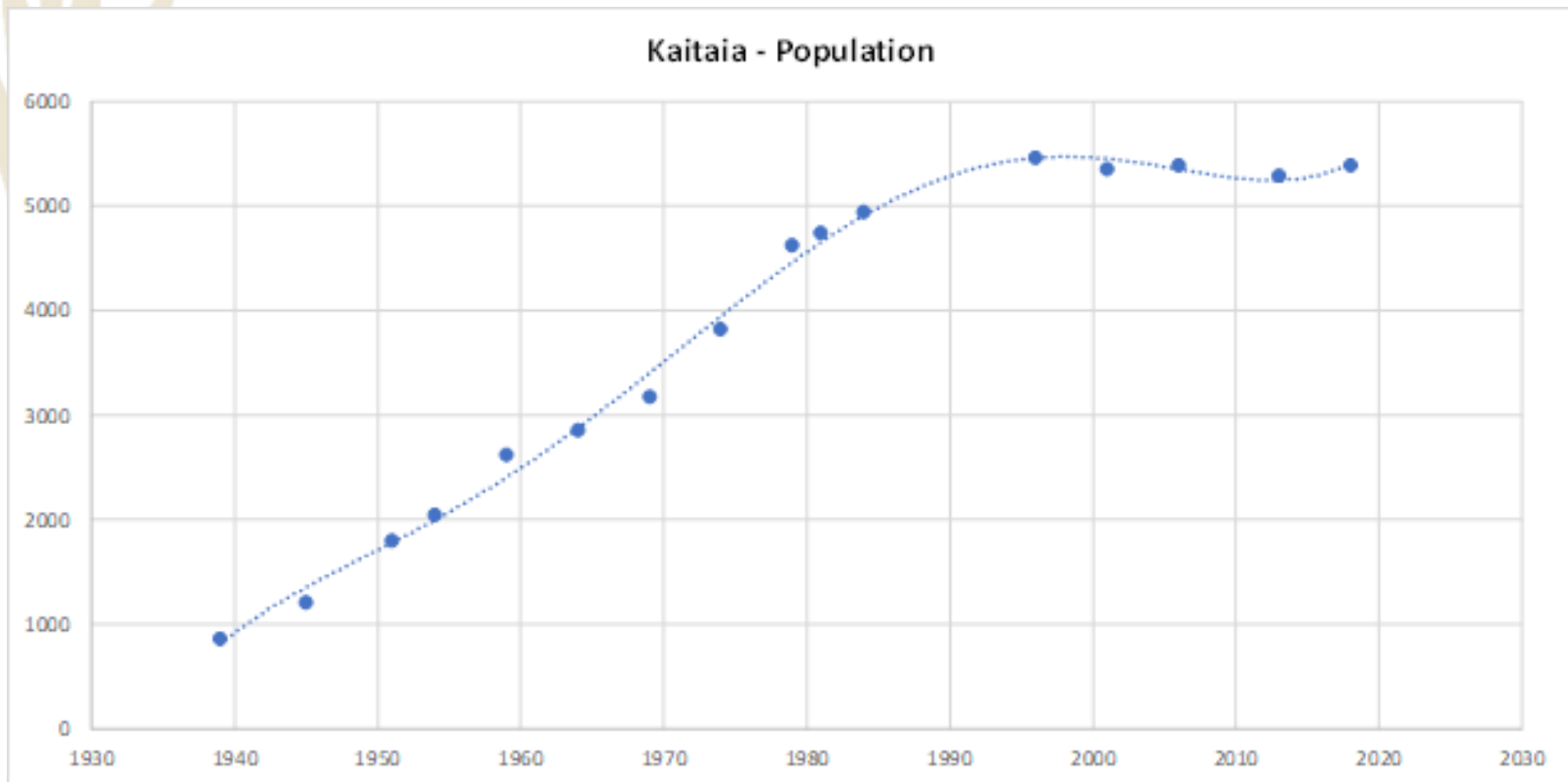
Own Sources	System Input	Water Exported			Billed Water Exported to other Systems	Revenue Water
		Water Supplied	Authorised Consumption	Billed Authorised Consumption	Billed Metered Consumption by Registered Customers	
Billed Unmetered Consumption by Registered Customers						
Unbilled Authorised Consumption	Metered		Non-Revenue Water			
Apparent Losses	Unmetered					
Water Losses	Real Losses			Unauthorised Consumption		
		Customer Metering Under-registration				
Water Imported	(allow for bulk meter errors)		Leakage on Mains			
			Leakage and Overflows at Service Reservoirs			
			Leakage on Service Connections up to the street/property boundary			

Over the last 8 years what might have changed with customer meter age and accuracy?

Lets look at the age profile of the meter fleet.

