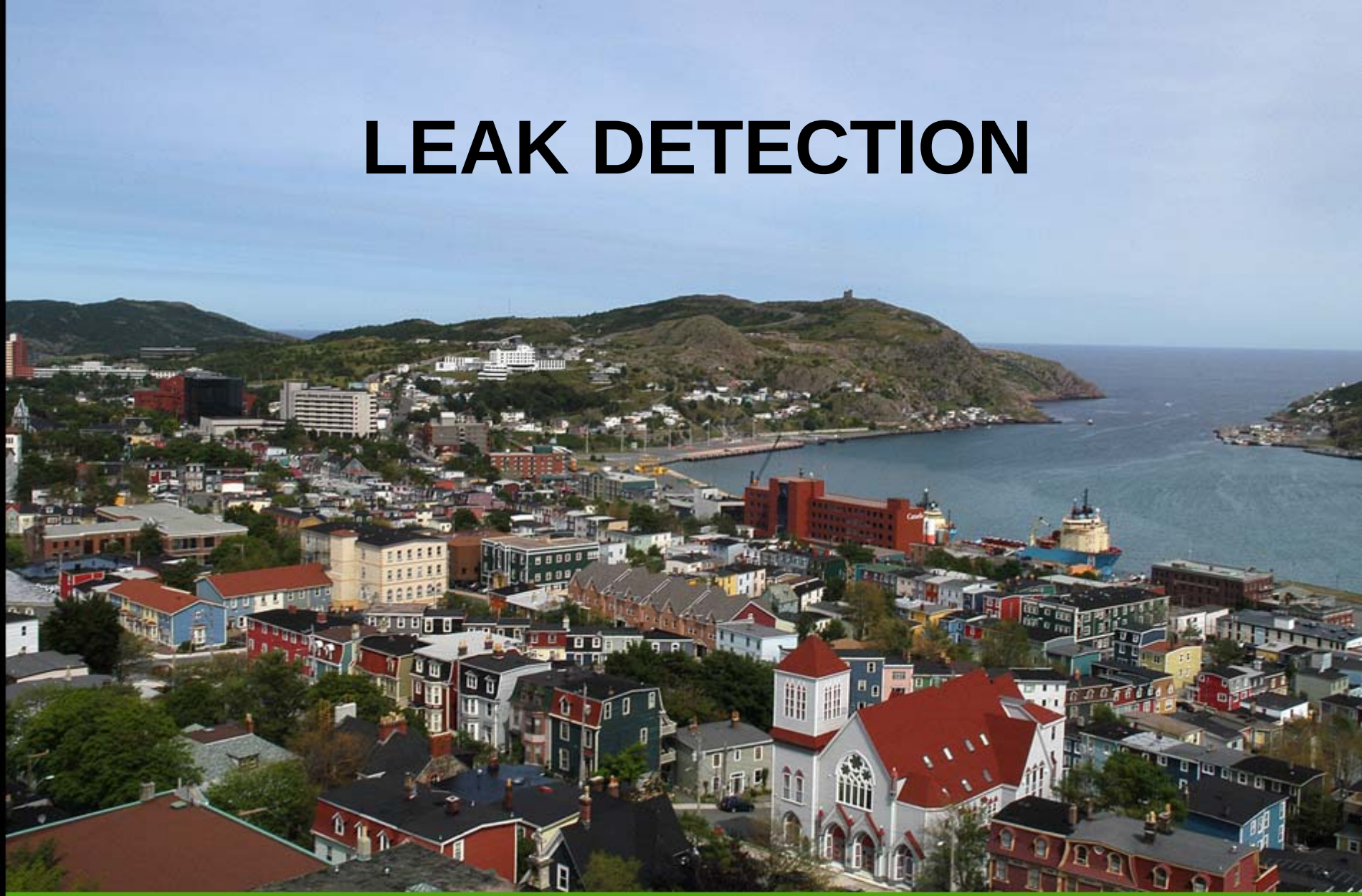
LEAK DETECTION



ST. JOHN'S

DEPARTMENT OF PUBLIC WORKS AND PARKS
ENVIRONMENTAL SERVICES DIVISION

Overview

- Theory
- City of St. John's Program
- New Advancements
- Future Projects

Leak Detection?

Leak Detection?

Leak Detection

What is Leak Detection?

- The process of identifying and reducing "non revenue" water.
  - Primarily Leaks
  - Illegal Use of Water

Leak Detection

What is Non Revenue Water?

- Unbilled Metered Consumption
- Unbilled Unmetered Consumption
- Unauthorized Consumption
- Customer Meter Inaccuracies
- Leakage within Water Distribution System

IWA Water Balance

<table>
<tr><td rowspan="8">System Input Volume</td><td rowspan="3">Authorised Consumption</td><td rowspan="2">Billed Authorised Consumption</td><td>Billed Metered Consumption</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorised Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="6">Non Revenue Water</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="5">Water Losses</td><td rowspan="2">Apparent Losses</td><td>Unauthorised Consumption</td></tr>
<tr><td>Customer Meter Inaccuracies</td></tr>
<tr><td rowspan="3">Real Losses</td><td>Leakage on Transmission & Distribution Mains</td></tr>
<tr><td>Leakage and Overflows at Reservoirs</td></tr>
<tr><td>Leakage on Service Connections up to metering point</td></tr>
</table>

IWA Water Balance

In Newfoundland & Labrador the IWA Water Balance is not commonly used due to lack of residential and commercial water meters.

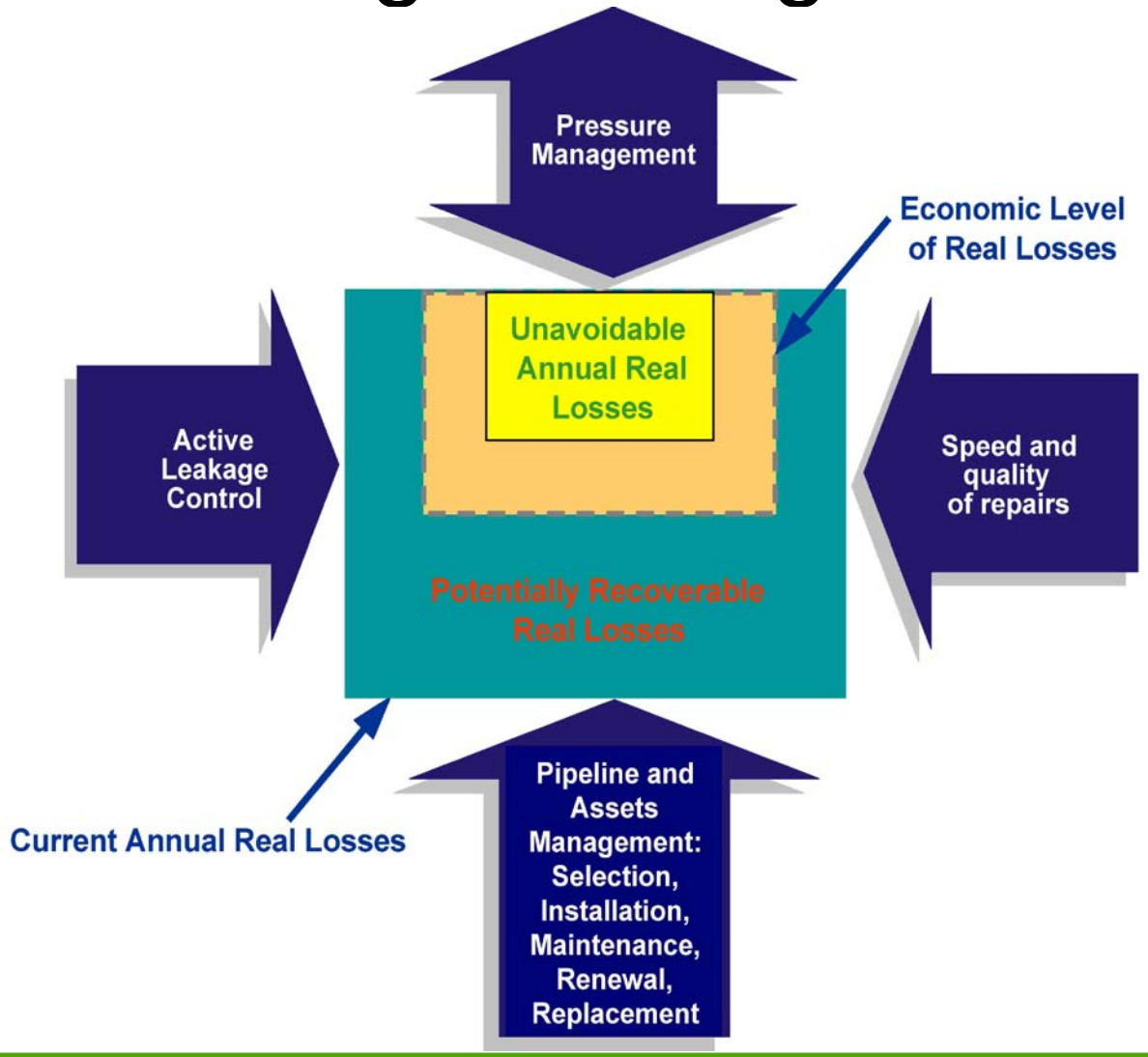
However, we can focus on "Real Losses" within the Water Distribution system.

Leak Management

Leak Management can be divided into four activities:

