Smart Distribution System Applications

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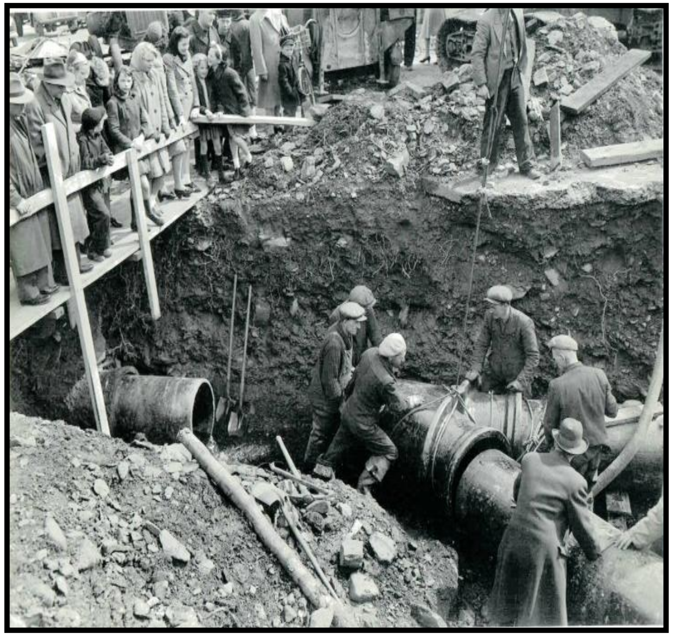
History of Halifax Water

- Halifax Water was originally formed as the Public Service Commission of Halifax in 1945 [system in rough shape after years of neglect; leakage and fire fighting capability of biggest concern].



- Municipal Amalgamation in 1996 transferred water assets from Dartmouth and Halifax County to Halifax Regional Water Commission [leakage and water quality concerns in Dartmouth]
- In 2007, Halifax Regional Municipality [HRM] transferred its wastewater and stormwater assets to HRWC [recognition that wastewater and stormwater system in rough shape; underfunded and out of compliance with regulations].

Halifax Water

Assets

- 2 large water treatment plants
- 7 large wastewater treatment plants
- 14 community plants (small systems)
- 22 water and 173 wastewater pump stations
- 18 water reservoirs
- 1,560 km of water mains
- 2,343 km wastewater and stormwater mains
- 8,146 fire hydrants
- 24 CSOs [Halifax Harbour]
- 83,000 water meters
- Serves a population of 355,000

Halifax Water

Current Smart Applications

- Water Loss Control
- Advanced Pressure Management
- Water Quality - Chlorine Monitoring/Injection
- Energy Optimization/Recovery
- SCADA Upgrades

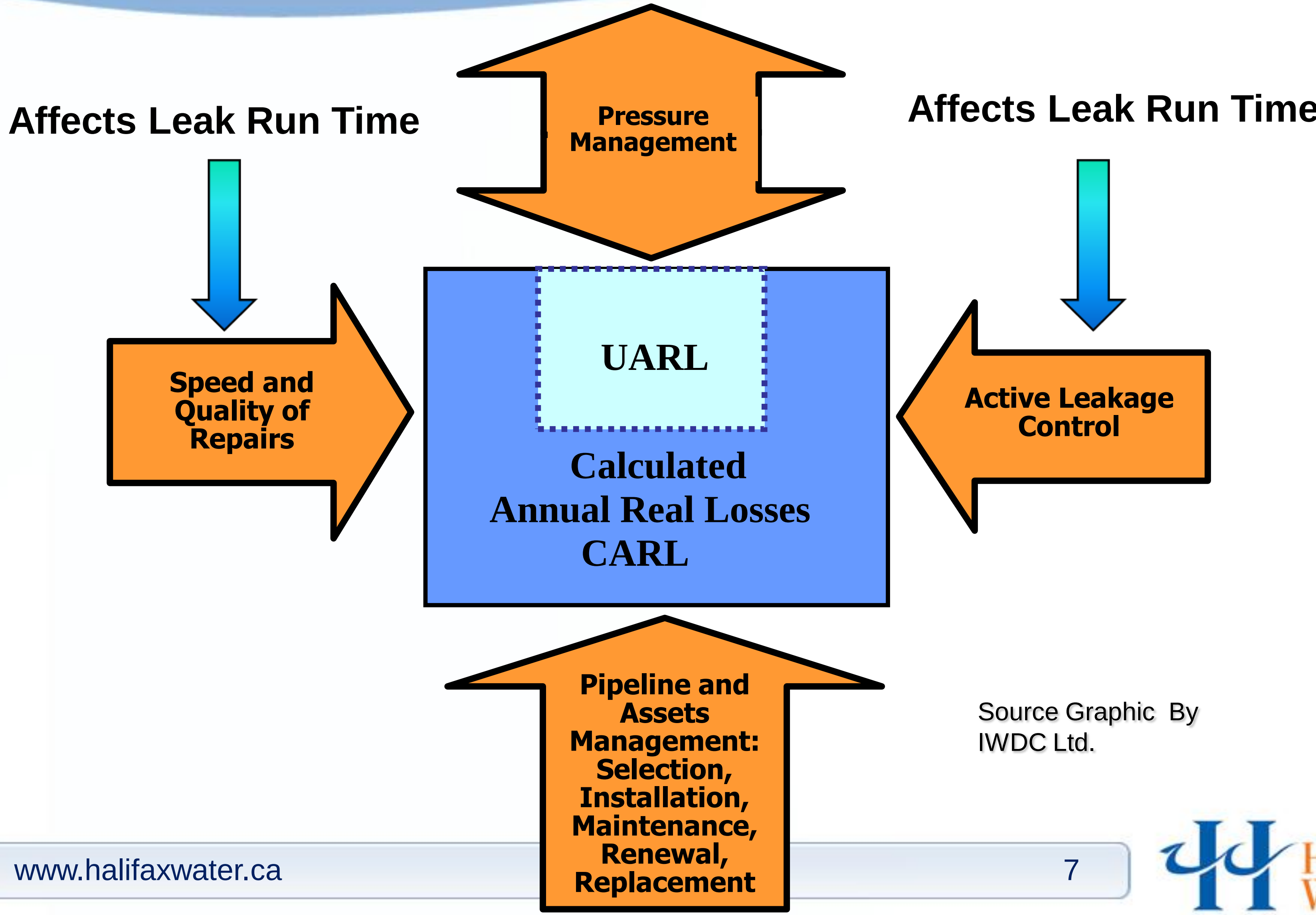
Lake Major Water Supply

Water Loss Control

- In 1998, searching for best practice to reduce water loss and discovered an emerging methodology being promoted by the International Water Association [IWA].
- In 1999, Halifax Water hired an international expert to assist with training and implementation of the methodology promoted by the IWA Water Loss Task Force, which included AWWA representation.
- Formally adopted IWA methodology in 2000 and banned the term “unaccounted-for water”.

Halifax Water

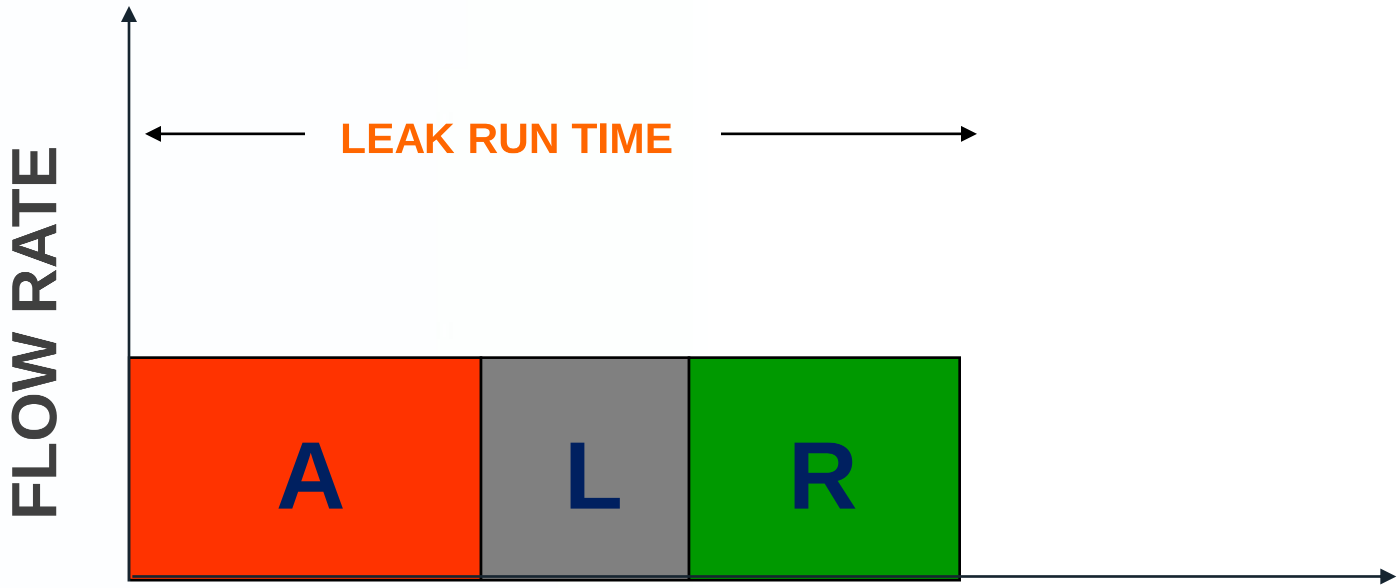
Four Strategies for Reducing Real Losses



Source Graphic By IWDC Ltd.