Case Study – Increased NRW

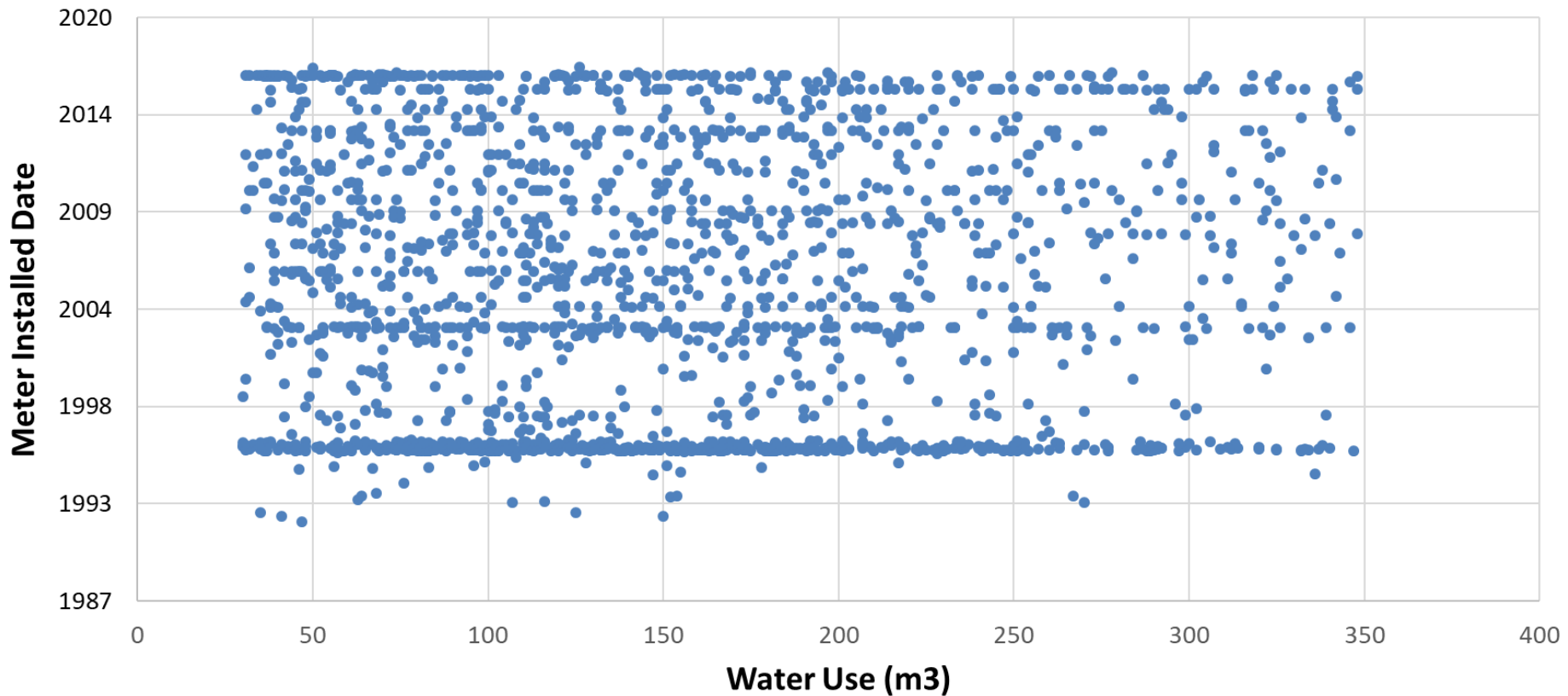
Firstly – Look at a Graph of Population since 1940



Case Study – Increased NRW

Let's look at the Customer 'Meter Fleet'

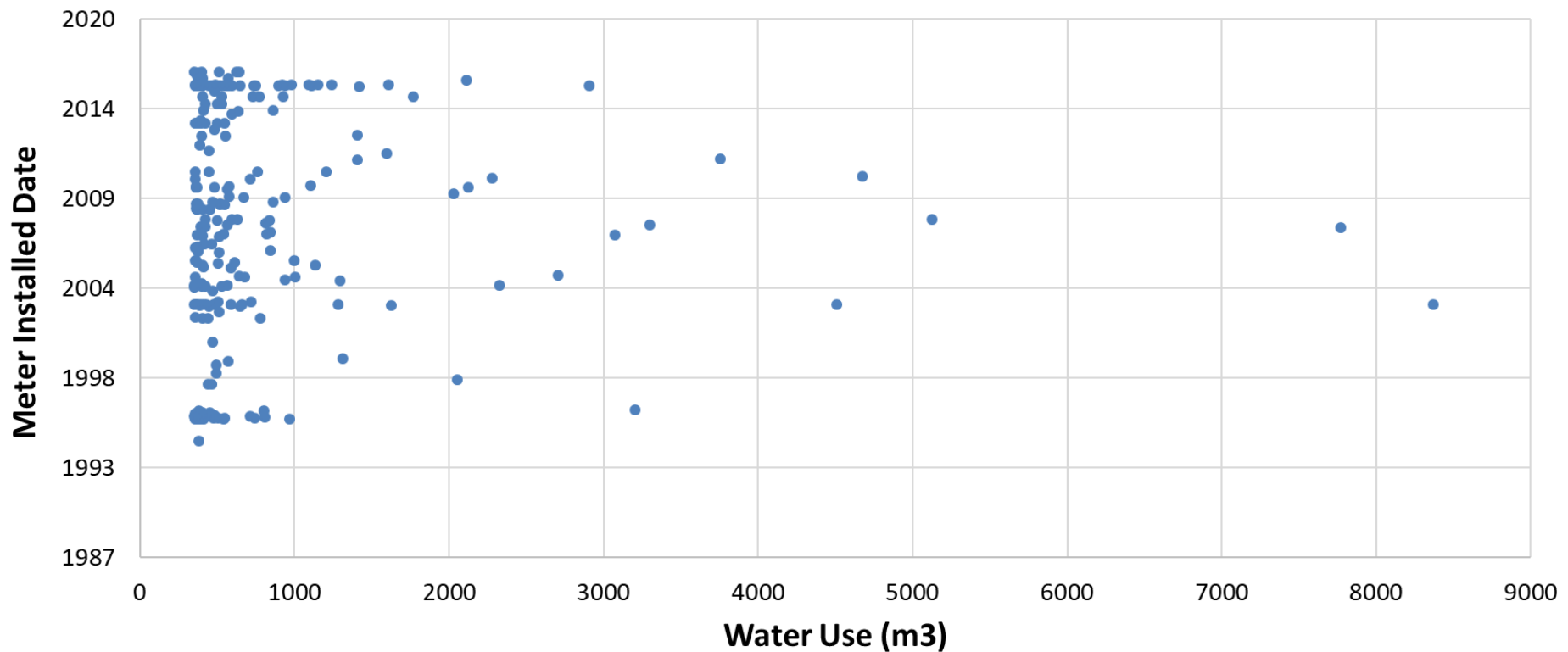
Meter Installed Date for Accounts with 30 - 350 m³ Water Use in 2017 - 2018