1. Asset Management
2. Speed and Quality of Repairs
3. Active Leak Detection
4. Pressure Management

Leakage Management



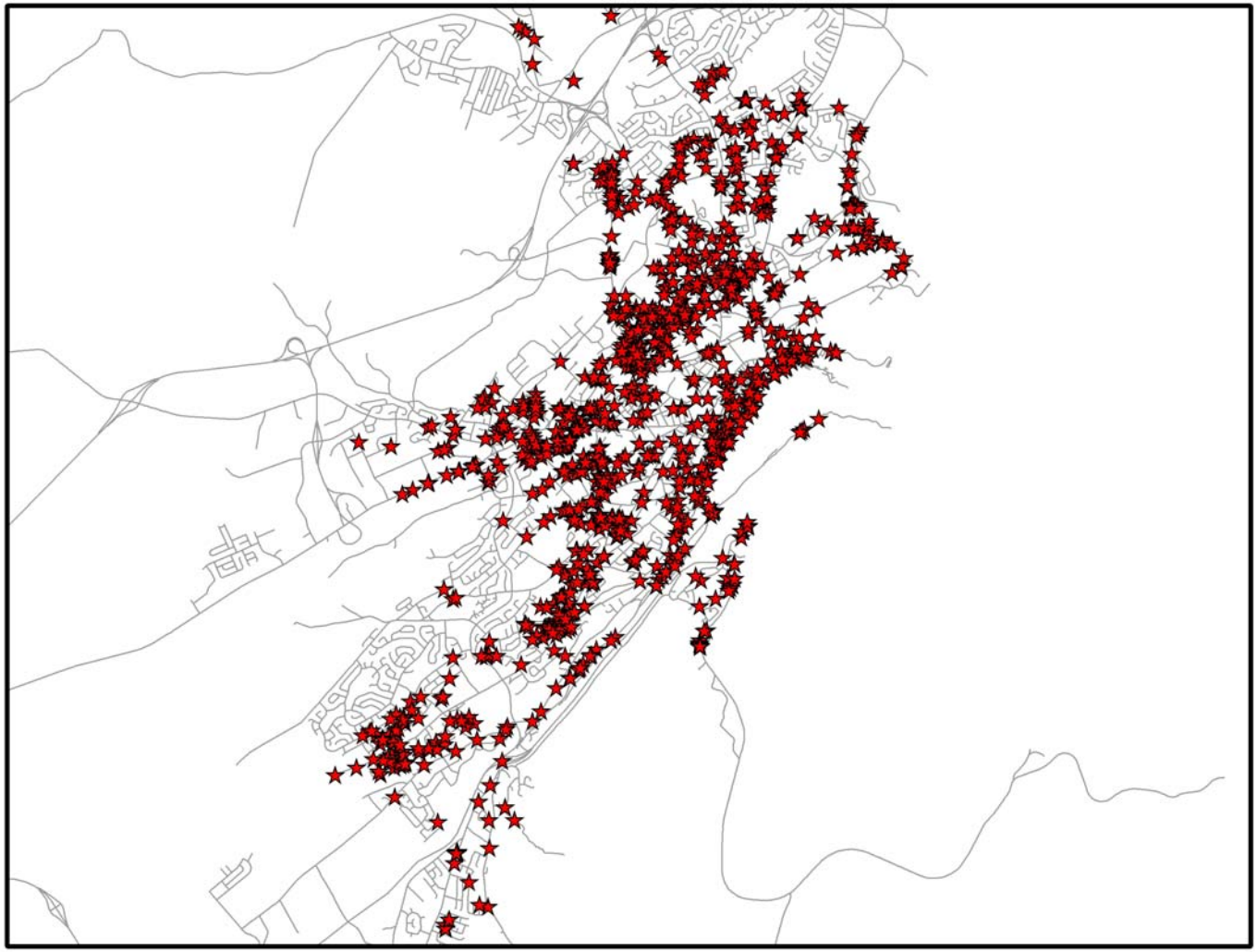
Asset Management

The City of St. John's records information on all water main breaks.

This information is entered into the GIS system. This data is reviewed to determine:

- High concentrations of breaks / leaks
- Areas requiring repairs or replacement
- Selection of Materials

Asset Management – All WM Breaks



Asset Management – DI WM Breaks

Asset Management

Leak Repairs

Leak Repairs

The volume of water loss due to leakage is a function of flow rate and time – Leak Run Time.

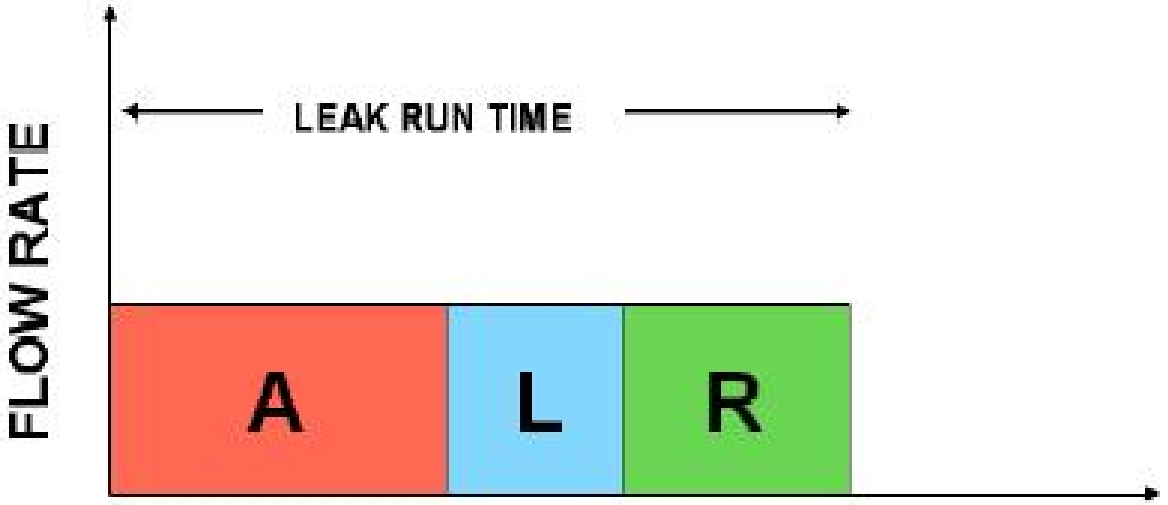
Leak Run Time is comprised of three components:

- Awareness
- Location
- Repair

Leak Run Time

Leak Run Time Awareness

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



RUN TIME = *Awareness + *Location* + *Repair***

Leakage Rates

How much water is lost from a water main leak or break?

Answer – It Depends

- Type of Break
- Size of Hole / Opening
- **Pressure**

Leakage Rates

Leakage Rates

Typical Water Main Break

- 30 m^3/hr
- Awareness = 1-2 hours
- Location = 1-2 hours
- Repair = 8 hours
- Total Time = 12 hours
- Volume = 360m^3

Leakage Rates

Leakage Rates

Typical Service Leak

- 3mm Hole in Pipe (1/8")
- Pressure = 70 psi
- Flow = 0.54 m^3/hr
- Awareness = 3 months
- Location = 1-2 hours
- Repair = 8 hours
- Total Time = 3 months
- Volume = 1166 m^3

Leakage Rates

Summary

- Majority of Water Main breaks are easily and quickly located and repaired.
  - Resulting in short "Leak Run Time"
  - Large Volume of Water lost in Short Period
- Majority of Service Leaks can go undetected for extended periods of time.
  - Resulting in long "Leak Run Time"
  - Large Volume of Water lost in Large Period
- Therefore Leak Detection should be focused on locating leaks that could go undetected.

Active Leak Control

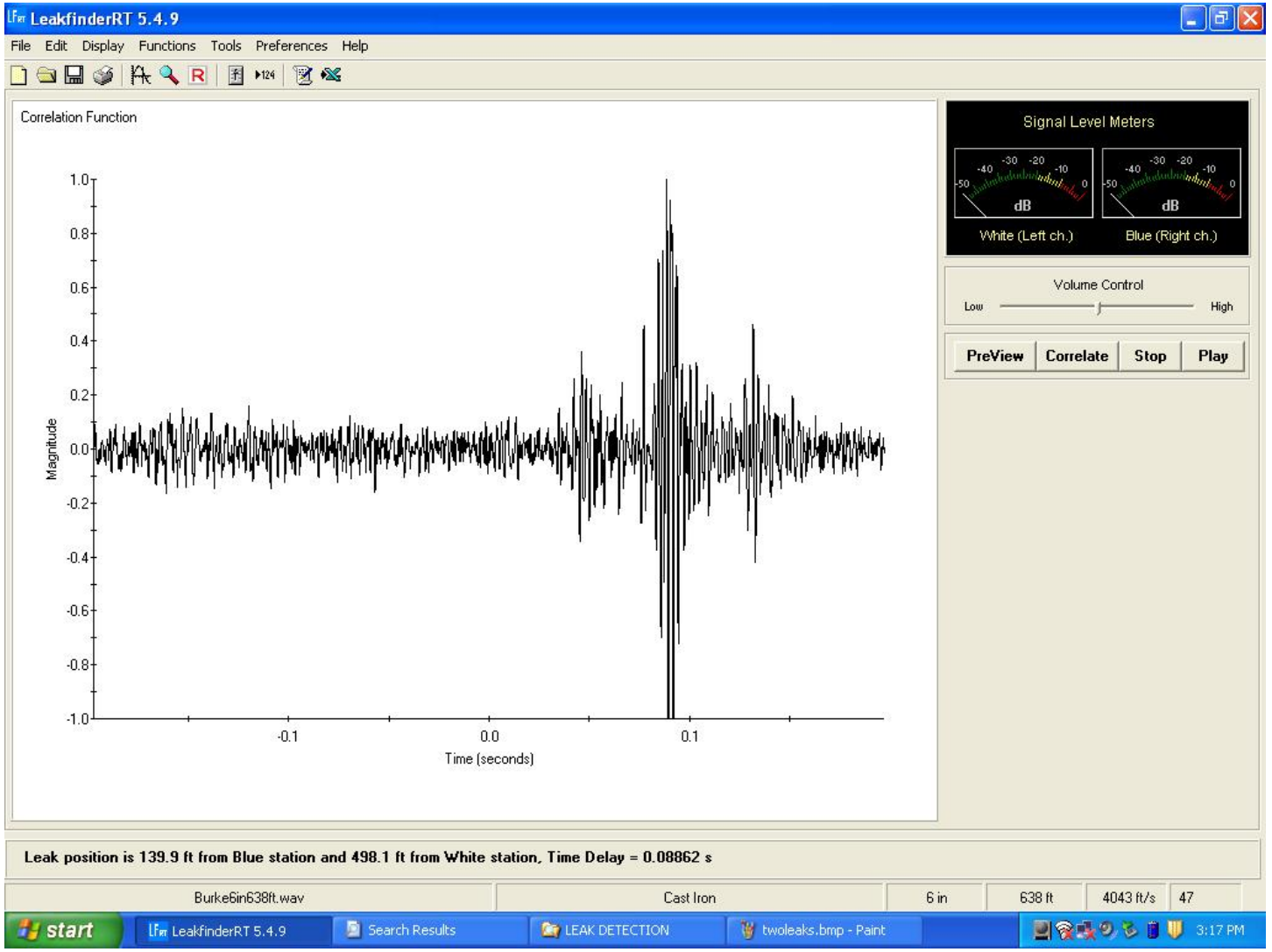
CSJ's Leak Detection Program is comprised of the following tasks:

- Hydrant Sounding
- Hydrant Leaks versus Main Leaks
- Pin – Point Leak Locations
- Repairs

