NRW Reduction Initiatives by JUSCO – A case Study from Jamshedpur, India

By

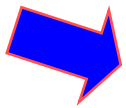
Pranay Sinha, Chief (Water Management), JUSCO

17th Oct 2008, Chennai

Parentage

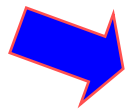
- Tata Sons
- Tata Steel Ltd.
- Tata Consultancy Services
- Tata Motors
- Tata Tea ….

(98 companies, 7 sectors)



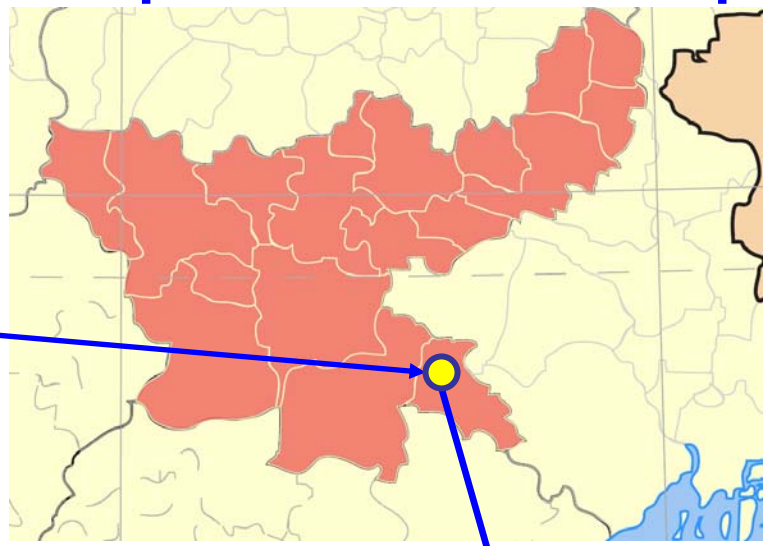
- Tata Steel
- JUSCO Ltd.
- T C I L
- TAYO Ltd ….

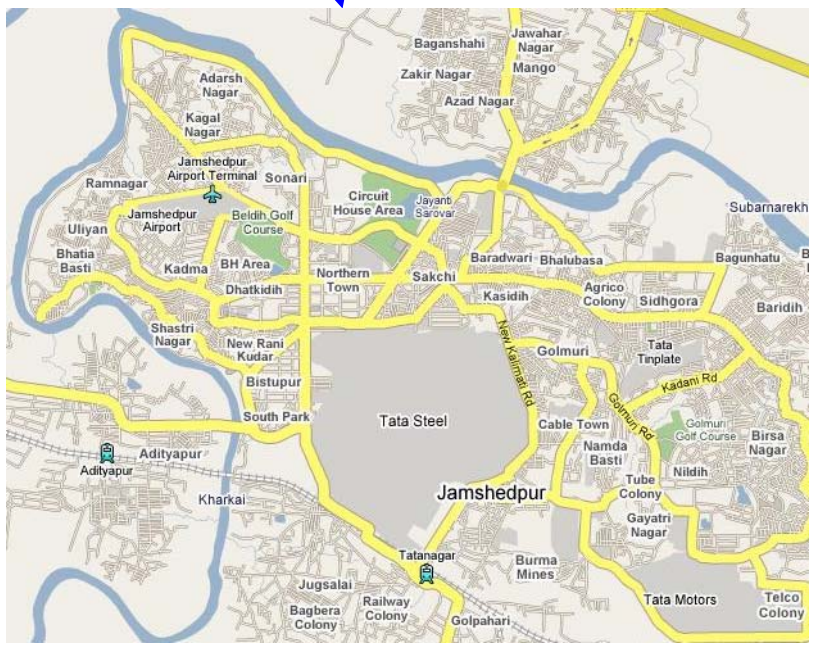
(59 companies)



- JUSCO Ltd.
- SEZAL
- NDITA

Location Map of Jamshedpur





Key Indicators	2004	2008
• Water Supply (*mld*)	160	173
• Non-Revenue Water (NRW)	44%	11.5%
• Number of Households Served	22000	52000
• Access to 24-hour water supply	5%	21%

The History

1907 : Tata Steel was established

1908-11: Steel township established

1918 : Town Division created

1919 : Township christened as Jamshedpur

August 25, 2003 : JUSCO was incorporated

April 1, 2004 : JUSCO became operational

9 decades of experience in providing civic & allied services

Size of operations at Jamshedpur

Area served – 64 sq km
Customer base – 0.7 million

Quality & Timely Supply of water

Products & Services

Water Services
- **Potable water**
- **Industrial water**
- **Treated sewage**

Power Services
- **Domestic power**
- **Commercial power**
- **Industrial power**

Fleet Management Services
- **Mobile equipment maintenance**

Planning Engineering & Construction
- **Civil construction**
- **Structural construction**

Public Health Services
- **Municipal solid waste management**

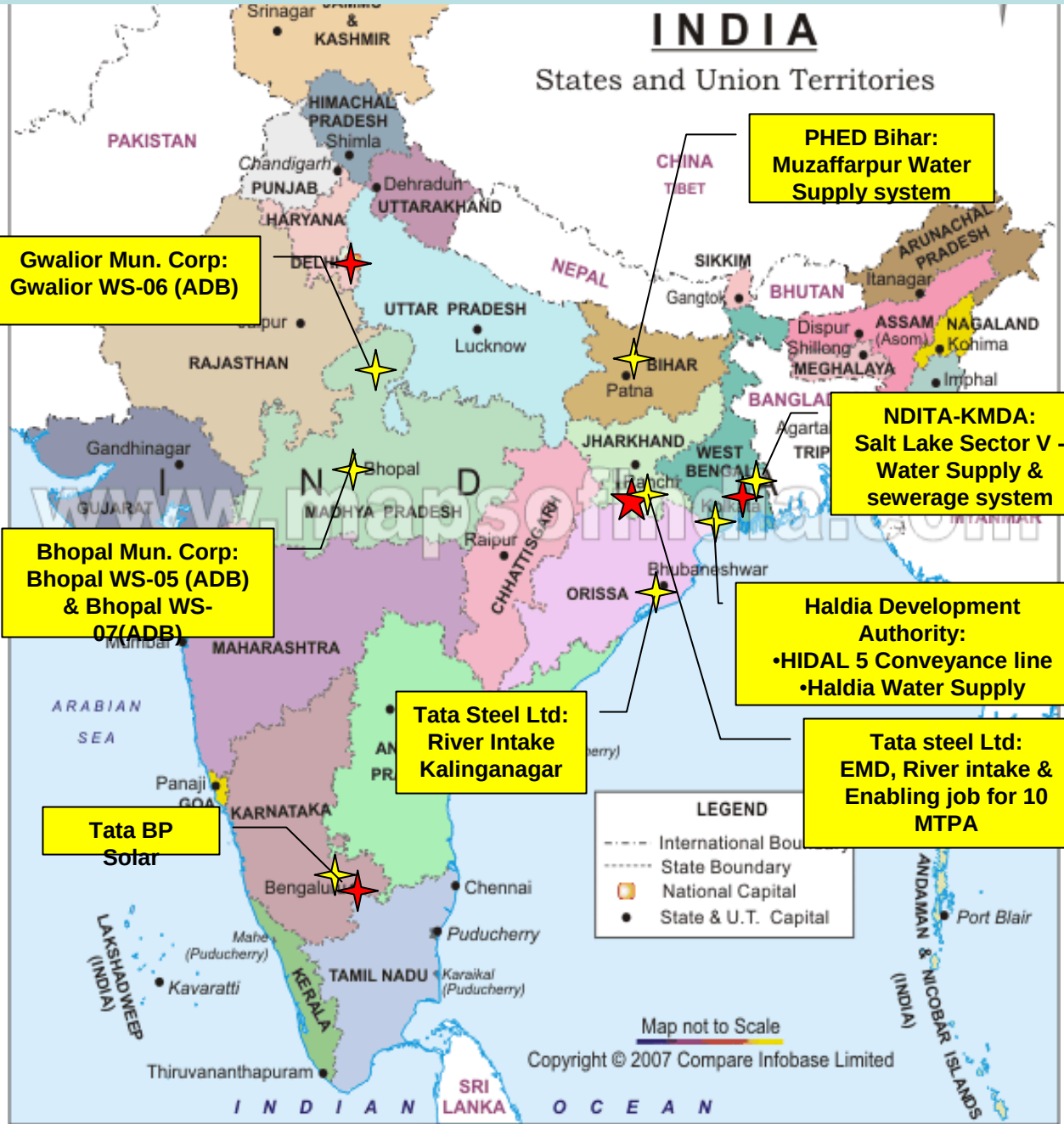
Water Supply Systems

RESERVOIR AND RIVER	TREATMENT PLANTS	PUMPING STATIONS	DISTRIBUTION FACILITIES
			
Dimna Reservoir & Subernarekha River	• Six Filtration Plants: total capacity 45 MGD	Seven Dstrbuton Towers	600 kilometers of distribution network

JUSCO'S GROWING PRESENCE – WATER SERVICES

- **Offices Setup at Out locations: Kolkata, Bangalore & Delhi.**
- **Site offices at Muzaffarpur, Haldia, Gwalior, Bhopal, Salt lake & Bangalore.**

Head Office
Regional Offices
Site Offices



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National Level Recognition

CRISIL Award 2004-05
for
‘Excellence in Improving Service Delivery through Corporatisation’

“JUSCO’s is probably the ‘first of its kind’ initiative in the country demonstrating the shift of urban services from a mere obligation to a viable business activity….

….The initiative has the potential to leave a mark in the history of Urban India’s developmental landscape….”

JUSCO won the prestigious "**5th Asia Water Management Excellence Award**" on April 1, 2008 at Kuala Lumpur Convention Centre in Malaysia, For its initiatives in **Water management and conservation**

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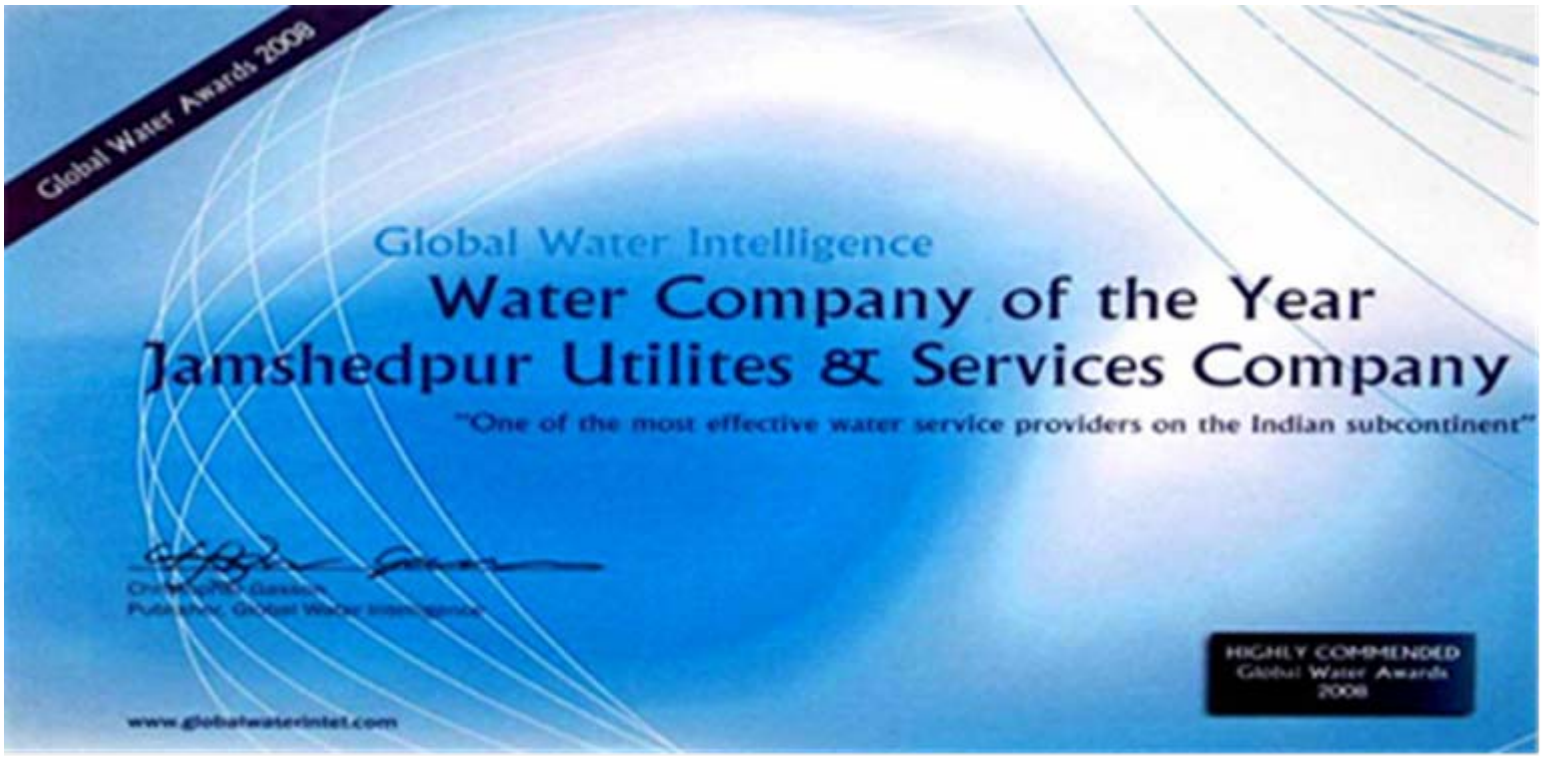
JUSCO has been conferred with Highly Commended Certification as “**One of the most effective water service providers on the Indian Subcontinent**” during the Global Water Intelligence Global Water Award 2008 function held on 21 April 2008 in London.



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Helping Sri Lankan Utility – under TWINNING Programme of ADB

Signed MoA as an Expert utility with NWSDB , Sri Lanka on 13th June, 2008 for reducing their NRW

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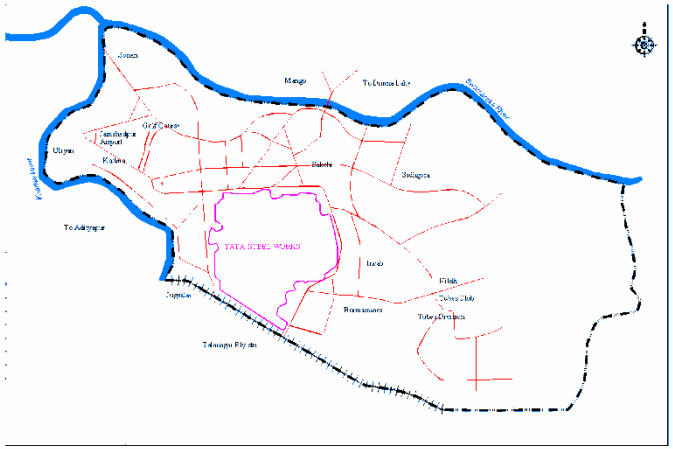
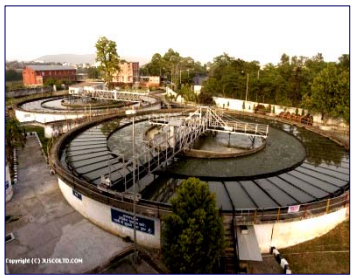
NRW Reduction Initiatives

JUSCO Experience



Jamshedpur Water & Wastewater system

Fact File	
Area served	64 sq. km
Population served	7.00 lakhs
Avg. daily consumption	206 lpcd
Length of Water Mains	600 kms
Length of Sewer lines	475 kms



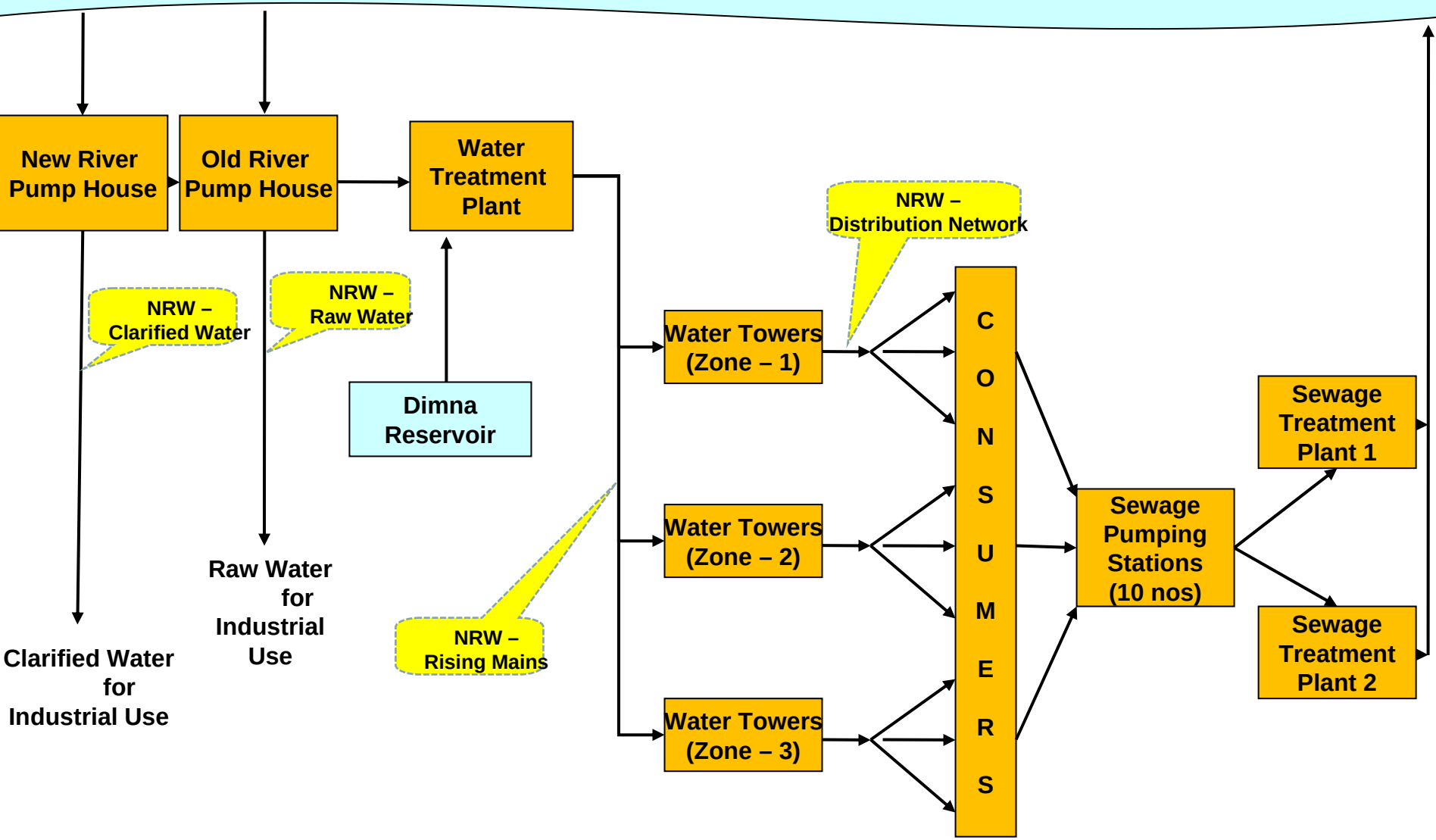
Water Infrastructure

- 2 River Pump houses : 264 MLD
- Raw Water Pump House : 173 MLD
- Clarified Water Pump House : 91MLD
- WTP capacity (potable water) : 190 MLD
- Dimna reservoir (1 month standby):35000 ML capacity
- 7 water towers : (46 ML)
- 600 kms of potable water network

•Wastewater Infrastructure

- 2 sewage treatment facilities : 64 MLD capacity
- 10 sewage pumping stations
- 475 kms of sewage collection network

Water Management – stage wise NRW



PROBLEM

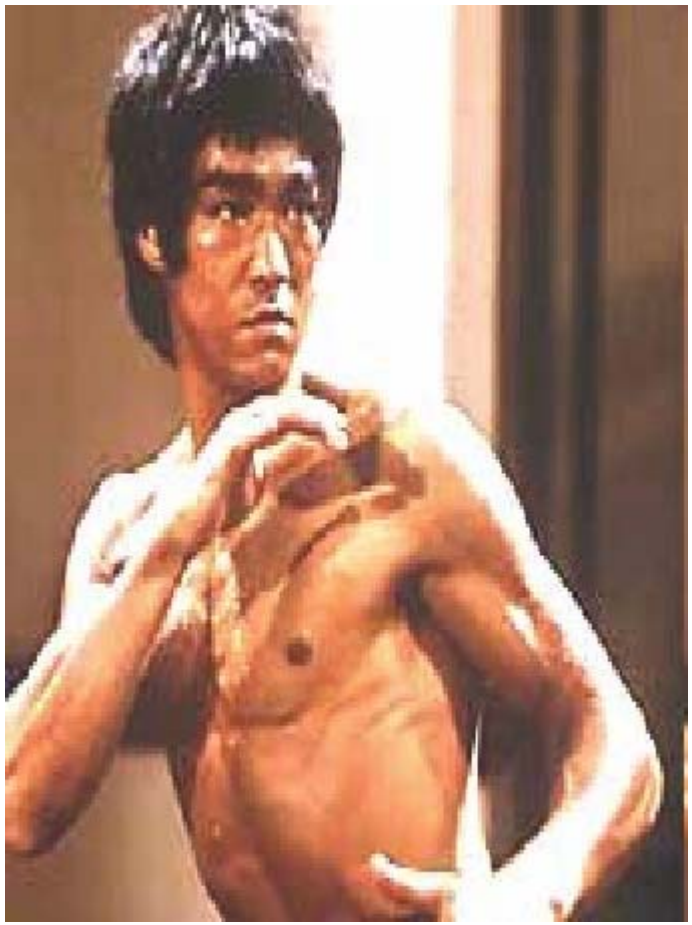
High Non – Revenue Water in Water Supply System

EXTENT OF PROBLEM

Percentage of Non Revenue water in FY 05

- **RAW WATER** — **29 % of 249 ML/day**
- **CLARIFIED WATER** — **23 % of 87 ML/day**
- **POTABLE WATER**
  - **RISING MAINS** — **12 % of 161 ML/day**
  - **DISTRIBUTION** — **36 % of 145 ML/day**

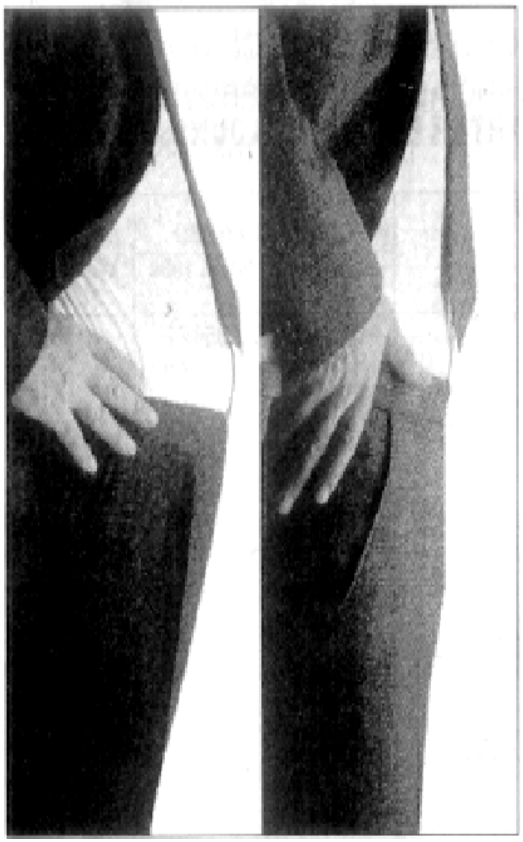
- **OVERALL NRW** — **33 % of 497 ML/day**



“Knowing is not enough, we must apply.
Willing is not enough we must do.”
- Bruce Lee

Knowing Doing Gap

OBJECTIVE : IDENTIFY AND MINIMIZE LOSSES



Earlier Scenario –Issues & Challenges

- Old Water distribution pipelines
- Non availability of maps/layouts
- Non availability of asset repository
- Information stored “skilled minds”
- No information on water supply & demand
- Limited use Topographical maps
- Designs - Thumb rule/traditional method
- No concept –pressure Management/DMA
- Meters- what / How ???