Case Study – Increased NRW

Let's look at the Customer 'Meter Fleet'

**Meter Installed Date for Accounts with 350 m3 or more Water Use in 2017 - 2018
(except Large Factory)**



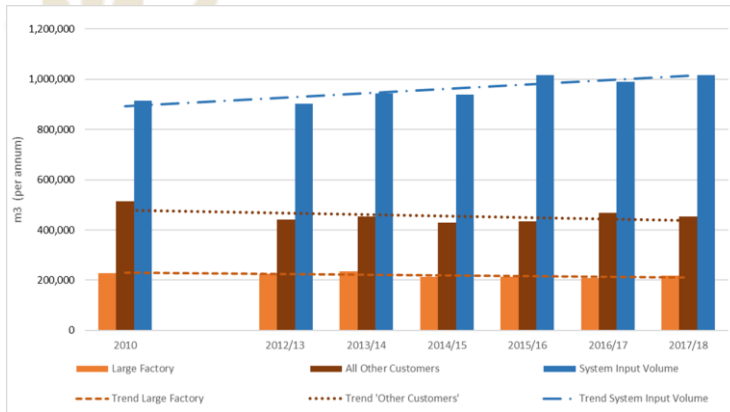
Case Study – Increased NRW

Billed Metered Consumption – Conclusions

- Population is static over the last 8 years
- Billed Consumption is reducing slightly over time and calculated water use per capita is low. This could be due to inaccurate meters – **BUT** -
- Meter Fleet has reasonable age profile, and the predominant meter type is a reliable brand. The two meters for the large factory are magflo meters.
- It is likely that meter under-registration is 2 – 3%.
Testing a sample of meters is recommended to confirm this.

Case Study – Increased NRW

For this case study, the increase in NRW is most likely due to an increase in Real Water Losses



Own Sources	System Input	Water Exported			Billed Water Exported to other Systems	Revenue Water	
		Water Supplied	Authorised Consumption	Billed Authorised Consumption	Billed Metered Consumption by Registered Customers		
Billed Unmetered Consumption by Registered Customers							
Water Imported	(allow for bulk meter errors)		Water Losses	Unbilled Authorised Consumption	Metered Unmetered	Non-Revenue Water	
				Apparent Losses	Unauthorised Consumption		
			Real Losses	Customer Metering Under-registration			
				Leakage on Mains			
				Leakage and Overflows at Service Reservoirs Leakage on Service Connections up to the street/property boundary			

NOTE: This is what is generally assumed, but **it should not be assumed!** In some countries, customer meter under-registration accounts for half or more of NRW.

KEY MESSAGE –

DATA CAN ANALYSED TO IDENTIFY THE LIKELY MAKEUP OF NRW

A Similar Case Study

Analysis of Customer Water Use

		Split of 2017-2018 Customer Billed Water Use (Excluding Two large Accounts)				
	Units	Water Use 350 m3 or more	Water Use 30 - 350 m3	Water Use 1 - 30 m3	Water Use 0 m3	Check Total
Billed Volume for 2017-2018	m3	221,380	160,161	1,940	0	383,481
Percentage of Total Billed Volume	%	49.6%	35.9%	0.4%	0.0%	86.0%
Number of Accounts		170	1,216	144	197	1,727
Percentage of Number of Accounts	%	9.8%	70.4%	8.3%	11.4%	100.0%
Average Billed Volume	m3	1,302	132	13		
Average Water Use per day	m3/conn/ day	3.568	0.361	0.037		0.608
Average Water Use per day	litres/conn/ day	3,568	361	37		608
Average water use per person/day - assuming average occupancy of 2.1	litres/person/ day		172			

Managing NRW

Options for Testing Customer Water Meters

1. Remove meter and carry out a '**Bench Test**' – test meter at low, medium, high flow rates;
2. Install a **new accurate meter 'in series'** with the existing meter and monitor over weeks or months;
3. Use a '**20 litre calibrated container**' (for smaller sized meters). Check no leaks, then fill container using outside tap (at various flowrates) and record 'full' meter readings before and after. **This is LOW COST and effective.**

Managing NRW

Options for Testing Customer Water Meters

4. For large properties use an 'ultra-sonic' clamp-on meter in series (if ready access), or a metered standpipe if there is a hydrant on site.