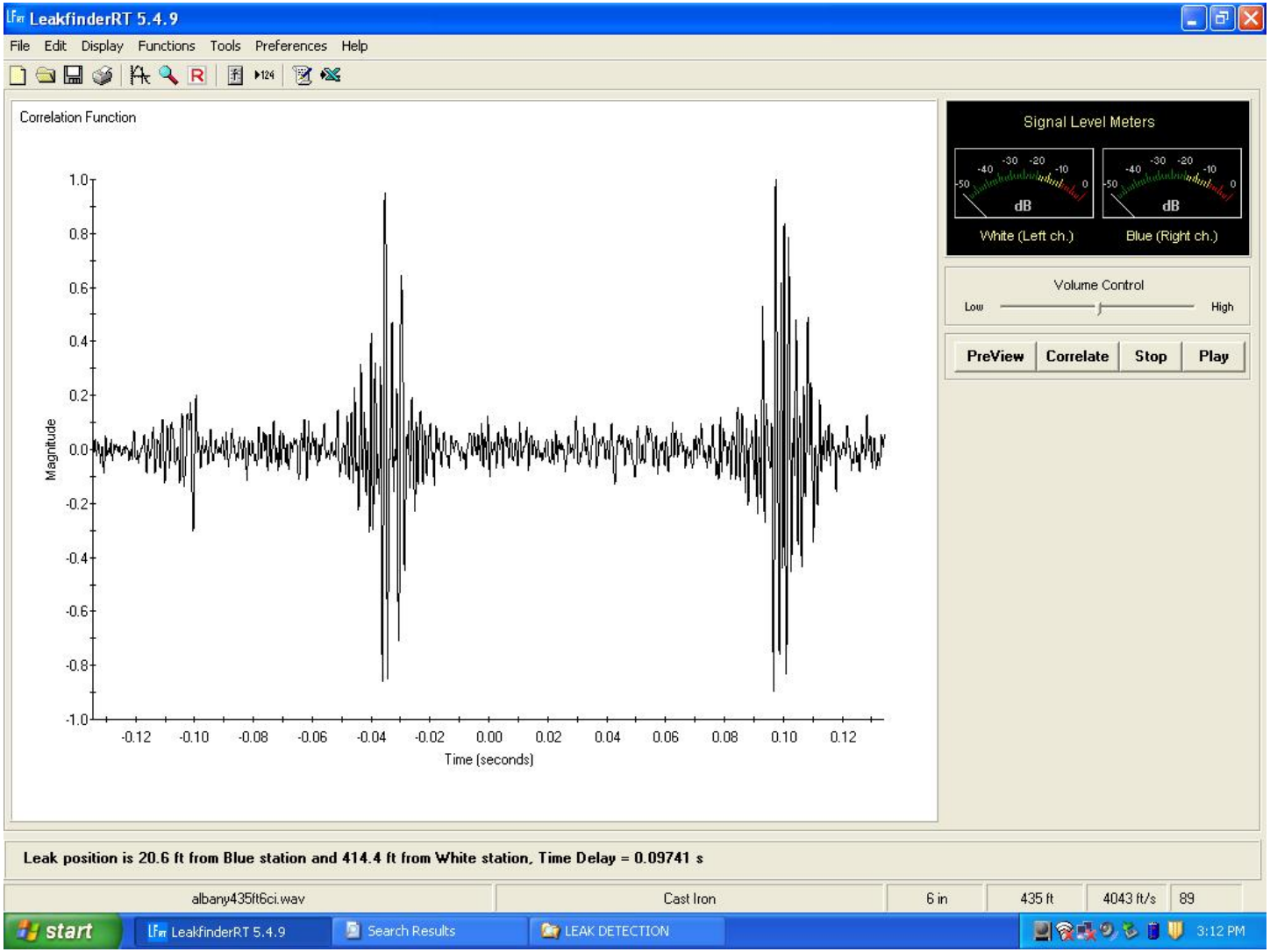
Active Leak Control

Leak Locations are determined using Leak Noise Correlator

Active Leak Control – Correlator Result



Active Leak Control – Correlator Result



Active Leak Control - Advancements

District Metered Areas:

- DMA's are defined as discrete areas in which all incoming (and outgoing) water is metered.
- Typically defined by pressure differences caused by various water distribution infrastructure – PRVs, pump stations, water storage reservoirs, etc.
- Flows are monitored to determine possible leaks.

Active Leak Control - DMAs

DMA Concept

- Minimum night time flow is calculated, leak detection completed to achieve minimum night flows (typically greater than theoretical calculated result).
- Flow data is monitored daily and minimum night flow is compared to actual flow
- Variance in flows = leak(s) or usage

Active Leak Control - DMAs

Ideal DMA Size

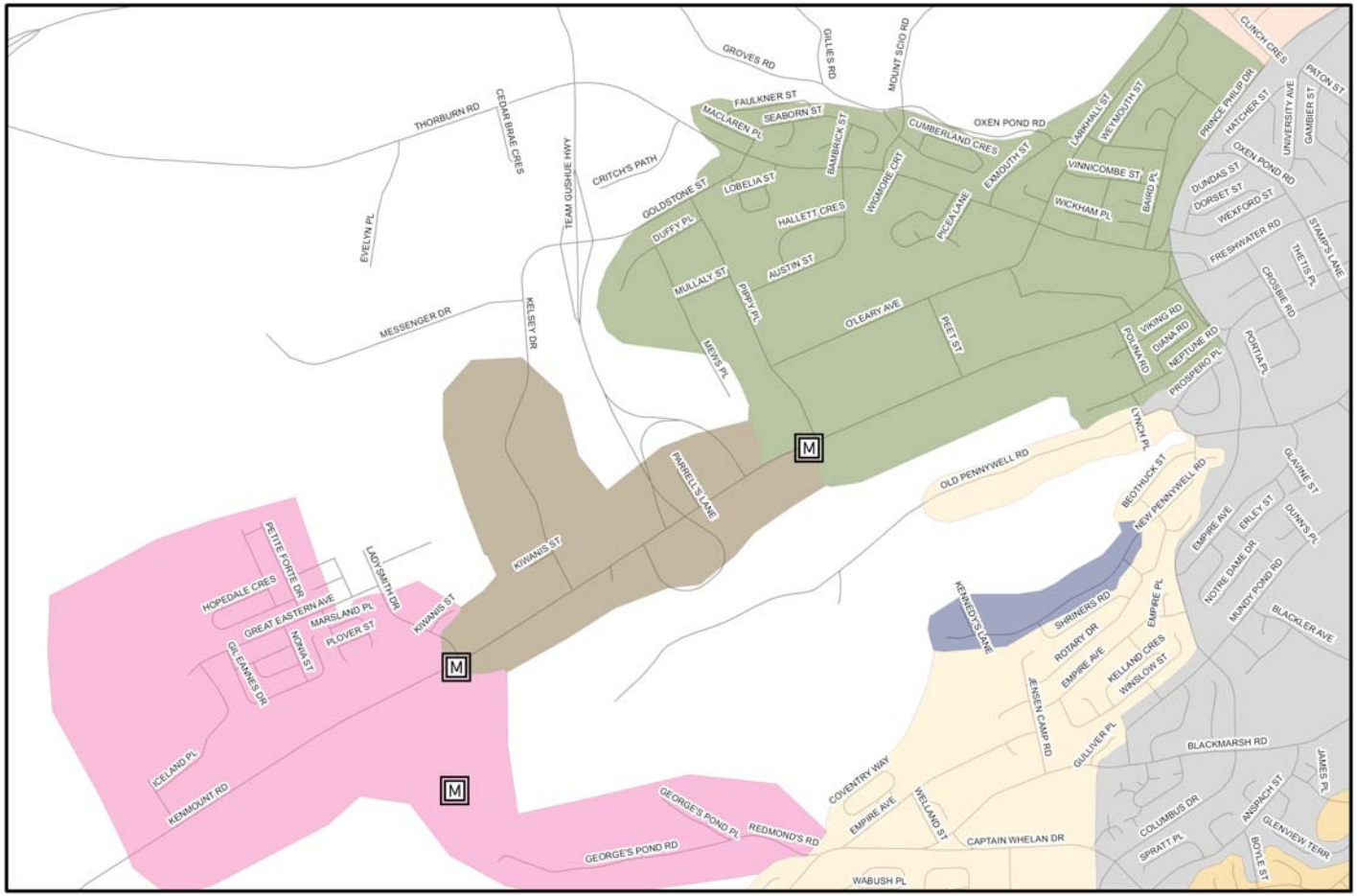
- 150-200 Fire Hydrants,
- 2500 Service Connections
- 30 km of Water Mains
- Leak Survey to be Completed in 1-2 days
- Total Leak Run Time of 3-4 days

Active Leak Control - DMAs

CSJ DMAs

- 23 Current Zones
- 28+ Proposed Zones
- 12 Zone Water Meters Installed
- 5 Zone Water Meters Installations Planned
- Remote Communications to be Installed in 2010