Leak Run Time Awareness

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



RUN TIME = **Awareness + Location + Repair*

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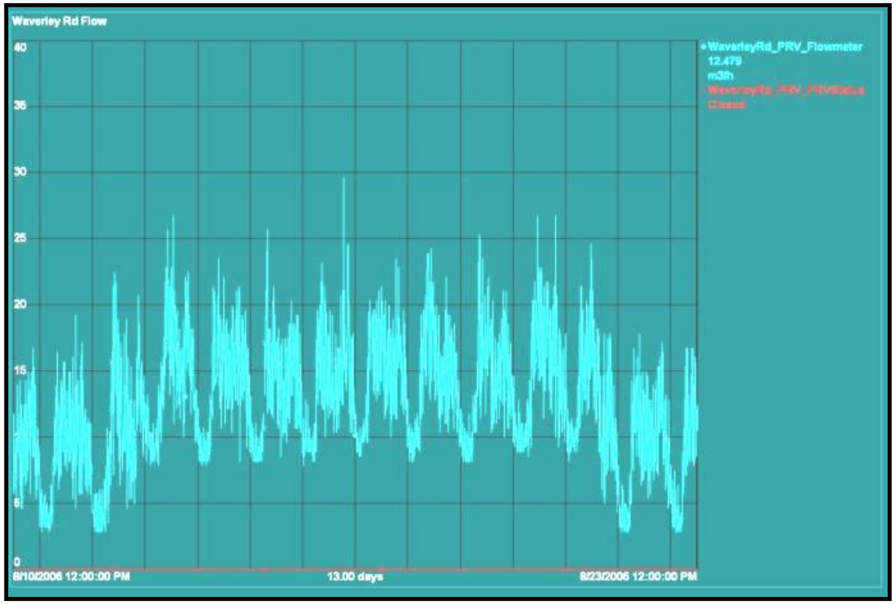
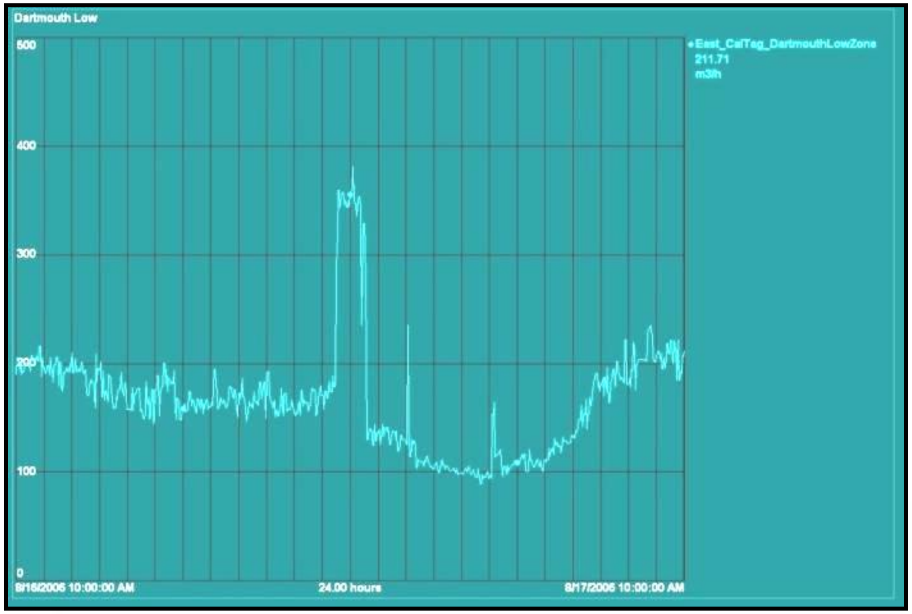
Actual Leak Sequences

Aug 12 – Aug 21

9 day runtime 5m3/hr

1080 m3 (237,000 Gal)





Aug 16

200m3/hr 1 hour runtime

200 m3 (44,000 Gal)

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Managing Leak Run Time

- The key to managing leak run time for the overall reduction of real losses is awareness of and the willingness to repair leaks.
- The key is finding the leak early when it is a small
- How does a utility become aware of unreported leaks?

District Metered Areas

- District Metered Areas (DMA's) can provide the awareness of leakage in near real time.
  - Allows monitoring of leaks via SCADA
  - Manageable zones in distribution system for acoustic leak detection
  - Ongoing monitoring of minimum night flows [3 to 4 am in the morning]
- If you can measure it, you can manage it

