

# LEAK DETECTION TOOLBOX



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# Overview

## Leak Detection Toolbox

- Discuss different techniques and options
- Basic – no special equipment
- Advanced – extra equipment and experience
- No one solution – need to know options

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# Leak Detection Toolbox

Before we start – what do we need?

## Basics

- Maps or Layout of Distribution System
- Water Meter
- Leak Listener or Sonophone

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# Leak Detection Basics

## System Maps

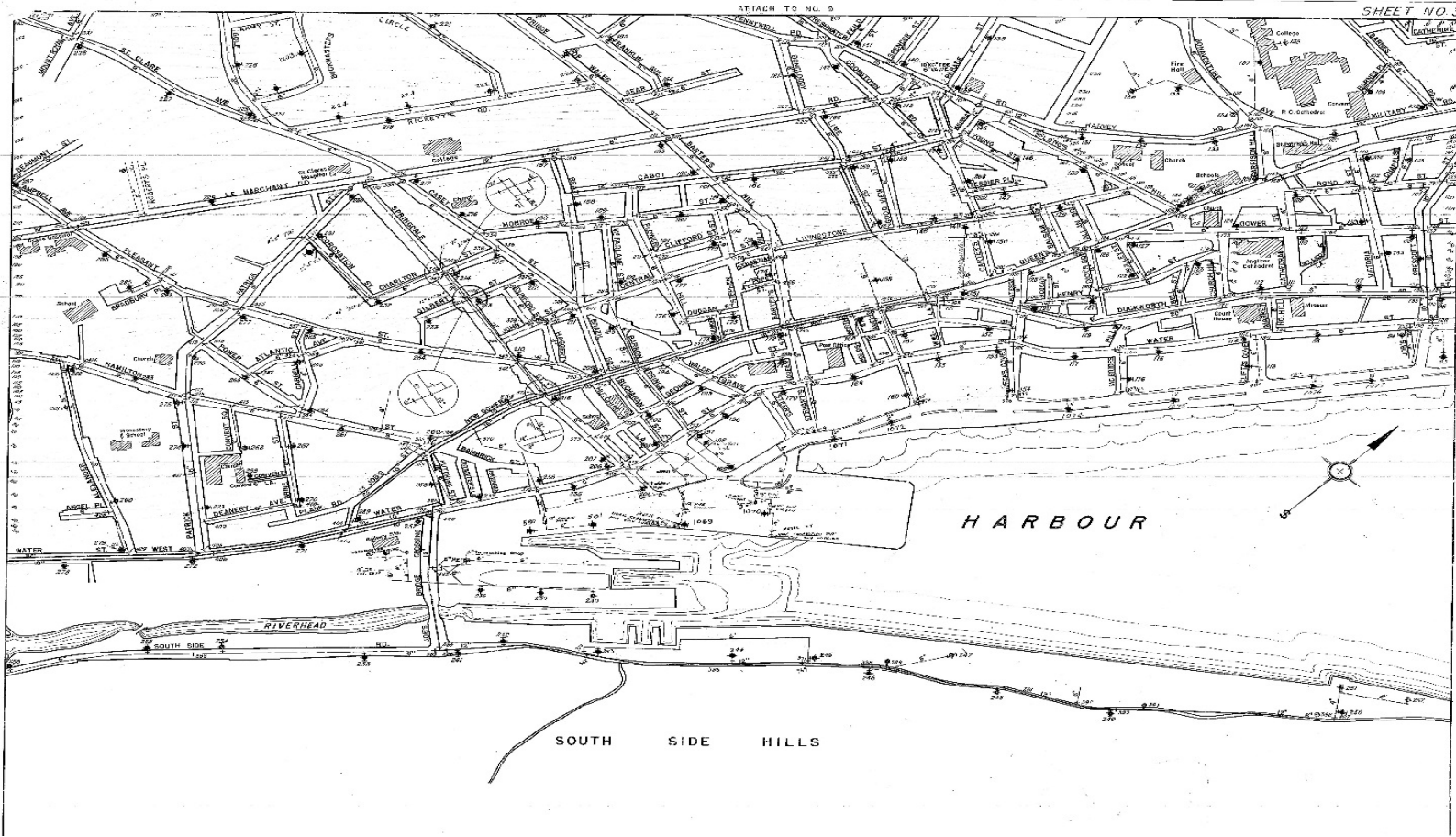
- Watermain Locations
- Watermain Diameter
- Valve Locations
- Fire Hydrant Locations
- Other Key Infrastructure – WTP, PRVs, Pump, Flow Meters, etc.