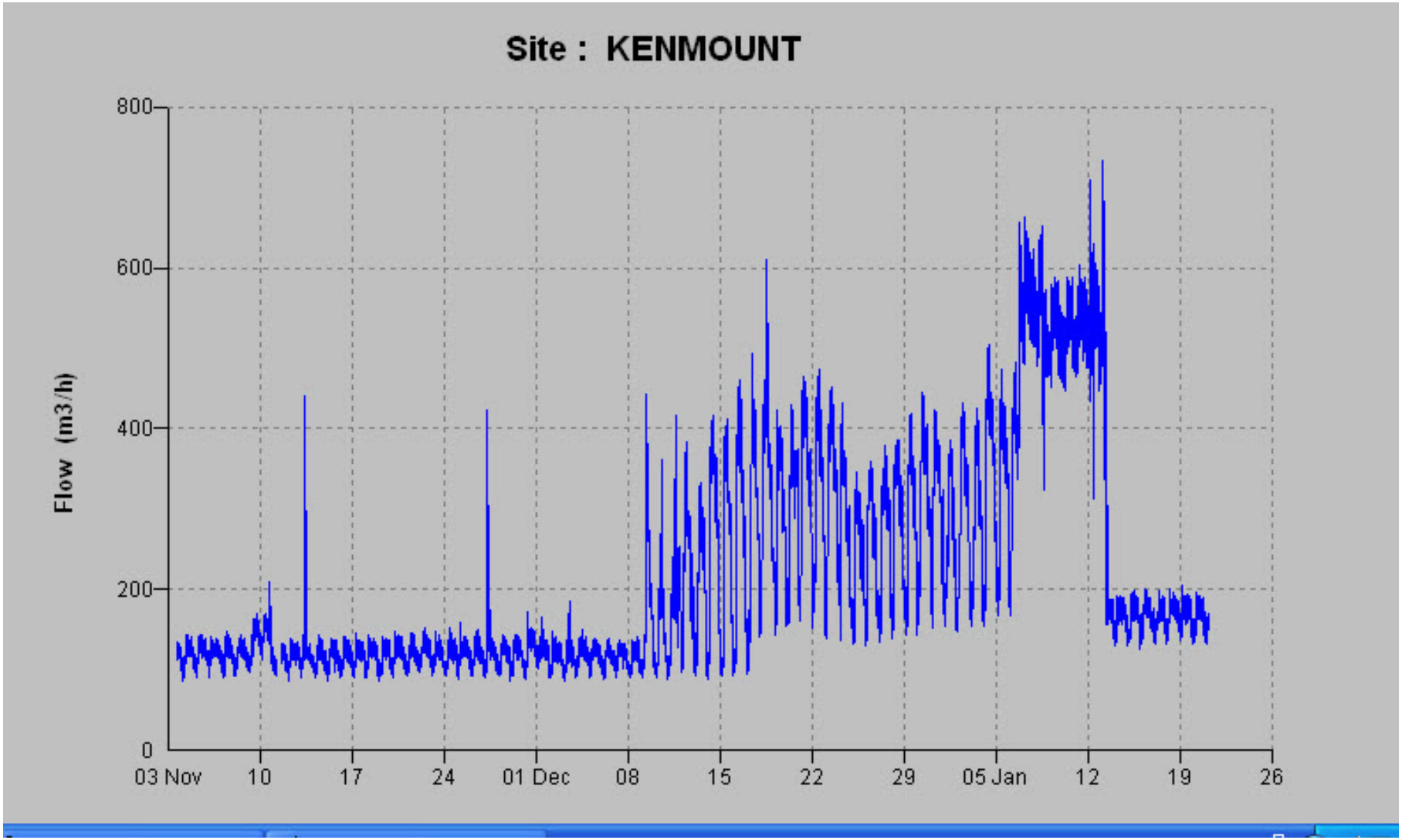
Active Leak Control - DMAs



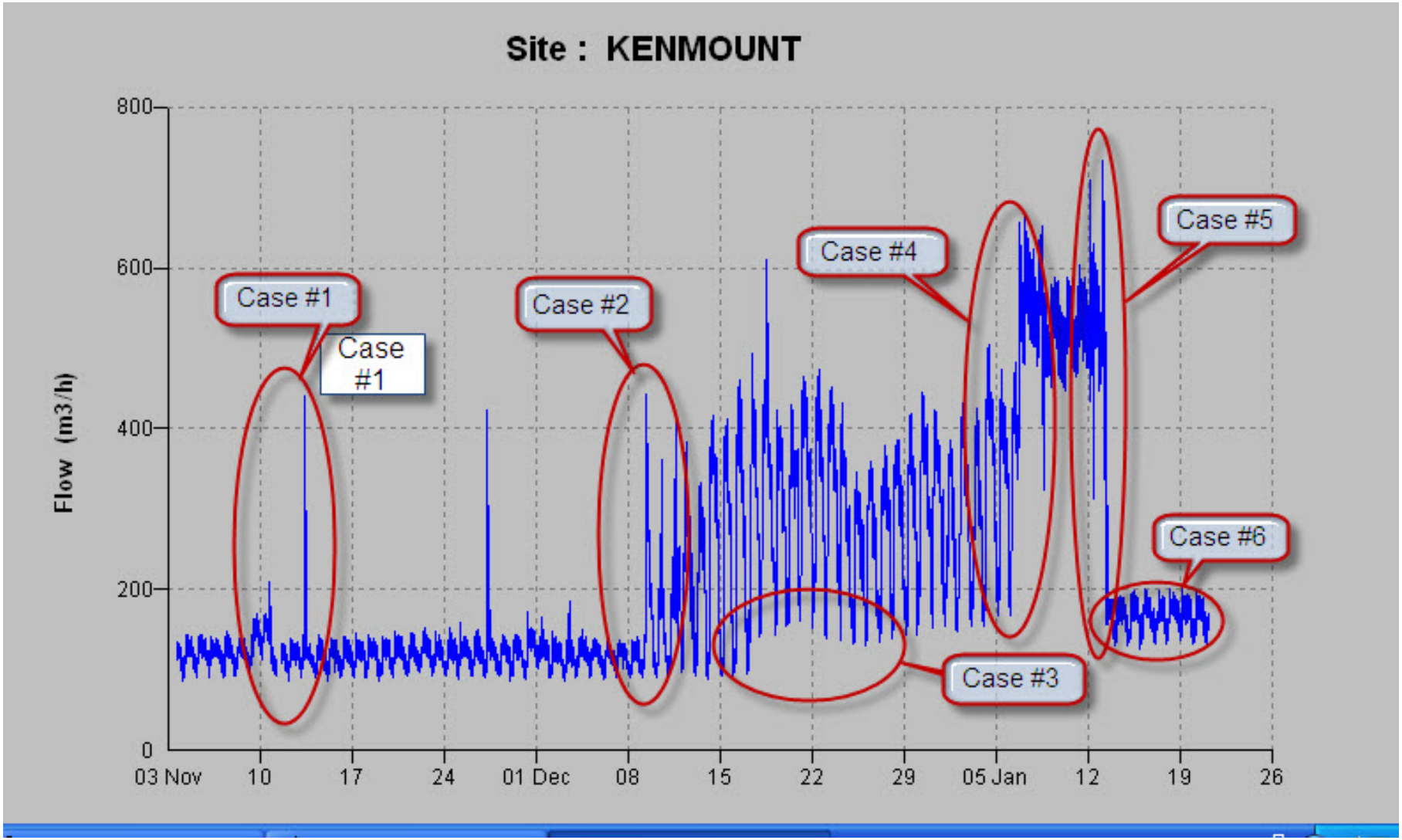
CSJ DMA - Example

- Master Meter + 2 Sub Meters

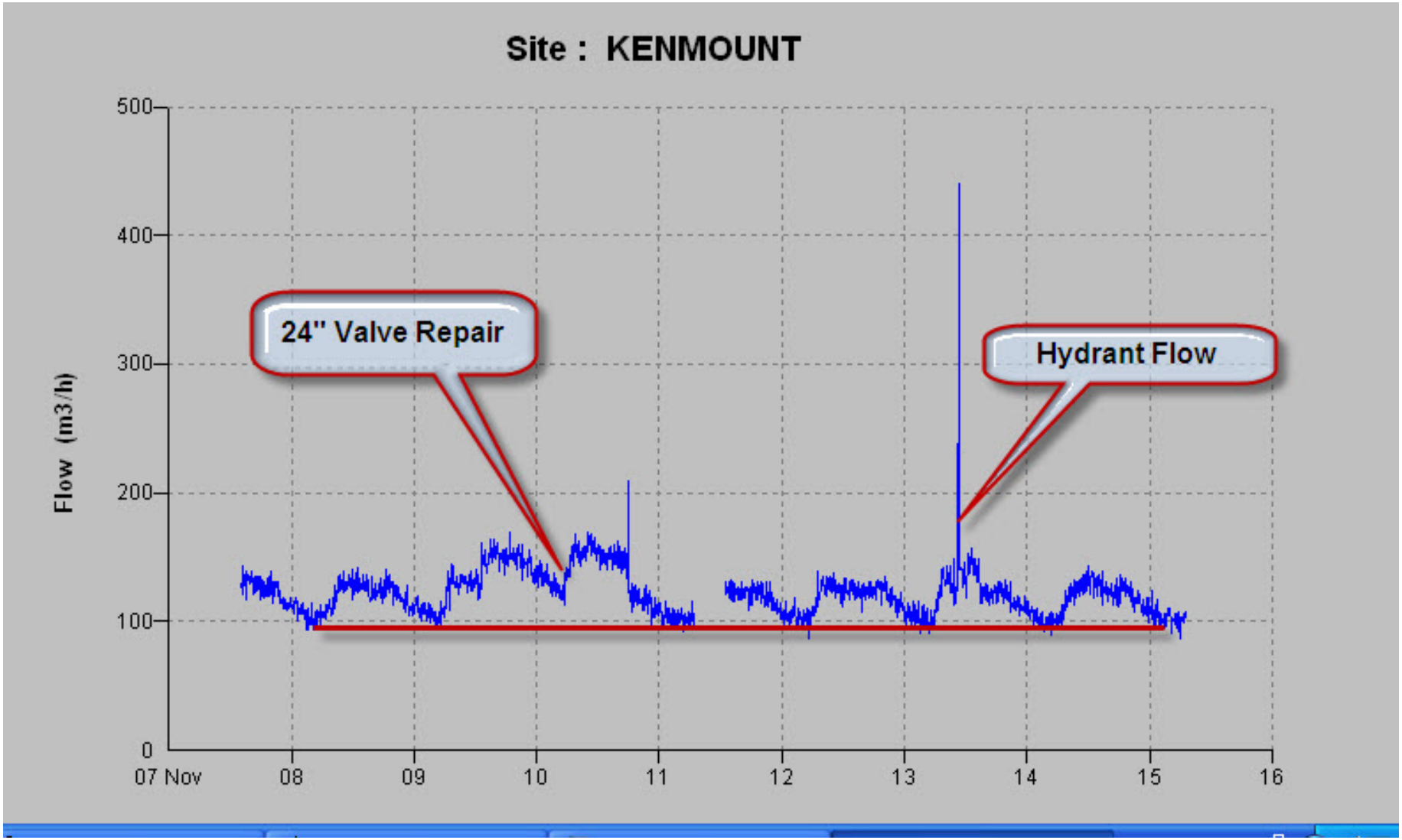
Active Leak Control – DMA Results



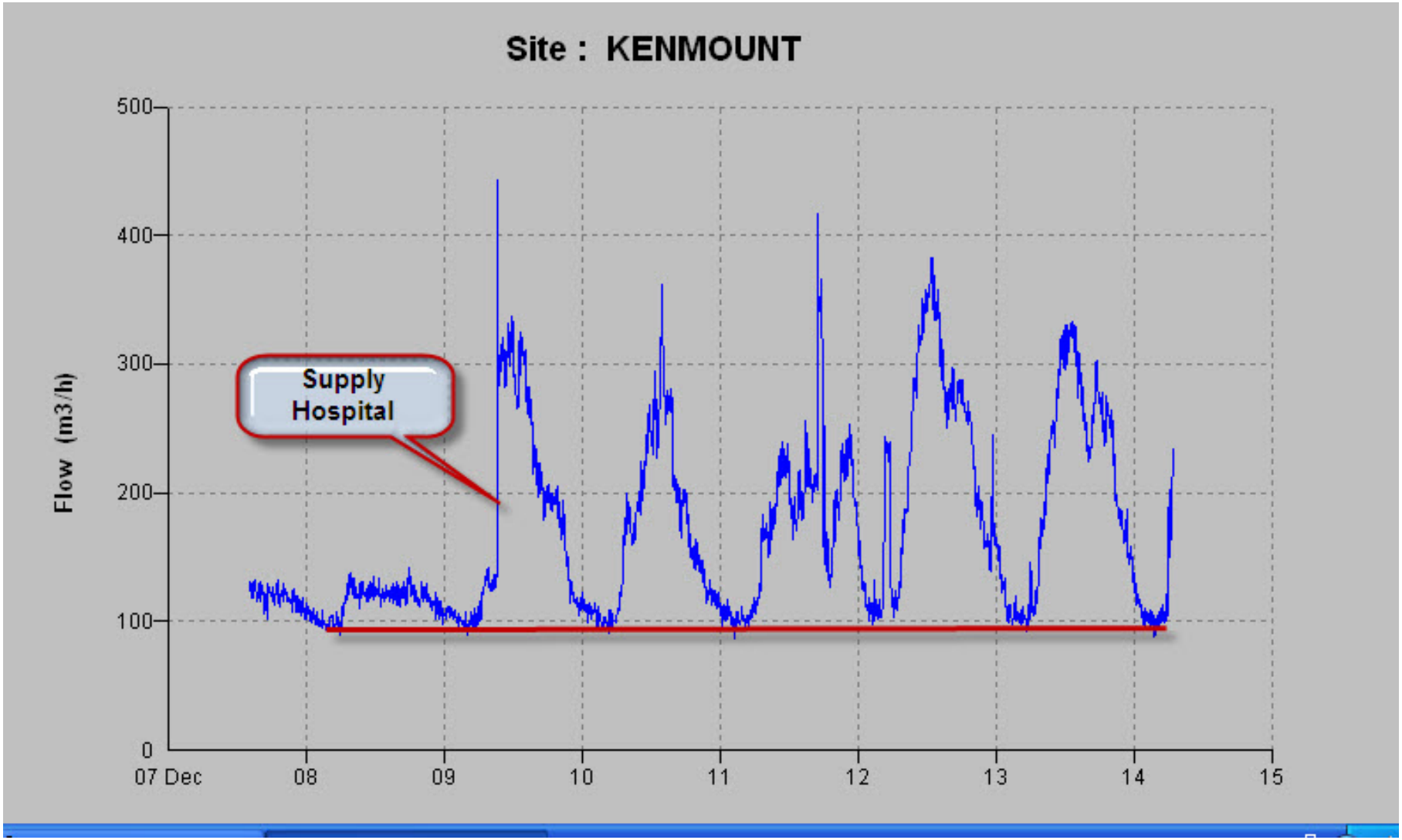
Active Leak Control – DMA Results



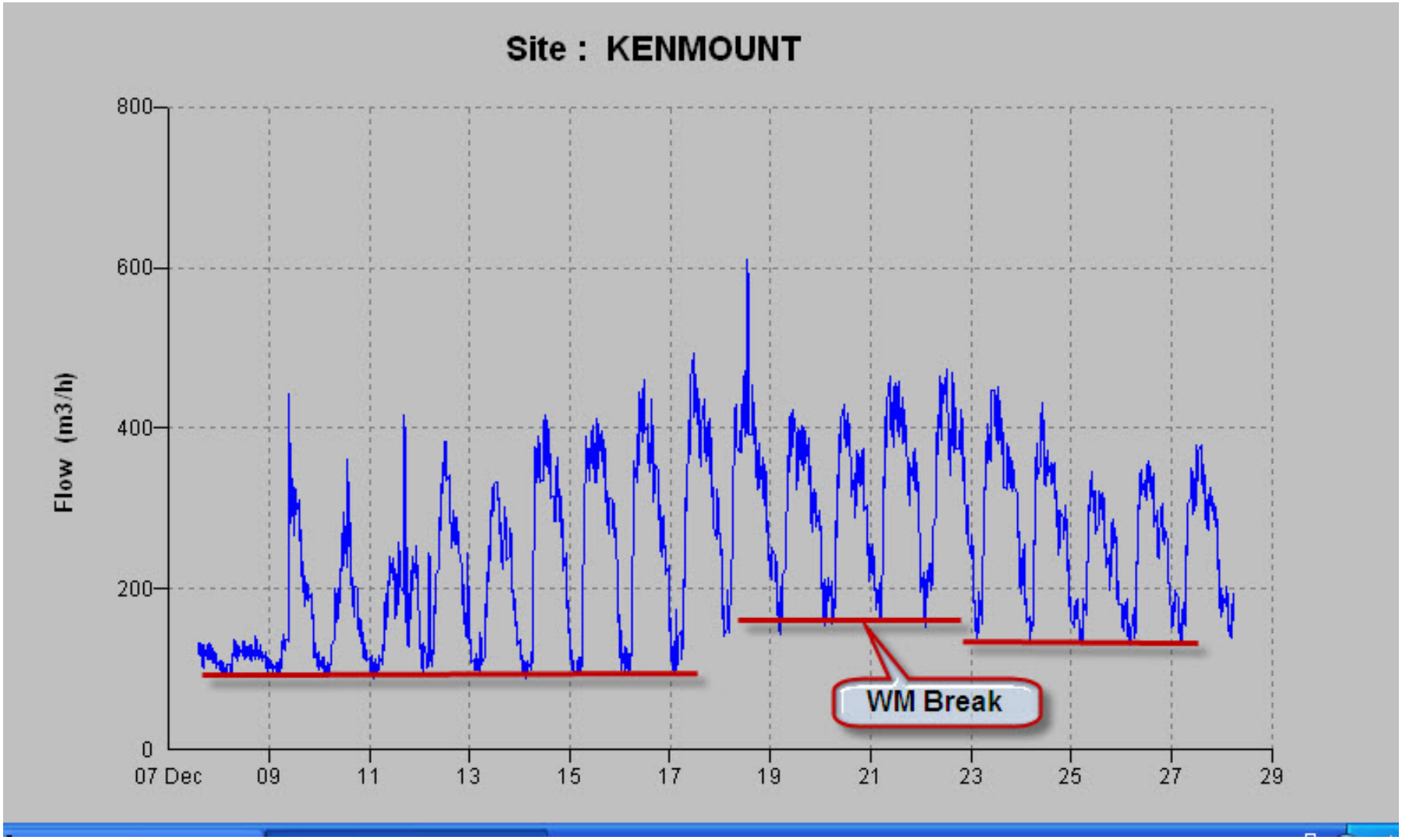