THEME

To reduce the Non Revenue Water for

- **Raw water**
- **Clarified water**
- **Potable Water**
  (Rising Mains and Distribution Network)

To the world bench mark levels:

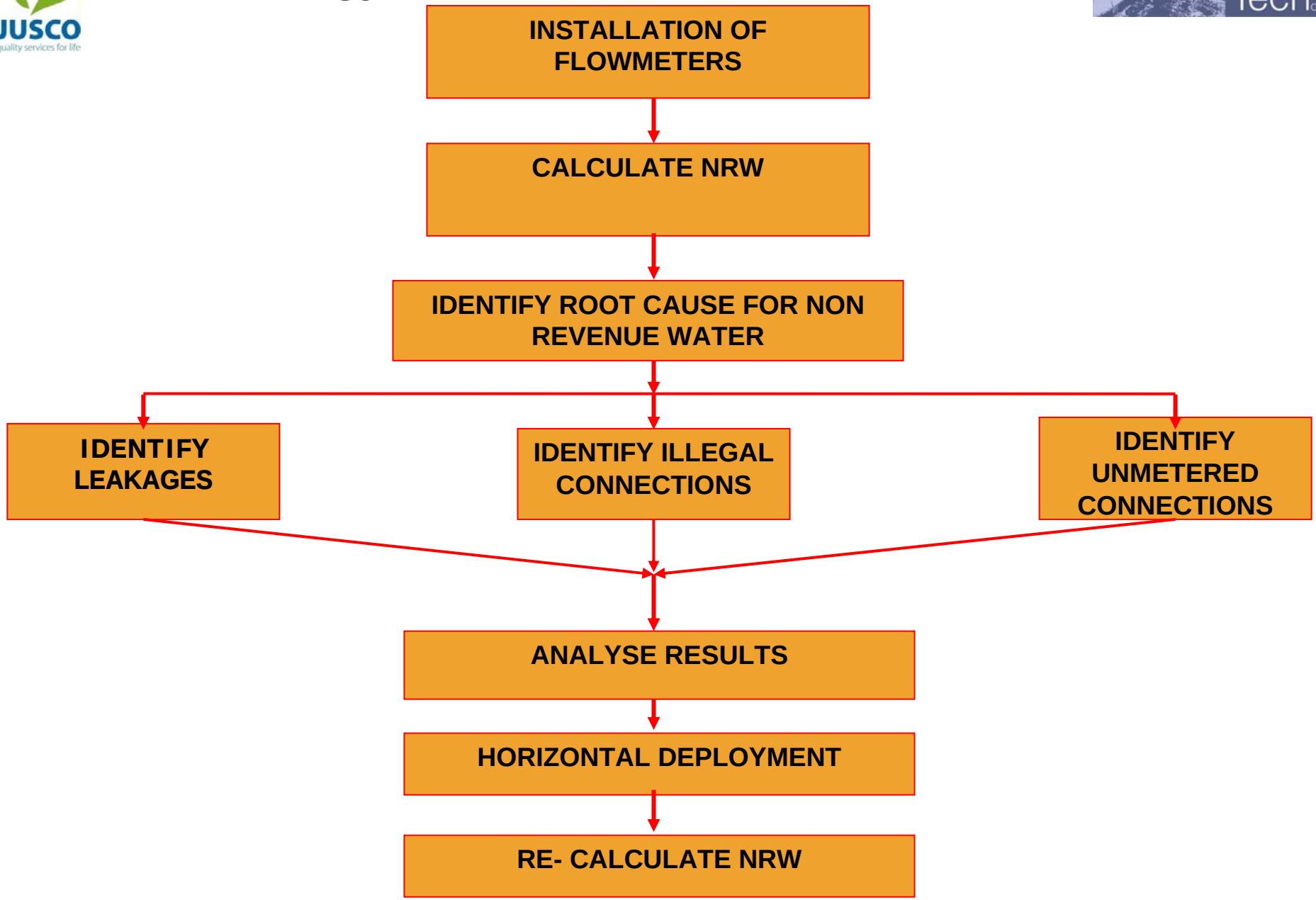
Singapore (4 %)

Non-Revenue Water

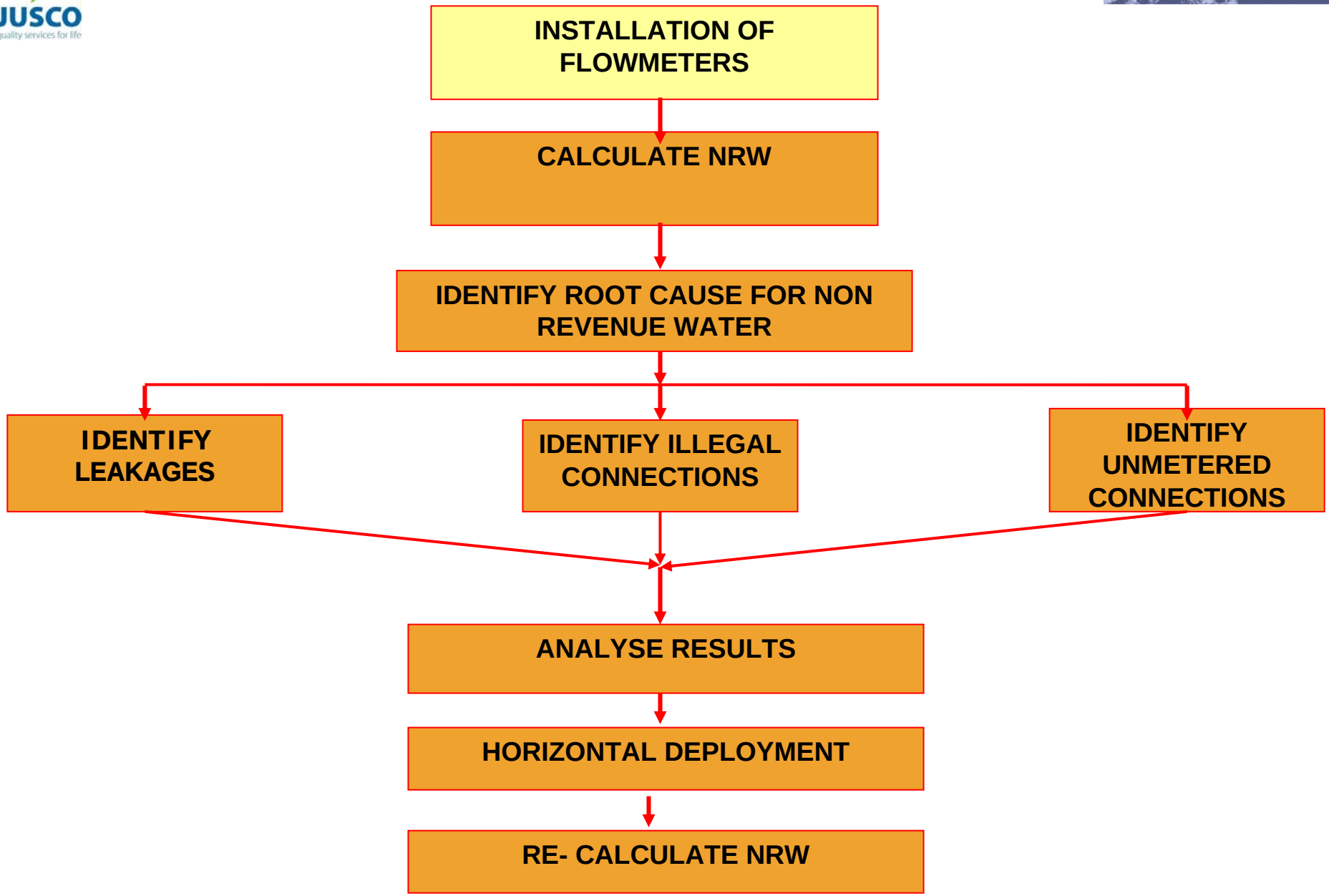
Water loss occurs in all distribution systems - only the volume of loss varies.

- **How much** water is being lost?
- **Where** is it being lost from?
- **Why** is it being lost?
- **What** strategies can be introduced to reduce losses and improve performance?
- **How** can we maintain the strategy and sustain the achievements gained?

Methodology for Non revenue water loss reduction

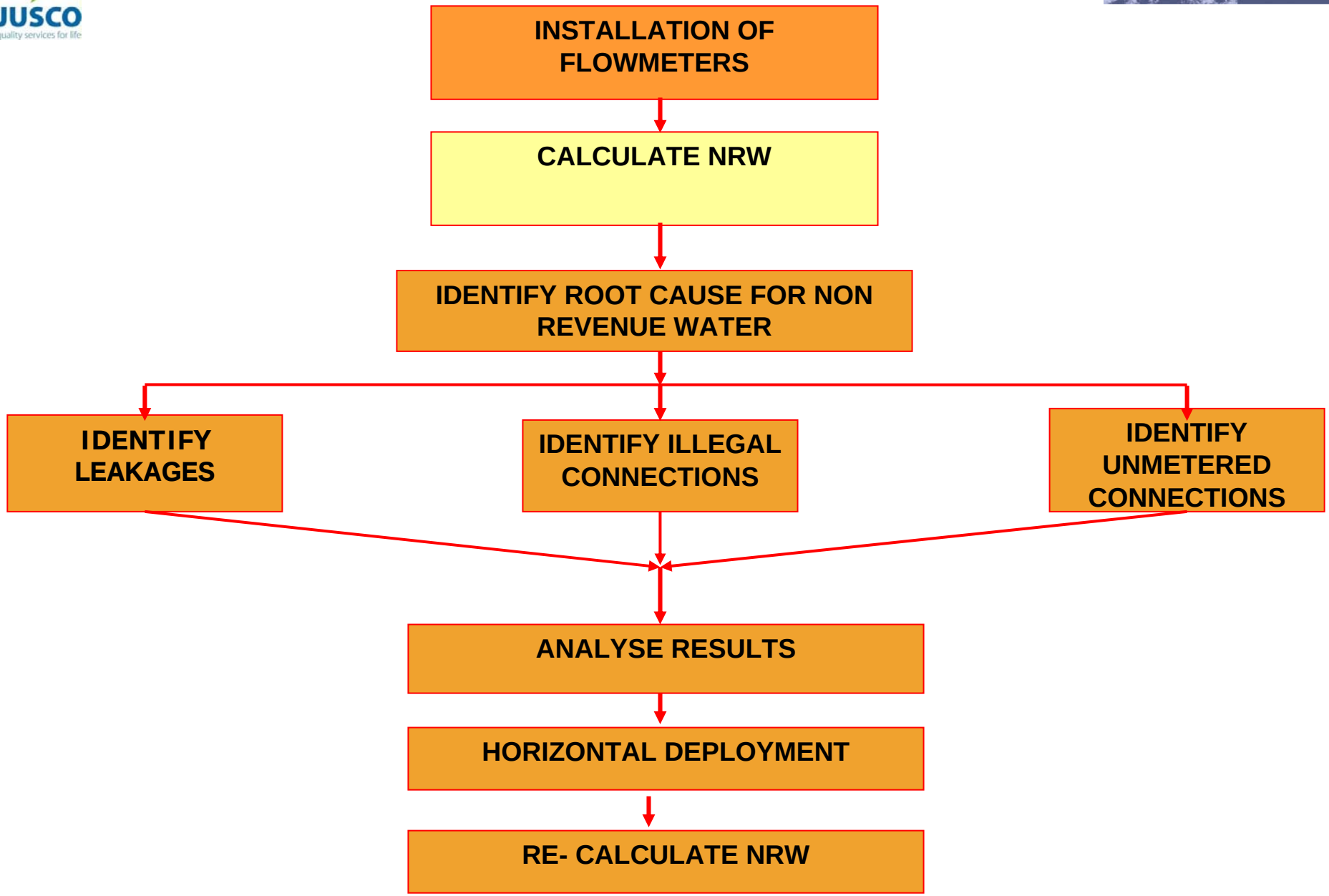


Methodology for Non revenue water loss reduction

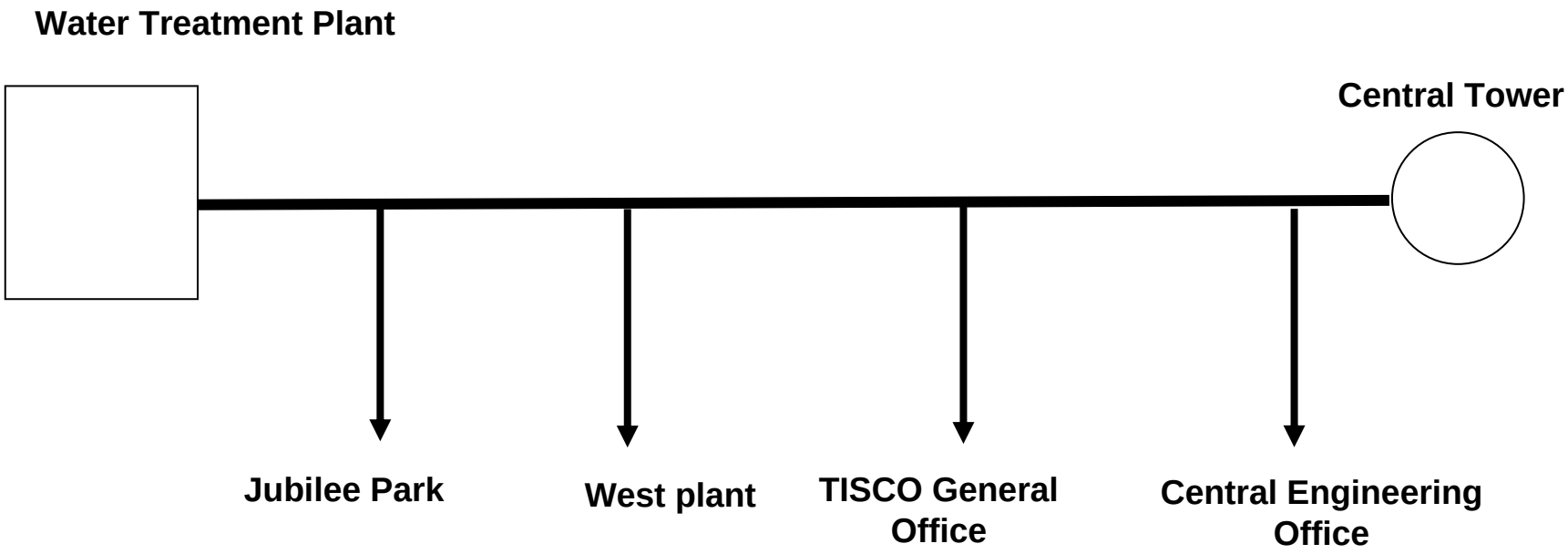


Electromagnetic Flow Meter installation

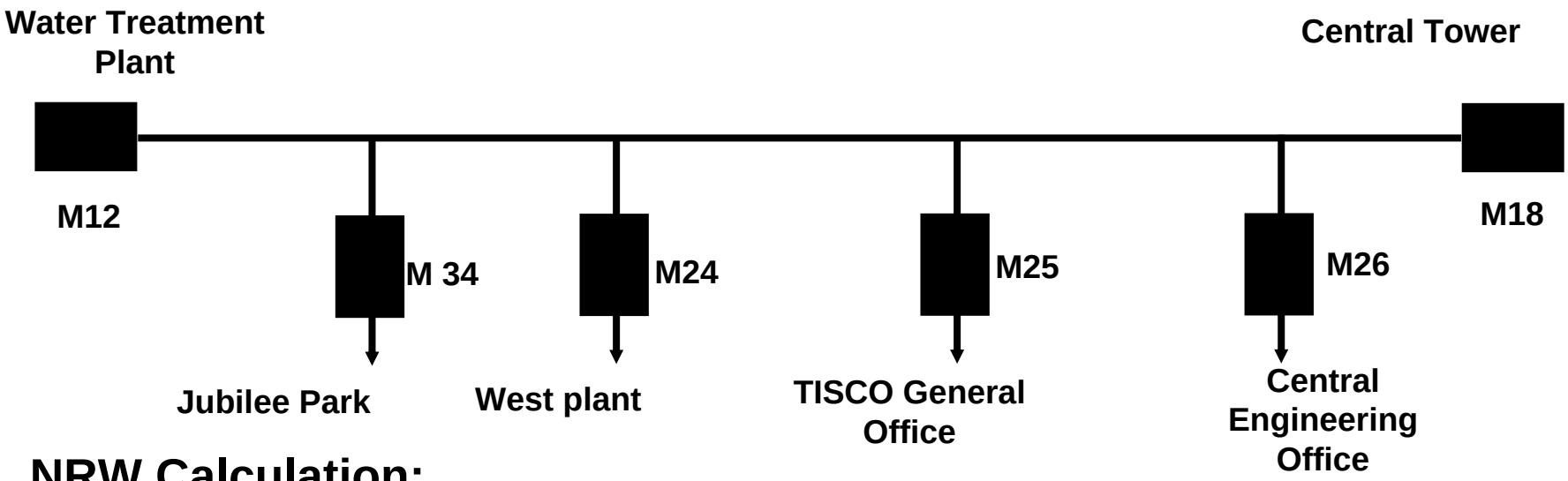
Methodology for Non revenue water loss reduction



Analysis: Example of NRW exercise: Central Rising Main



NRW Calculation : Central Rising Main



NRW Calculation:

NRW (Volume) = Water Supplied – Water Consumed

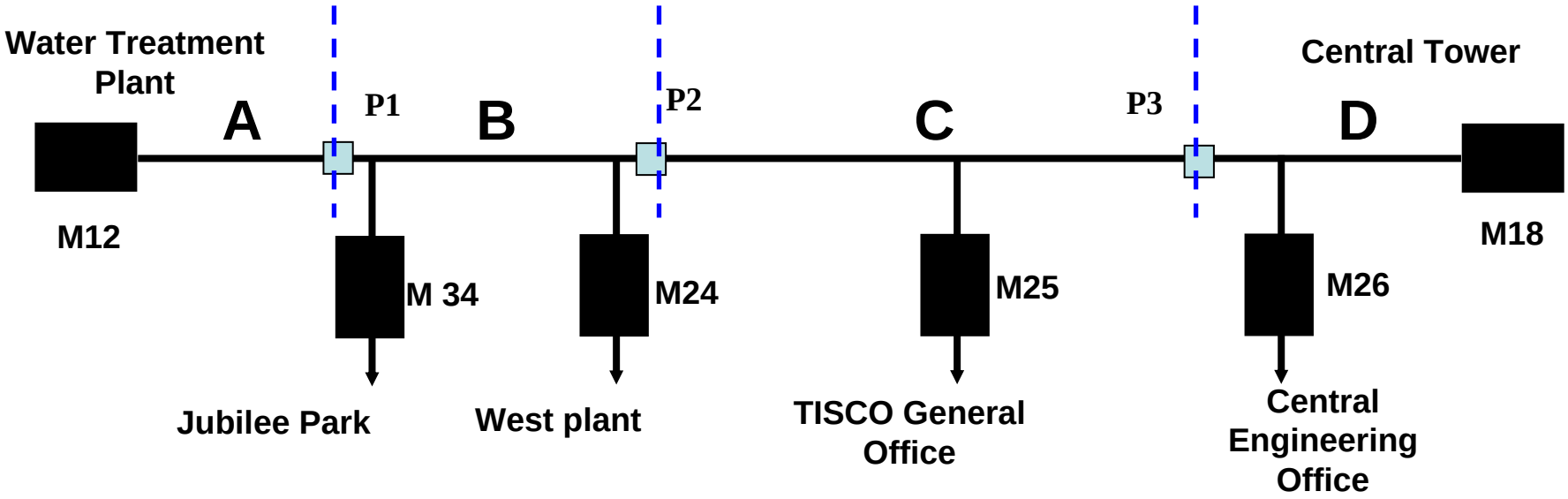
NRW in volume = M12 - (M34 + M24 + M25 + M26 + M18)

$$\text{NRW in \%} = \frac{\text{NRW Volume} * 100}{\text{M12}}$$

NRW (Central Rising) = 12 %

→ **Flow meters**

Sectional NRW Analysis



Theoretical Calculation:

M 12 = P1

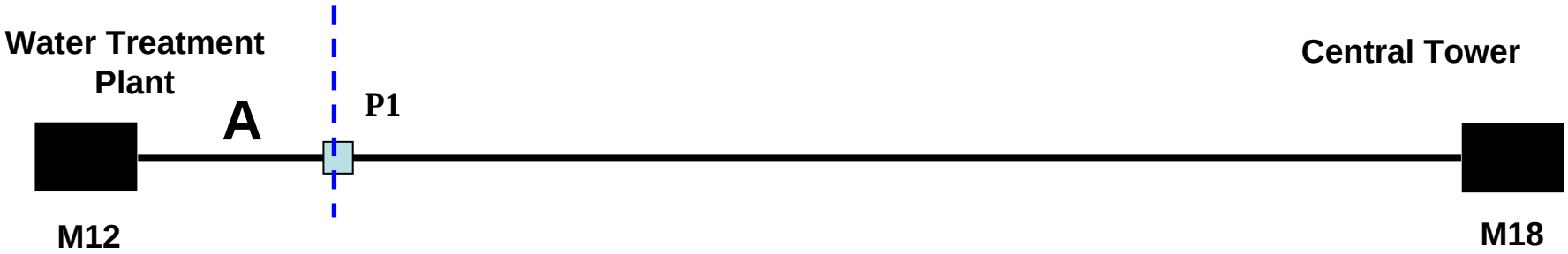
P1 = P2 + M 24 + M 34

P 2 = P 3 + M 25

P 3 = M 18 + M 26

Sectional NRW Analysis

Section A



Theoretical Calculation:

M 12 = P1

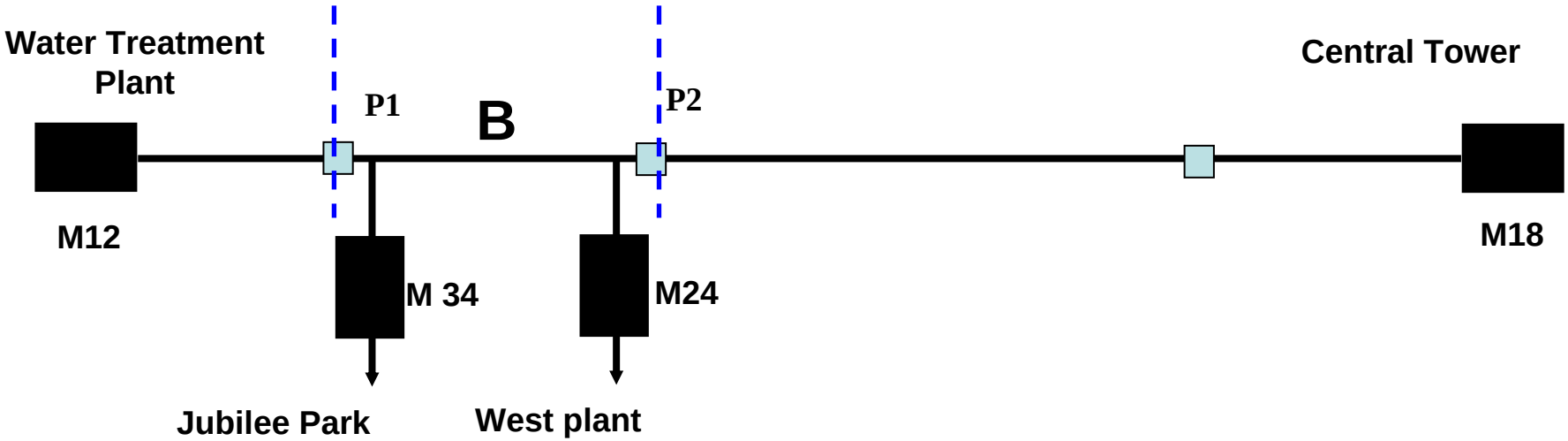
Actual Calculation:

M 12 = P1

Water Supplied = Water Consumed

Sectional NRW Analysis

Section B



Theoretical Calculation:

P1 = P2 + M 24 + M 34

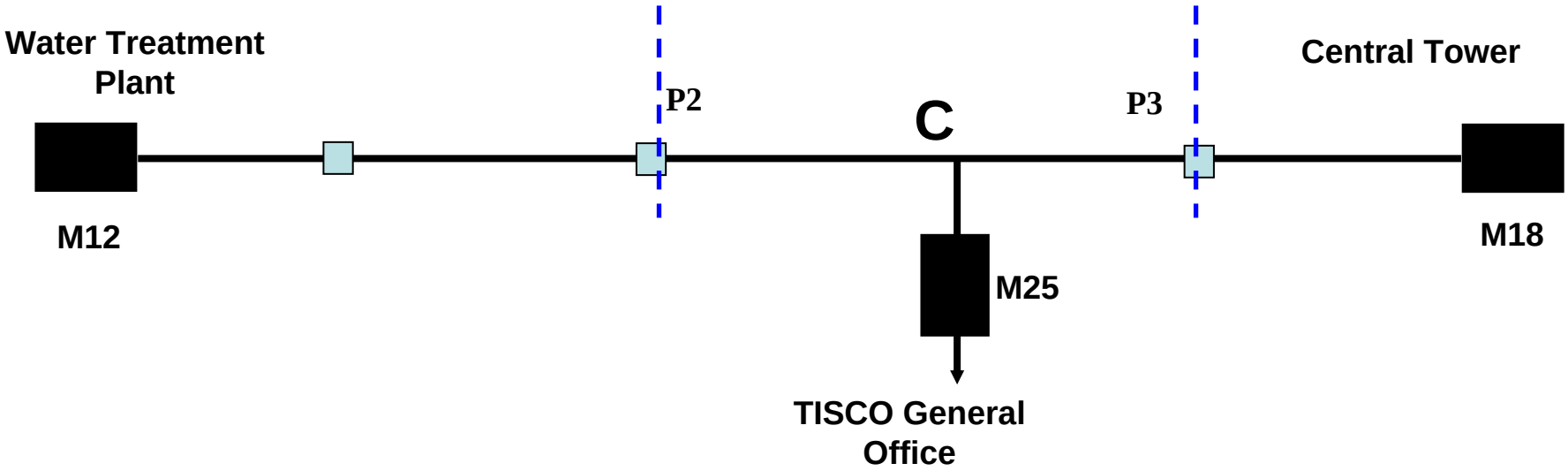
Actual Calculation:

P1 > P2 + M 24 + M 34

Water Supplied > Water Consumed

Sectional NRW Analysis

Section C



Theoretical Calculation:

P 2 = P 3 + M 25

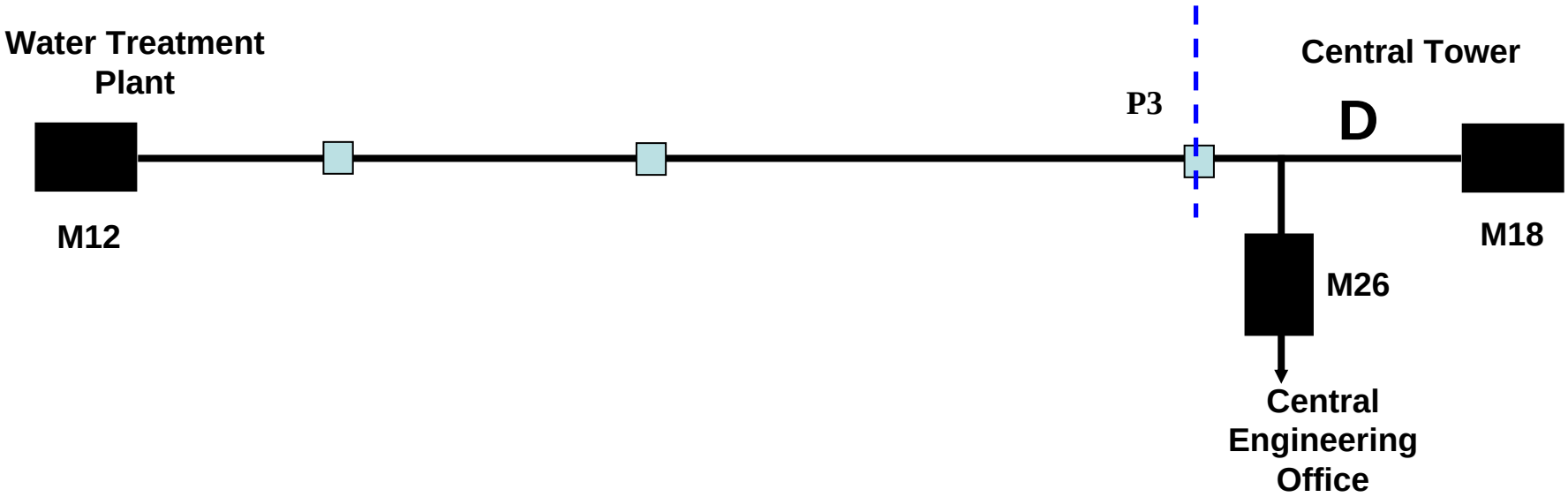
Actual Calculation:

P 2 = P 3 + M 25

Water Supplied = Water Consumed

Sectional NRW Analysis

Section D



Theoretical Calculation:

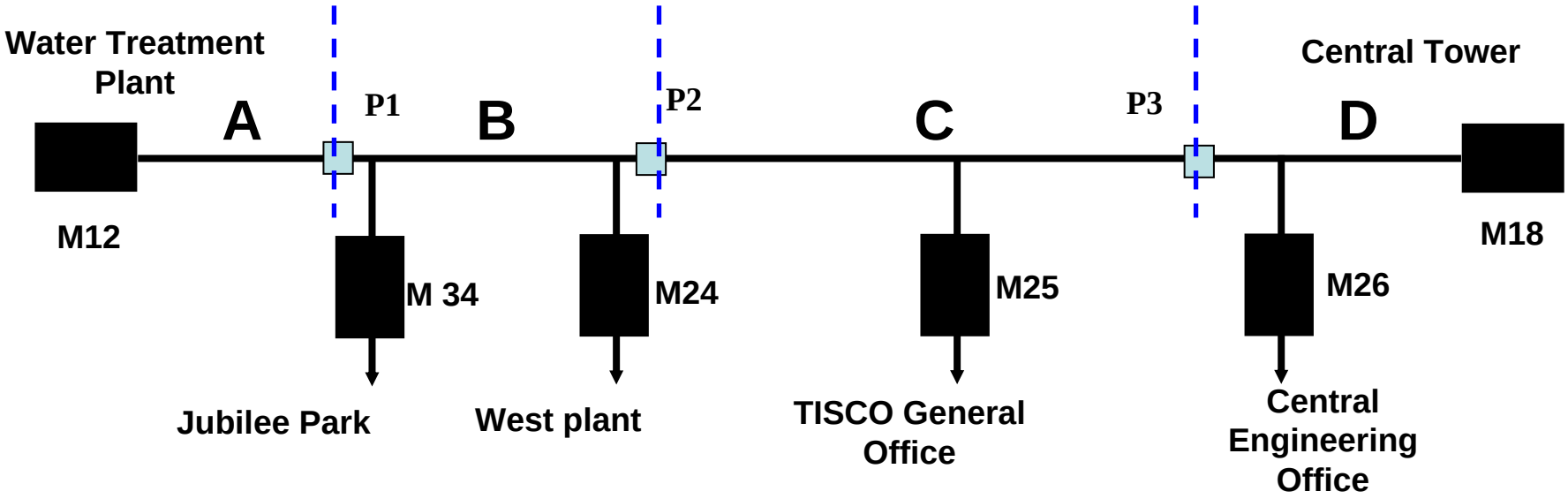
P3 > M26 + M 18

Actual Calculation:

P3 > M26 + M18

Water Supplied > Water Consumed

Sectional NRW Analysis



Theoretical Calculation:

M 12 = P1

P1 = P2 + M 24 + M 34

P 2 = P 3 + M 25

P 3 = M 18 + M 26

Actual Calculation:

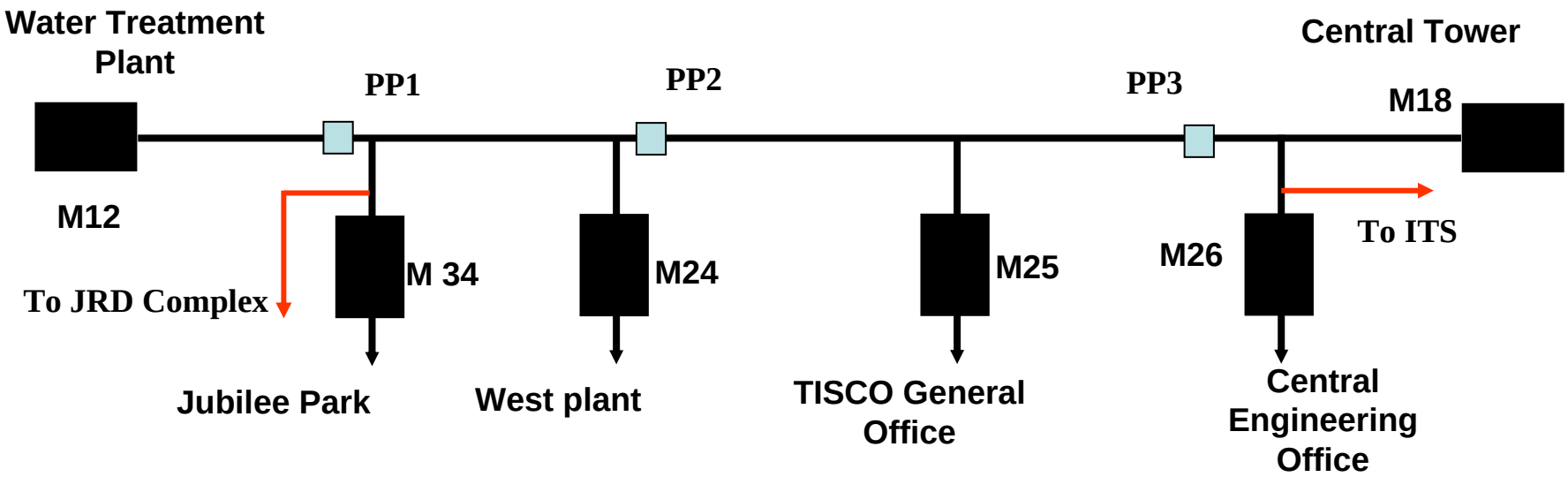
M 12 = P1

P1 > P2 + M 24 + M 34

P 2 = P 3 + M 25

P3 > M 18 + M 26

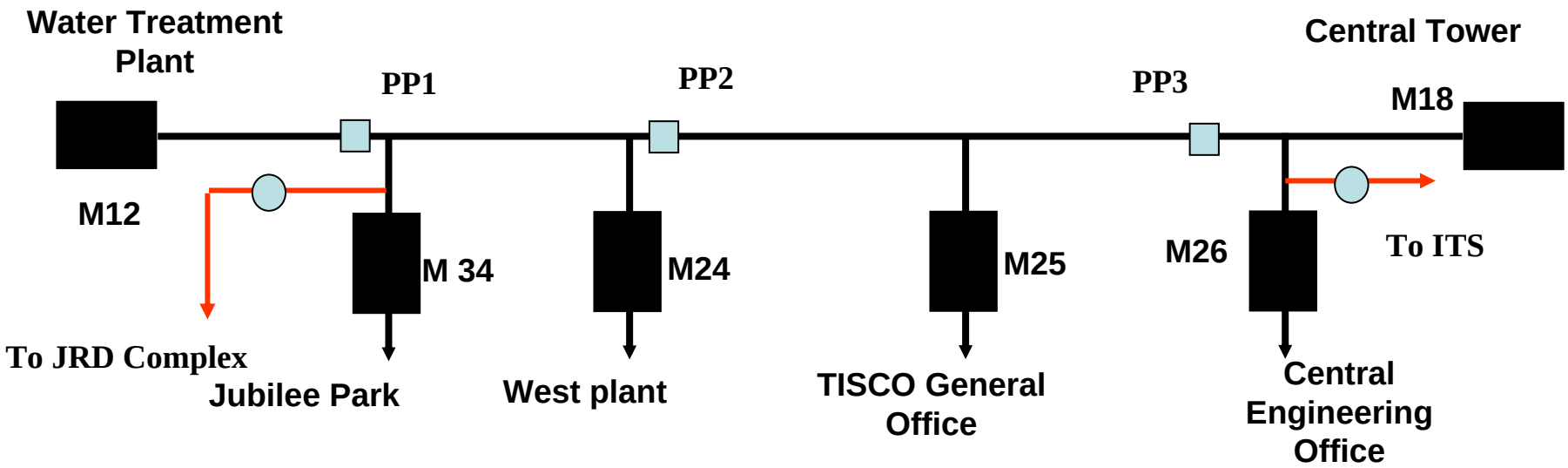
Rising Main - Sectional NRW Analysis



Findings :

- connection to JRD complex
- Connection to ITS

Rising Main - Sectional NRW Analysis



Results :

- **Metering of JRD complex – NRW reduced from 12 % to 8 %**
- **Metering of line to ITS – NRW reduced from 8 % to 4 %**

Mechanical Meter

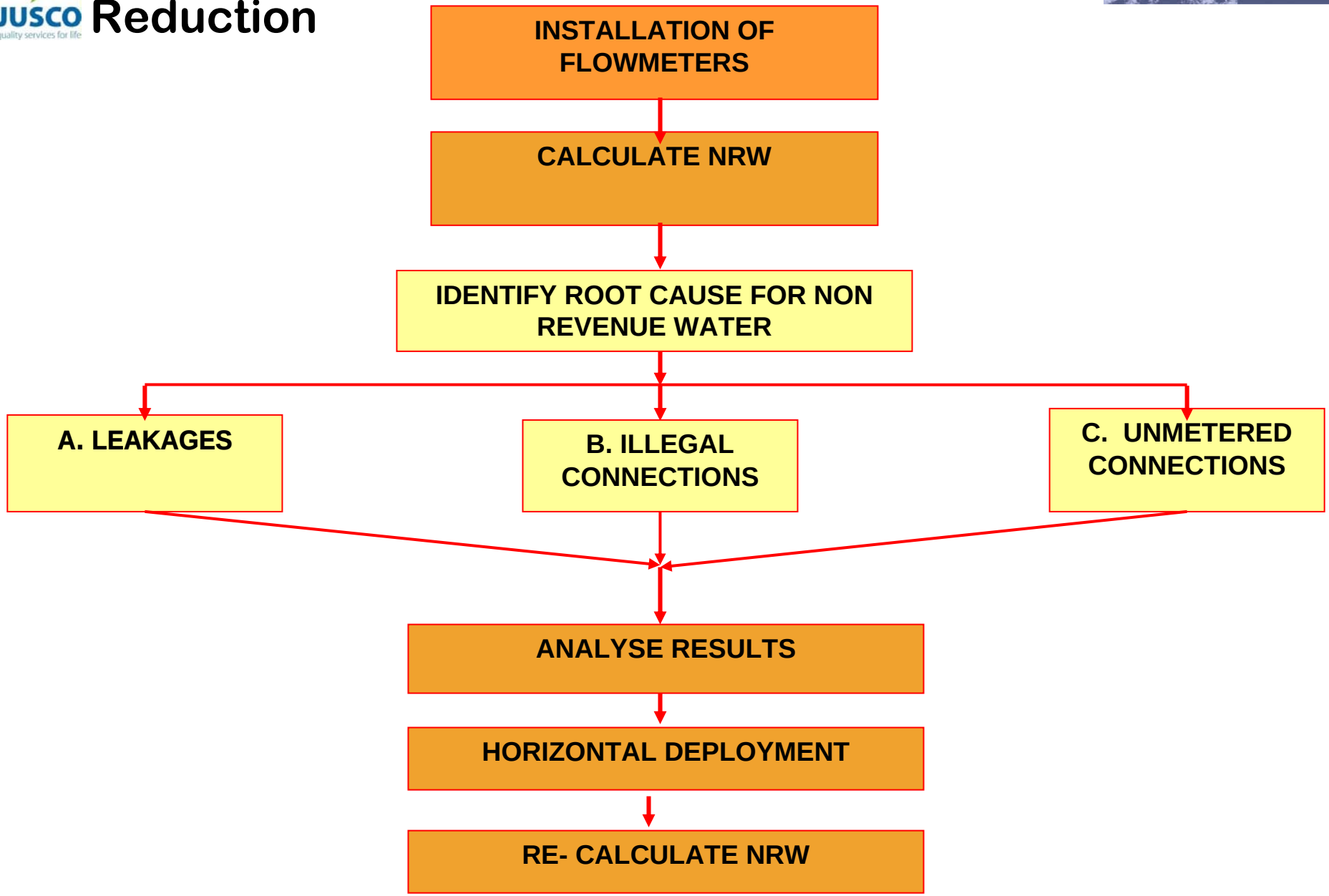
Root Cause

Improper / Incomplete registration of network

Solution

Mapping of all pipe lines

Methodology for Non-Revenue Water Loss Reduction



Concept of NRW Reduction

1. Install Flow meters

1.1 Estimate NRW

Loss quantity
= Supply Volume – Consumption Volume

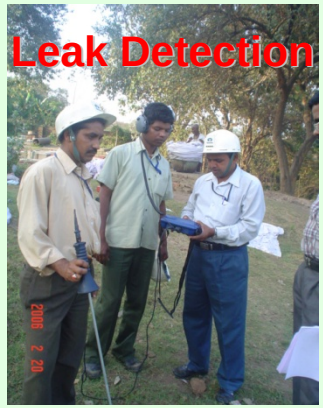
Implement Tools
- Identification of Networks
- Install Flow Meters
- Calcualte NRW

2. Identify Root Cause for NRW

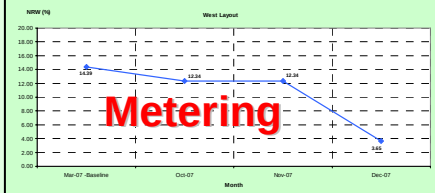
Implement Tools
- Identification of Leakages
- Identification of Illegal Connections
- Identification of Under reading Meters
- Identify Unmetered Connections

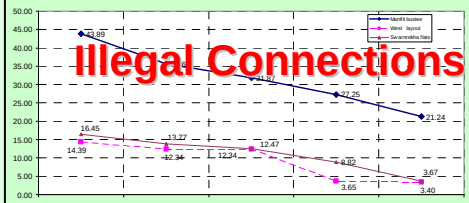
Reference :
- Theory
- Benchmarking
- Best performance record
- International Water Association Standard Water Balance

2. Calculate Each type of Loss



4. Analyze Results





5. Standardization & Horizontal development

Standardization
Education & Training

Horizontal Development

6. Recalculate NRW for Continuous Improvement

District Metered Areas

District Metering Area or DMA is defined as an area with a metered source of water and closed boundaries.