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# Leak Detection Basics

## System Maps

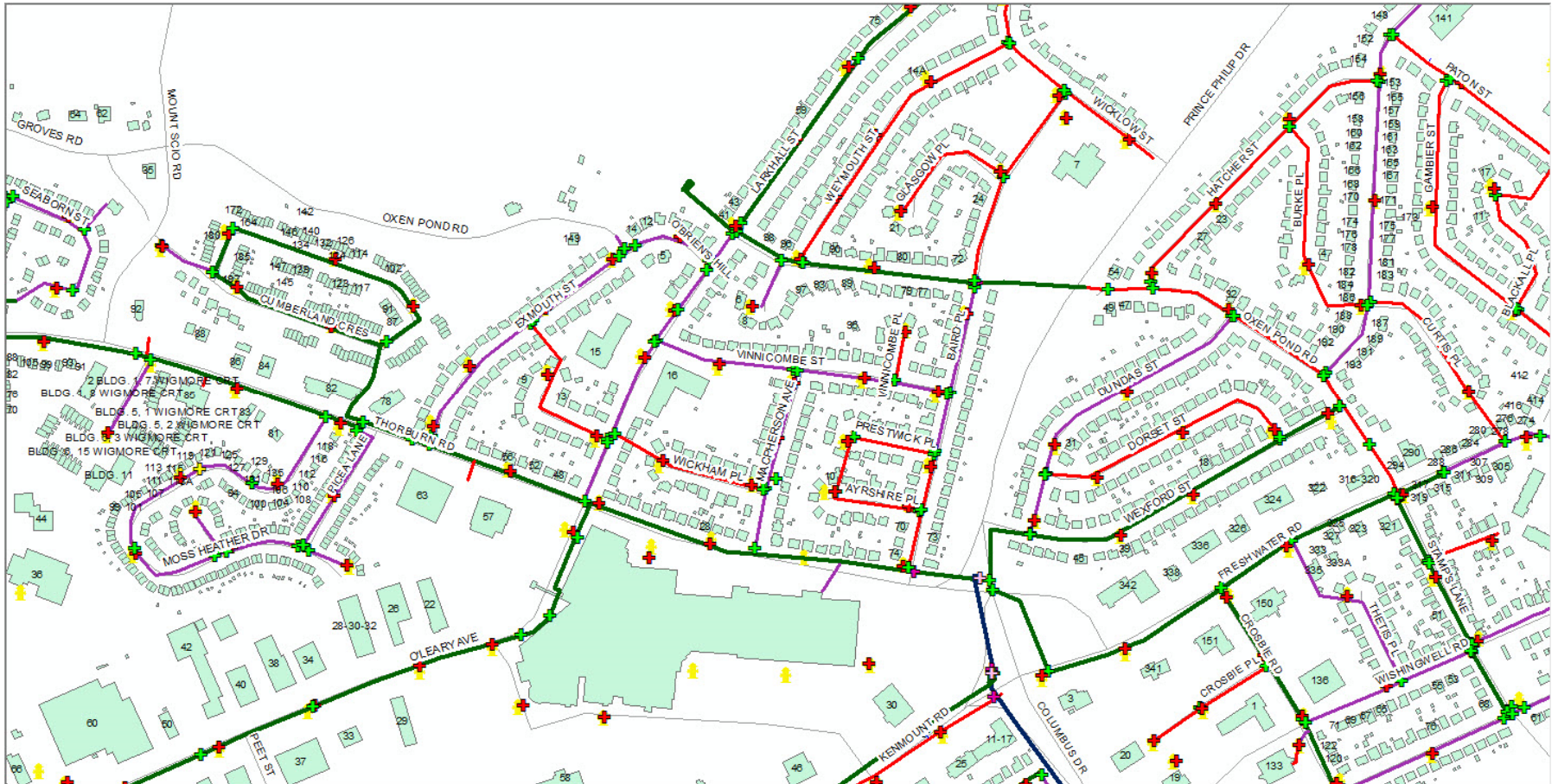


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# Leak Detection Basics

## System Maps



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# Leak Detection Basics

## Flow Meter



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# Leak Detection Basics

## Flow Meter Data

- Manual Records
- Data Logger
- Remote Monitoring or SCADA

2017 MLD			2018 MLD						2019 MLD		
WL	PHLP	BBBP	WL	PHLP	BBBP	WL	PHLP	BBBP	WL	PHLP	BBBP
December			January			December			January		
38.3	8.9	19.2	37.8	8.6	21.0	39.2	8.9	23.8	33.1	9.7	21.4
35.8	8.9	20.5	41.9	9.5	15.8	35.5	9.4	21.0	34.0	9.9	21.3
35.8	9.1	21.4	43.1	9.5	27.6	36.6	9.1	22.4	37.4	10.1	21.3
37.0	9.5	22.9	41.3	9.3	21.6	36.9	9.4	23.7	36.5	9.8	22.1
38.3	9.4	24.0	42.2	9.1	25.2	37.8	9.2	20.1	35.7	9.7	19.9
37.6	9.4	22.6	40.0	9.1	20.3	35.9	9.0	23.1	35.3	10.0	24.4
37.9	9.1	20.6	39.8	9.4	21.8	34.9	8.7	23.2	37.0	9.9	21.8
37.6	8.7	22.7	41.6	9.5	24.8	35.5	8.9	19.8	37.6	10.0	21.6
36.0	8.8	25.2	42.5	9.5	23.5	34.9	9.2	20.4	38.2	10.2	23.8
36.5	9.1	23.1	40.6	9.5	22.3	37.5	9.3	23.6	36.9	9.9	24.6
38.1	9.0	24.0	41.5	9.4	23.5	36.5	9.4	21.6	35.8	9.5	22.5
37.6	9.3	20.7	41.0	9.1	20.4	35.8	9.1	22.6	35.5	9.2	23.1
37.9	9.3	23.8	39.1	9.2	22.2	35.9	8.9	21.6	34.2	9.5	21.9
38.9	9.1	20.9	39.9	9.6	21.9	34.5	8.7	23.8	36.3	9.3	21.8
38.7	9.0	24.6	41.0	9.1	24.4	34.3	8.9	21.5	37.0	9.4	23.5
35.8	9.3	18.7	41.1	9.4	23.2	34.3	9.0	23.5	34.8	9.3	24.9
35.6	8.9	22.0	39.6	9.4	23.4	37.5	9.4	24.4	36.5	9.3	21.5
38.7	9.2	24.7	41.1	9.5	22.1	35.1	9.4	20.3	36.2	8.9	19.6