Active Leak Control – DMA Case #1



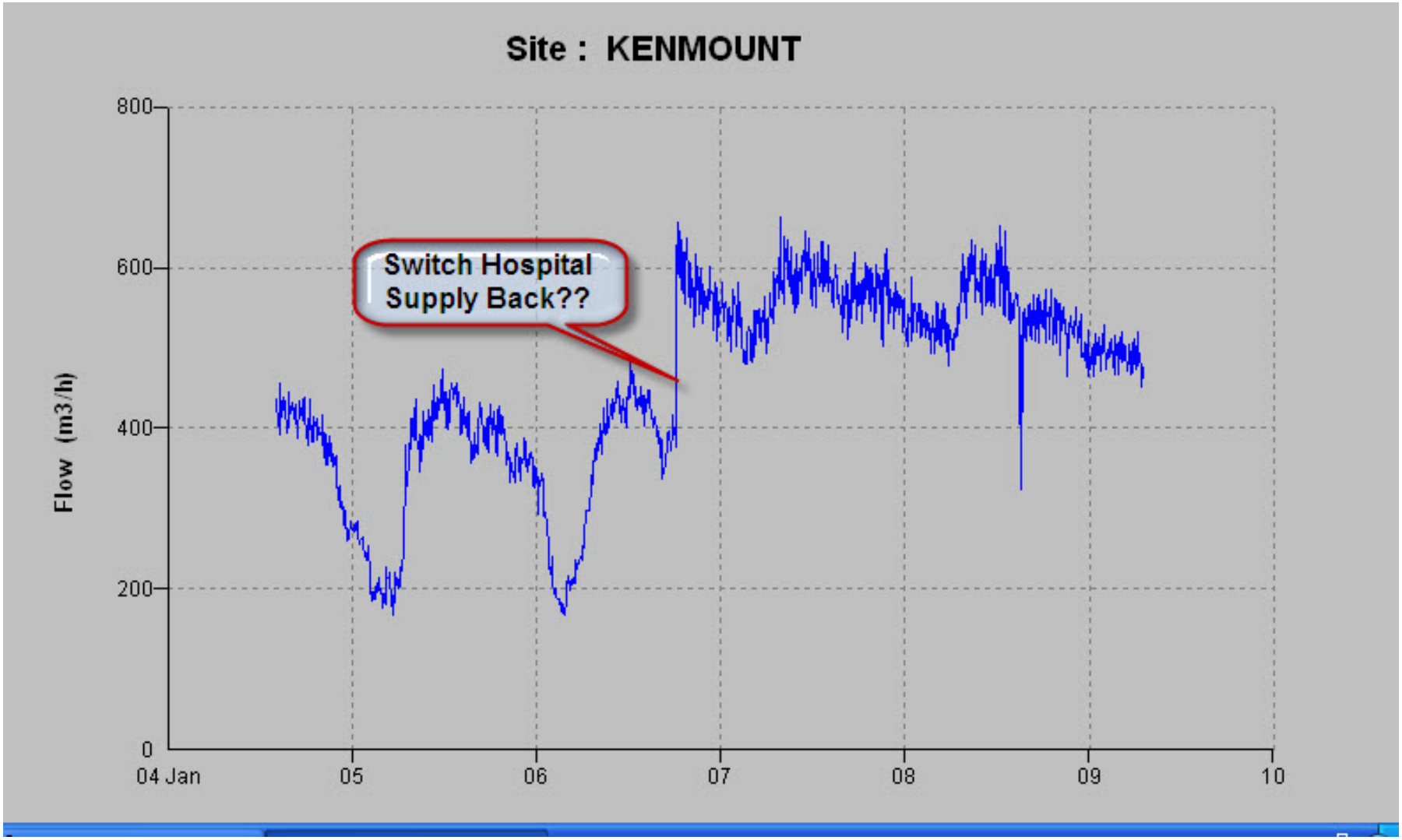
Active Leak Control – DMA Case #2



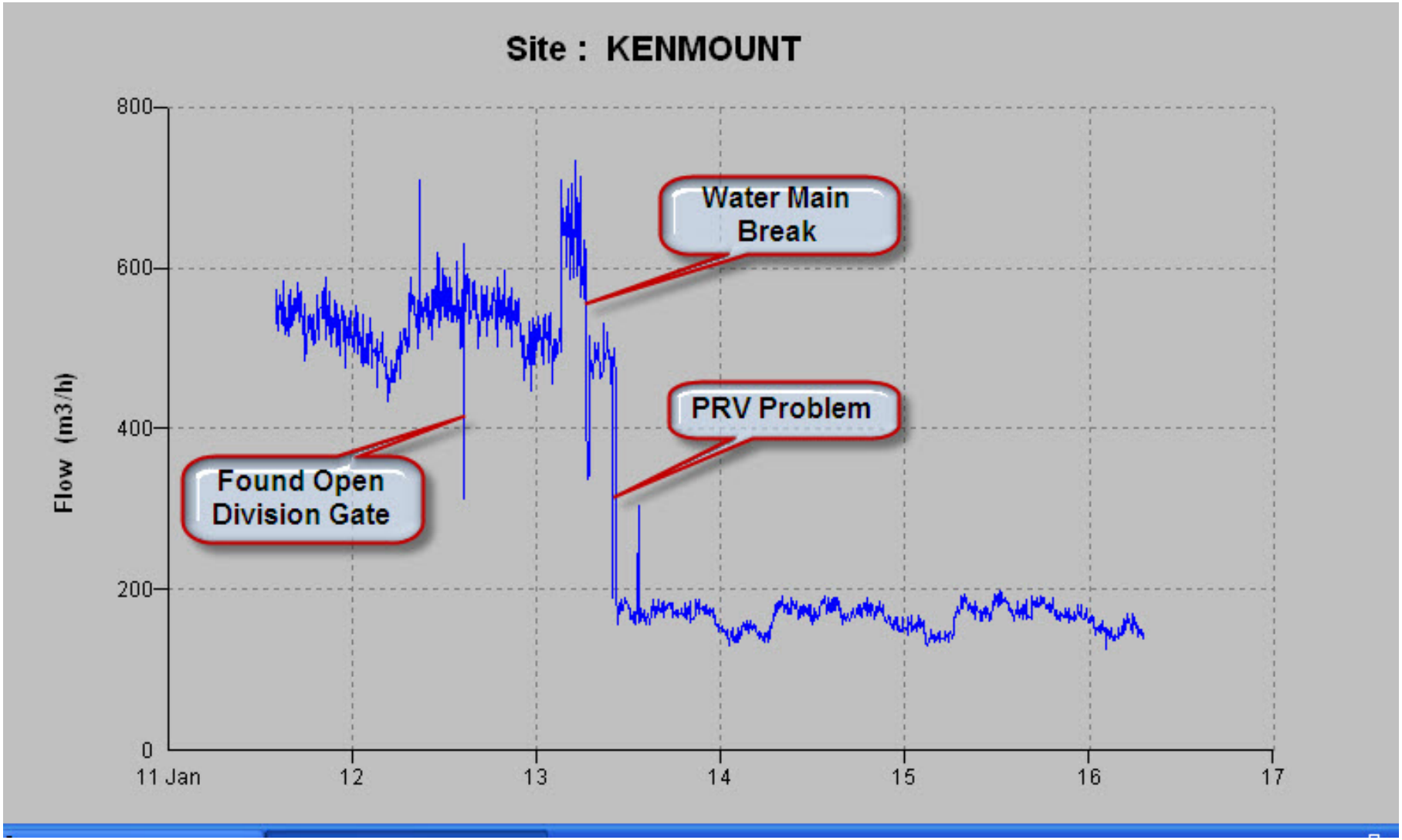
Active Leak Control – DMA Case #3



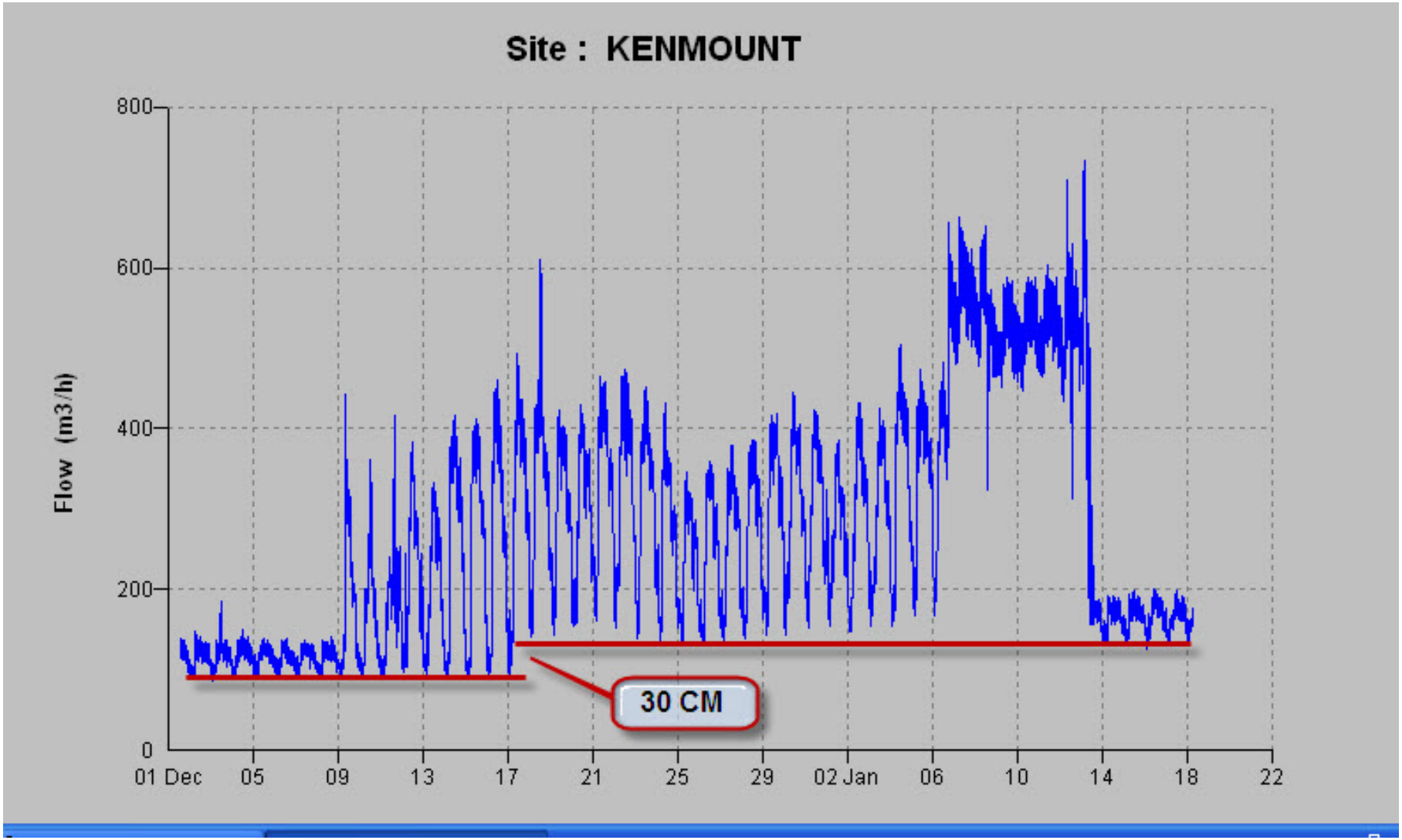
Active Leak Control – DMA Case #4



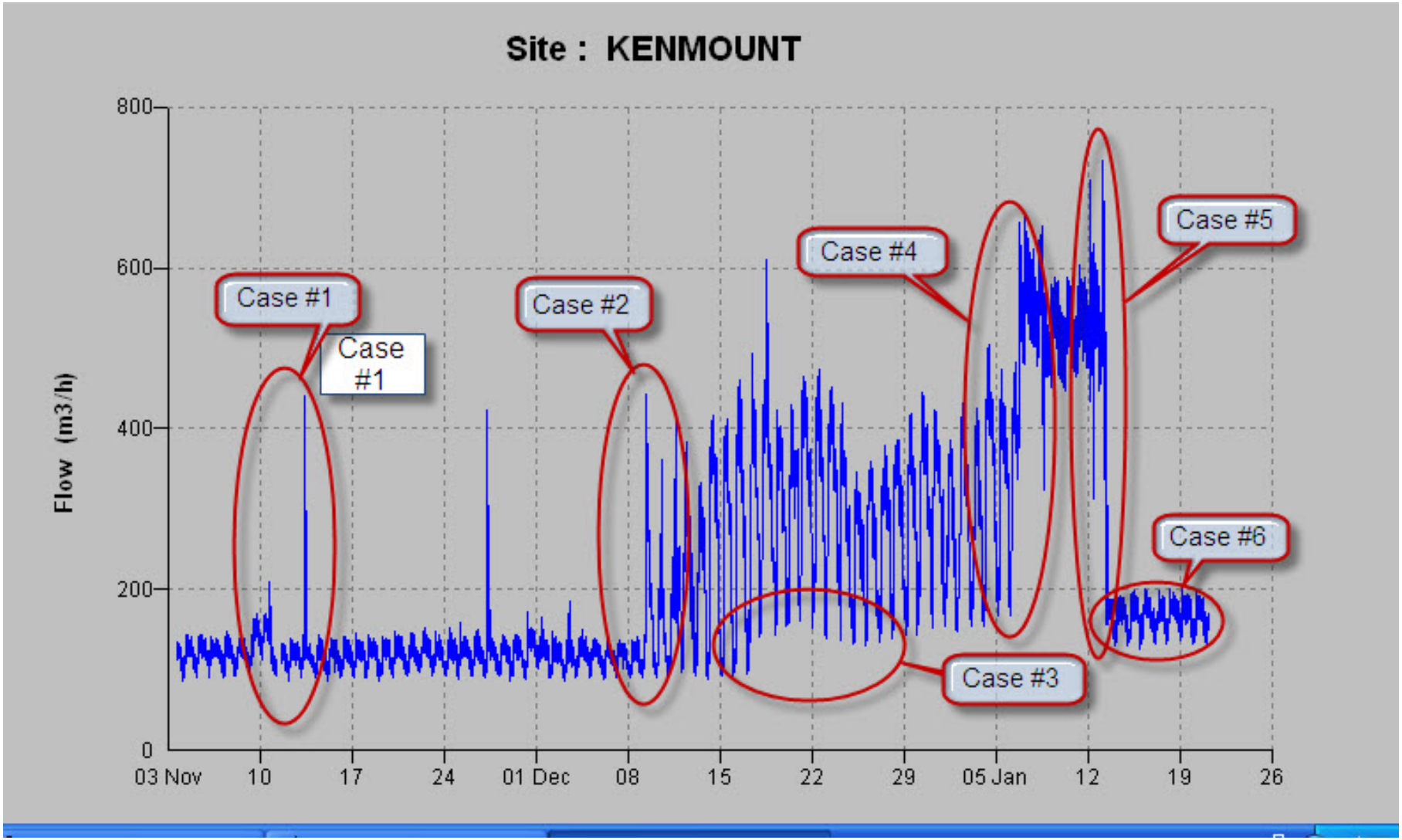
Active Leak Control – DMA Case #5



Active Leak Control – DMA Case #6