DMA:

- 7 command area tower wise Segregated for creating DMA

- command area wise DMA created –Field studies-GIS

- 74 DMA created

- DMA wise Monthly NRW Assessment /leakage/complaints/consumption pattern
- DMA wise billing Revenue assessment monthly

Condition for DMA:

- network area must be “hydraulically segregated”

- operable valves to ensure complete opening & closing of water

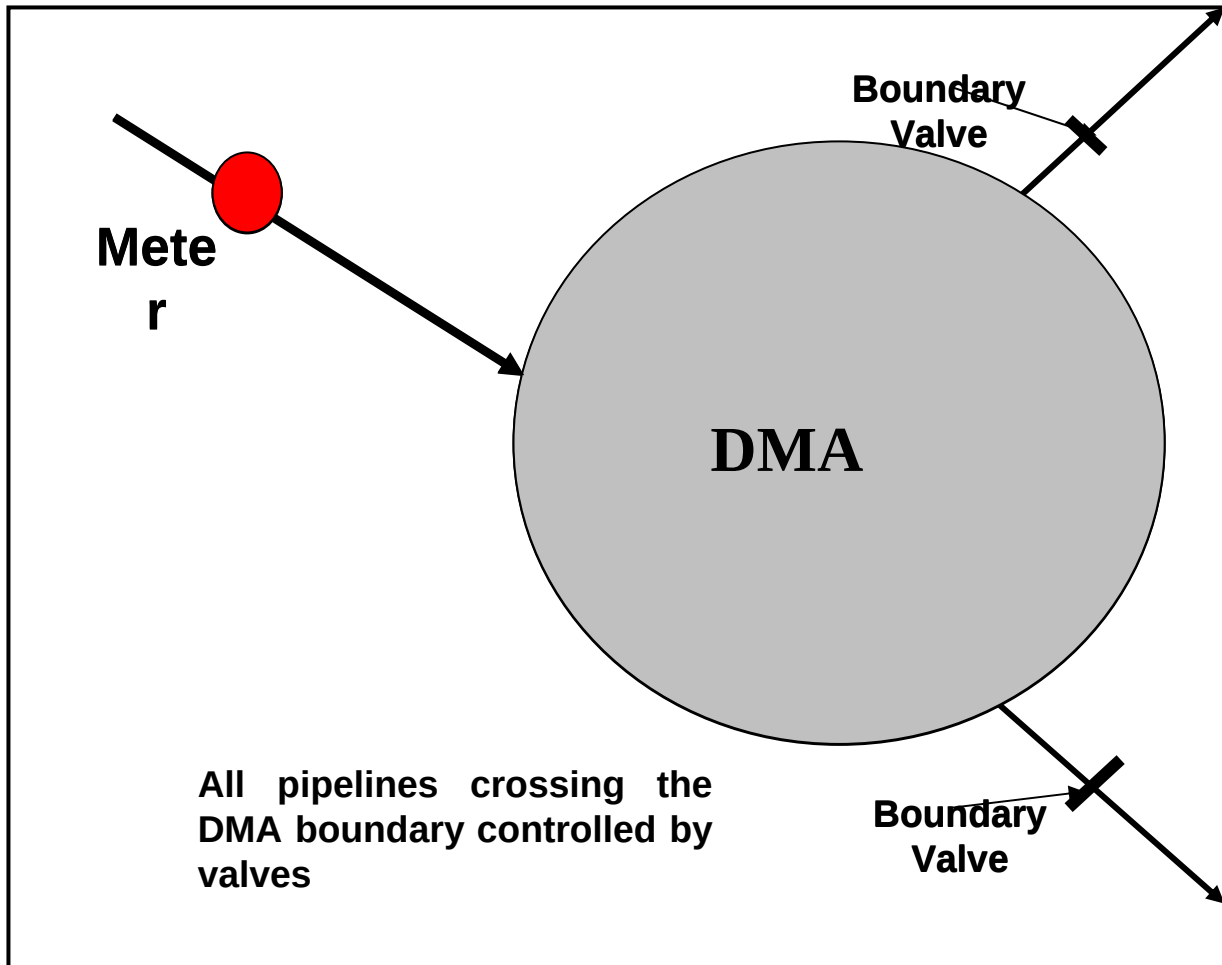
- all water supply source is metered

Impl. of District Metering Area (DMA) for 24x7 supply

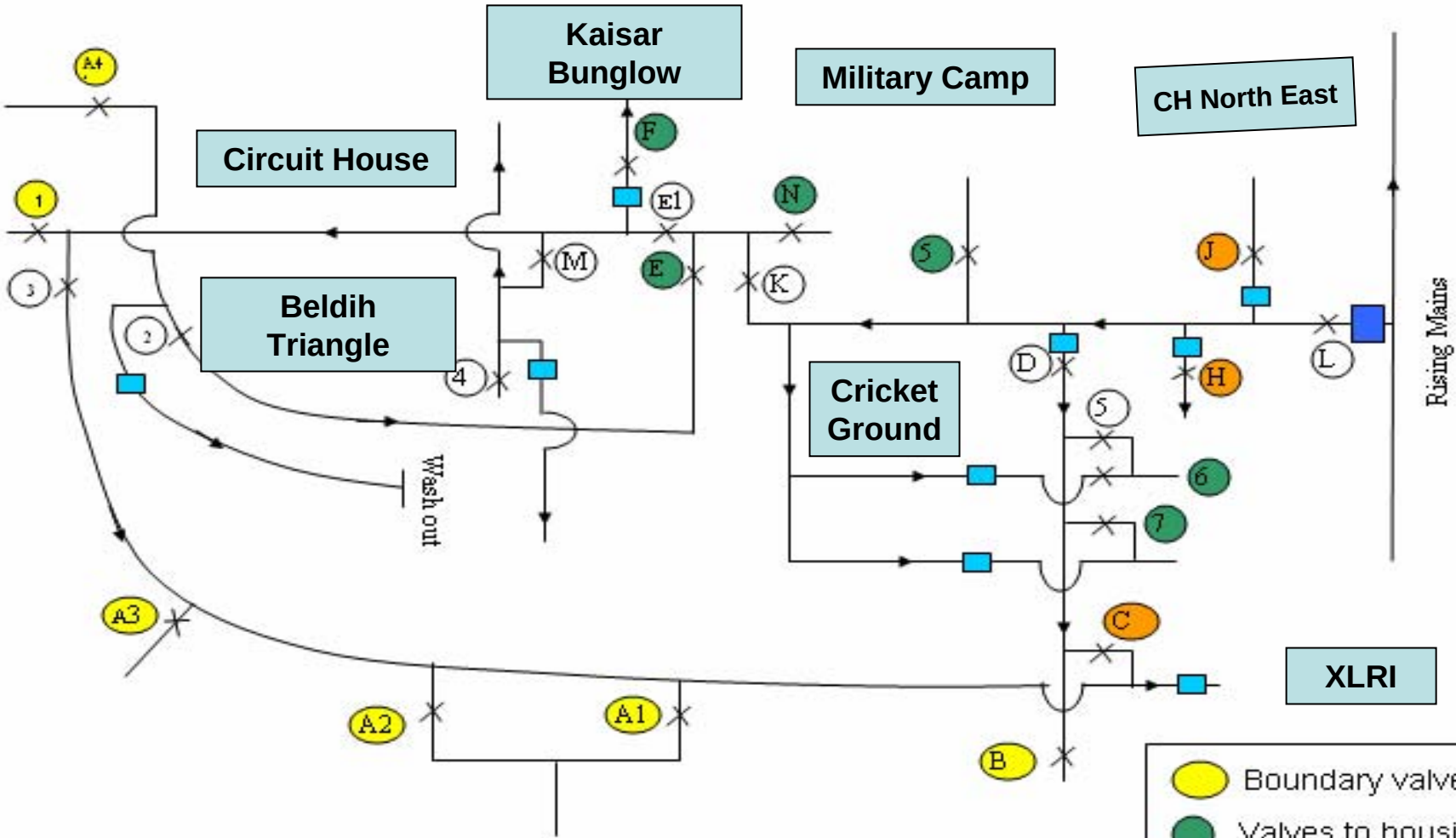
For implementation of 24 x 7 the entire CH area was to be converted to a DMA with hydraulically closed boundaries.

Condition for DMA:

- **network area must be "hydraulically segregated"**
- **operable valves to ensure only from metered inlets.**



CH Area schematic: after DMA formation



The initial UFW base line of CH Area was 29 %

Step Test : a tool for NRW reduction

Definition –

The principle of the technique is to systematically reduce the size of the area by closing valves on each section of pipe in turn, at the same time noting changes in flow rate at the meter.

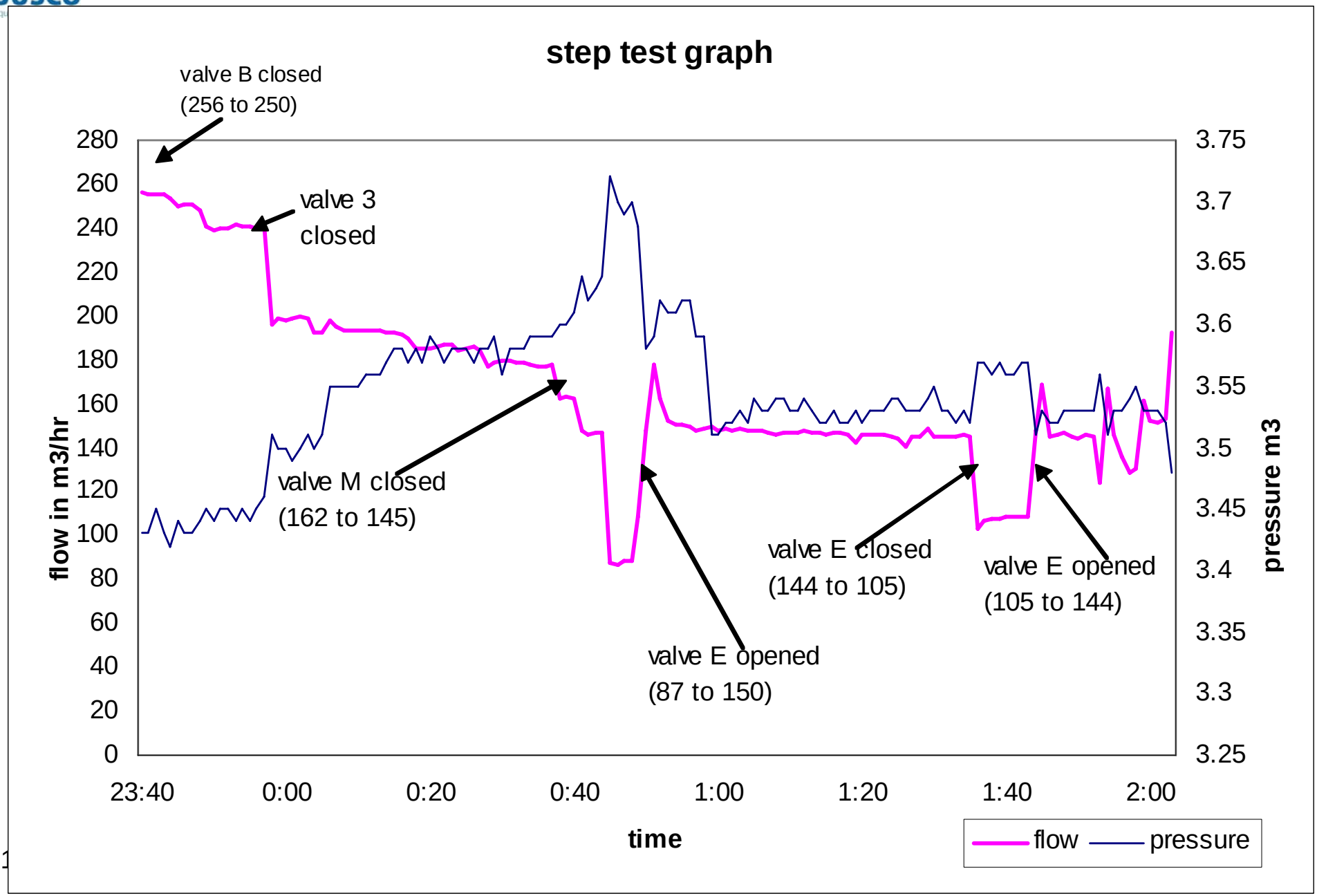
Step test is conducted at night time when it is assumed that the consumption is minimum.

Objective -

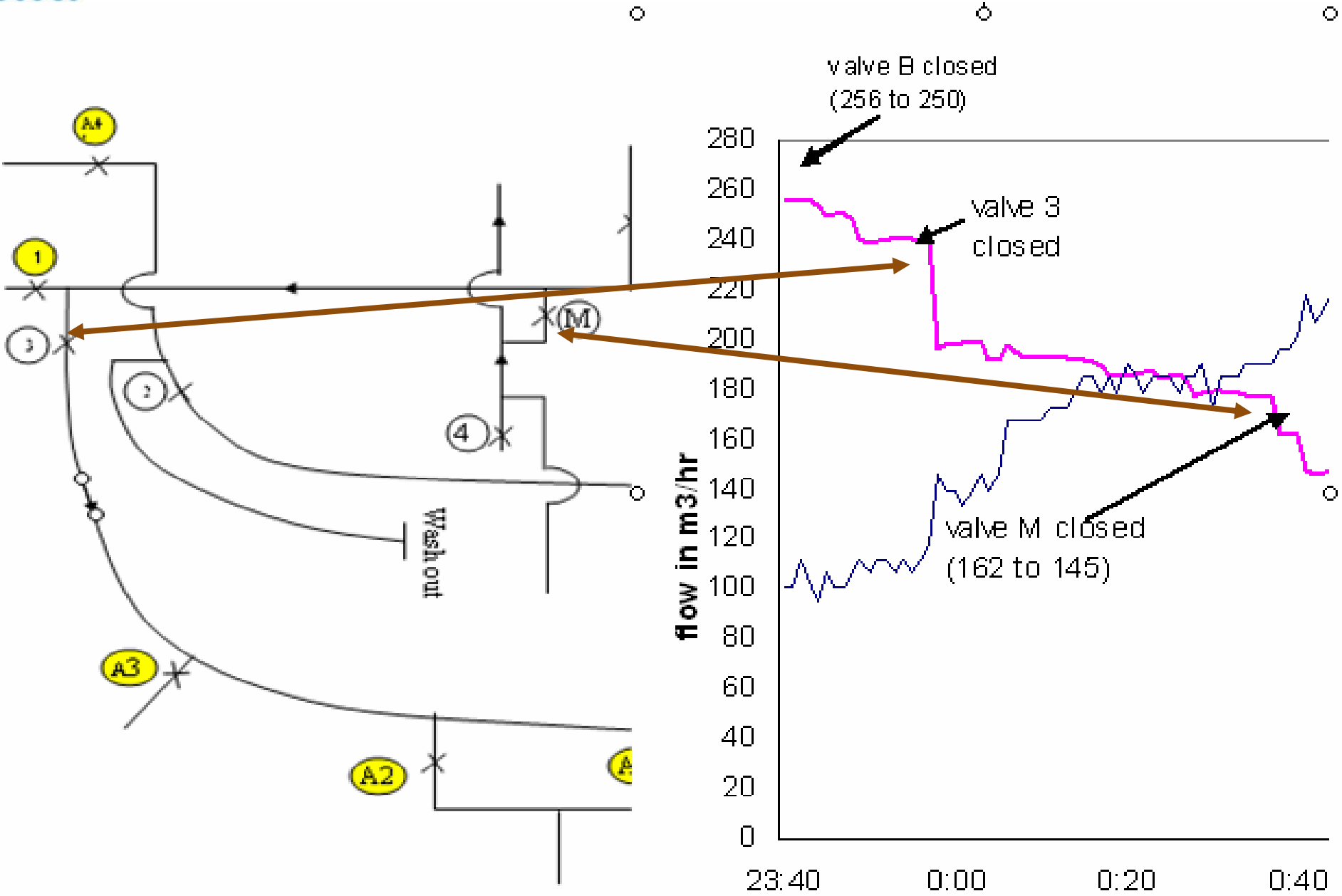
To break the distribution network into smaller section and determine sectional NRW and identify sources of losses & leakages.