Managing NRW

Meter Starting Flow

Many meters won't record up to 10 litres/hour

Dripping tap – 2 litres/hour

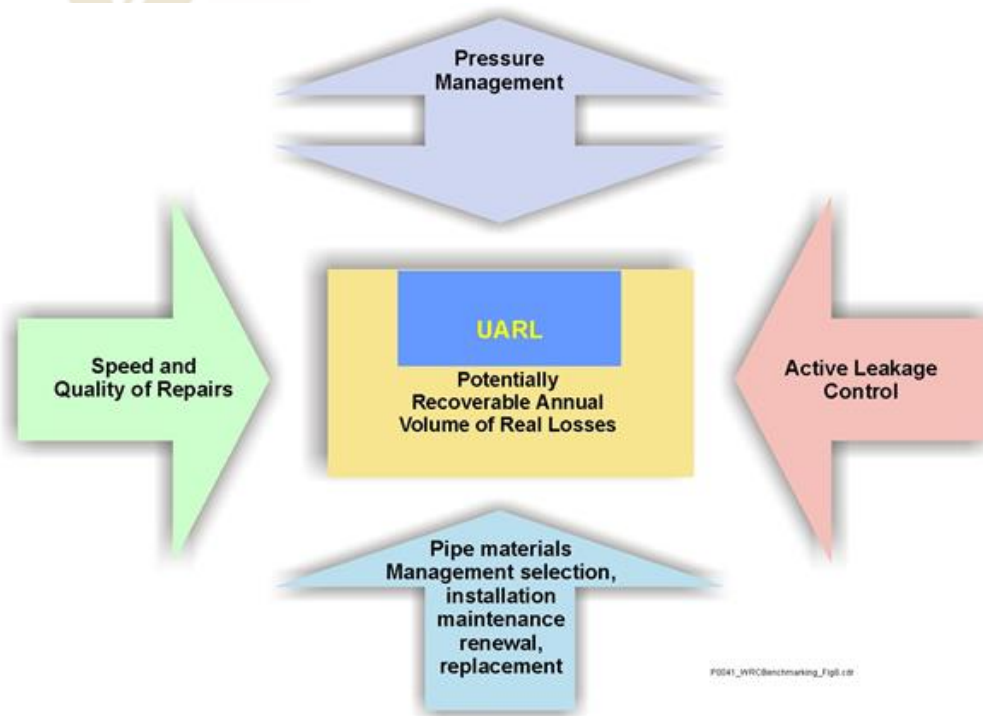
2mm Tap Flow - 5 litres/hour

For Case Study – say 1,000 of 2,345 connections have dripping/ leaking taps, toilets leaking, overflowing hot water cylinders etc. at 10 litres/hour not being recorded on the meter for 22 hours/day (when there is no other water use) = 220 litres/day x 1,000 = 220 m³/day

This would account for 8% of the 35% NRW!

Managing NRW

Managing Real Losses



Own Sources	System Input	Water Exported	Billed Water Exported to other Systems		Revenue Water	
		Authorised Consumption	Billed Authorised Consumption	Billed Metered Consumption by Registered Customers		
Water Imported	(allow for bulk meter errors)	Water Supplied	Authorised Consumption	Billed Unmetered Consumption by Registered Customers	Revenue Water	
				Unbilled Authorised Consumption		Metered
				Apparent Losses		Unmetered
				Water Losses		Customer Metering Under-registration
			Real Losses	Leakage and Overflows at Service Reservoirs Leakage on Service Connections up to the street/property boundary	Non-Revenue Water	

The Four Complementary Leakage Management Activities

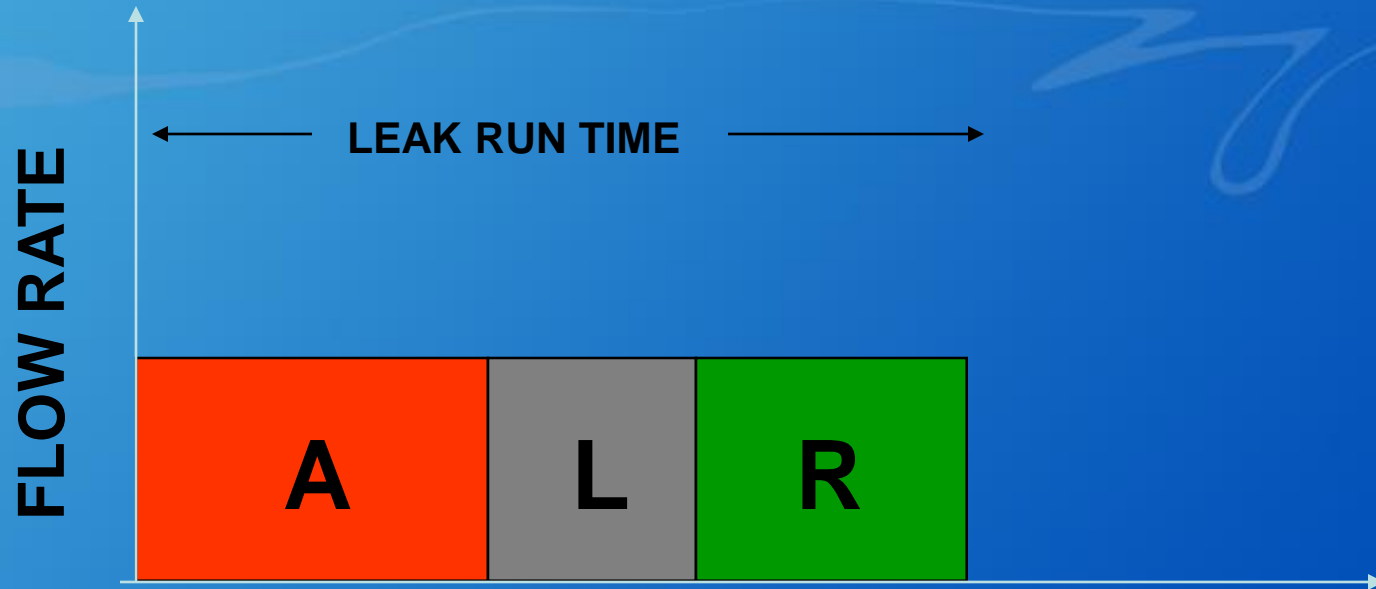
Managing NRW – Speed and Quality of Repairs