Halifax Water

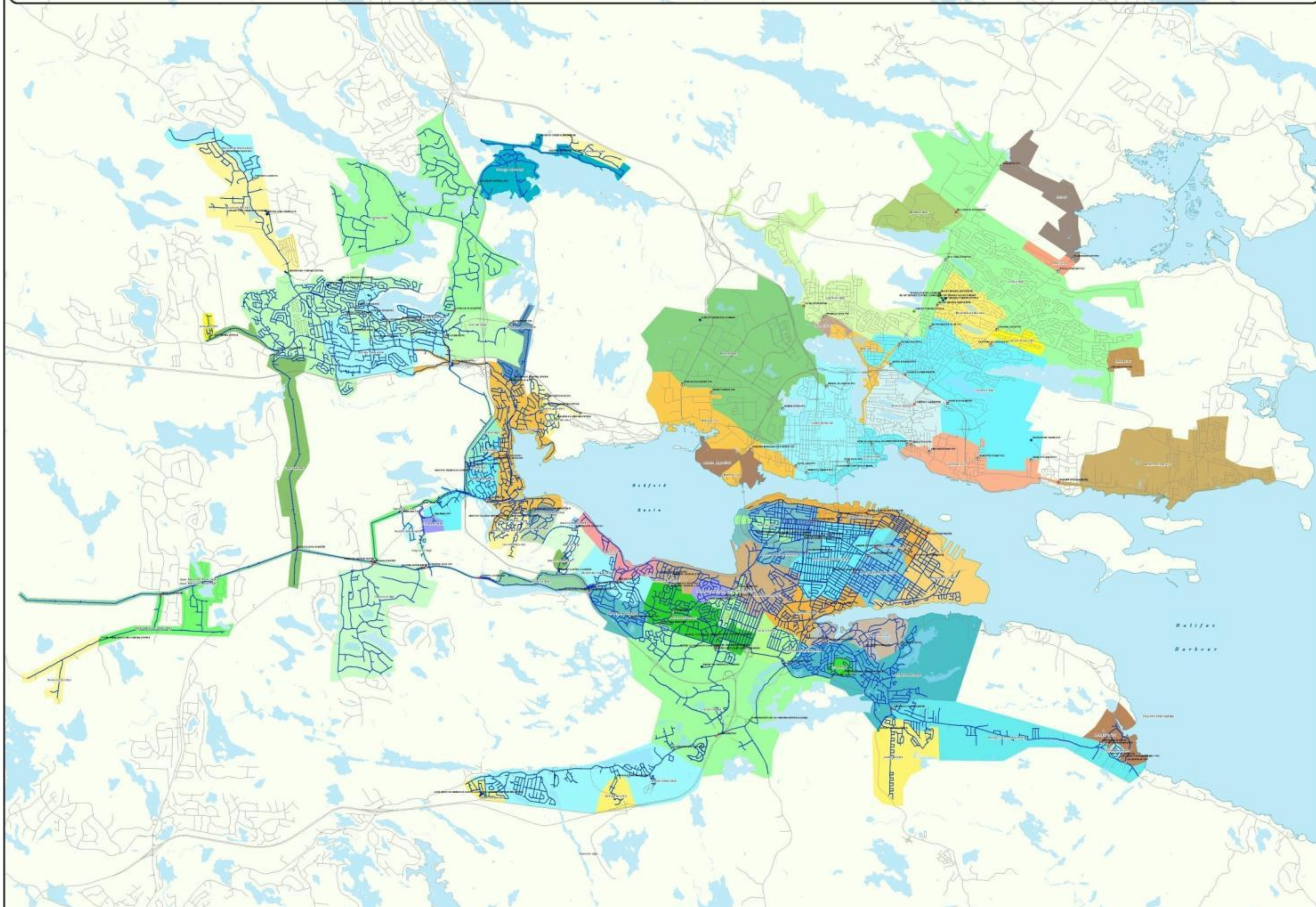
HALIFAX REGIONAL WATER COMMISSION
REGIONAL METER ZONE MAP

Control Chamber
Meter Chamber
PRV
Pumping Station
Reservoir Chamber

THIS MAP IS FOR HRWC
INTERNAL USE ONLY

NORTH

Halifax Water



Mt. Edward Boosted DMA

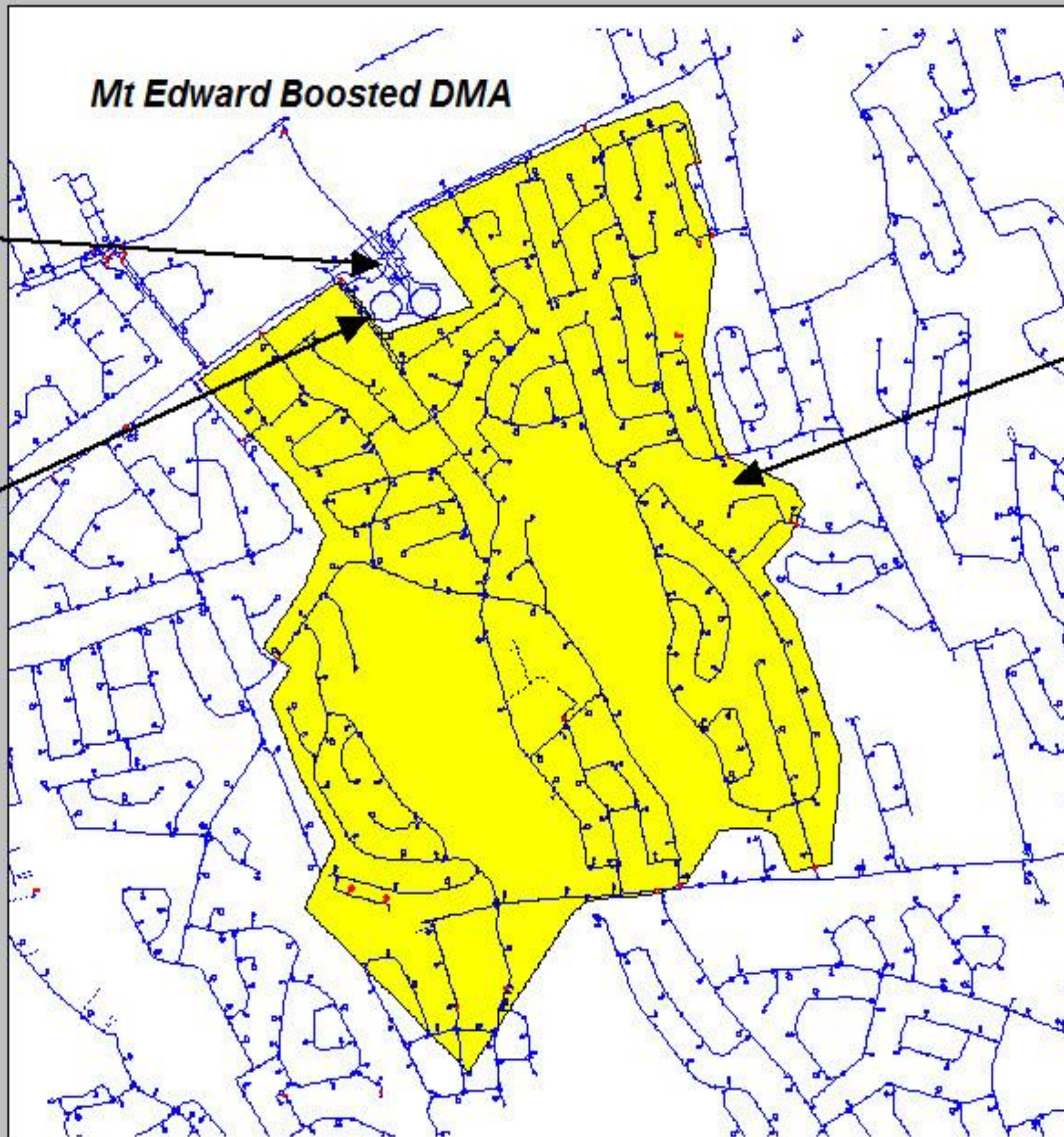
Click Value To Trend

Mt Edward Booster

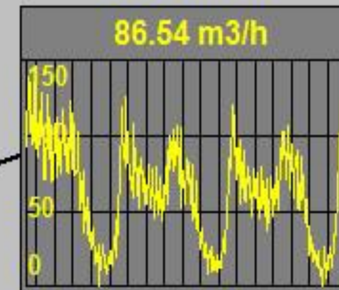
86.54 m3/h
406.79 kPa

Mt Edward Reservoirs

8.24 M



Mt Edward Booster Zone Flow



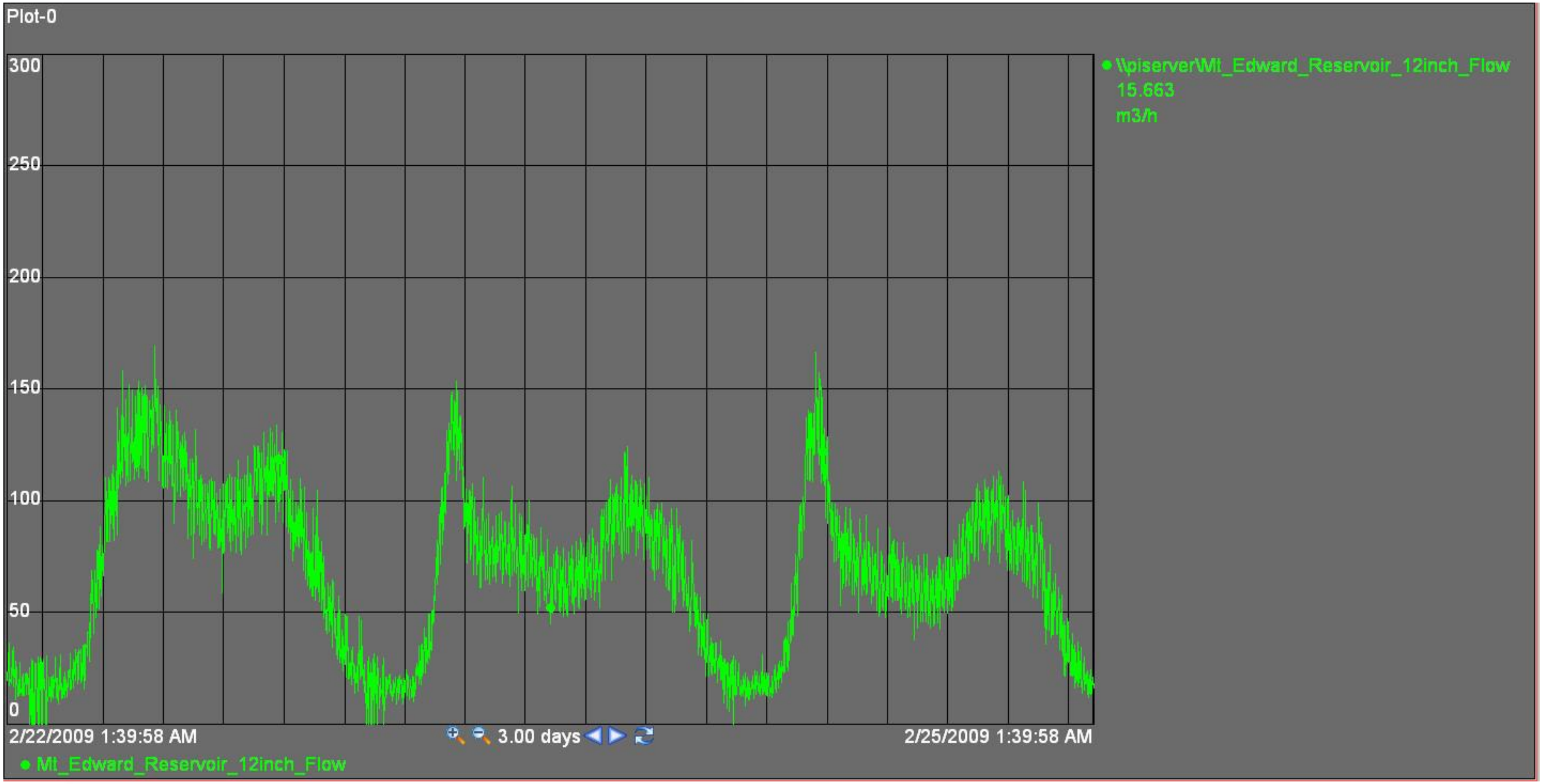
Calculated Minimum Night Flow

18.61 m3/h

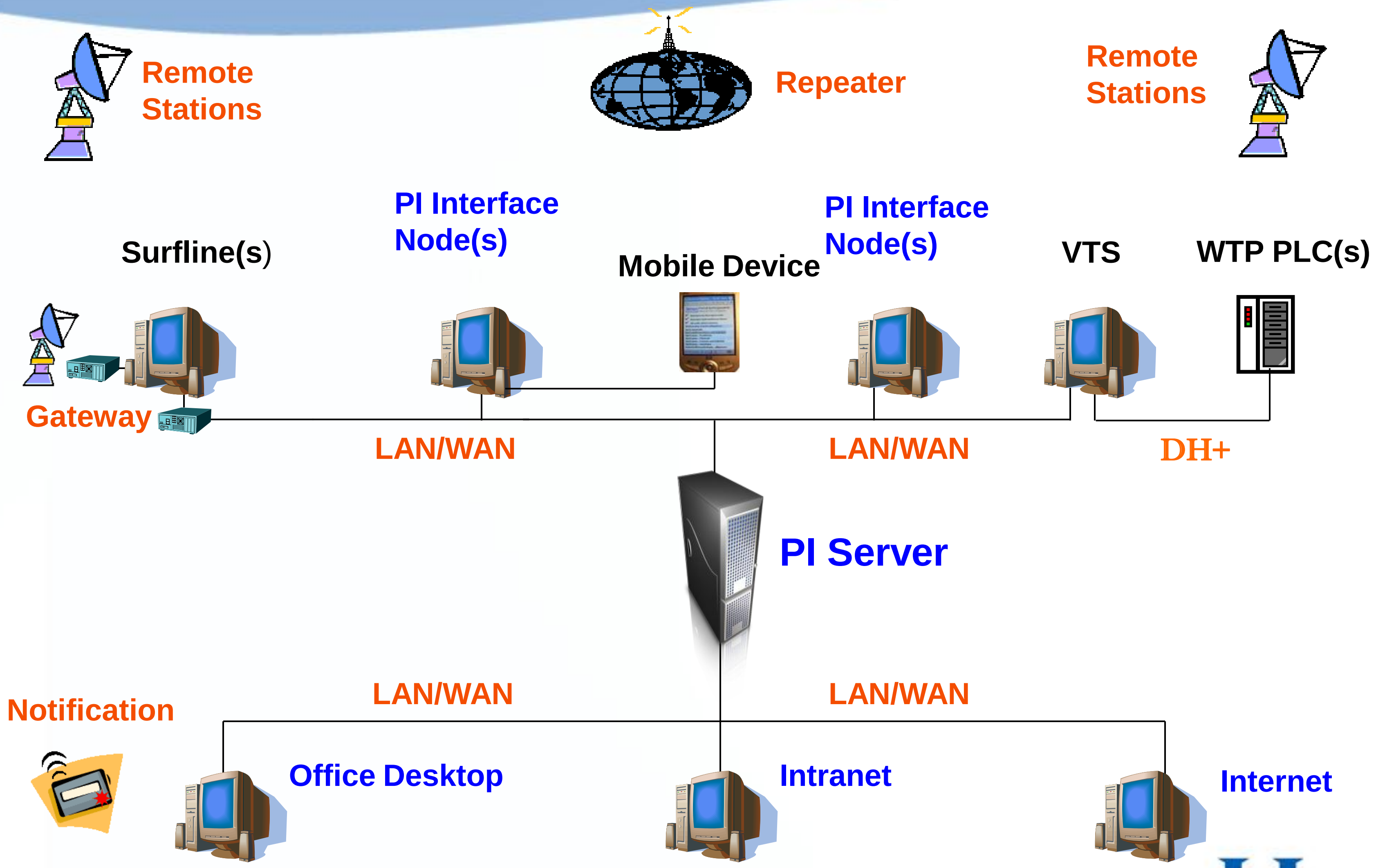
System Attributes

- Length of Pipe - 26.7 km
- Public Hydrants - 155
- Private Hydrants - 4
- Service Connections - 2766
- Sprinklers - 2
- Average Pressure - 64 M
- Density - 103.6 Conn./km