39.9	9.3	21.2	41.7	9.0	21.9	36.9	9.2	21.6	34.5	9.0	22.6
41.3	9.3	21.3	39.5	9.4	23.7	36.3	9.1	21.2	34.4	9.5	22.5
40.0	9.2	24.2	38.7	9.8	20.6	35.1	9.1	21.9	36.6	9.4	25.8
40.0	9.1	22.7	41.2	9.9	23.8	33.3	9.4	21.7	37.6	9.9	23.3
37.9	9.2	20.5	41.4	9.7	22.9	34.2	9.6	21.7	36.7	9.7	22.7
37.1	9.2	20.6	40.6	9.8	20.4	33.8	9.7	19.6	36.8	9.4	21.2
36.1	8.8	19.6	42.0	9.4	21.6	30.1	9.0	22.9	36.5	8.9	22.6
36.4	8.8	21.2	40.7	9.0	27.2	32.9	9.2	17.9	35.2	9.8	23.1
39.3	9.0	19.0	39.5	9.1	21.6	35.0	9.4	21.6	35.0	10.5	23.5
39.9	9.2	26.3	38.8	9.4	20.5	35.1	9.5	21.0	35.8	10.0	20.5
40.0	9.0	20.9	40.8	9.6	21.9	32.8	9.5	22.3	36.2	10.4	22.4
37.7	9.0	20.9	38.8	9.4	24.2	33.3	9.4	20.7	35.6	10.5	22.8
39.2	9.1	20.5	41.5	9.5	22.1	36.6	9.6	22.0	36.6	9.7	22.4
38.0	9.1	21.9	40.7	9.4	22.5	35.3	9.2	21.8	36.0	9.7	22.5
69.0			72.5			66.3			68.1		

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# Leak Detection Toolbox

You have noticed an increase in water flows – now what?



Determine the source of the water flow increase.

Don't assume it's a leak - it could be actual usage!

- Usage from commercial / industrial properties;
- Fire flows;
- Hydrant flushing;
- Recreational – swimming pools
- Other

If the source cannot be determined – assume it is a leak.

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# Leak Detection Toolbox

You suspect a leak – how do you find it?



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# Leak Detection Toolbox



Based on our experience only 10-20% of water leaks surface.

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# Leak Detection Toolbox

What Tools and Techniques are available?