Active Leak Control – DMA Overview

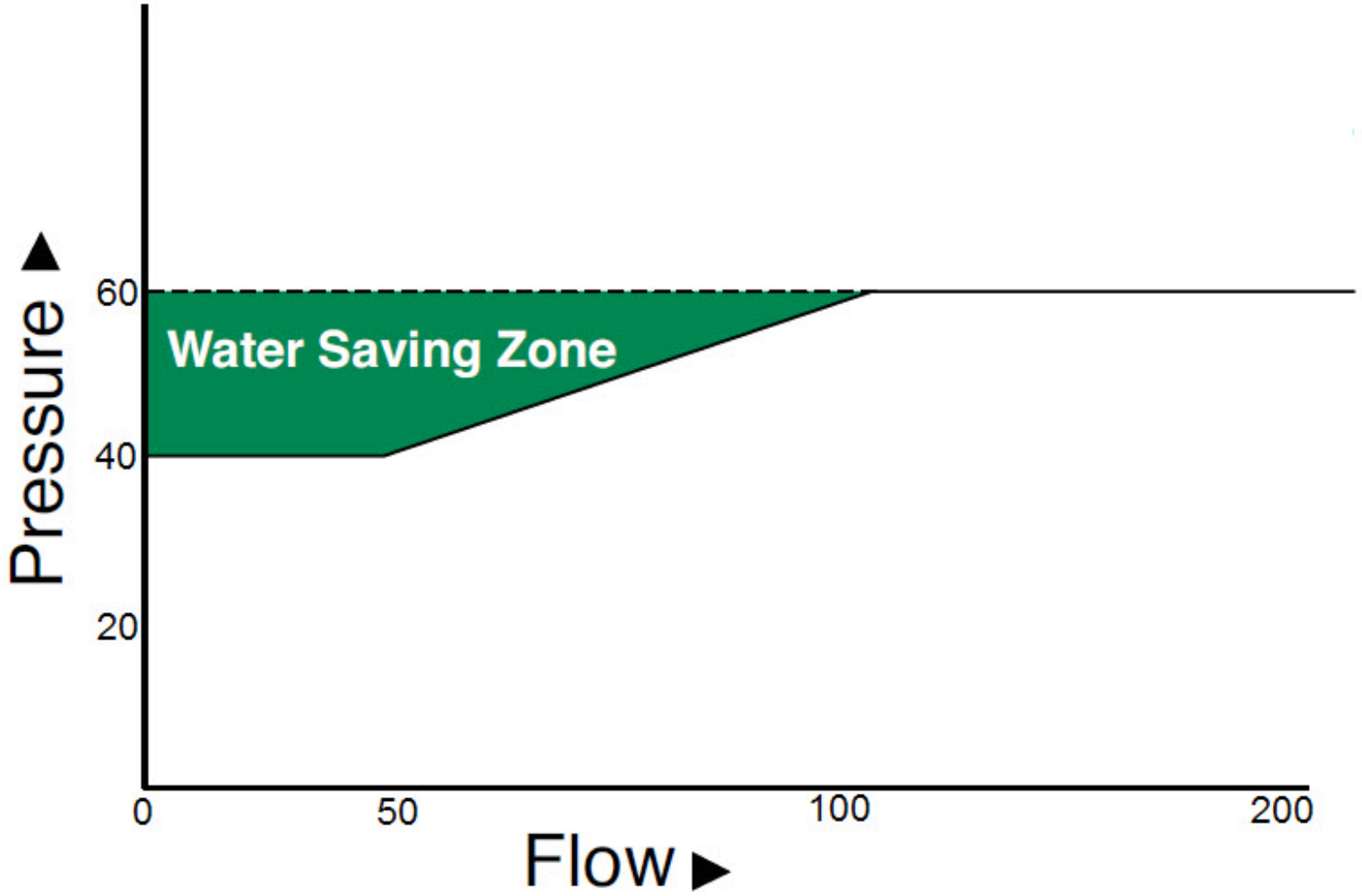


Pressure Management - Future

Theory of Pressure Management

- During periods of low demand water pressure is reduced below normal setting.
- Lower water pressure will result in reduced leakage and reduced water main breaks
- Typically pressure management is completed during off-peak hours – night time.