Residential DMA Data for Cost of Service Study – Mt Edward



Collecting The Data



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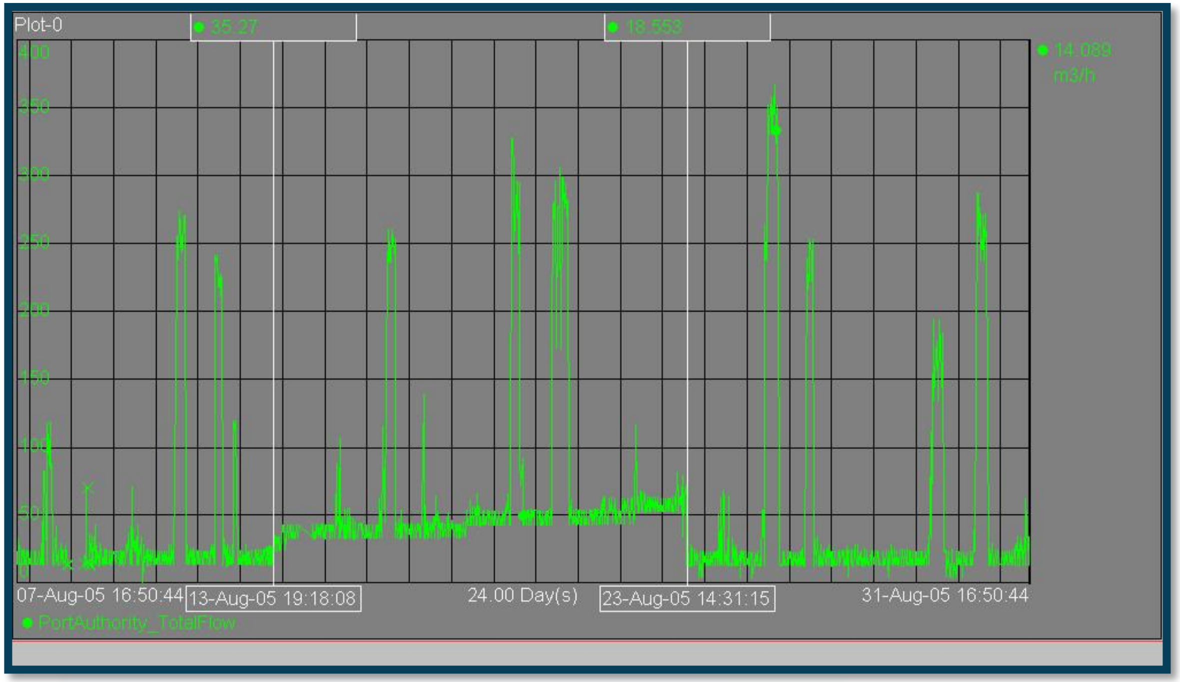
Customer Partnerships [Port of Halifax]

Spring through fall, cruise ships take on water from Halifax Port Authority

Offered to monitor their flow via SCADA to demonstrate benefits

Customer Partnerships [Port of Halifax]



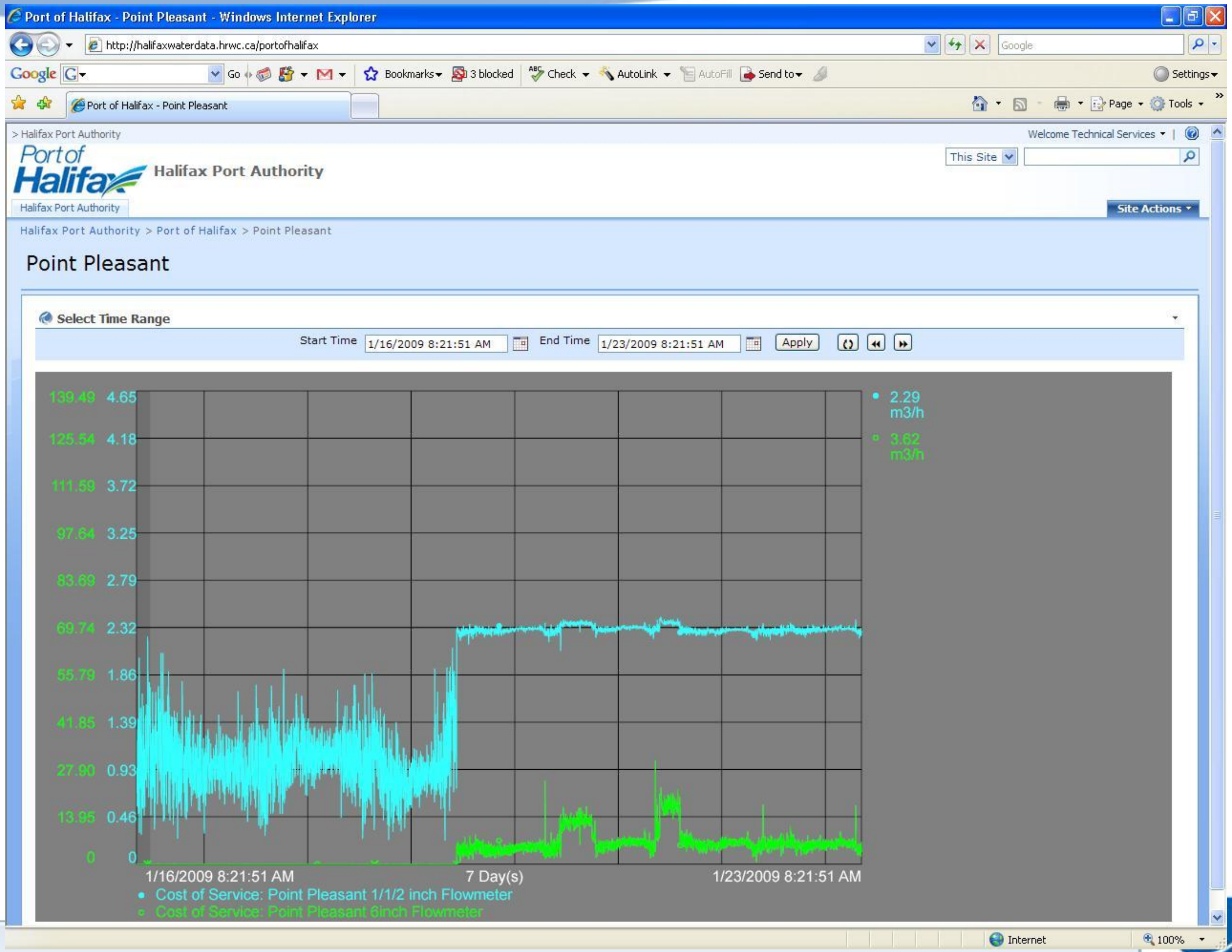
Port Authority
24 day graph

40 m3/hr burst 10 day run time [175 sup]

Port of Halifax Meter Installation

Port of Halifax RTU Installation

Port of Halifax Portal



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Pressure Management

- Pressure Management is one of the 4 accepted strategies of the IWA/AWWA Water Loss Control Methodology.

- Reducing pressure will reduce breaks.

- There is a direct relationship between pressure and the amount of leakage.
  - Reduced pressure reduces flow rates from active and background leakage.