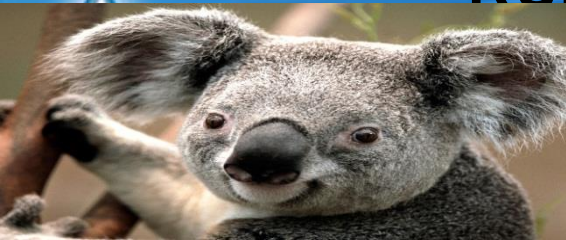
**Fixing Leaks
Quickly**

Leak Run Time Awareness

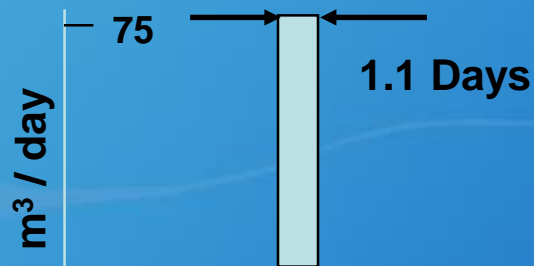
Leak Volume Loss = (A+ L+R) Time x Flow Rate



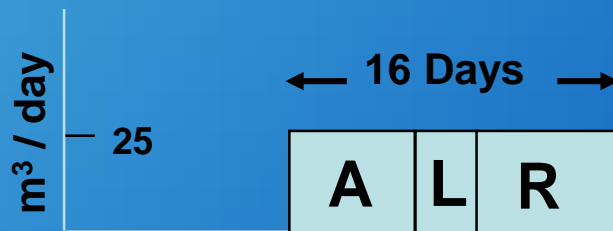
RUN TIME = *Awareness + Location + Repair



Bursts with high flow rates don't produce the largest volumes of Real Losses! Run time is a key factor.