Leak detection equipment

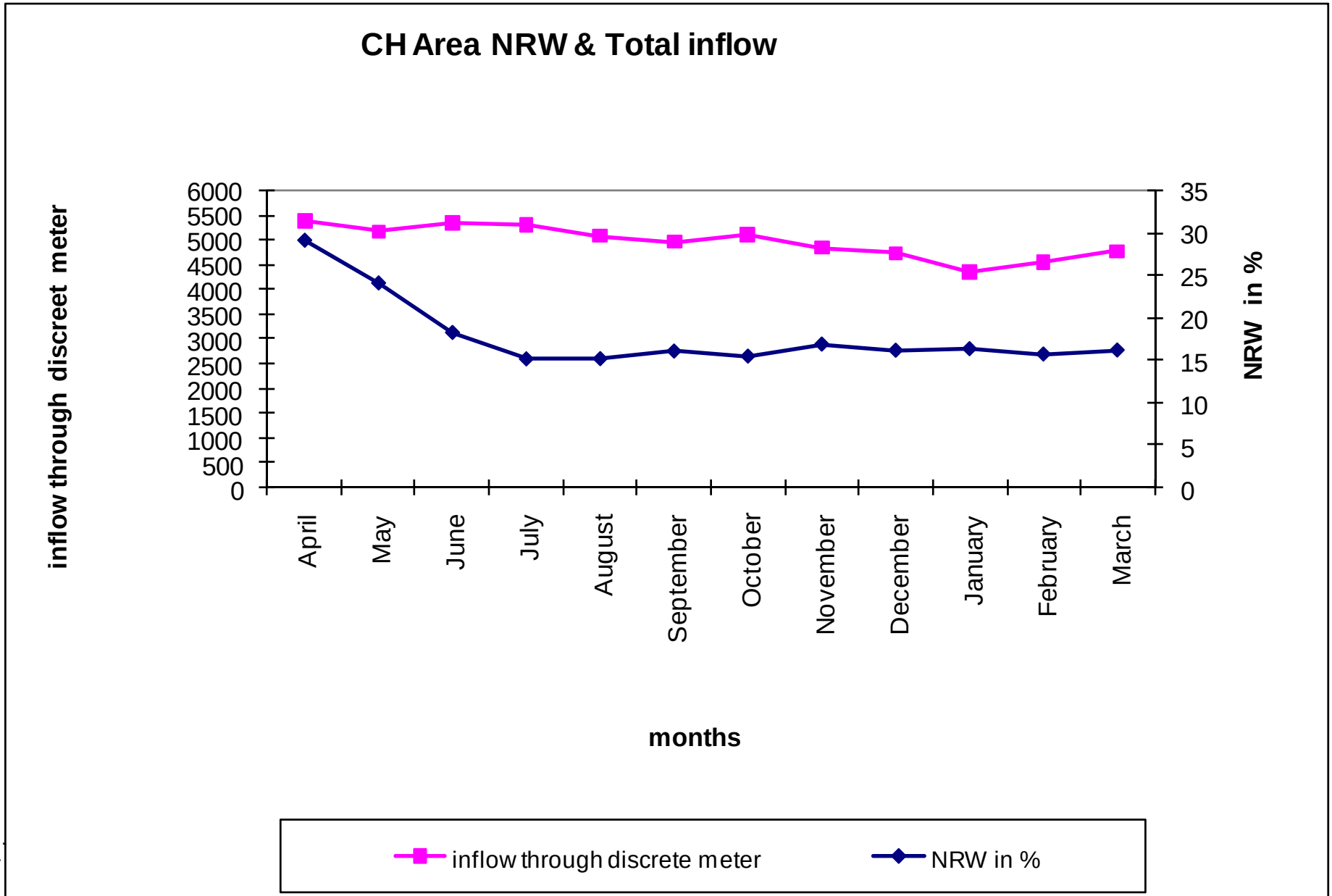
Step test curve – CH area discreet meter data



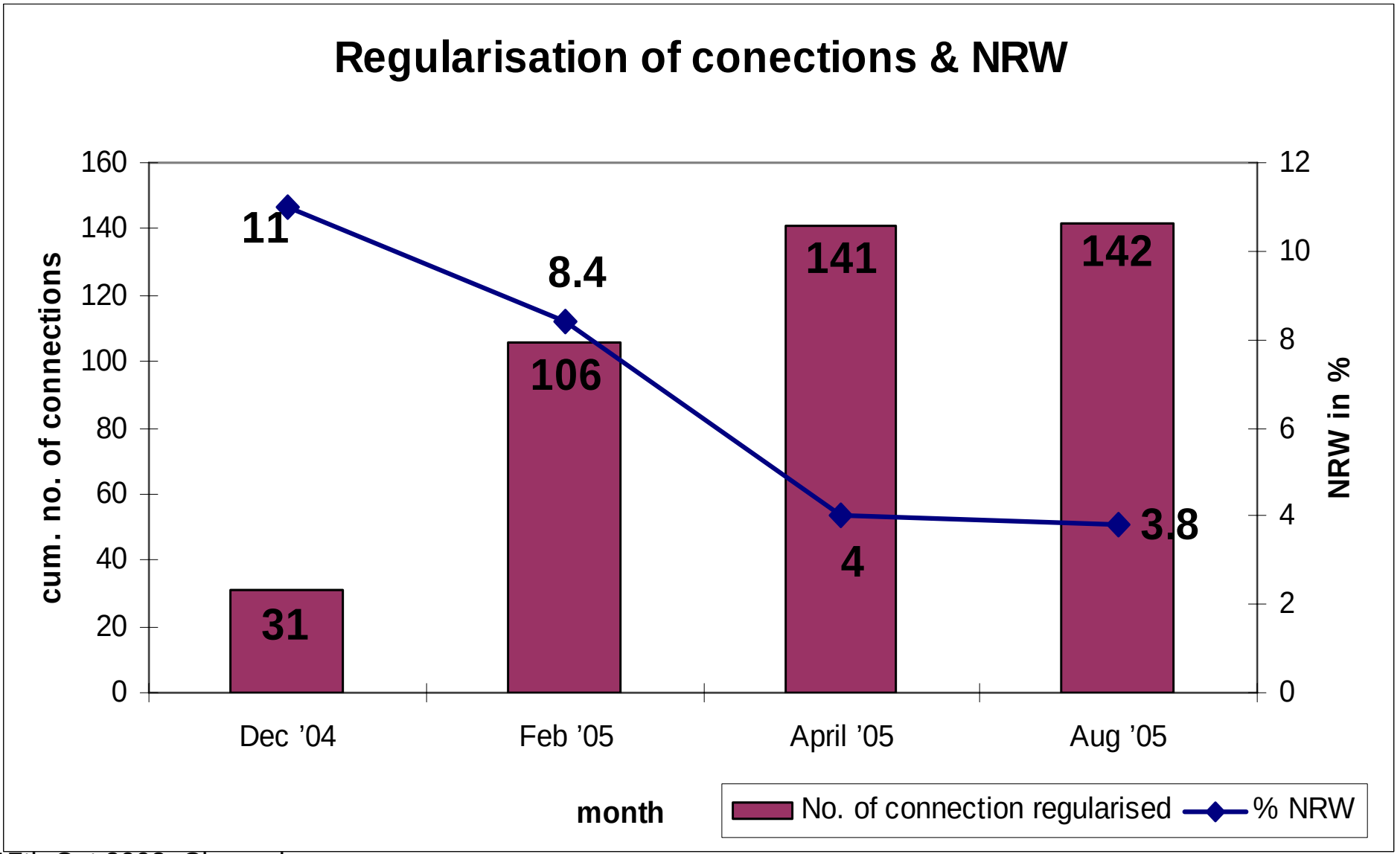
Step Test : Interpretation



CH Area - Total Inflow & NRW



Non-Revenue Water (NRW)



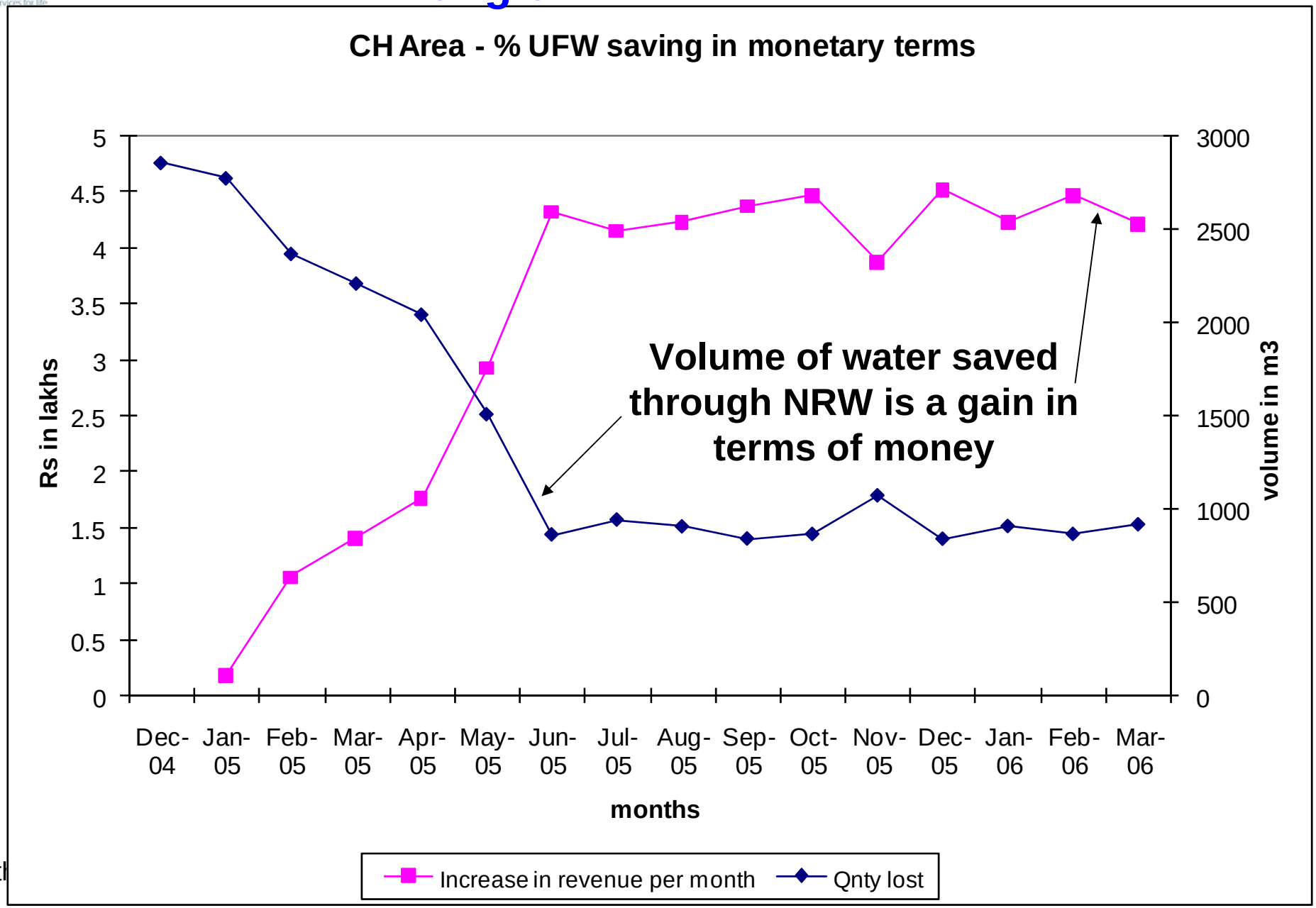
Financial aspects

- **Revenue generation**
- The 24x7 concept has resulted in increased revenue from this area.
- Increase in revenue was about 1.9 lakhs / month due to
  - Metering of large customers
  - Regularization of unauthorized connections

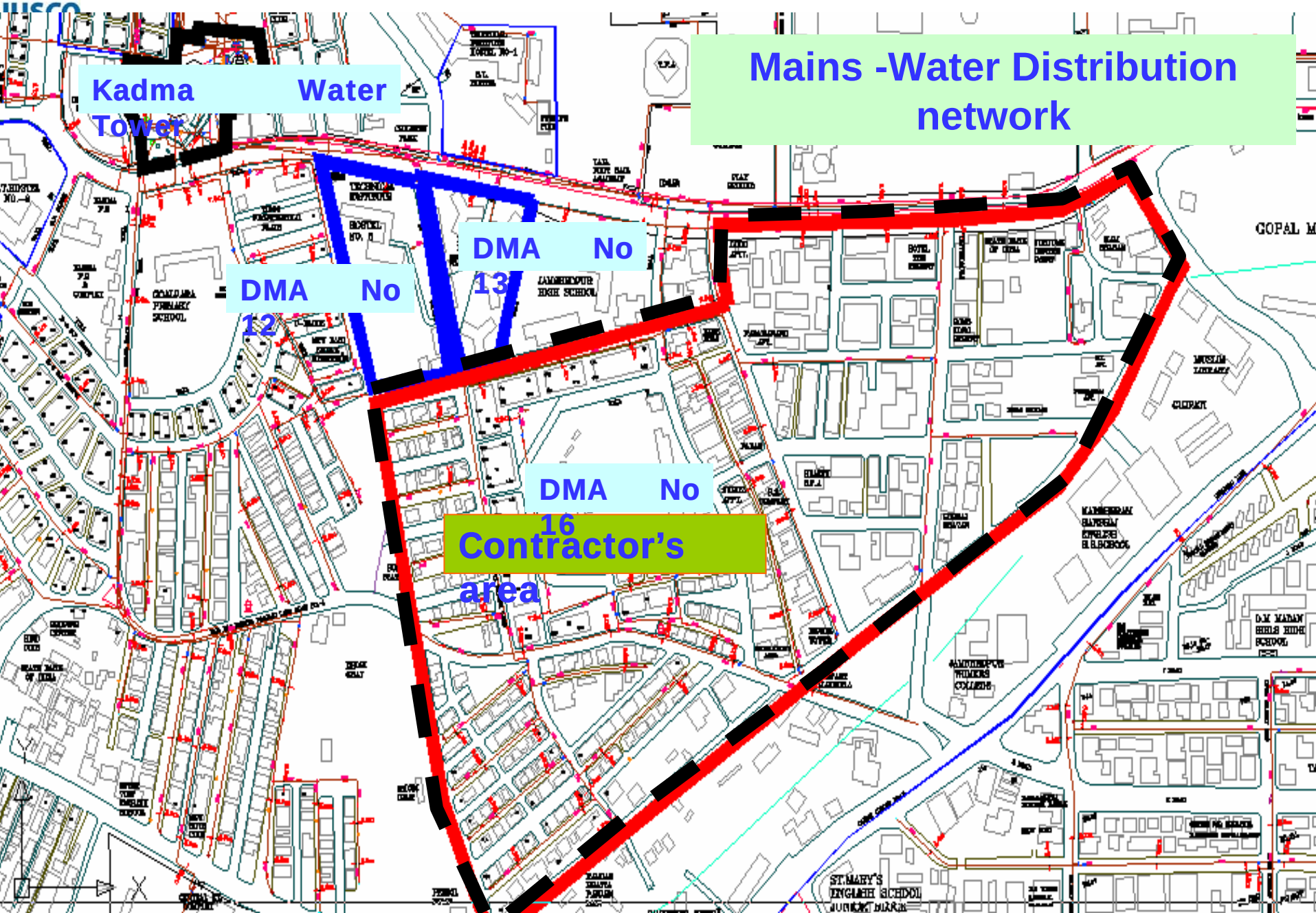
Saving through UFW

- **A potential saving was done in terms of reduction of UFW in the area.**
- **UFW initially was 29 % and came down to 15 % within 4 months.**

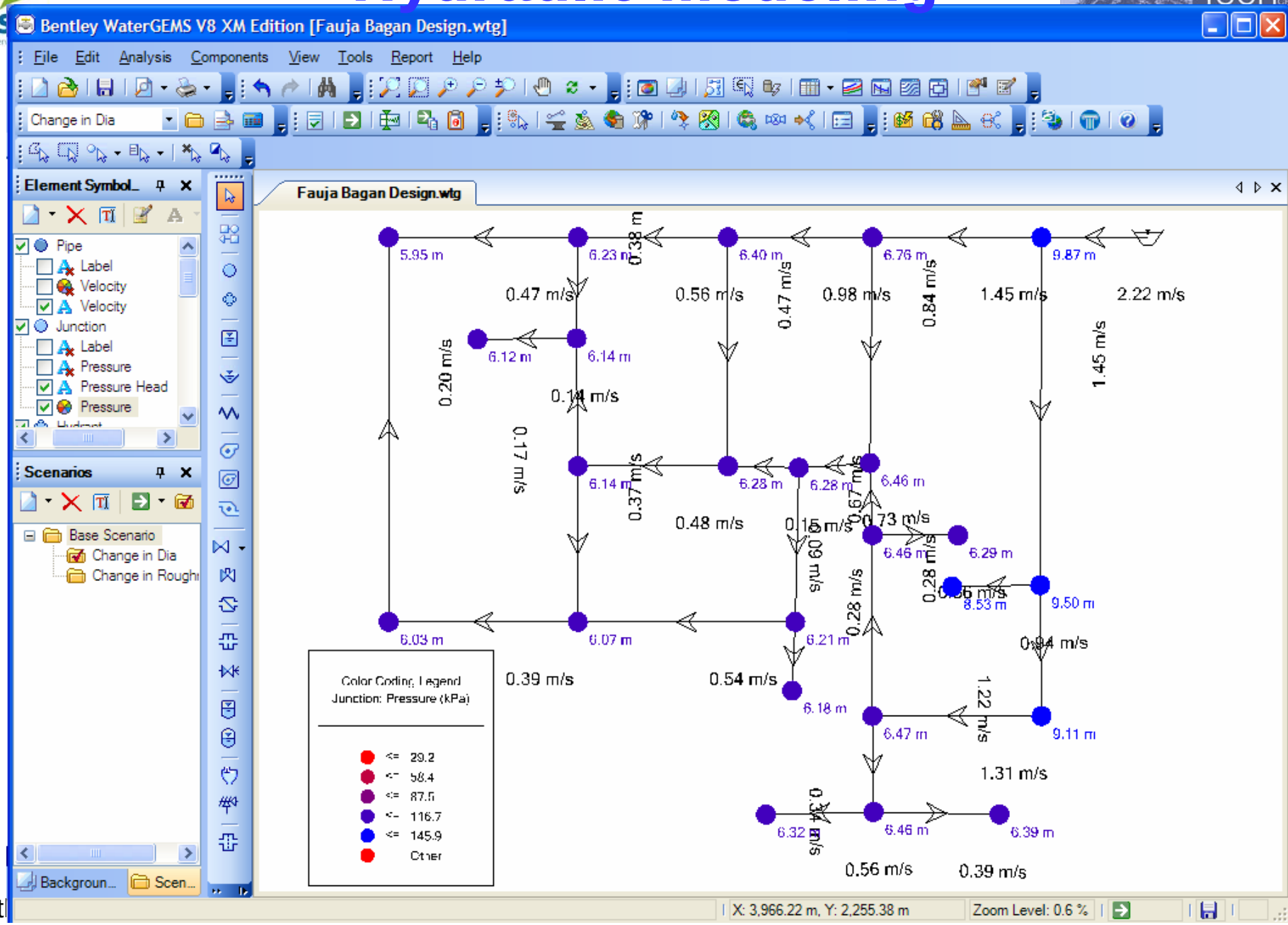
Savings through UFW reduction – Financial angle



Location of D.M.A's –Contractors area

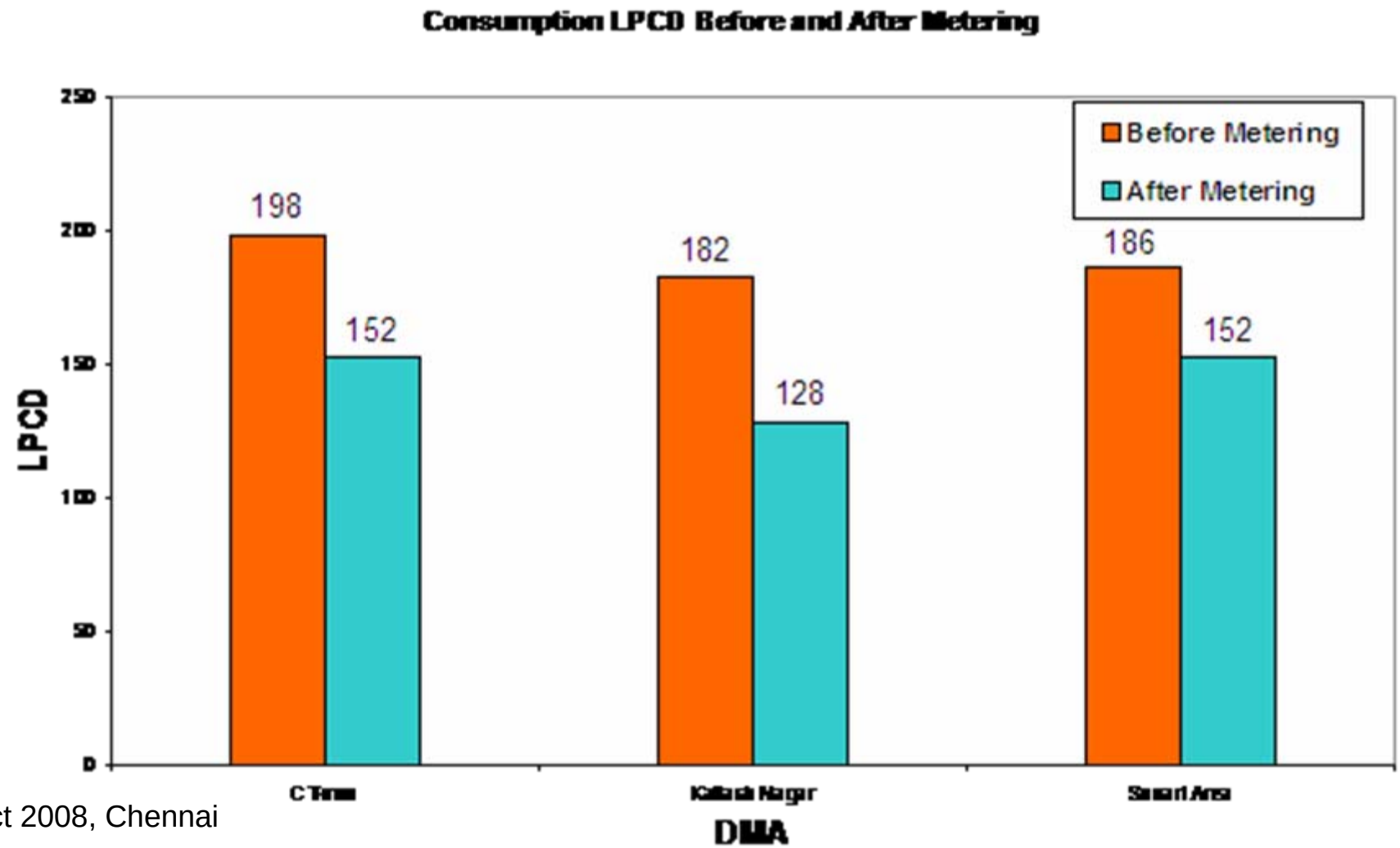


Hydraulic modeling



DMA Benefits

Introduced 24 x 7 continuous water supply in 14 DMA's with 100 % metering



Drink straight from tap, thanks to Tata's water utility

By Joydeep Gupta
(Visiting Delegate with World Bank Team on 18th Sept.'08)
Indo-Asian News Service

QUOTE
Jamshedpur, Sep 28 (IANS)

This could be India's only city where you can drink water straight from the tap, thanks to the local utility Ask oil mill owner Manoj Singh, who has paid Rs.10,500 for a connection - a month's income - but doesn't regret a single paisa.