Pressure Management - Concept

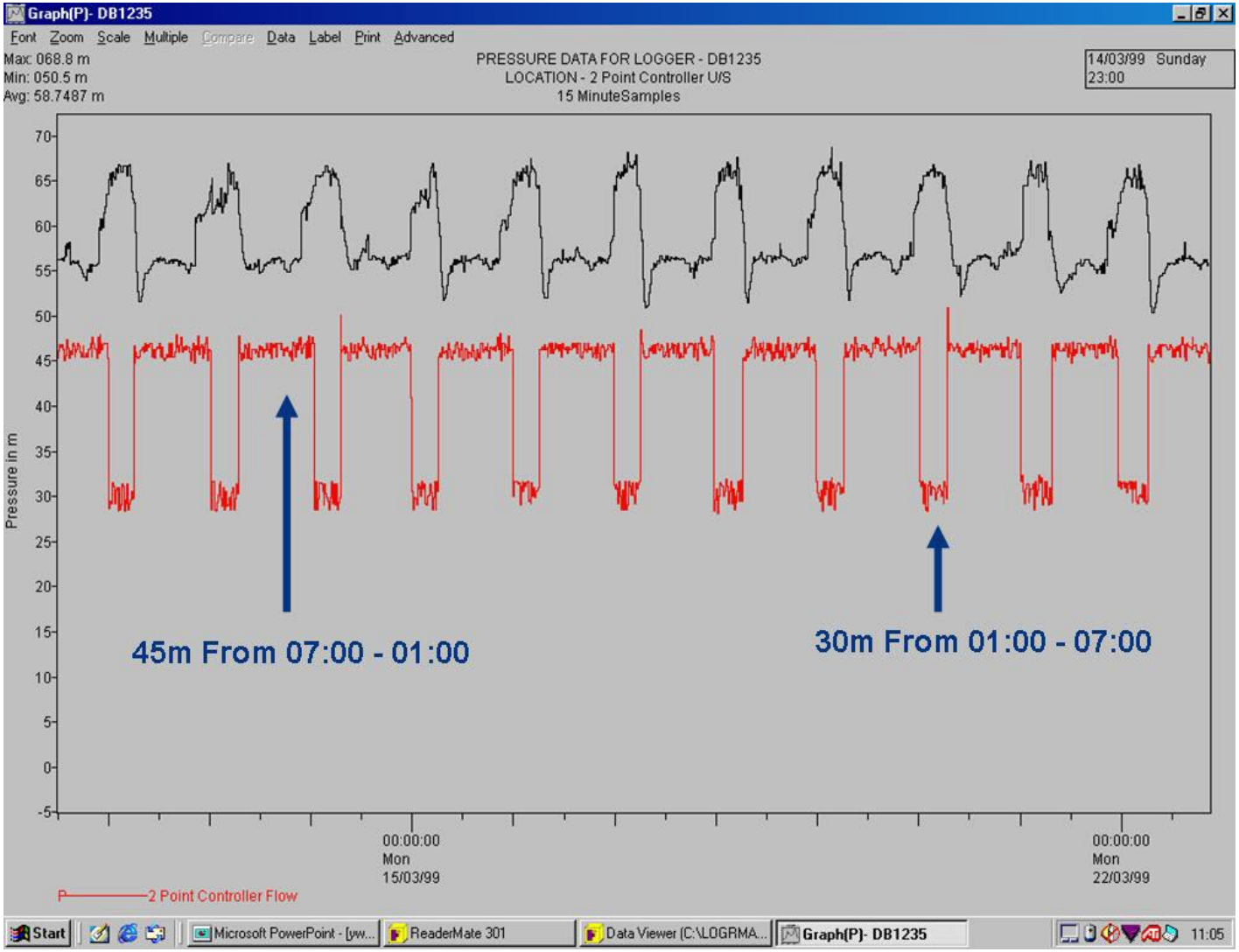


Pressure Management - Concept

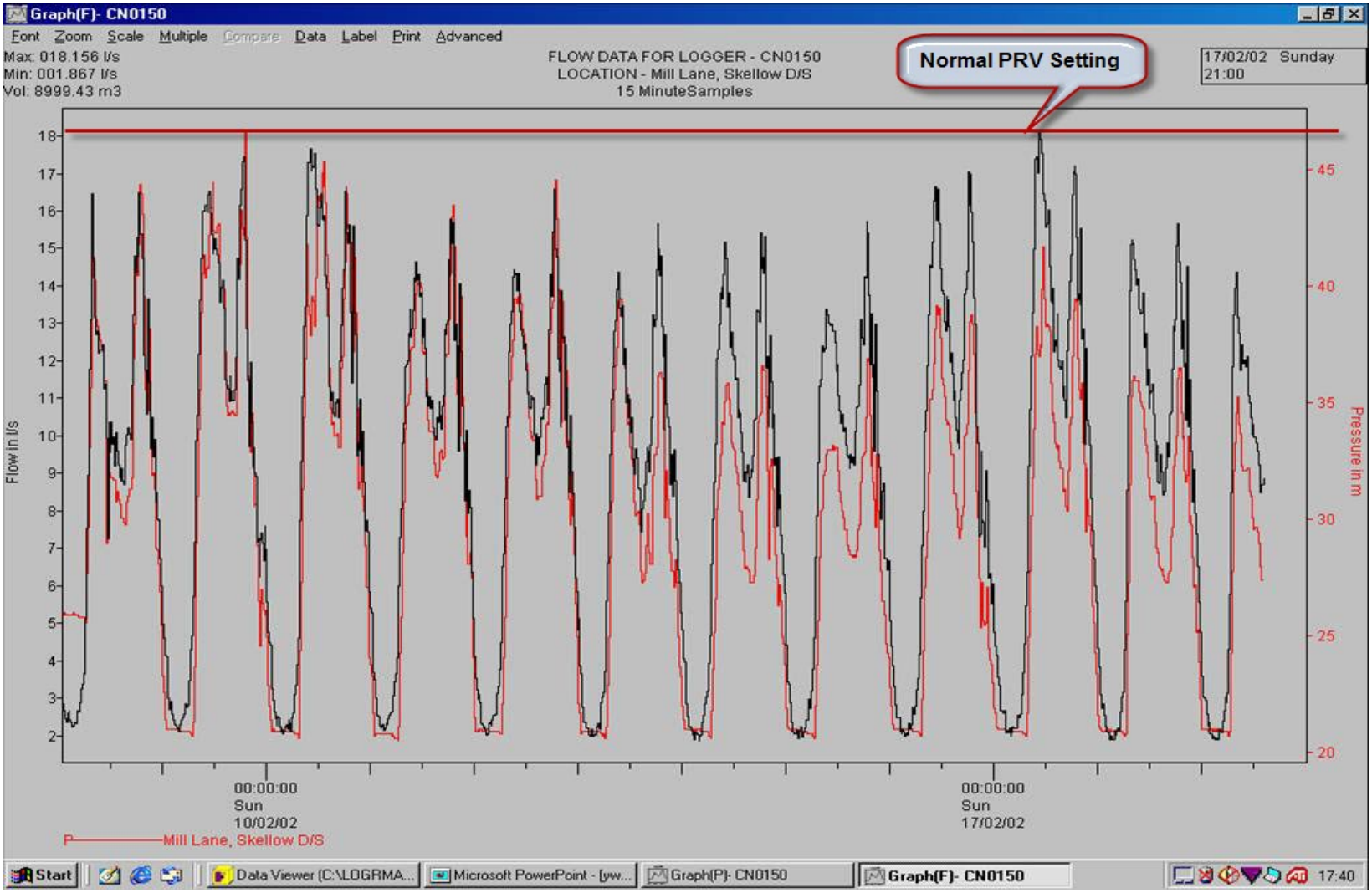
Two Basic Types of Pressure Management

- Time of Day
  - Pressure Setting Changed for different times of the Day
- Flow Modulation
  - Pressure Varies with Flow
  - Higher Flow = Higher Pressure
  - Lower Flow = Lower Pressure