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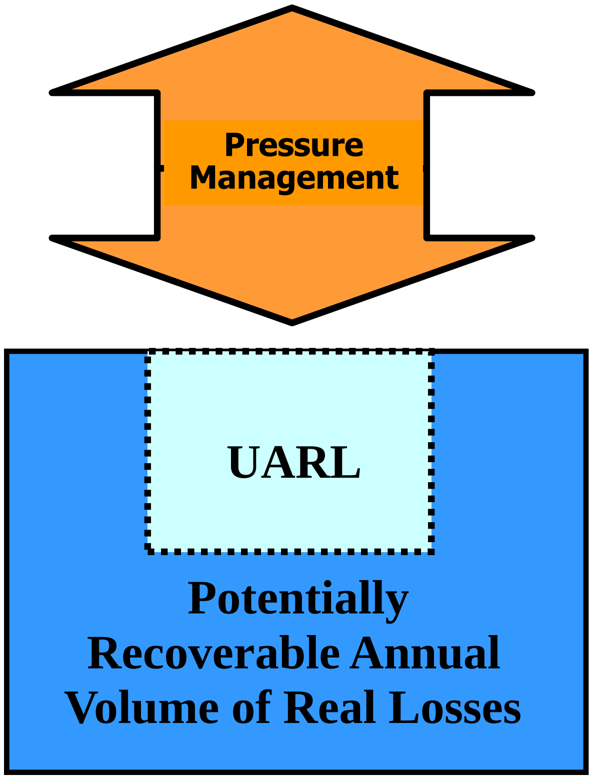
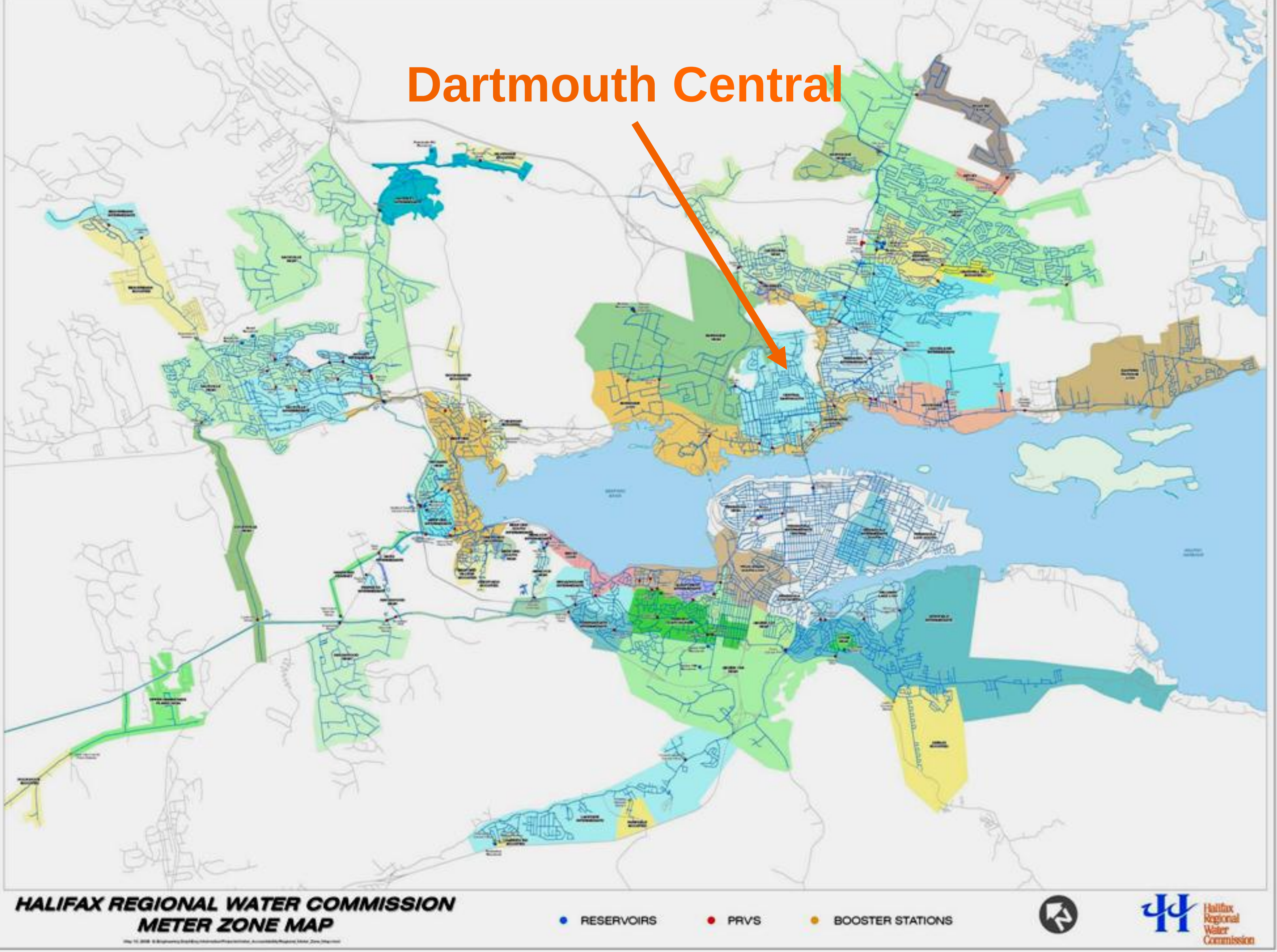
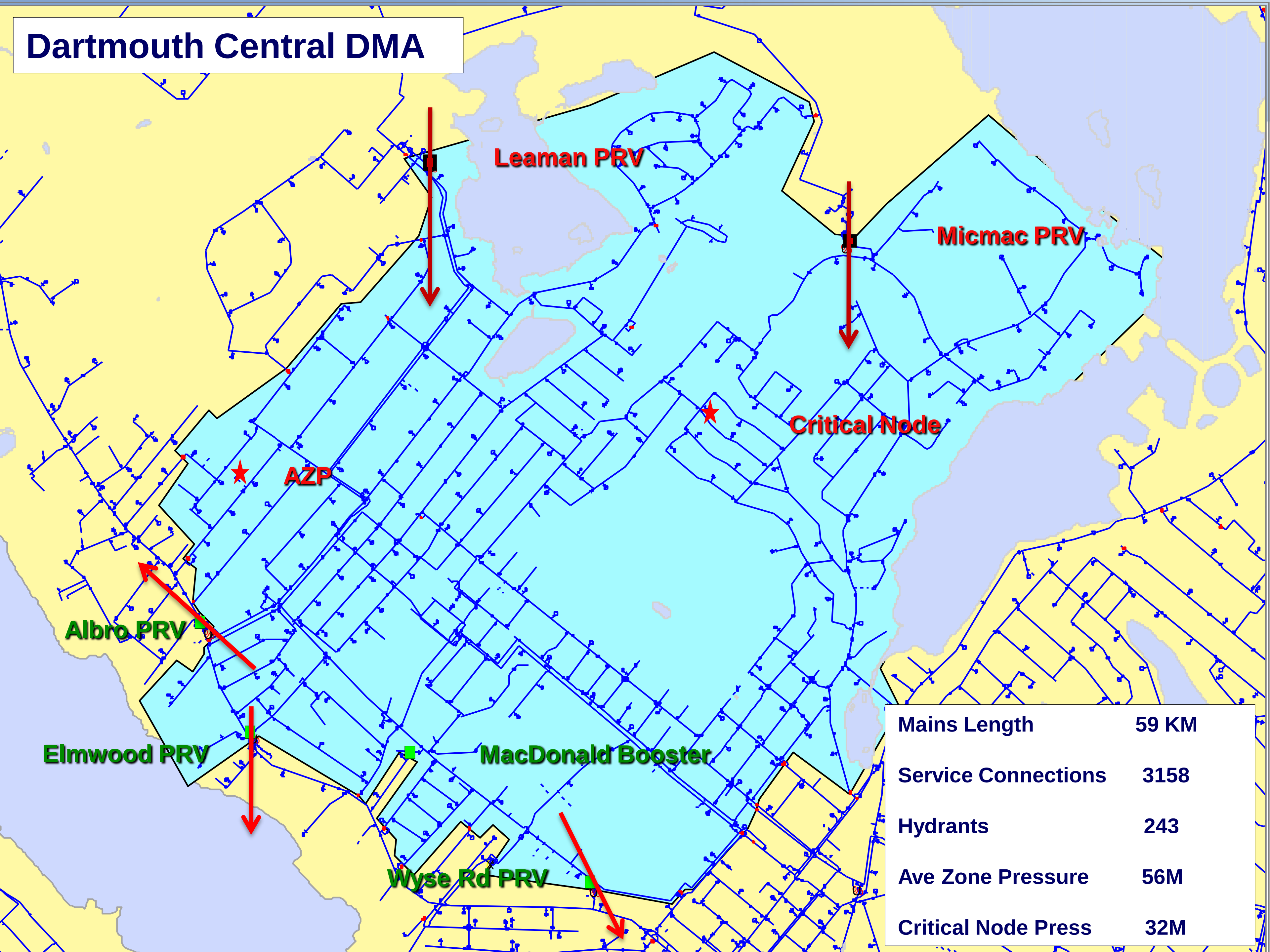
Pressure Management

- Pressure Reducing Valves (fixed outlet control)
- Pressure Control through flow modulation (allows downstream pressure to trend with flow, with limits)
- Optimized approach through WaterRF research under Leakage Management Technologies project.



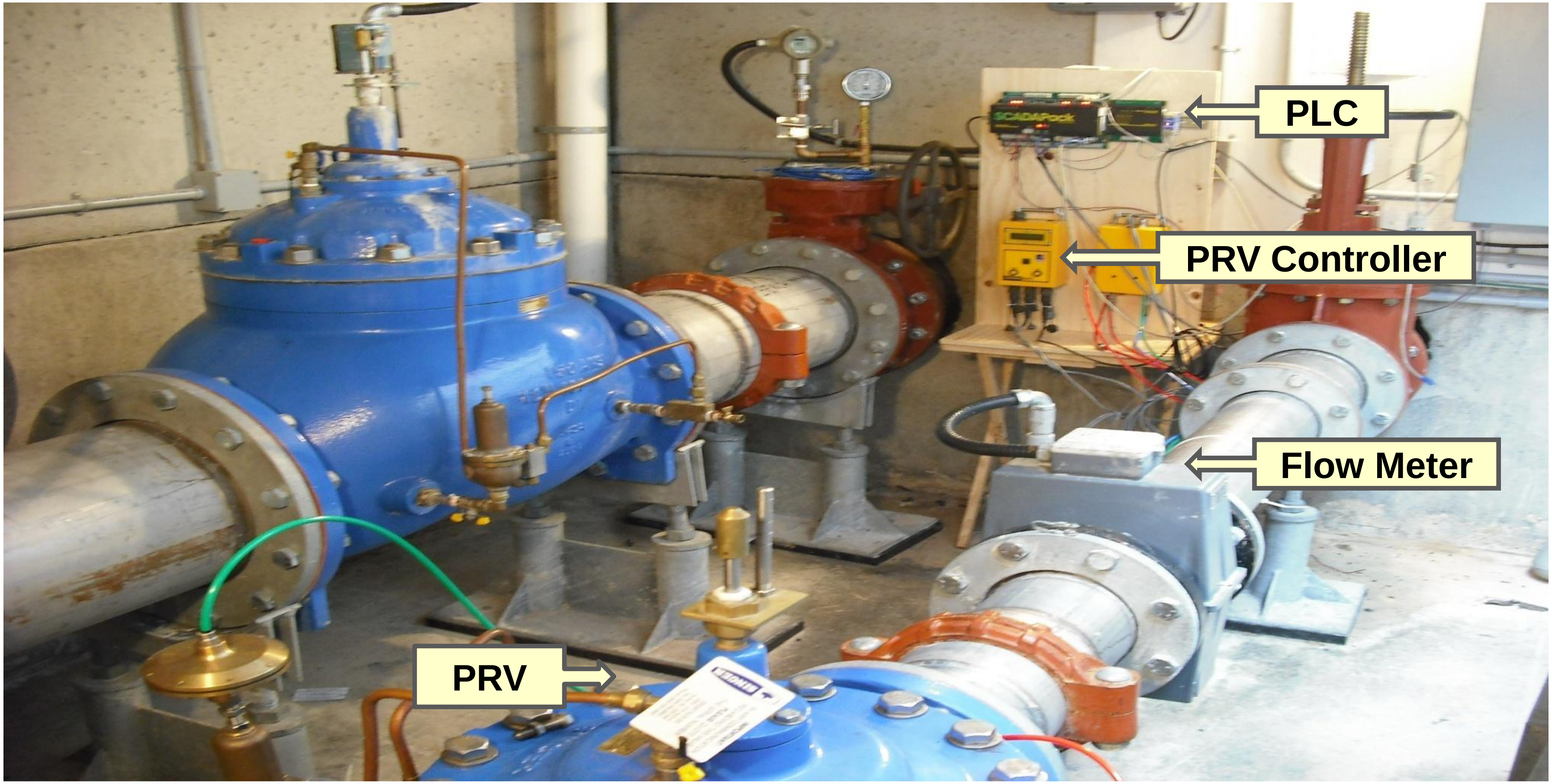

Dartmouth Central
HALIFAX REGIONAL WATER COMMISSION
METER ZONE MAP
RESERVOIRS
PRVS
BOOSTER STATIONS
Halifax Regional Water Commission

Dartmouth Central DMA



Mains Length	59 KM
Service Connections	3158
Hydrants	243
Ave Zone Pressure	56M
Critical Node Press	32M

Test Setup [WRF Project 2928]