Singh has found no cause for complaint since his working class neighbourhood Shastri Nagar, just outside the township, was connected to the JUSCO network last November.

"Yes, I paid a lot of money for the connection," Manoj Singh told IANS. "But it has been worth it. Now the women do not have to go and queue up for hours to fetch drinking water. We get clean water in our taps, 24 hours a day. Where else in this country will you get that?"

UNQUOTE

Major Components of NRW

Major Components of NRW are

- Leakage
- Illegal Connections
- Metering Errors
- Public Hydrants

Leakage Management

- Monitoring Daily NRW for Rising Mains
- Regular checking of leakages which includes
  - Proactive
  - Reactive Measures

- Replacements of pipes, valves, etc.
- Weekly reporting and Management of all leakage in detail

Leak Measurement for Service Mains / Houses

1.DMA Name and Tower Name:

2.Address:

Procedure (Bucket and Stop Watch Method)

- **Take an empty Bucket or mug which has volume demarcation**
- **Fill the bucket with water from leakage and measure the time taken to fill it to known volume**
- **Repeat the exercise 5 Times to estimate total leak from the pipe.**

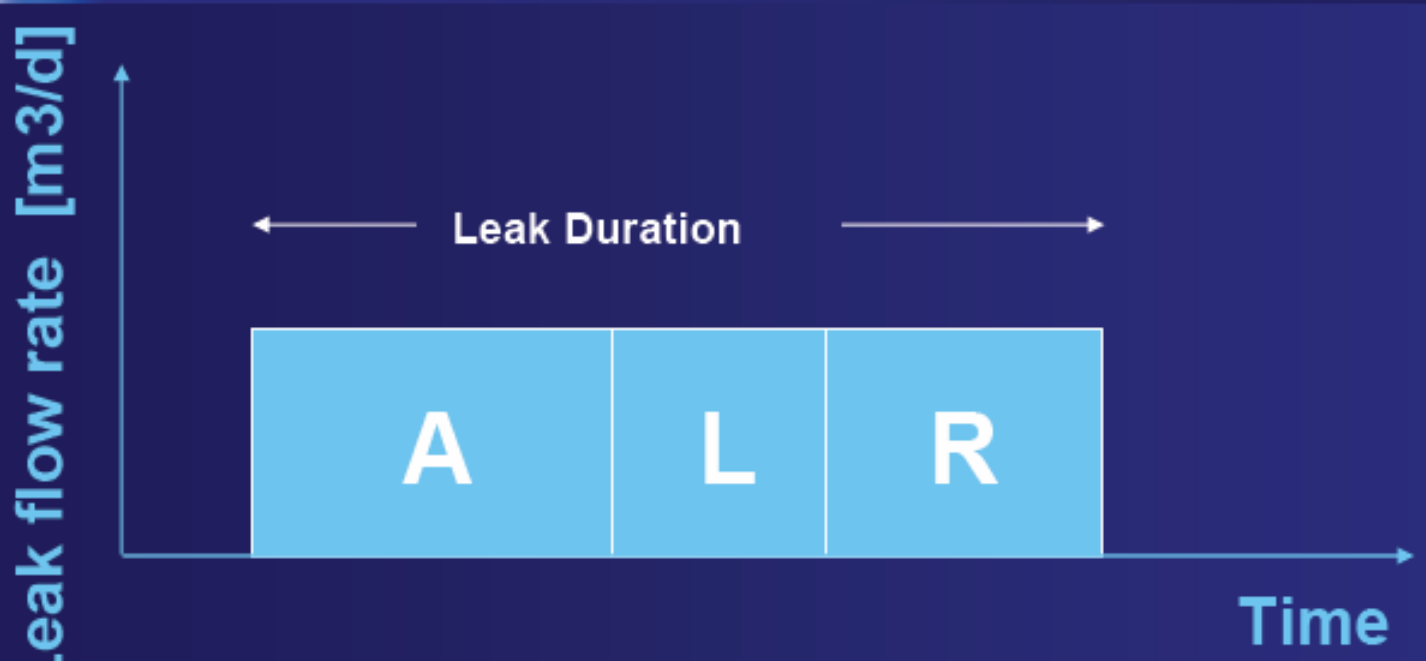
Leak Location

- **Inside House**
- **Service Connection**
- **Alley**
- **Distribution Mains**

Awareness (A): Leak Duration (Ask local people / Household for Leak duration)
_____ Hours / Days
Localization (identify exact location) (L): _____ Hours
Leak Repair Time (R): _____ Hours
(A + L + R) x Flow Rate = _____ Liters

Serial No	Volume (Liters)	Time taken (Seconds)	Water Loss (Liters / Second)
Example	**20**	**10**	**20 / 10 = 2**
1			
2			
3			
4			
5			

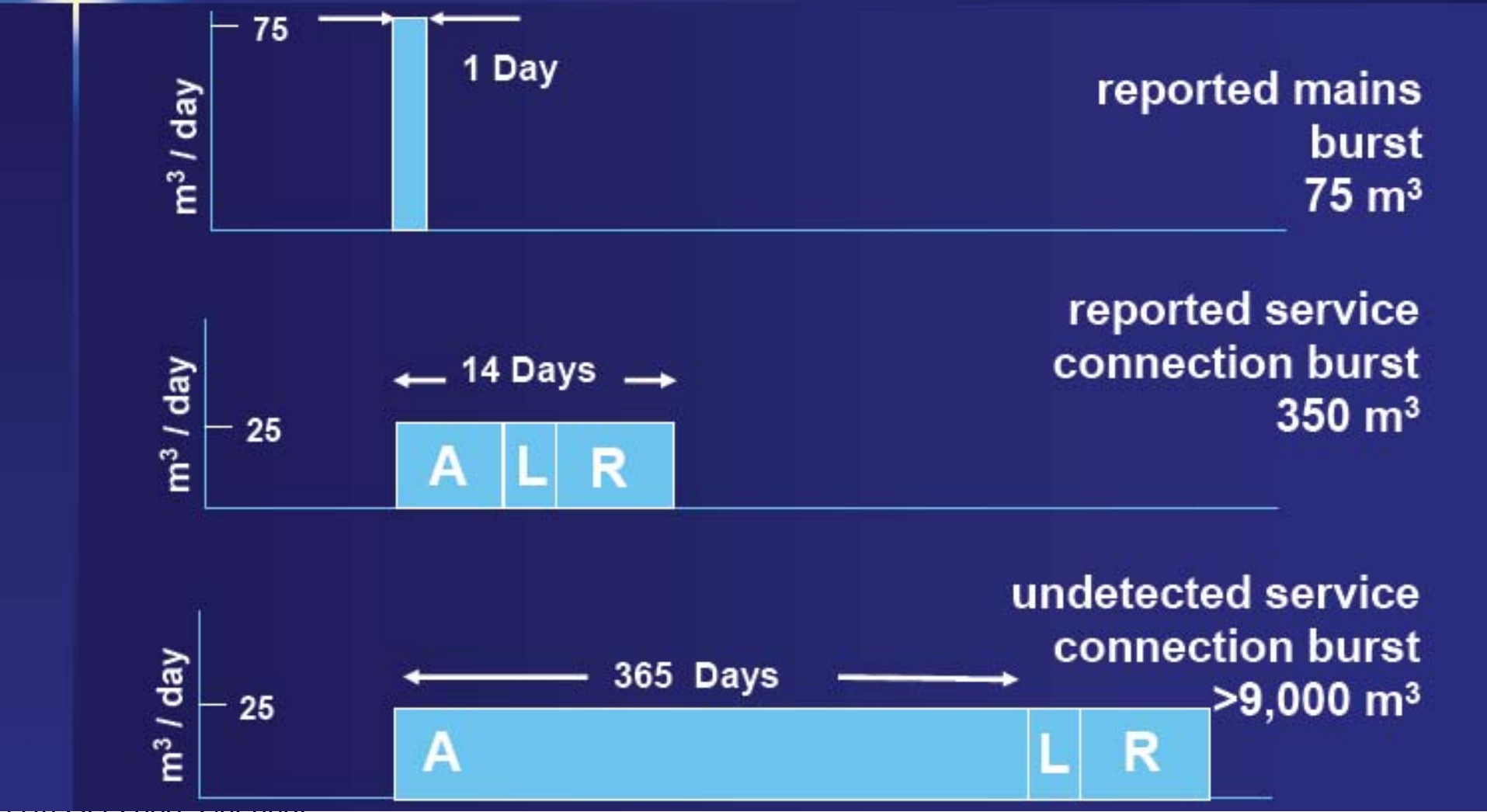
Leak Volume: A Function of Time and Flow Rate



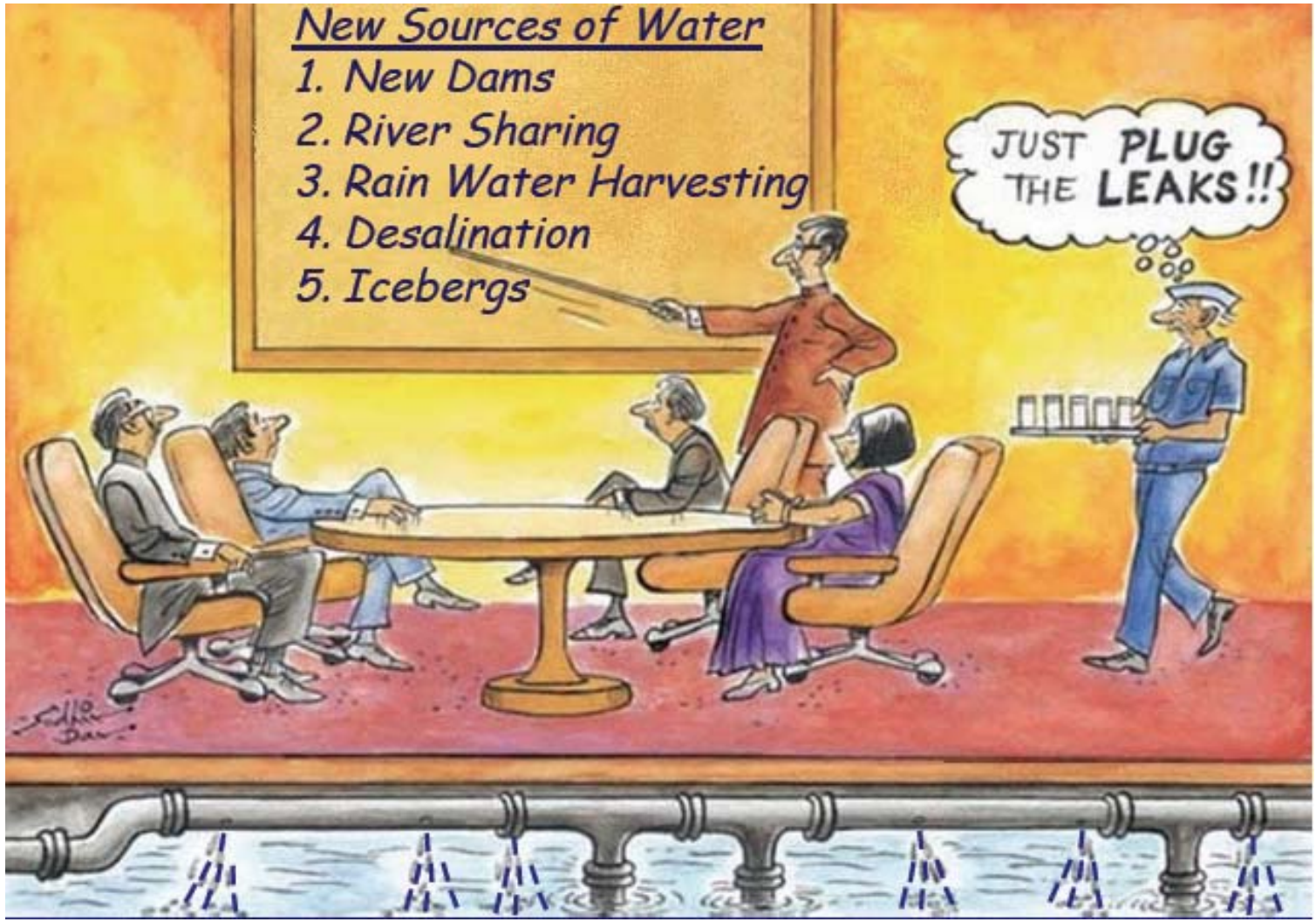
Leak Volume = Time (A+L+R) x Flow Rate

A: Awareness; L: Localization; R: Repair

Time Makes a Big Difference



Leak Calculation



Leak Calculation

Leak Detection

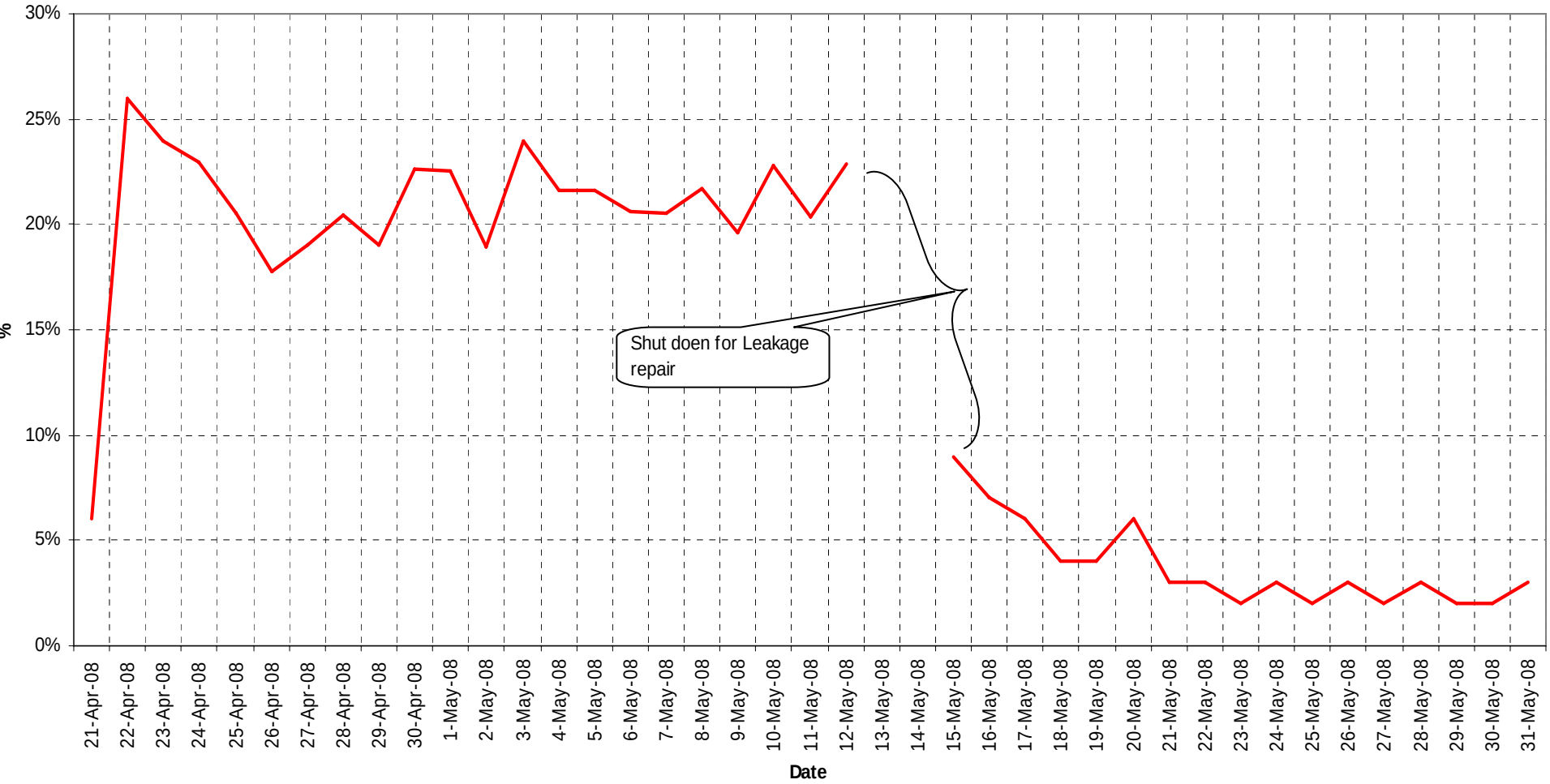
Proactive actions to reduce number of leaks in the network
such as asset and leakage history mapping, preventive
maintenance and replacement of old and worn out pipes.

MGM Case Study

- Use of Base map : GIS
- Tracing of pipeline : GPR
- Depth of pipeline : EPL
- Identification of leaks : X-mic Leak detection Instrument

Use of modern equipment like leak detection equipment for underground pipe leakages

Tatanagar Rising Main Leakage



Illegal Connections

- Illegal or un-authorised connections forms a major part of NRW in the network
- Regular checking of unauthorized connections by walk through survey
- Authorizing illegal connections is carried out on a daily basis and reported weekly
- Most of the water saved through NRW program is used for providing new connections.
- Till now about **2874** disconnections have been carried out, and all the consumers have been given authorized connections
- Customer Friendly disconnection program has been introduced, which was called as "**Amnesty**"

Major Disconnections Programs

AREA	Disconnected
Anand Nagar	228
Kailash Nagar	400
Vijay Nagar	544
Cable Town	788

WATER DISCONNECTION REPORT BETWEEN Start date TO End date

USER: User ID SCREEN ID: POWER_WATER_MIS_REPORT_CUMULATIVE1_BAGAN

This Week :: Week start date to week end date

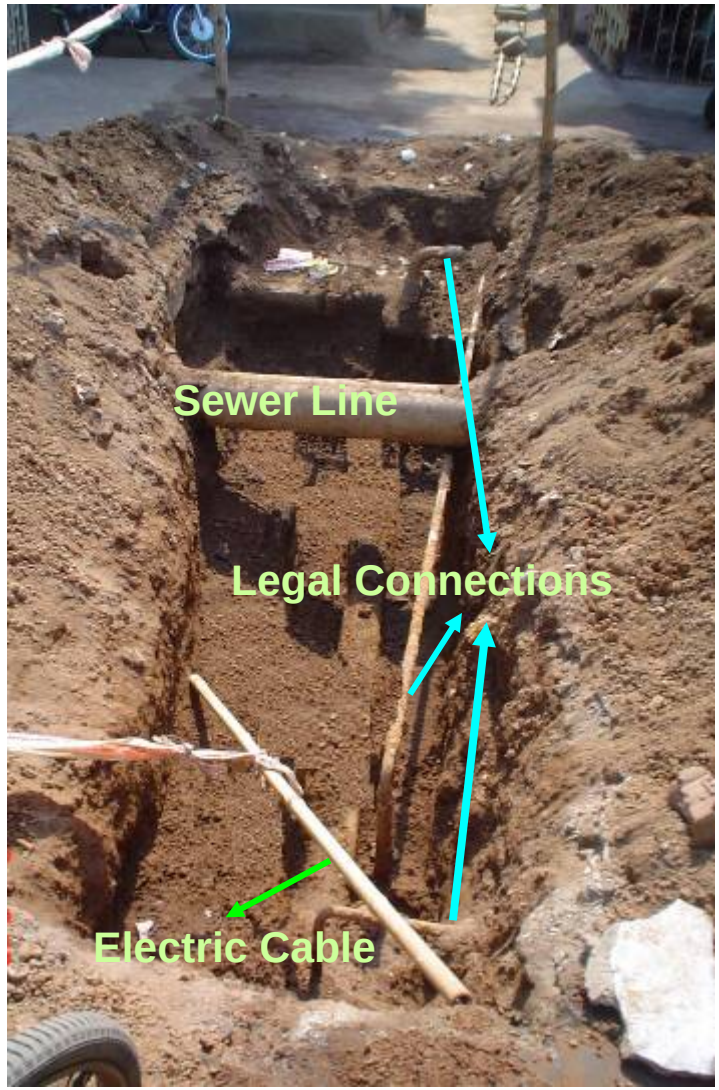
BAGAN AREA DETAILS

Zone	Unauthorized Disconnection			Party Turned Up For Connection				Amount Recovered				
	Up to Last week	This Week	Total	Potential	Up to Last week	This Week	Total	Potential	Commited Amount	Up to Last week	This Week	Total
SONARI												
KADMA												
SIDHGORA												
BURMAMINES												
CENTRAL												
BISTUPUR												
SAKCHI												
TMH												
GRAND TOTAL												