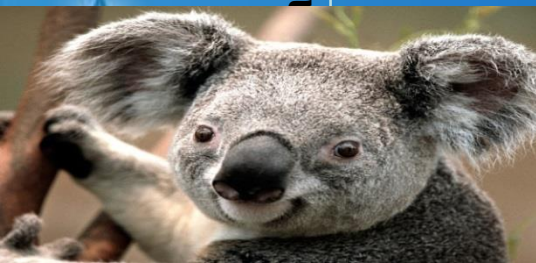
**reported mains
burst
82.5 m³**



**reported service
connection burst
400 m³**

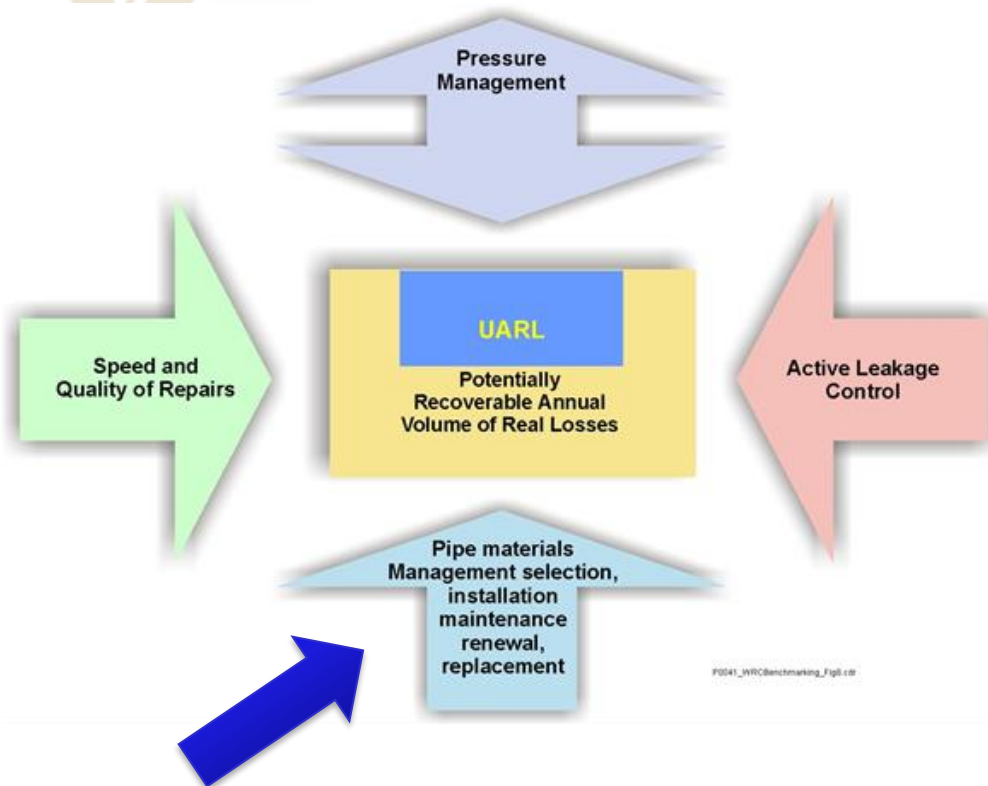


**unreported service
connection burst
> 4500 m³**



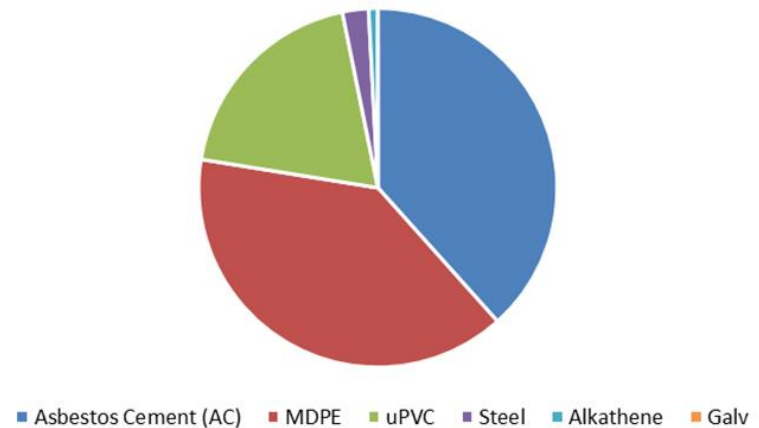
Managing NRW

Replacing OLD Leaking Watermains



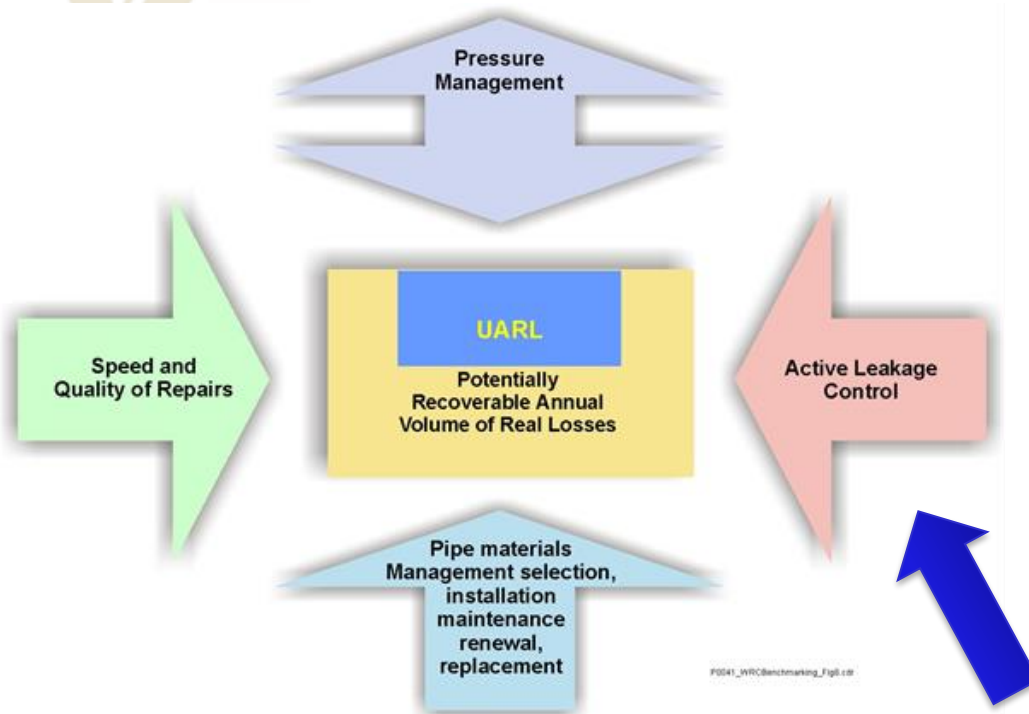
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Watermain Materials (% by length)



Managing NRW

Active Leakage Control



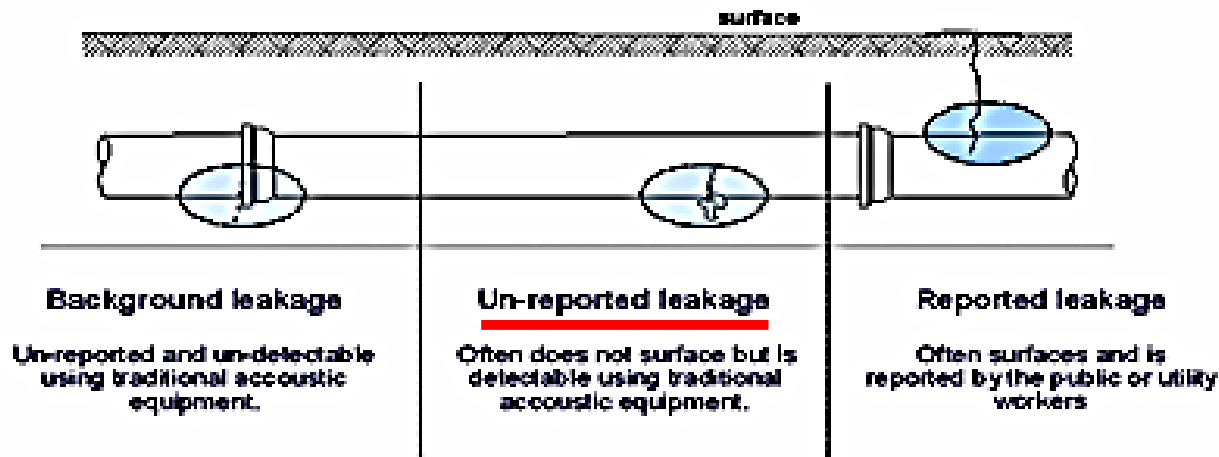
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		Water Losses	Real Losses	Leakage and Overflows at Service Reservoirs	
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The Four Complementary Leakage Management Activities

Active Leakage Control

Active Leakage Control (ALC) is the only way to locate 'Unreported' leaks.