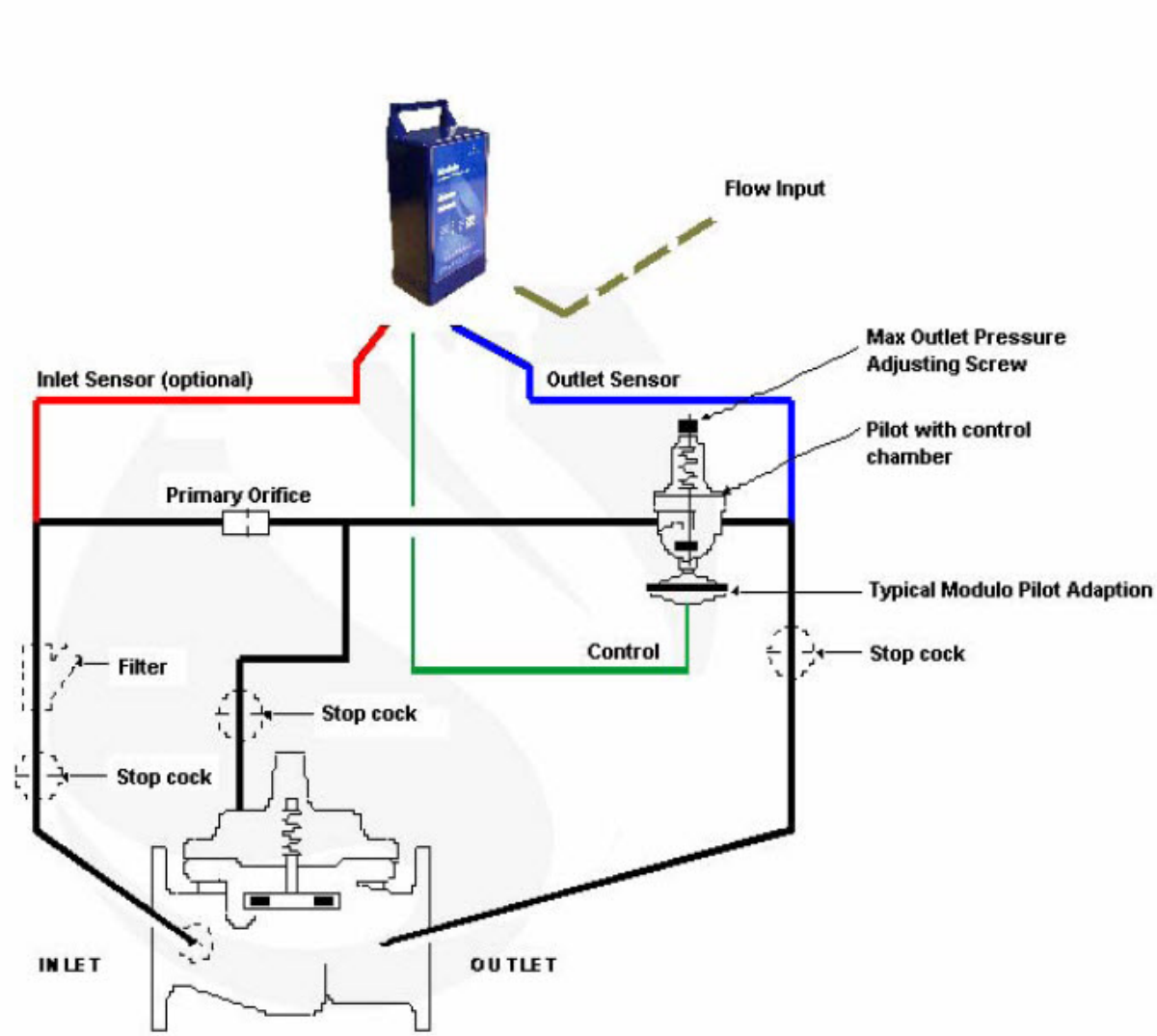
Pressure Management – Time of Day



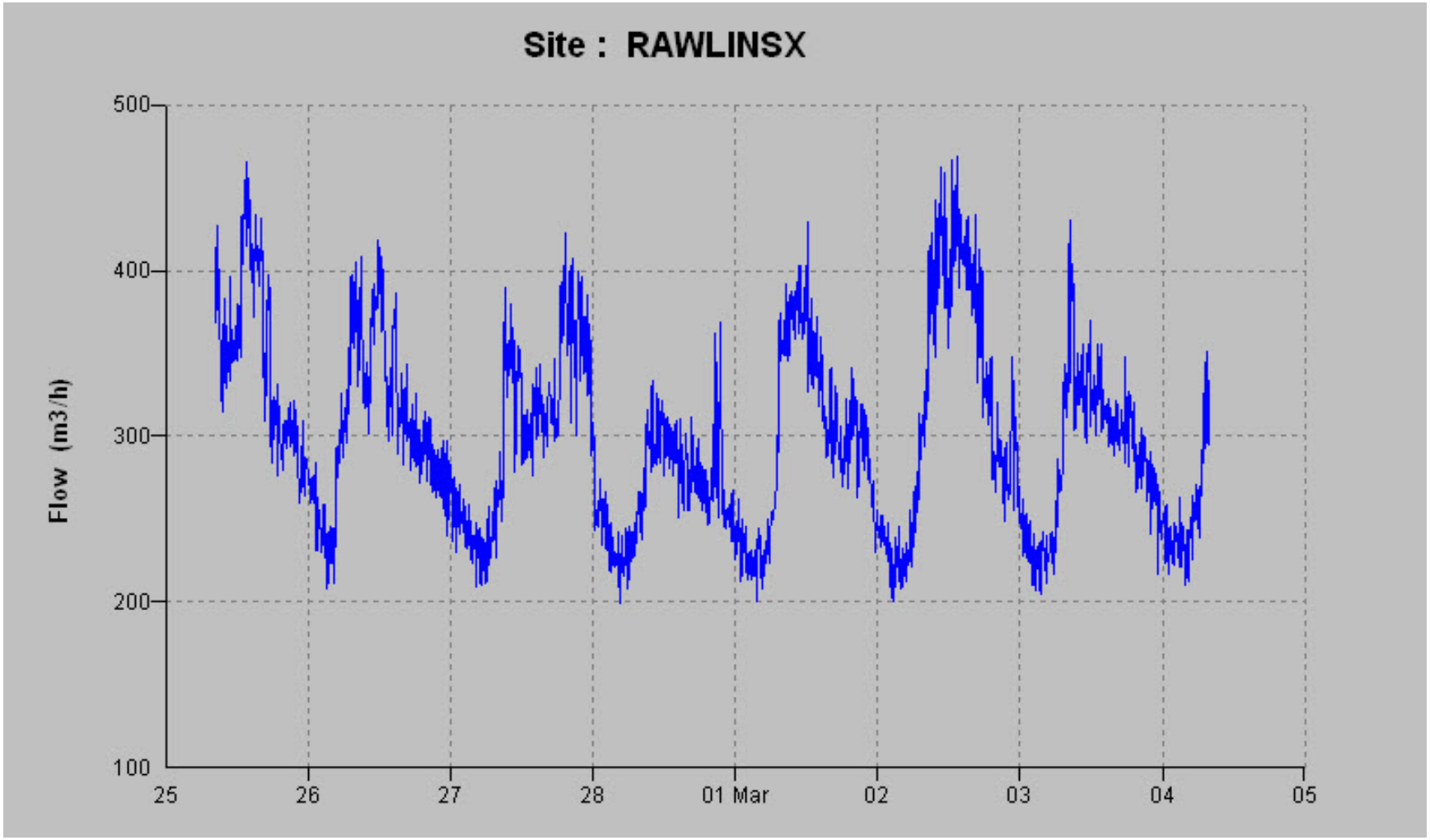
Pressure Management – Flow Mod.



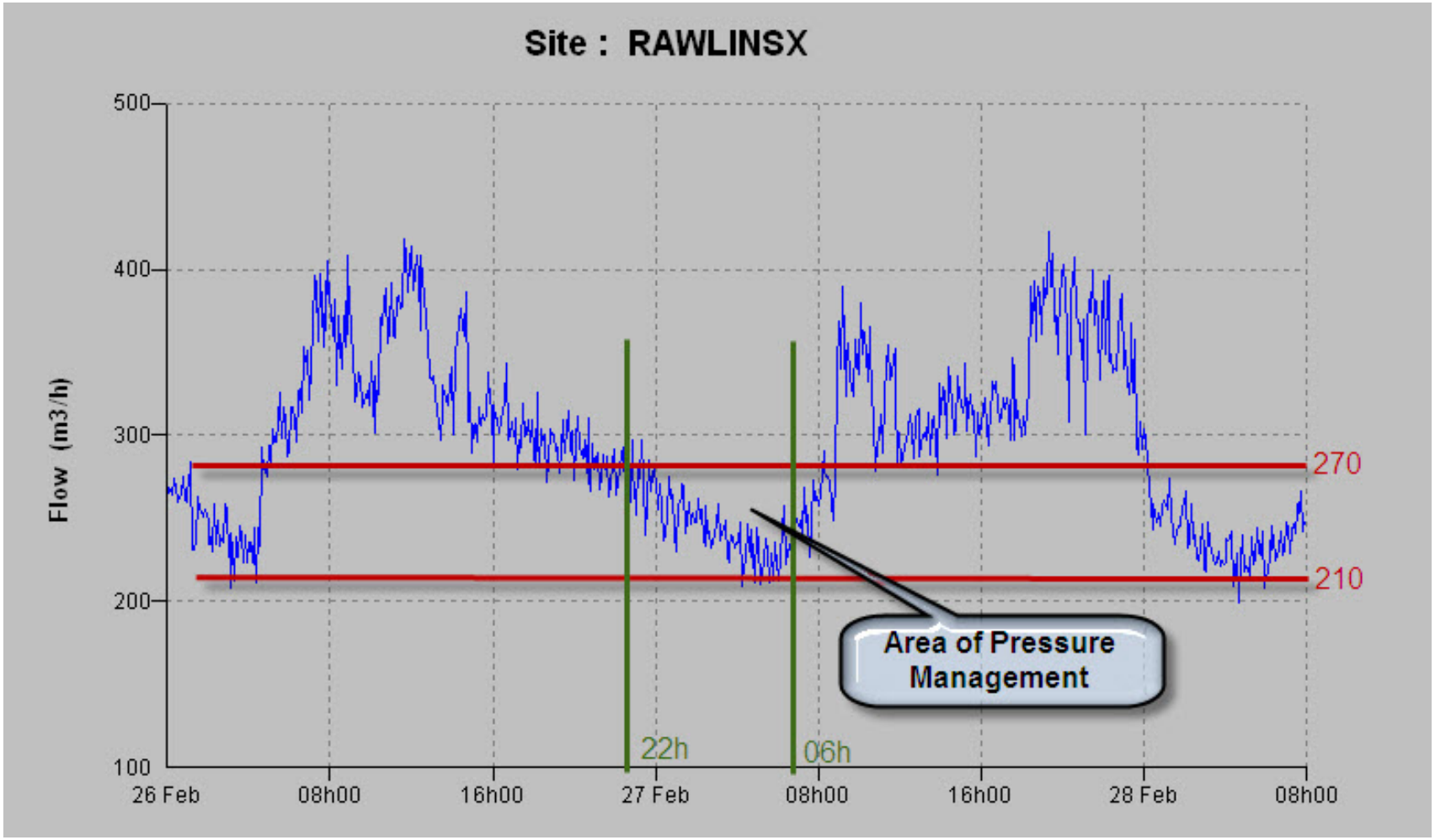
Pressure Management - Equipment



Pressure Management – CSJ Example



Pressure Management – CSJ Example



Pressure Management - Savings

Example of Flow Rates

	3mm (1/8") Hole		4.8mm (3/16") Hole		6.5mm (1/4") Hole	
Pressure	Flow	Volume	Flow	Volume	Flow	Volume
120 psi	0.71m^3/hr	6195 m^3	1.59m^3/hr	13940m^3	2.83m^3/hr	24782m^3
110 psi	0.68m^3/hr	5932 m^3	1.52m^3/hr	13347m^3	2.71m^3/hr	23727m^3
100 psi	0.65m^3/hr	5656 m^3	1.45m^3/hr	12725m^3	2.58m^3/hr	22623m^3
90 psi	0.61m^3/hr	5362 m^3	1.37m^3/hr	12072m^3	2.45m^3/hr	21462m^3
80 psi	0.58m^3/hr	5059 m^3	1.30m^3/hr	11382m^3	2.31m^3/hr	20235m^3
70 psi	0.54m^3/hr	4732 m^3	1.22m^3/hr	10647m^3	2.16m^3/hr	18928m^3
60 psi	0.50m^3/hr	4381 m^3	1.13m^3/hr	9857 m^3	2.00m^3/hr	17524m^3
50 psi	0.46m^3/hr	3999 m^3	1.03m^3/hr	8998 m^3	1.83m^3/hr	15997m^3
40 psi	0.41m^3/hr	3577 m^3	0.92m^3/hr	8048 m^3	1.63m^3/hr	14308m^3

Pressure Management - Savings

Example of Potential Savings

- Assume 6 – 3mm leaks
- 8 hour reduction period

Case 1 - Pressure Reduction - 100 psi to 80psi

- Annual Volume of Water Saved = 1200 m^3

Case 2 - Pressure Reduction - 80 psi to 60psi

- Annual Volume of Water Saved = 1350 m^3

Leak Detection

Future Plans for CSJ

- Continue to Install Zone Water Meters
- Implement Remote Data Collection
- Calculate Minimum Night Flow for each zone
- Conduct Pilot project for Pressure management
- Investigate feasibility of extending leak detection to 12 month operation.

Thank You

ST. JOHN'S

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