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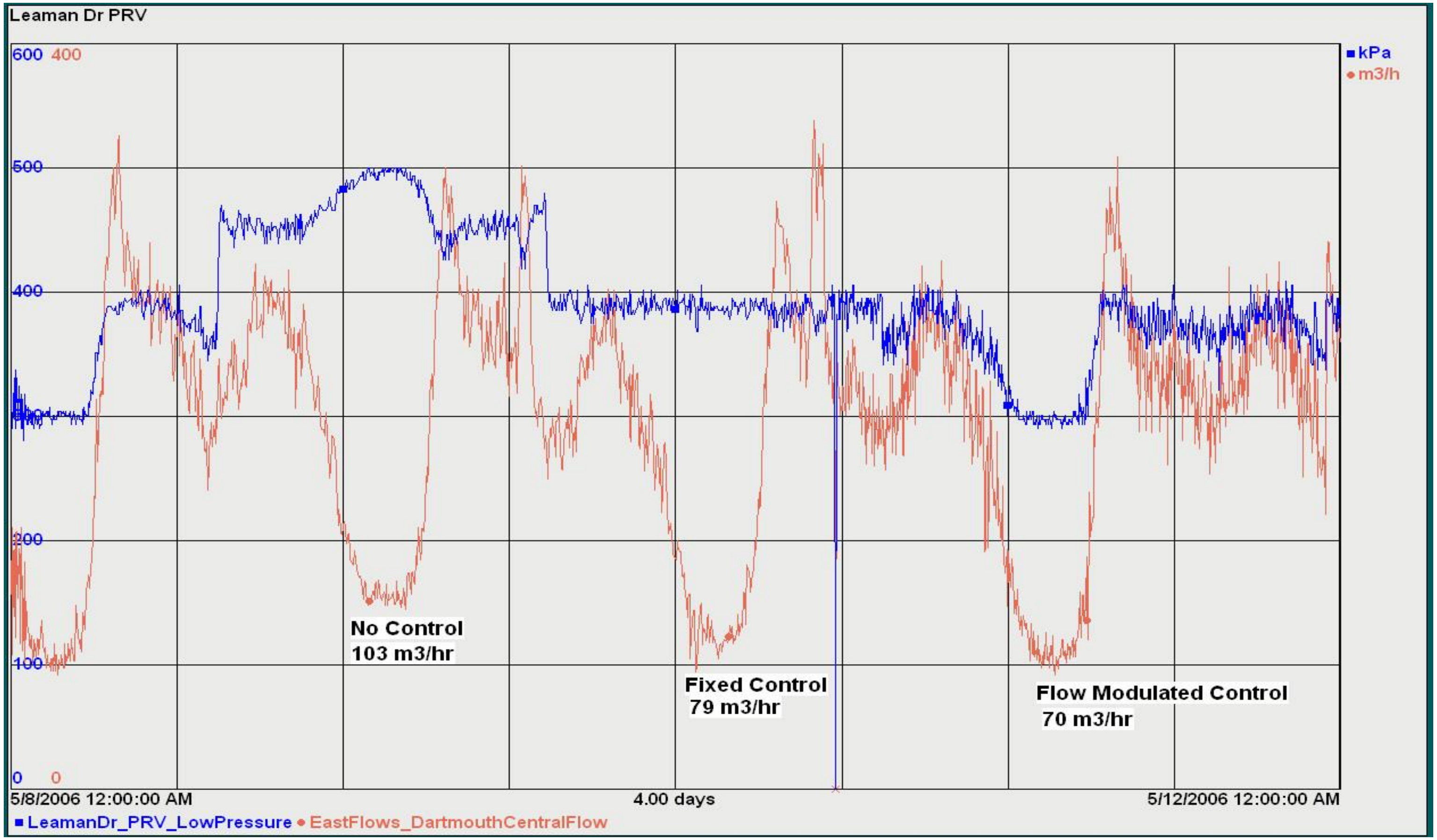
Minimum Night Flows [WRF Project 2928]
No Control - Fixed Outlet - Flow Modulated



Graph reflects single feed from Leaman supply chamber

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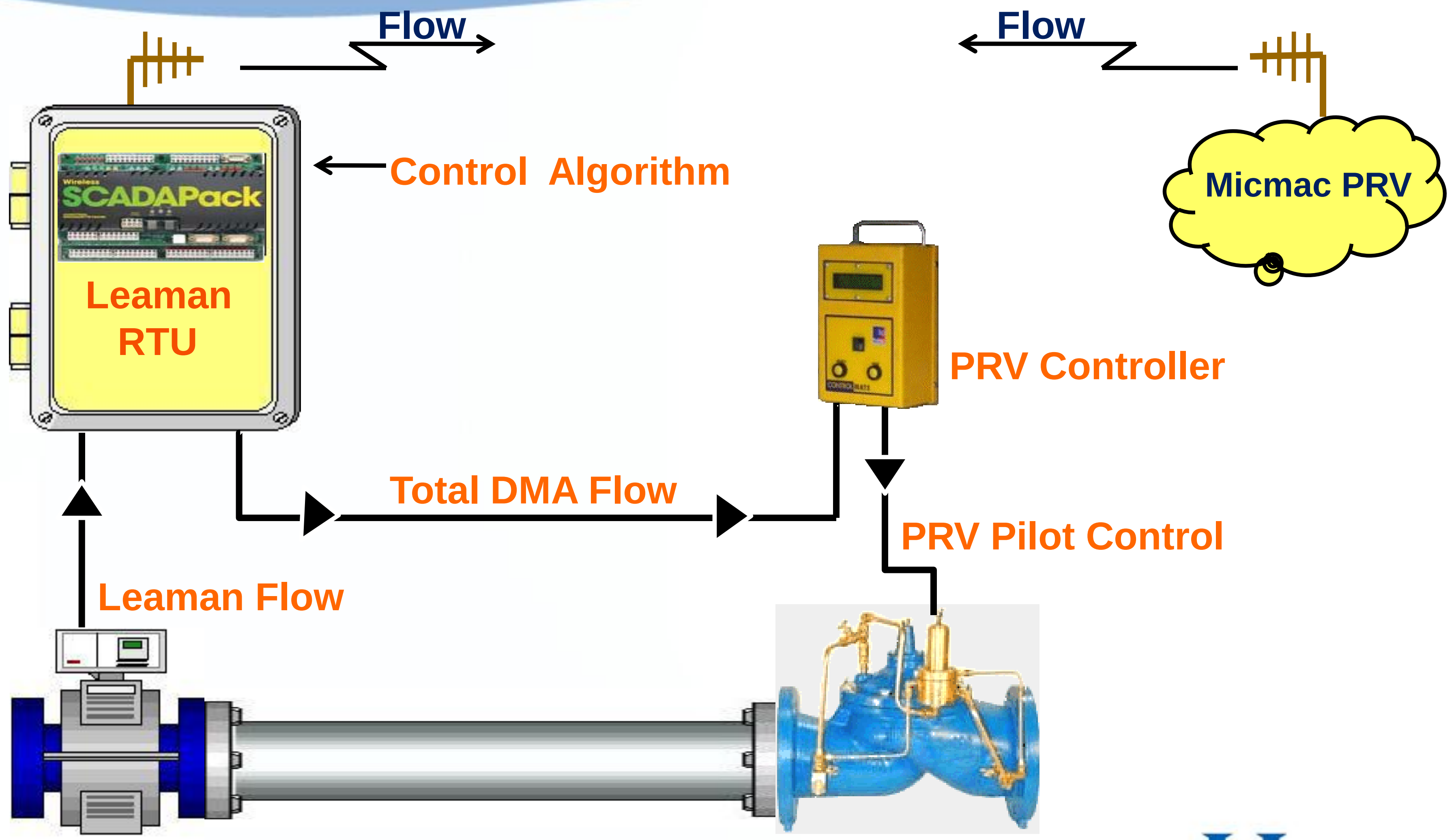
Advanced Dual Supply Pressure Control

- Challenge - Apply flow modulated pressure control in a DMA with two supply feeds.
- Problem - An increase in output from one supply chamber causes a reduction in flow at the second supply chamber, eventually shutting the second feed in.
- Solution - Establish communications between the supply chambers. Develop a control algorithm that combines the individual flows into a single DMA demand flow that is used as the control variable for both supply chambers.

Solving The Dual Supply Challenge



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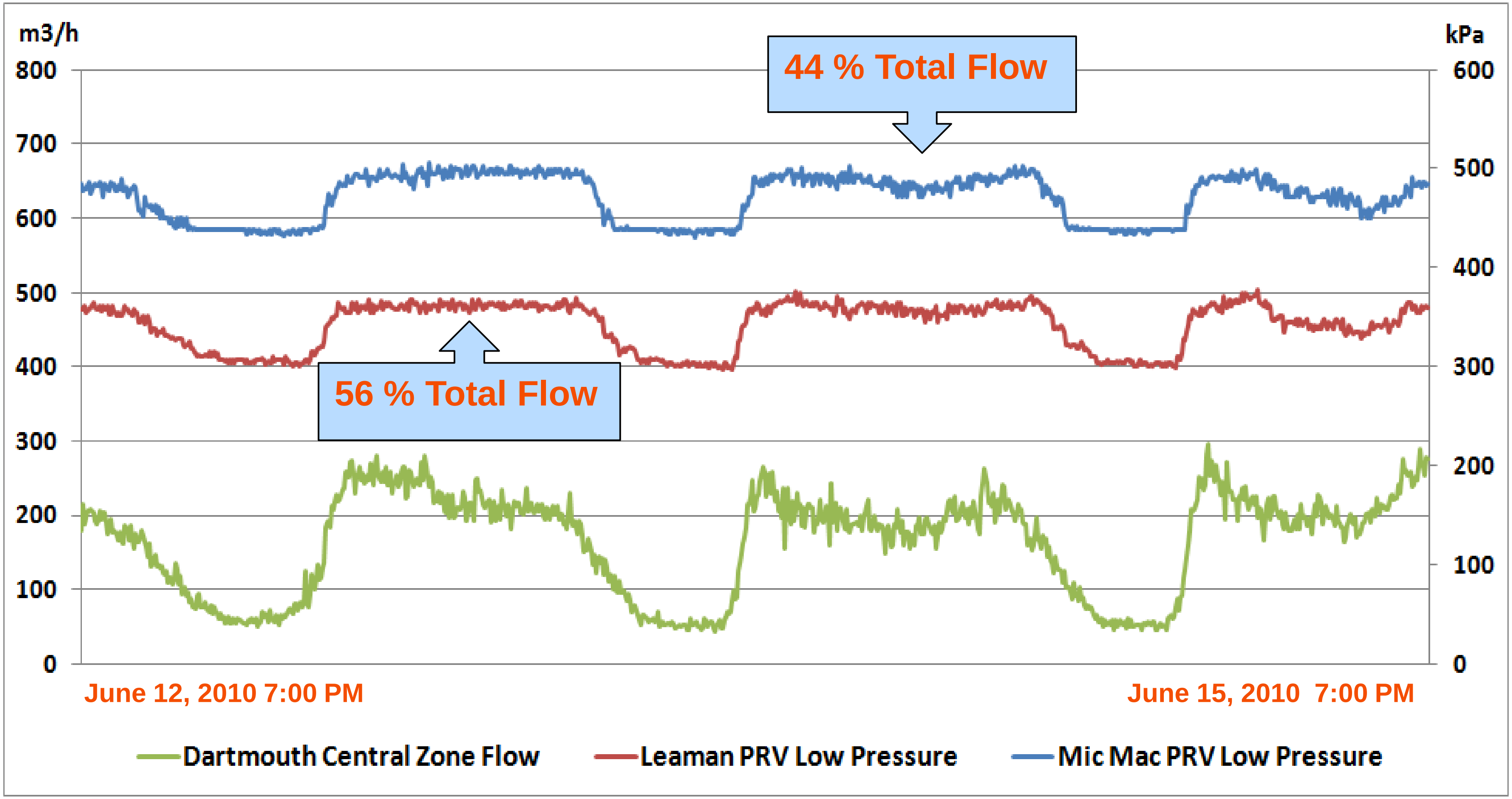
Each Supply Chamber Contributes