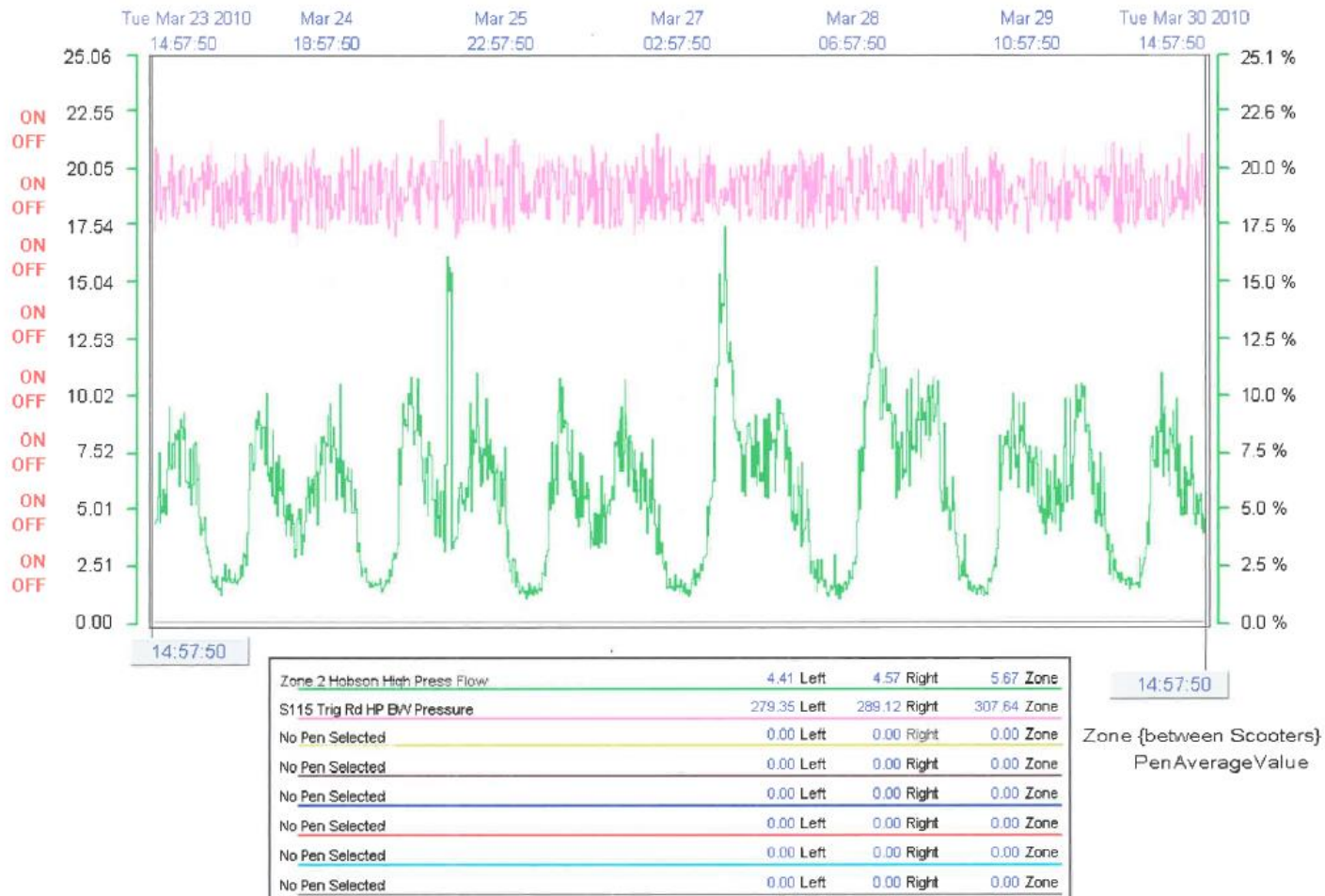
Categories of Network Leakage Background and Bursts Estimates (BABE)



Work SMARTER – Monitor Flows and Pressures (SCADA Screen Shots ex WCC)