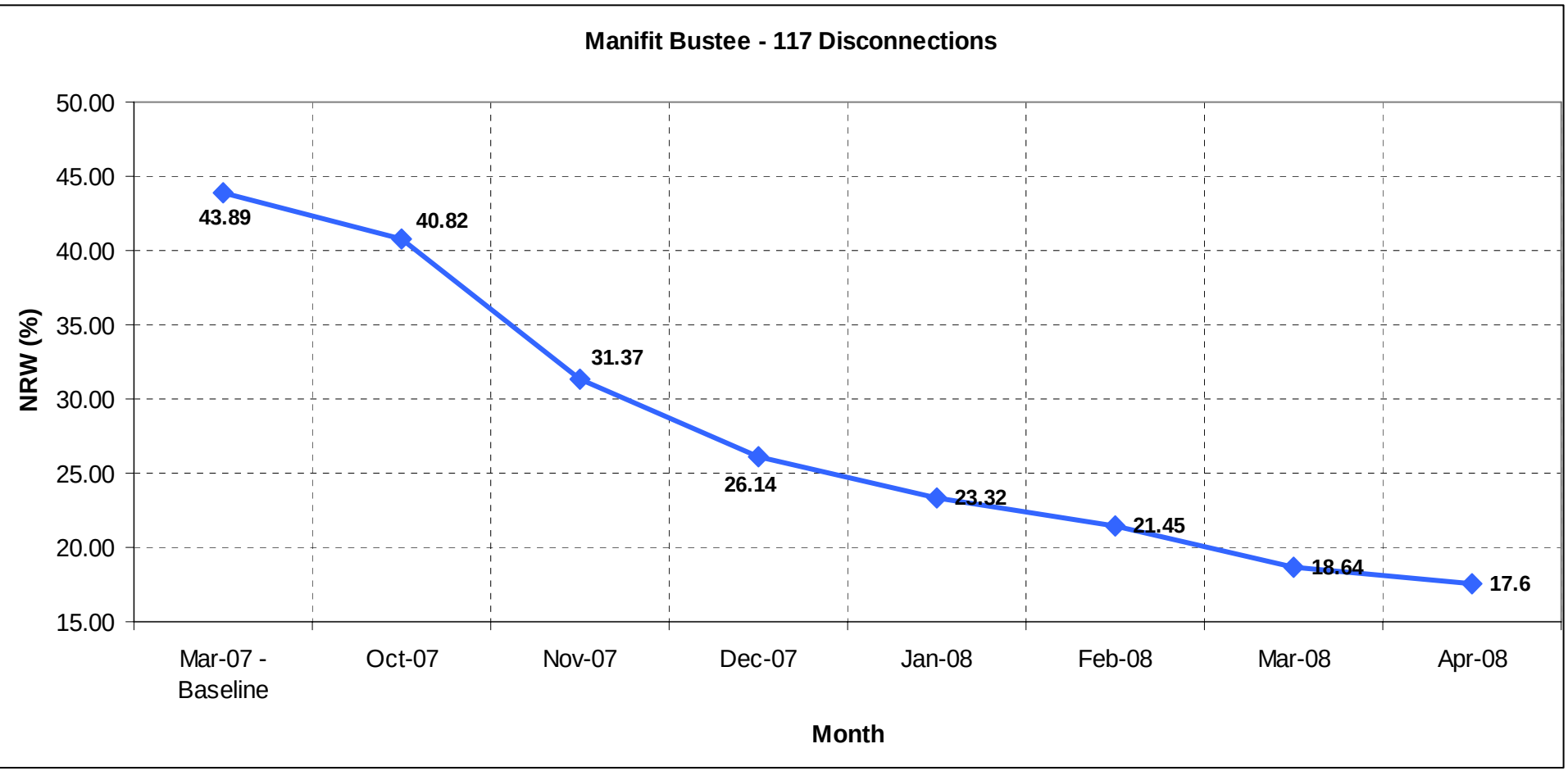
Illegal Connections

Before Disconnection

After Disconnection



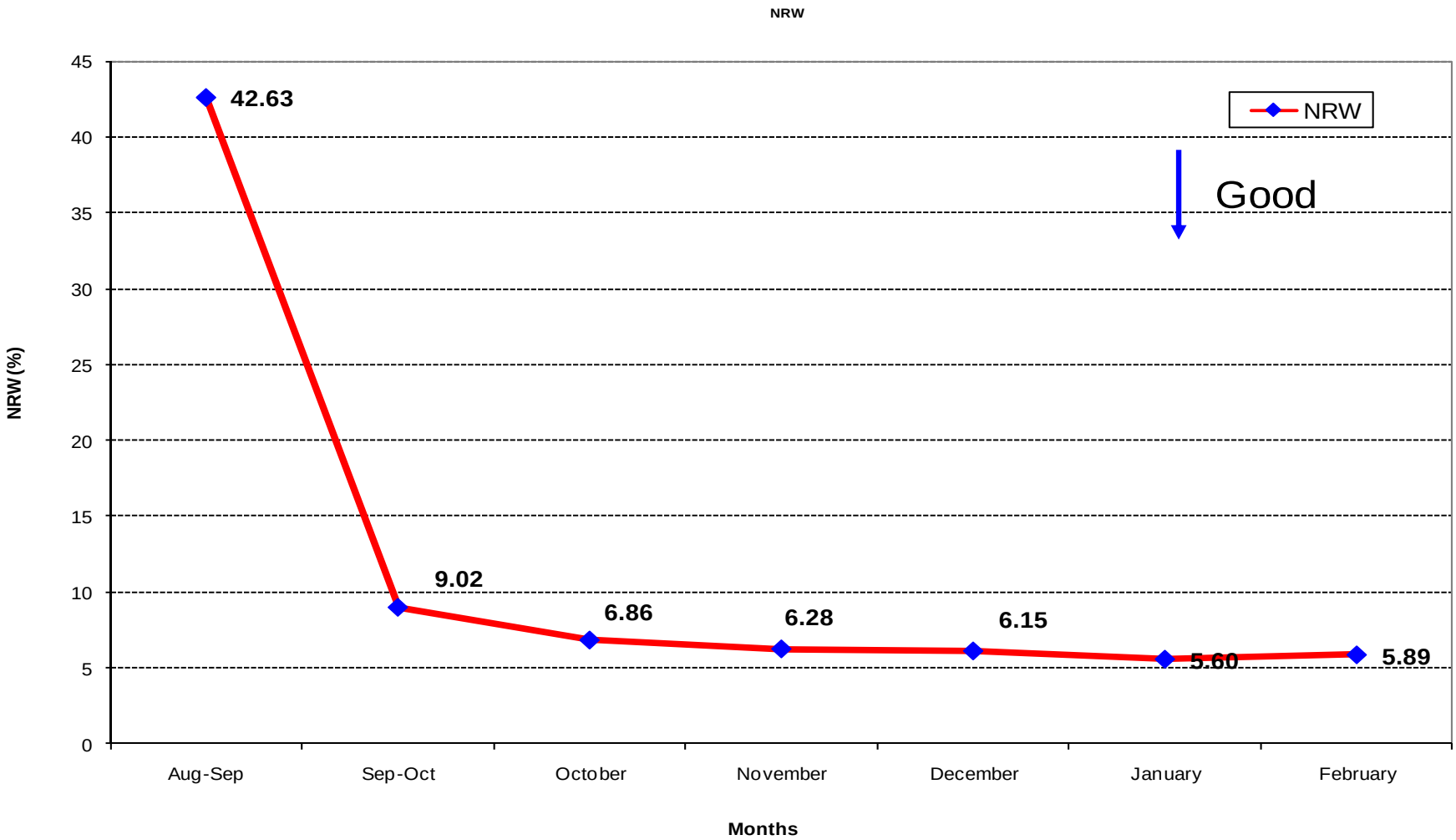
NRW reduction due to Illegal Connections



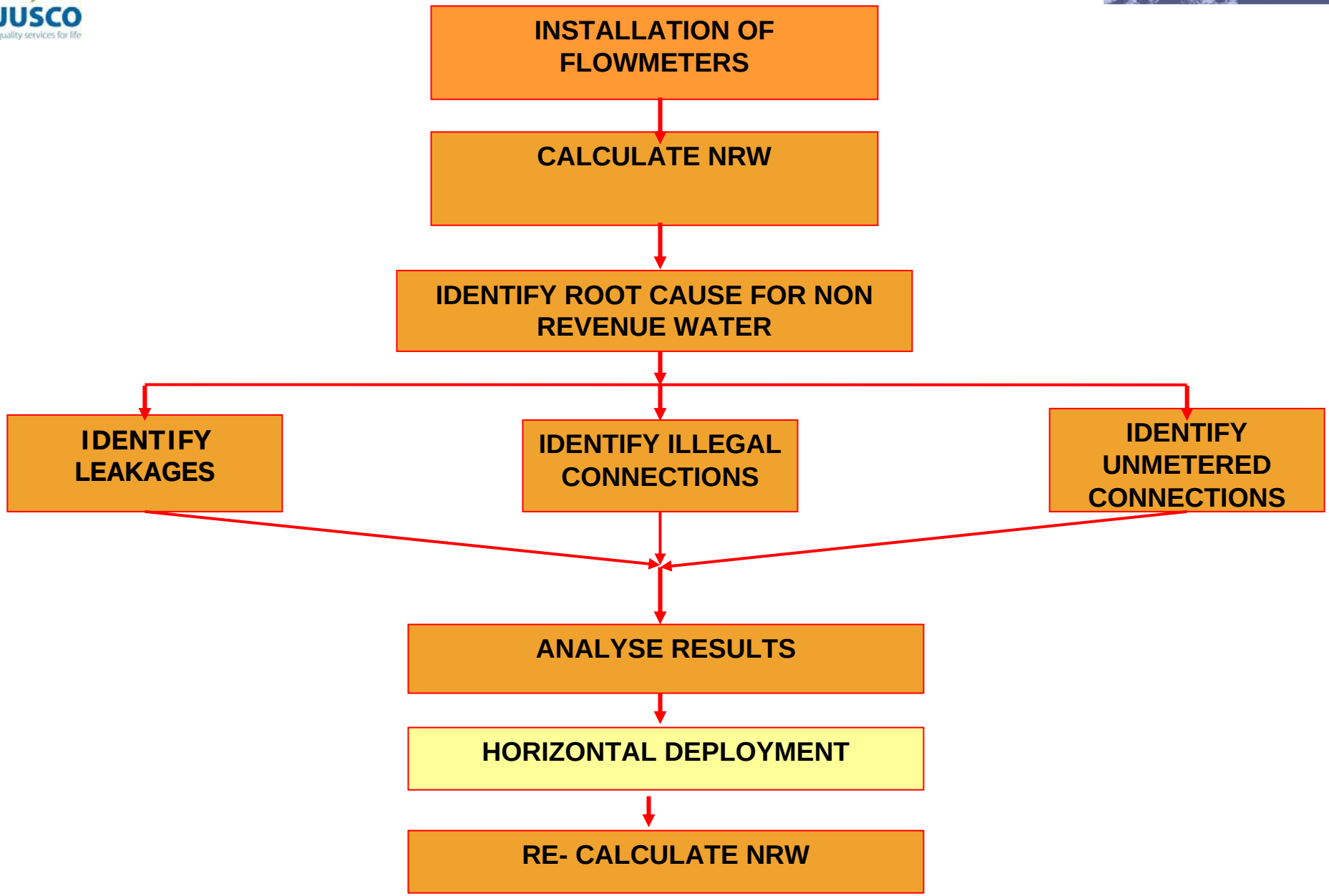
Example : NRW reduction due to disconnection program

C-Town Area

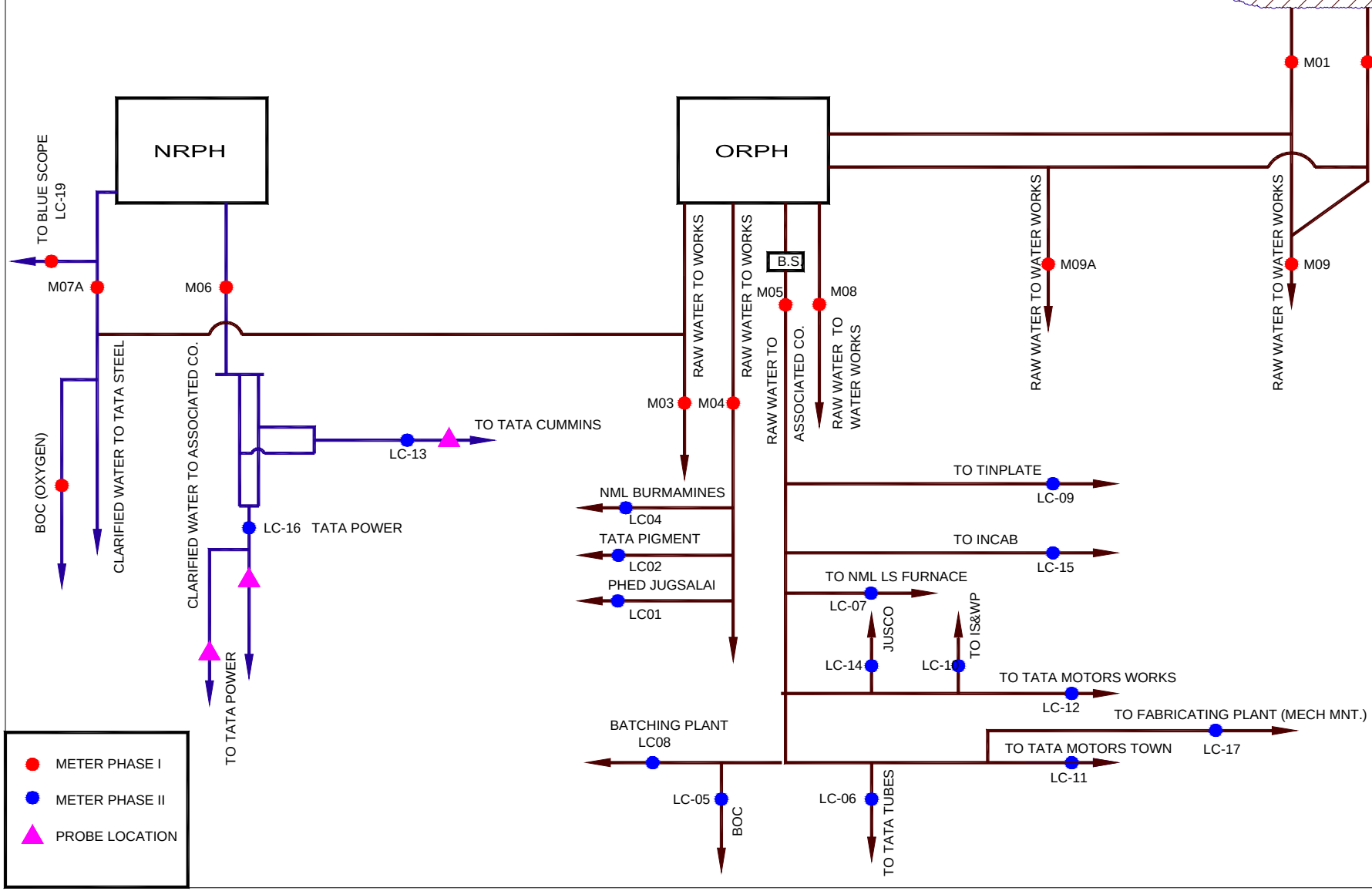
Name of DMA : C- Town
Zone : Central Town
Source of Water : Tatanagar Rising Main
DMA Meter : Mechanical Meter



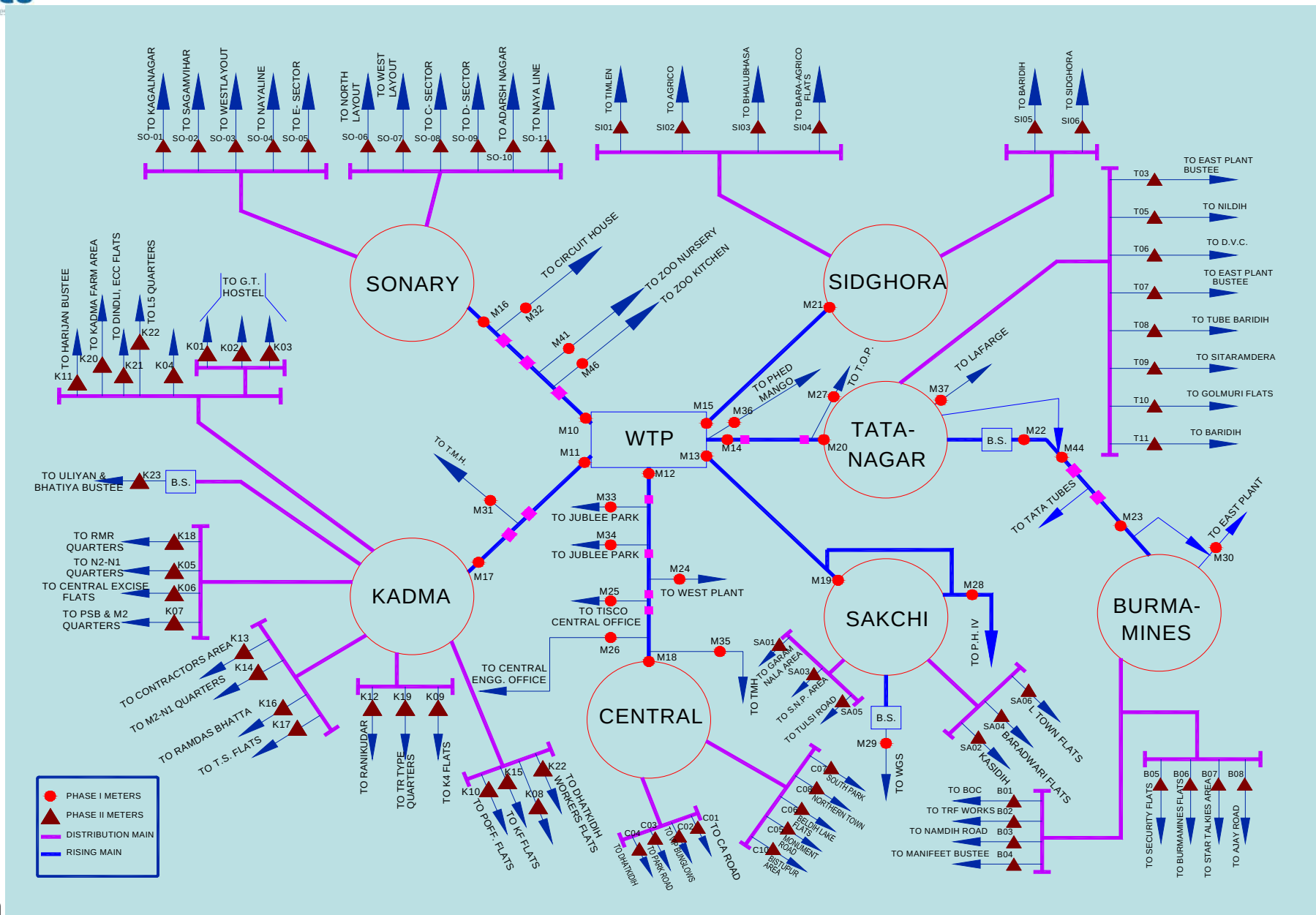
Methodology for Non revenue water loss reduction



RAW WATER & CLARIFIED WATER NETWORK : SCHEMATIC



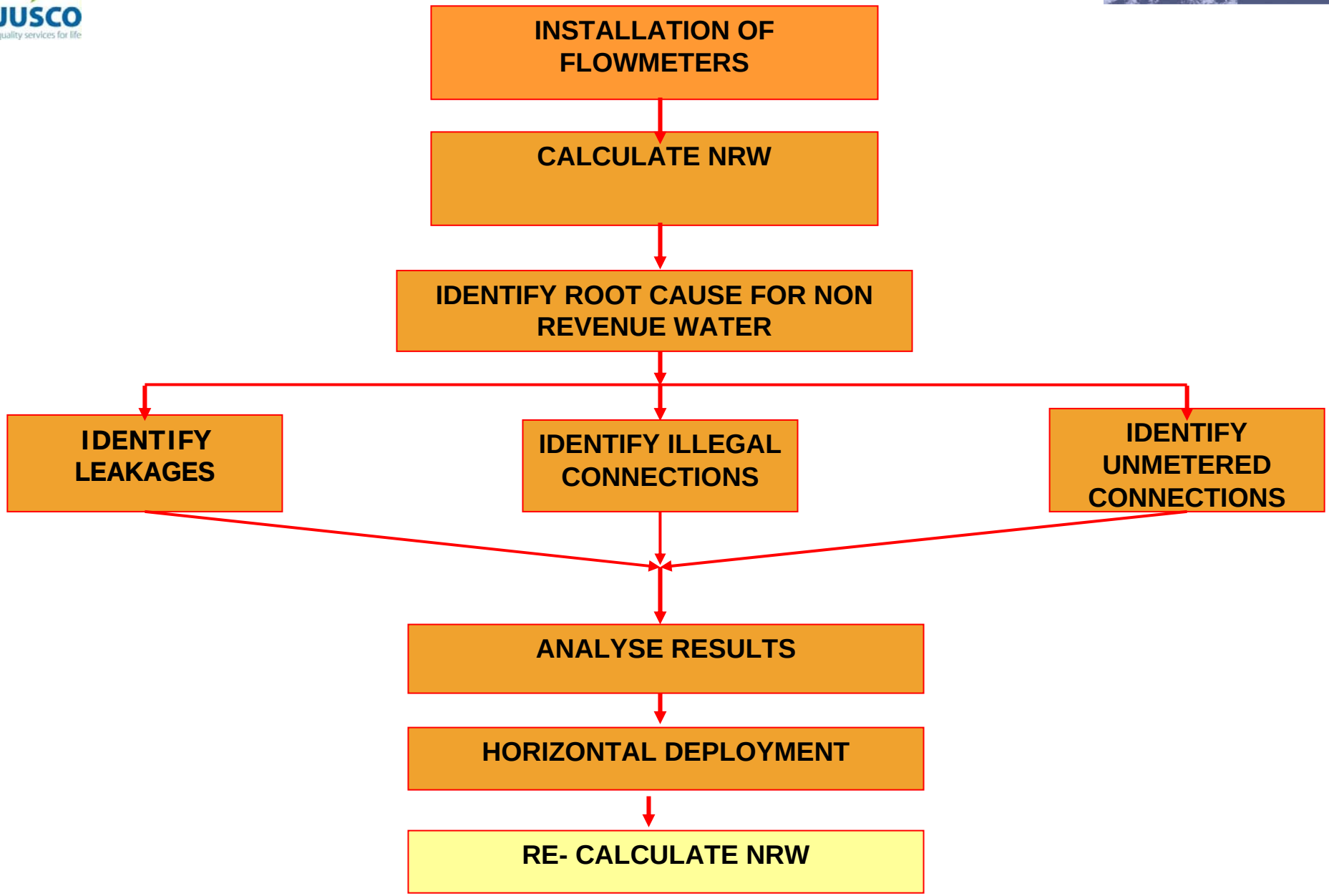
Potable water Network system



Horizontal deployment-Metering

- Meters provided at all the outlets of WTP and RPH .
  (22 nos. electromagnetic meters)
- Meters provided at the inlet and outlets of all the water towers .
  (102 nos. electromagnetic meters)
- Meters provided at the strategic locations in the networks.
  (50 nos. mechanical meters)
- Meters provided at all Institutional, commercial & Industrial consumers.
- Domestic Metering is under progress
  (10% completed).