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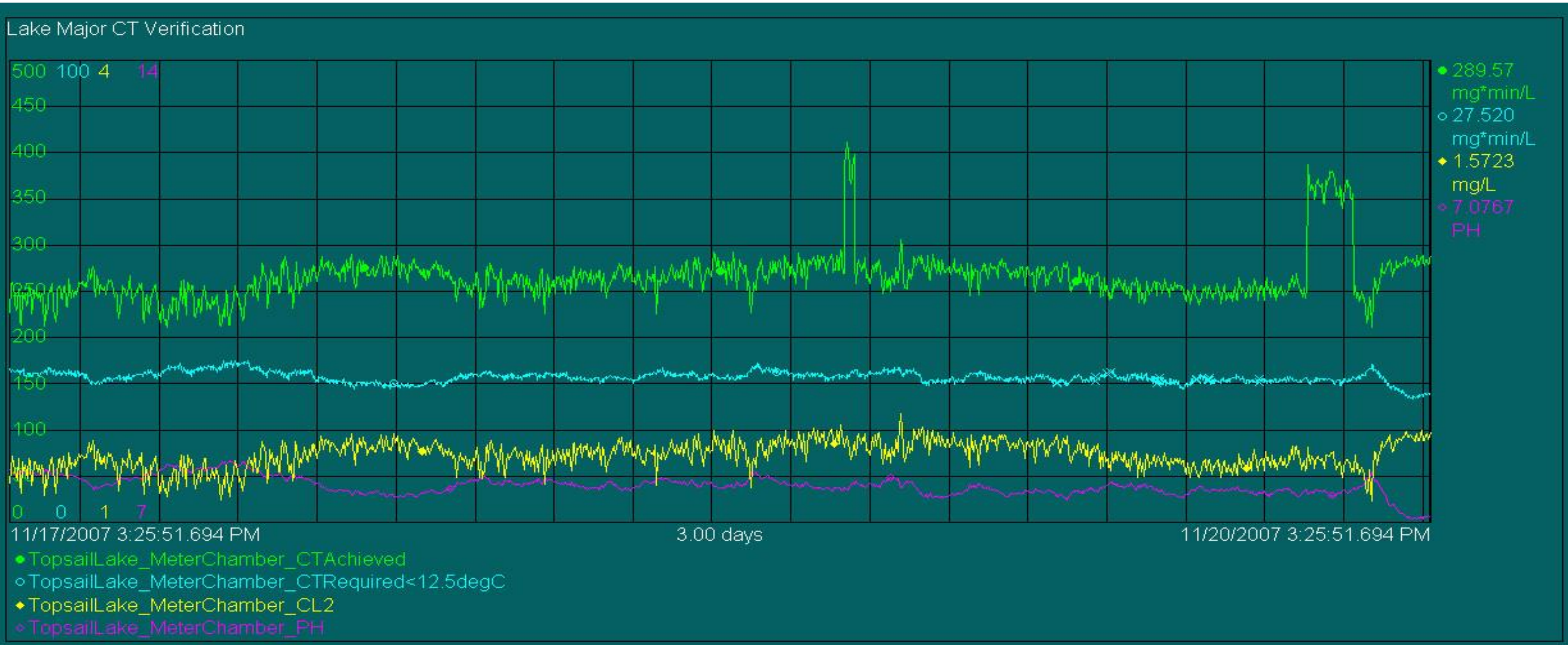
Chlorine CT Application

- Minimum chlorine contact time prior to customer consumption is a regulatory requirement
- For quality assurance and efficient operation, application developed for plant operations to optimize chlorine use and optimize public health protection
- Real time online CT calculation provides operators instant confirmation
- Real time alarming and archived records

CT Calculator



CT Acheived : 284.57 mg*min/L

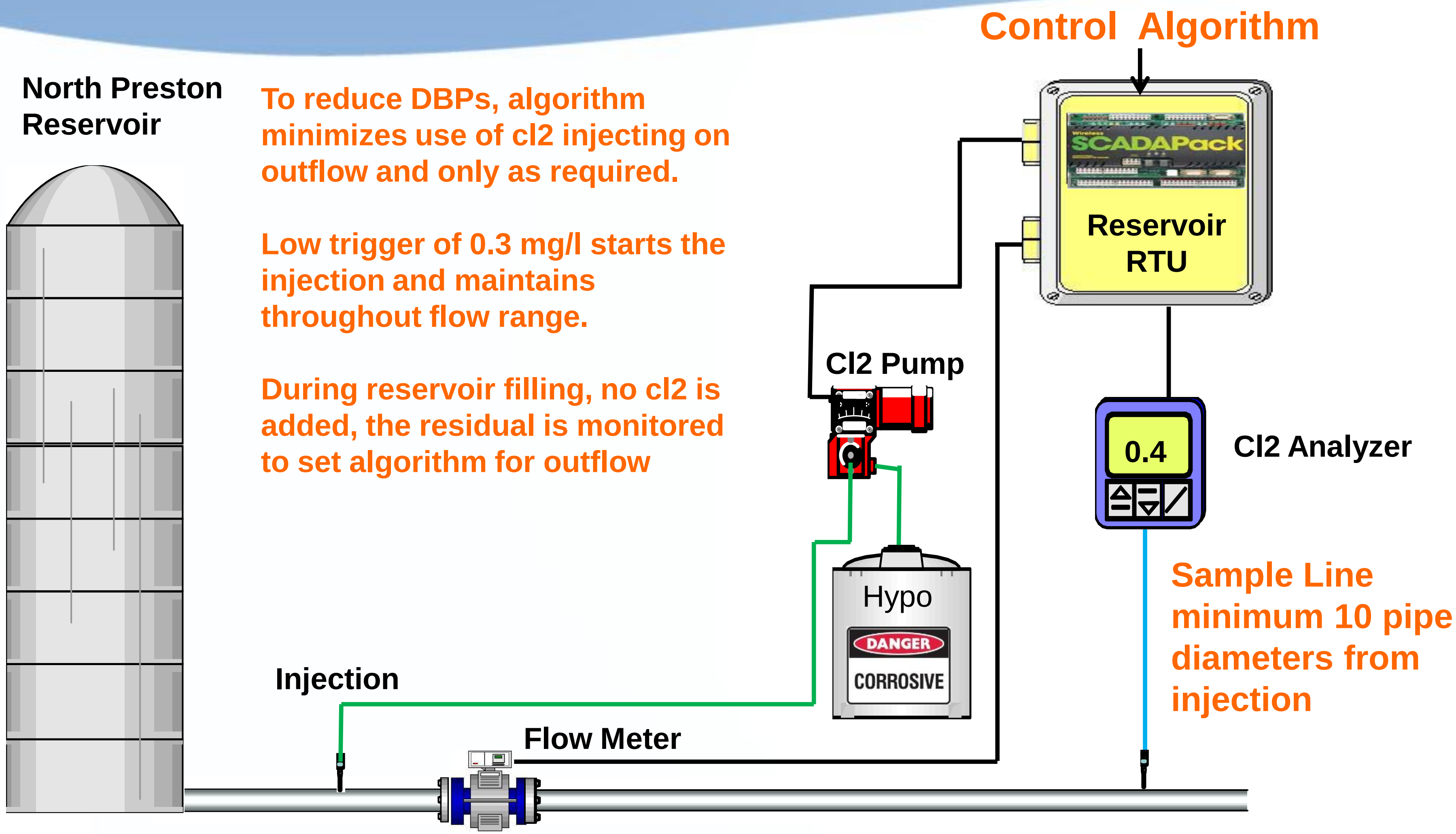
CT Required : 27.51 mg*min/L

Chlorination Injection Control Loop

To reduce DBPs, algorithm minimizes use of cl2 injecting on outflow and only as required.

Low trigger of 0.3 mg/l starts the injection and maintains throughout flow range.

During reservoir filling, no cl2 is added, the residual is monitored to set algorithm for outflow



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Energy Recovery Potential

J.D. Kline WSP
- Elevation = ~170 m (~60 m above PS)
-Total Hydraulic Power = ~1.7 MW

WSP vs. Orchard
Elevation Difference ~ 93 m

Pockwock vs. Orchard
Elevation Difference ~ 33 m

Pockwock Lake/Pumping Station
- Elevation = ~110 m
- Total Hydraulic Power = ~1.1 MW
- Flows = ~31,500,000 m^3/yr or ~1.0 m^3/sec

Orchard PRV Chamber
- Elevation = 77 m (Gravity Fed)
- Average Power = ~32 kW
- Flows = 6,977,350 m^3/yr or 0.22 m^3/sec

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Energy Generation via In-Line Turbine

- **Project Economics**
  - COMFIT Project ~ $0.14/kWh
  - Capacity ~ 33 kW / 225,000 kWh/yr *
  - Revenue ~ $31,500/yr *
  - Project Cost ~ $468,000
  - Funded by WRF + NS DOE $200,000
  - NPV ~ $350,000
  - IRR ~ 11.4%
  - SPB ~ 8.6 Years

* Estimated

Halifax Water

SCADA Master Plan Progress

innovation instead of replacement

Over 100 of the 170 waste water stations communicate through, and are controlled by the 1990 vintage 9015 pump controller.