WAITAKERE CITY COUNCIL HISTORICAL TREND



Examples of 'High' and 'Low' levels of leakage in a network or zone

Fig. A1: Weekly inflows, high leakage DMA

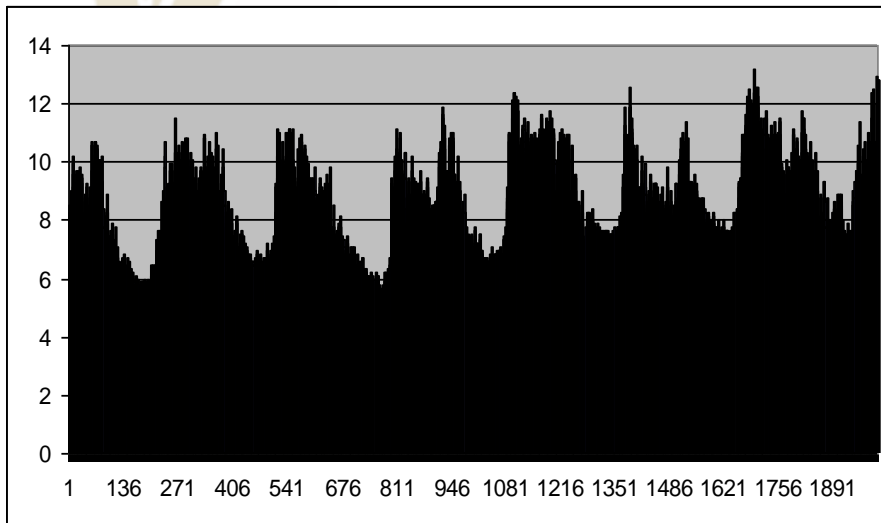
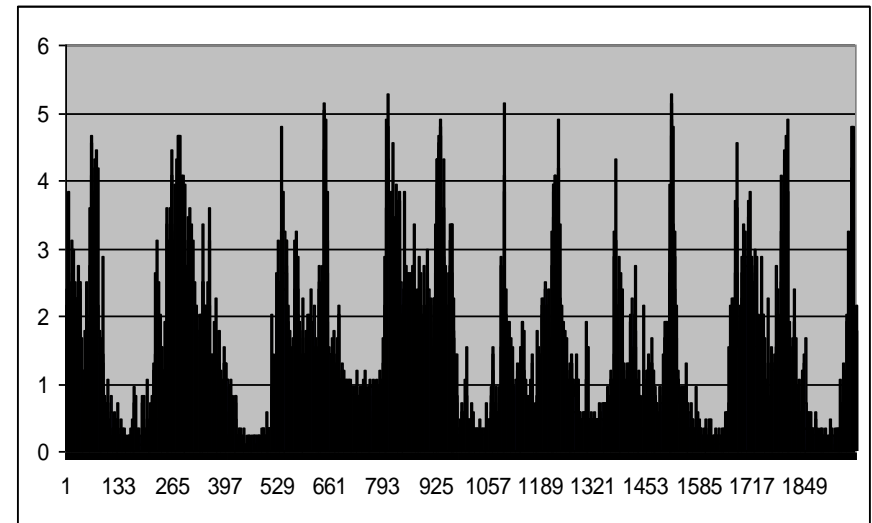
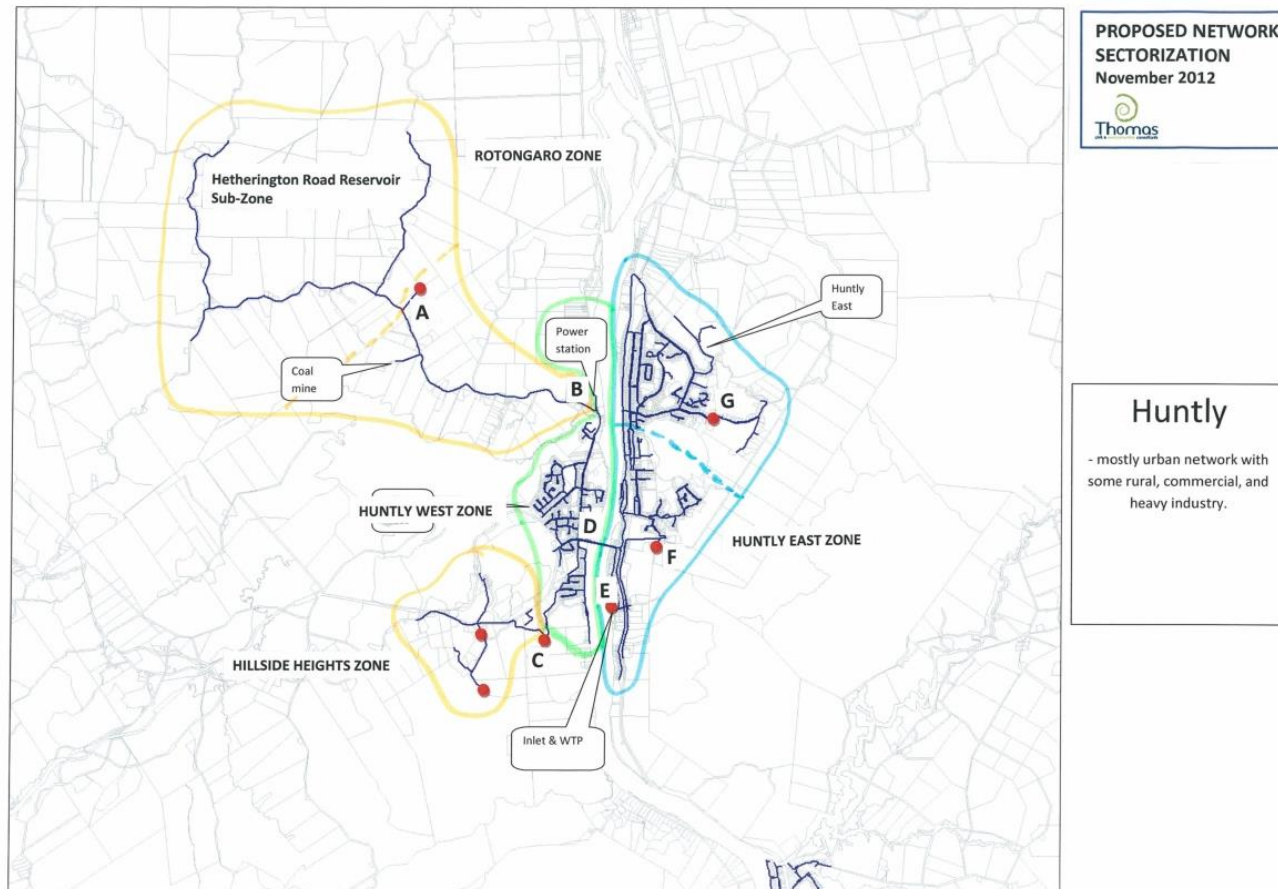


Fig. A2: Weekly inflows, low leakage DMA



Graphs from NZ Water Loss Guidelines

Work SMARTER - Sectorizing a Water Supply Network



Managing NRW

Managing Real Losses



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The Four Complementary Leakage Management Activities

To Summarise

- Remember that NRW has four components. **All four** need to be considered when managing NRW. **Don't assume anything!**
- Existing data sets can be used to identify the likely makeup of NRW.
- Meter accuracy is an important NRW issue. There are low cost, effective ways to check meter accuracy.

I encourage you to work
SMARTER when managing NRW.



Any Questions?

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