Methodology for Non revenue water loss reduction



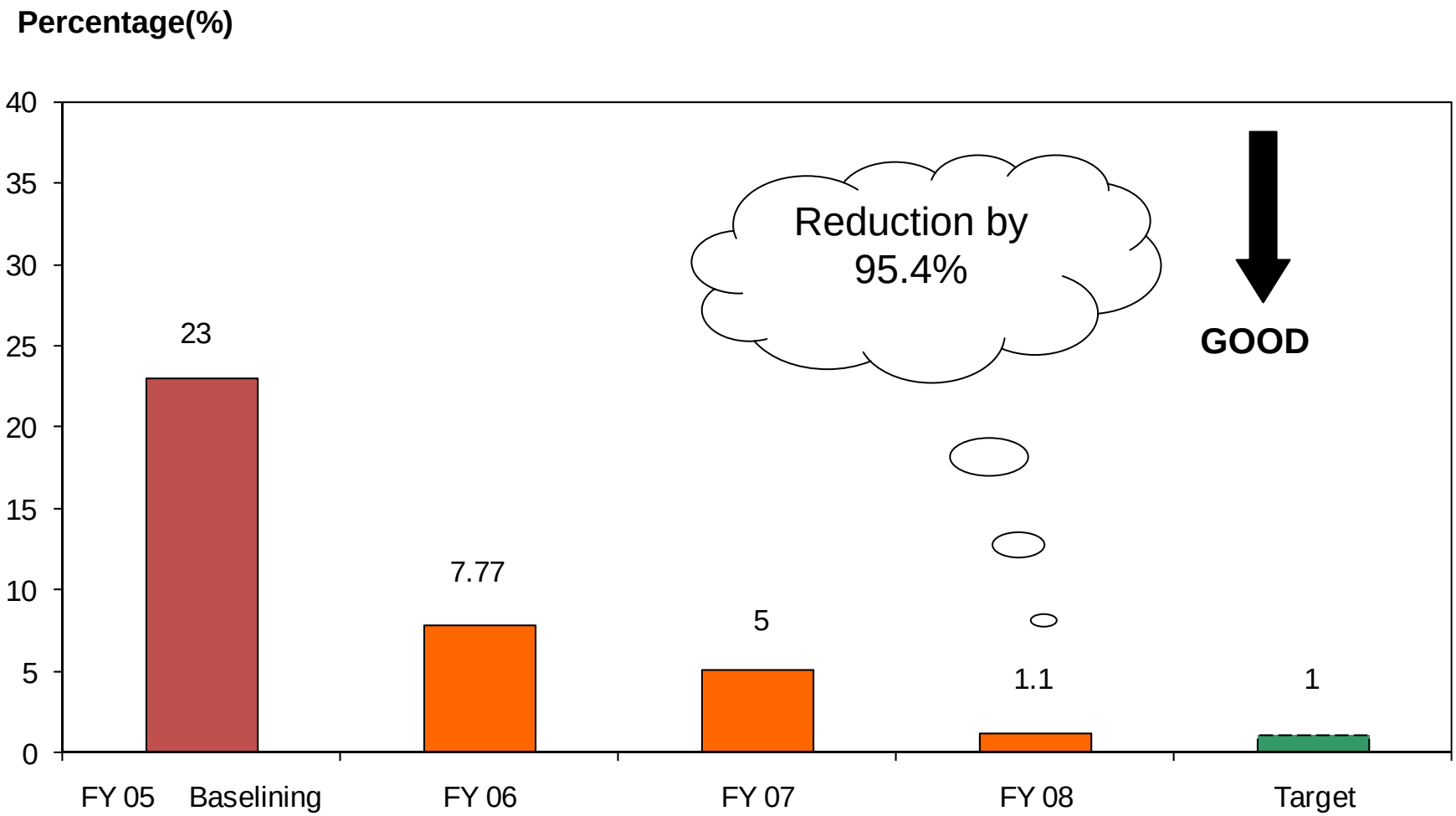
Key Initiatives

- NRW

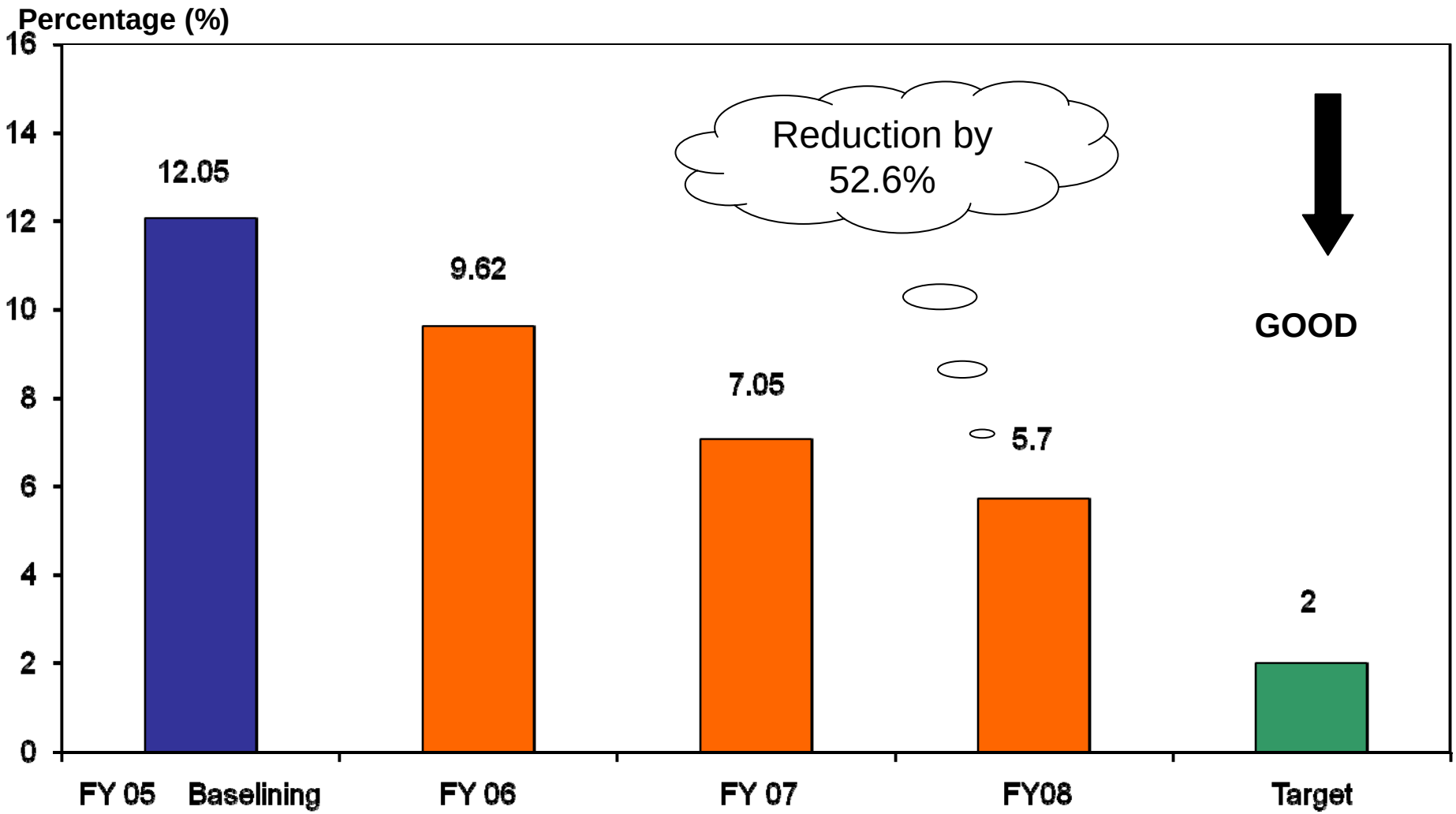
RESULTS ACHIEVED

SO FAR…….

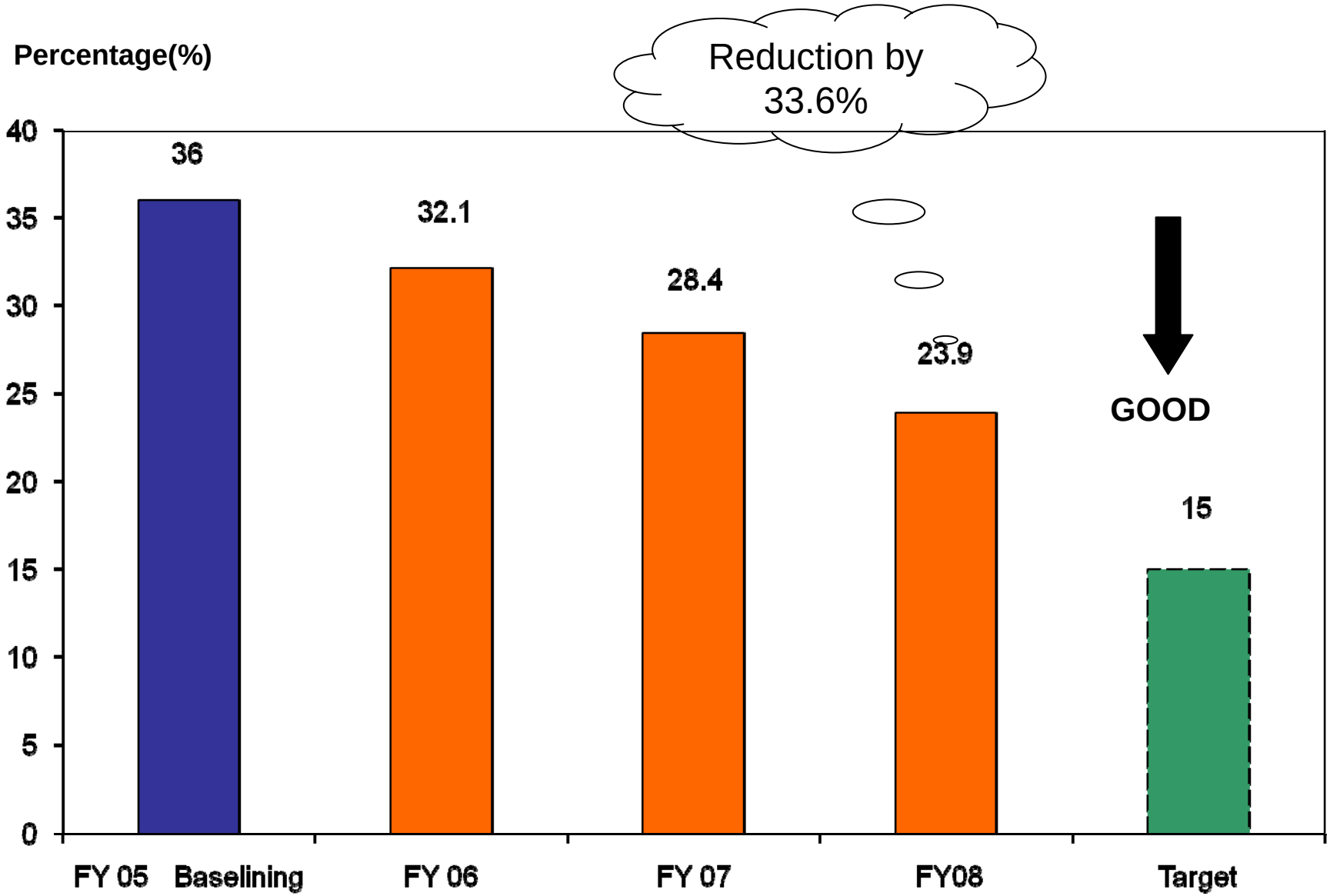
NRW (Clarified Water)



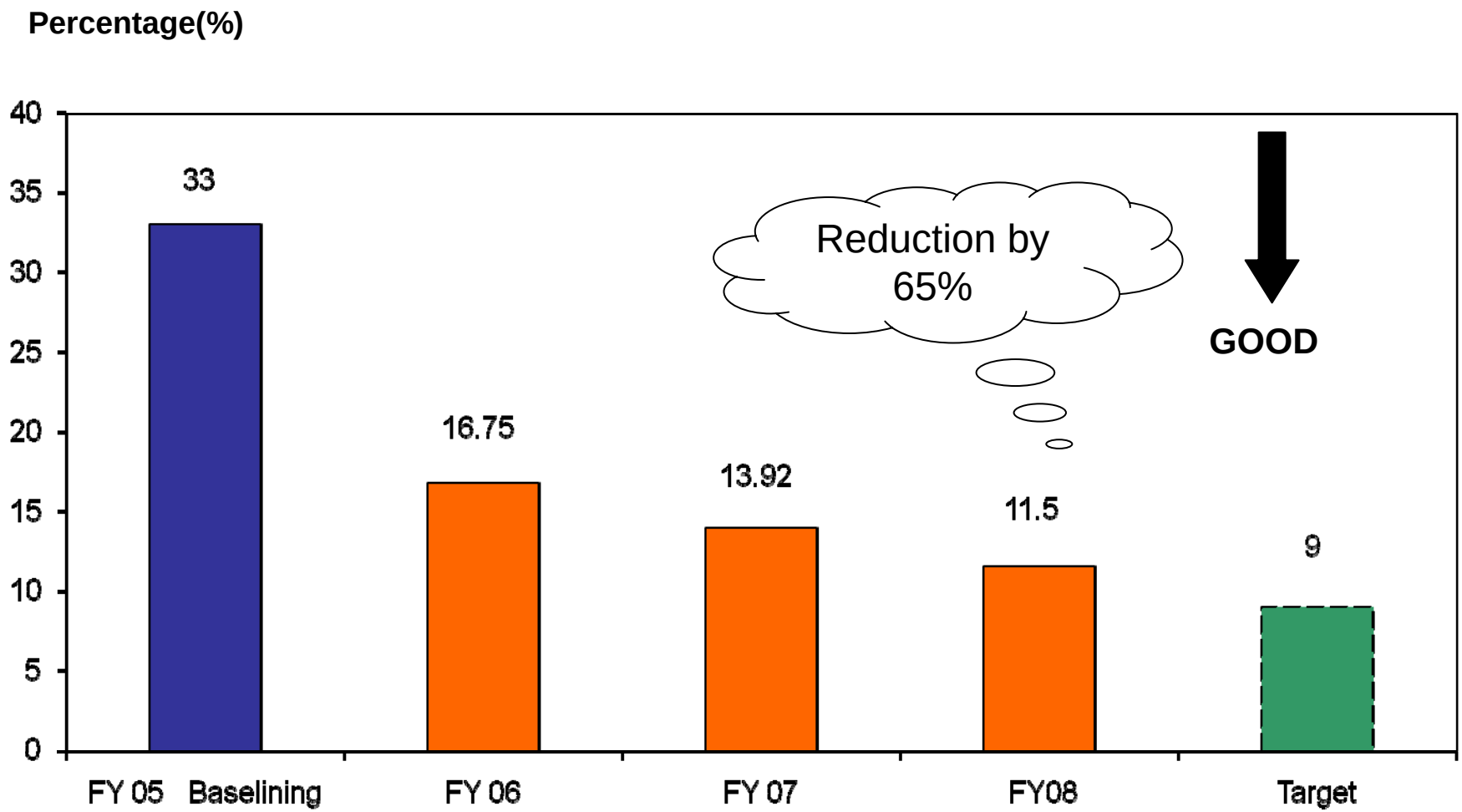
NRW (Rising Mains)



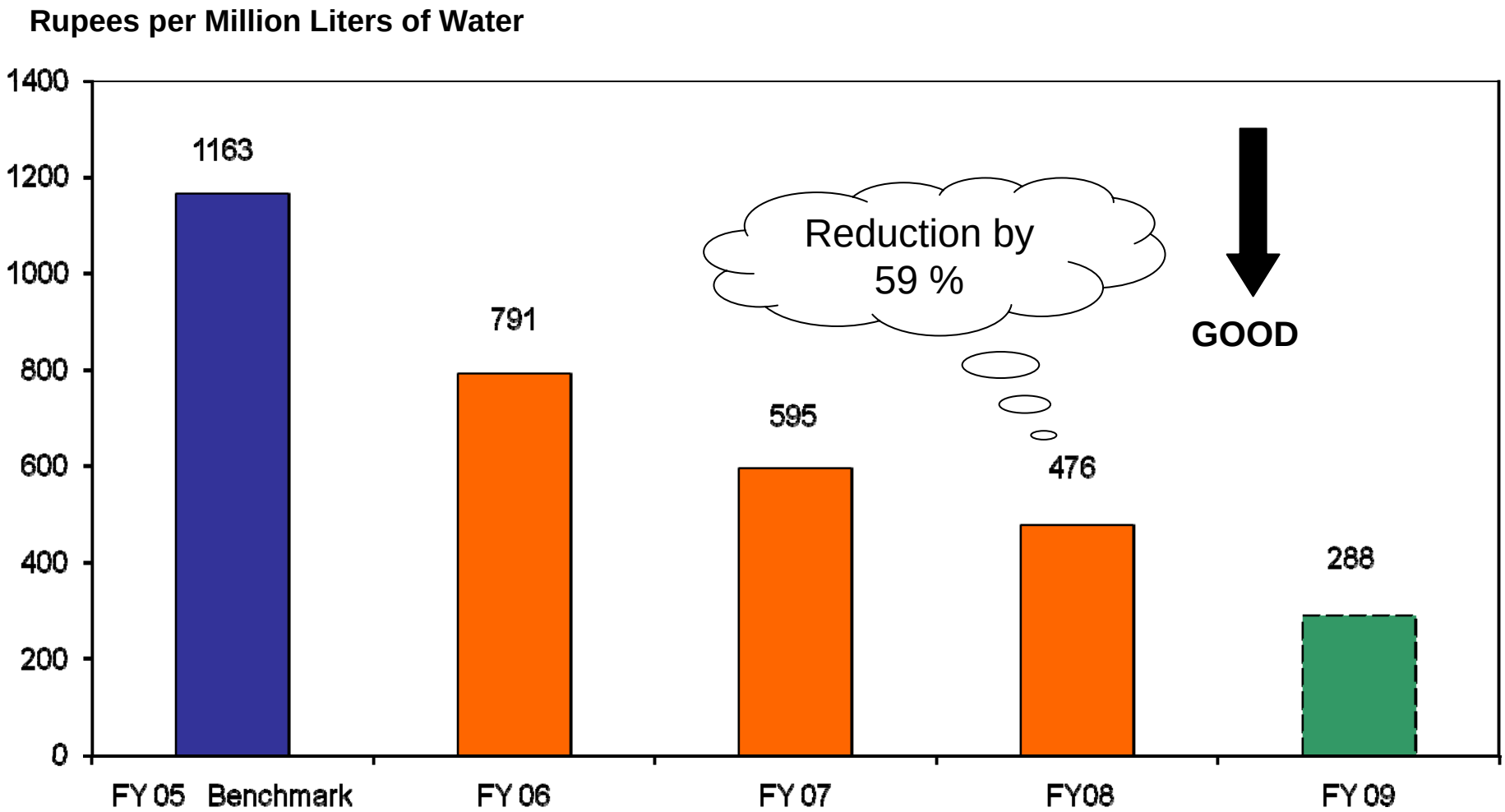
NRW (Distribution network)



NRW (Overall)


Percentage(%)
40
35
30
25
20
15
10
5
0
33
16.75
13.92
11.5
9
Reduction by 65%
GOOD
FY 05 Baselining
FY 06
FY 07
FY08
Target

NRW (Overall)


Rupees per Million Liters of Water
1400
1200
1000
800
600
400
200
0
1163
791
595
476
288
Reduction by
59 %
GOOD
FY 05 Benchmark
FY 06
FY 07
FY08
FY 09

Many other initiatives

----------the journey continues

- TIME

FOR DISCUSSION……