Approximately 25 water sites equipped with 9015 controller

Limited by 8 bit resolution, proprietary protocol and no ability to execute complex logic

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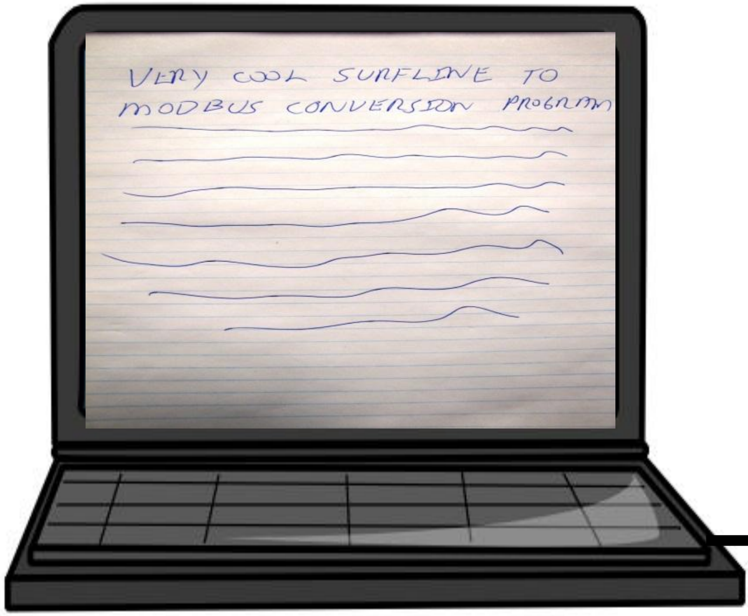
Master Plan Progress
S3 Modbus conversion



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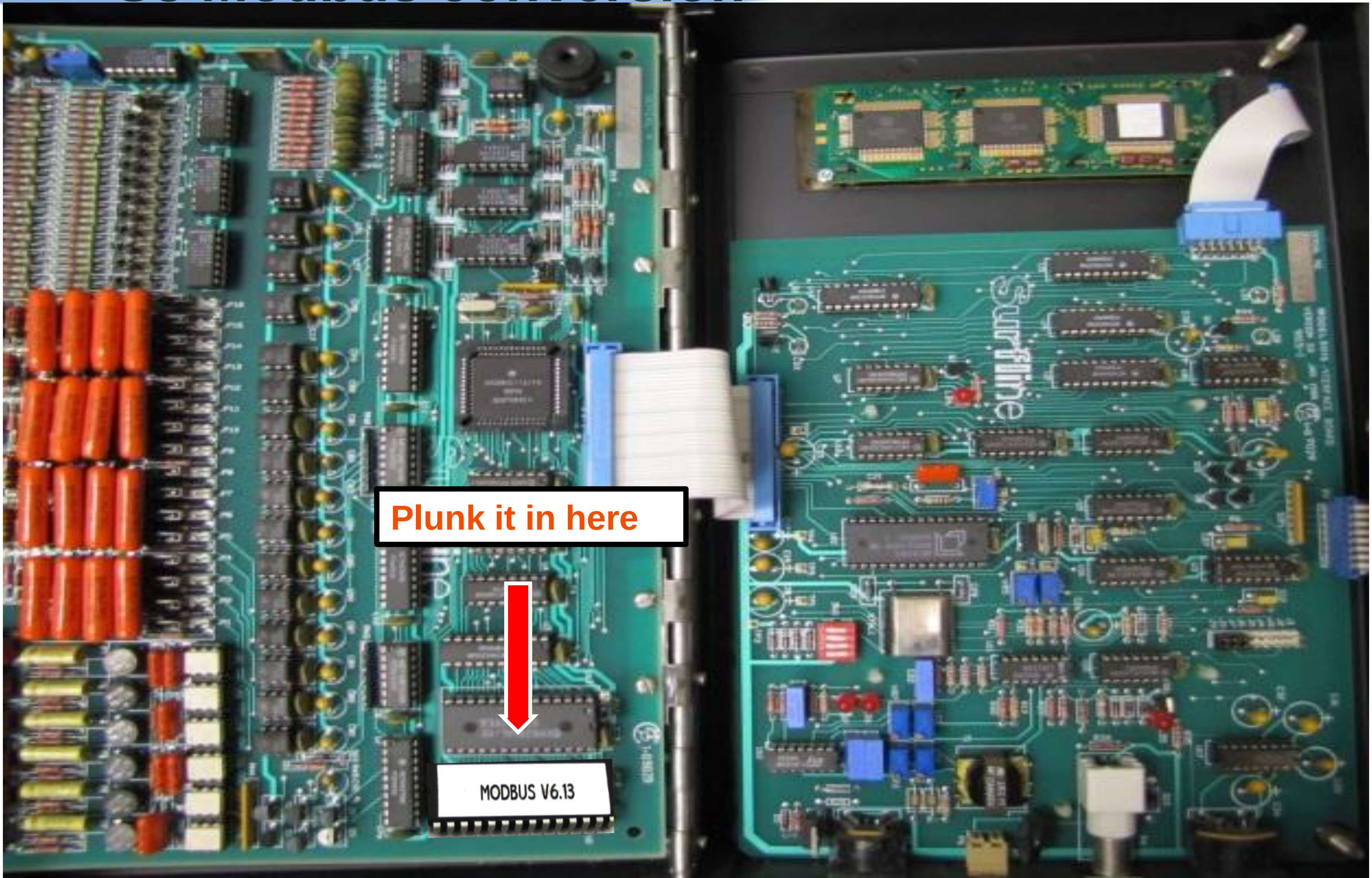
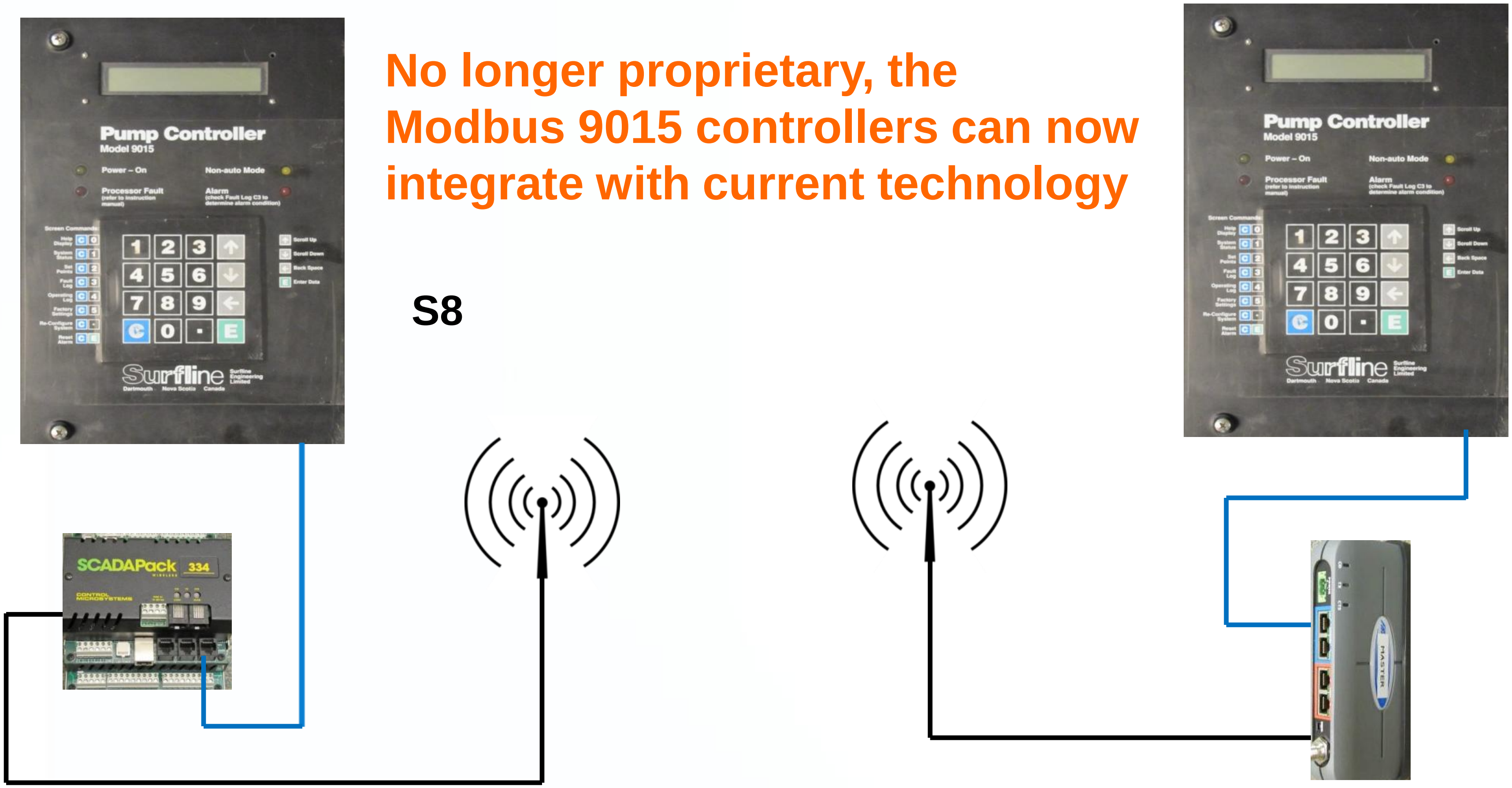
Master Plan Progress
S3 Modbus conversion



Master Plan Progress

S3 Converted 9015 pump controller

No longer proprietary, the Modbus 9015 controllers can now integrate with current technology



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Future Applications

- Advanced Meter Infrastructure [AMI]
- Smart Pipes
- Asset Management

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Advanced Meter Infrastructure

- **Currently looking at feasibility to implement AMI**
- **Recognized that AMI is much more than obtaining data for customer billing**
- **AMI facilitates two way communication between utility and customer**
- **Customer alerts for premise leakage**
- **Provides minimum night usage to compare to flows within DMAs**

Smart Pipes

- **Instrumentation built in to pipe walls to:**
  - Measure pressure
  - Detect leakage
  - Monitor corrosion

Asset Management

- **Currently developing Computerised Maintenance Management System**
- **Currently developing Customer Relationship Management System**

Halifax Water

Do not follow where the path may lead. Go instead where there is no path and blaze a trail.

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