## Basic Techniques

### Step 1: Noise Survey

#### Tools required:

- Sonophone
- Electronic Listener

### Step 2: Ground Listening

#### Tools Required:

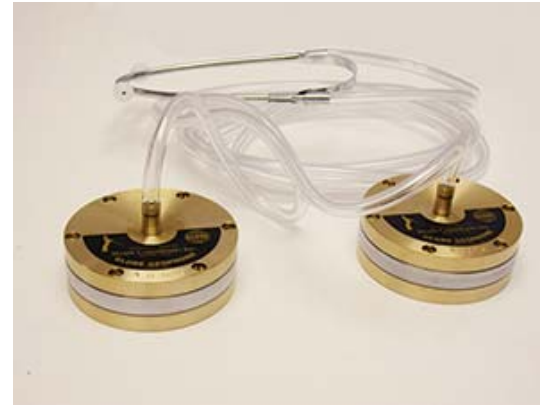
- Geo Phone
- Electronic Geo Phone

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# Leak Detection Toolbox

## Basic Tools - Listening



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# Leak Detection Toolbox

## Noise Survey (\*note only metallic systems)

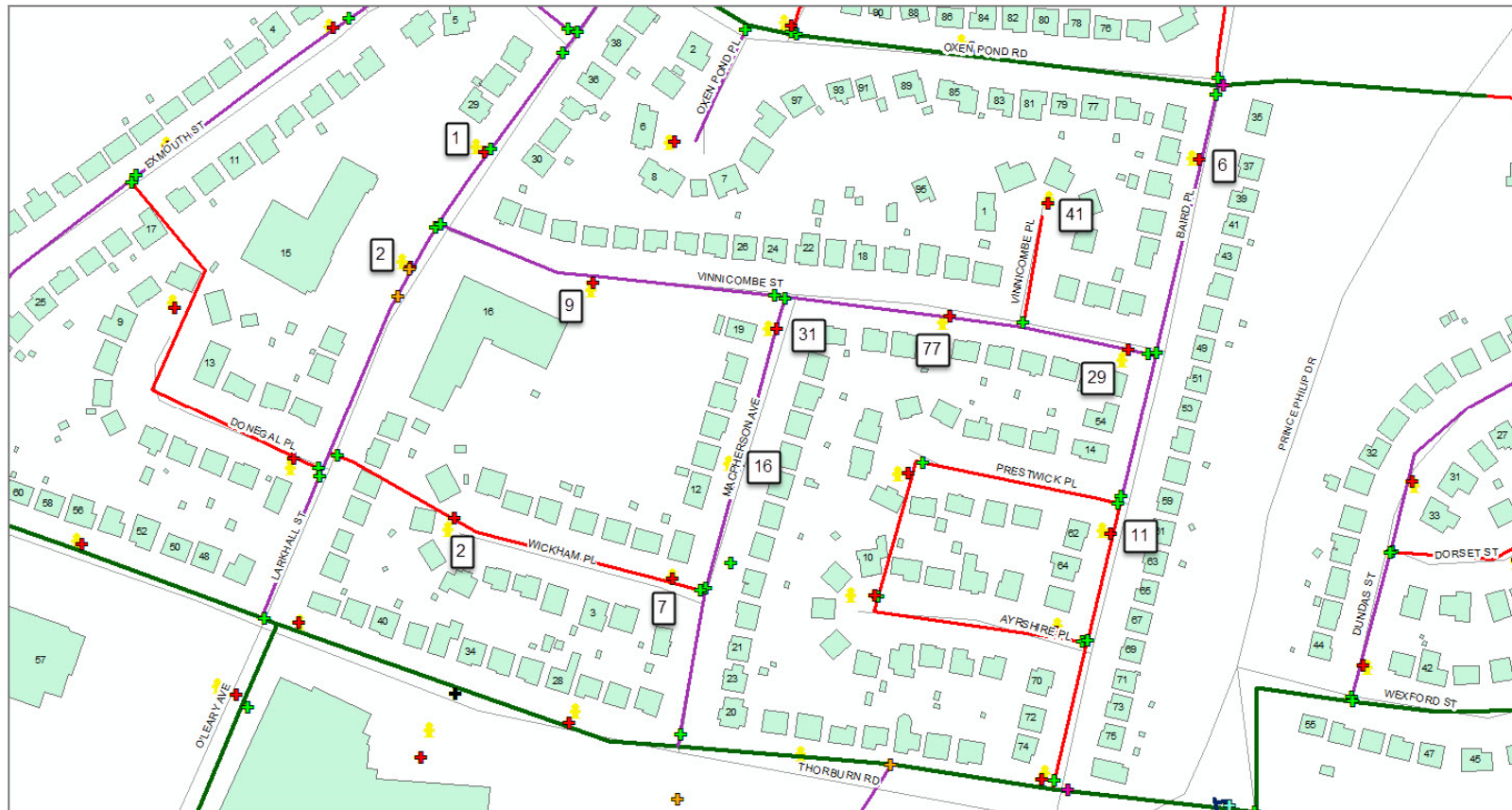
- Typically from Hydrants, easy access
- Valves, curb stops or other accessible points within water distribution system;
- Crews listen to each hydrant / valve and record notes;
- Can be done from a list or map;
- Results are reviewed to determine a potential leak area (area of interest).

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# Leak Detection Toolbox

Noise Survey – record value or Y/N



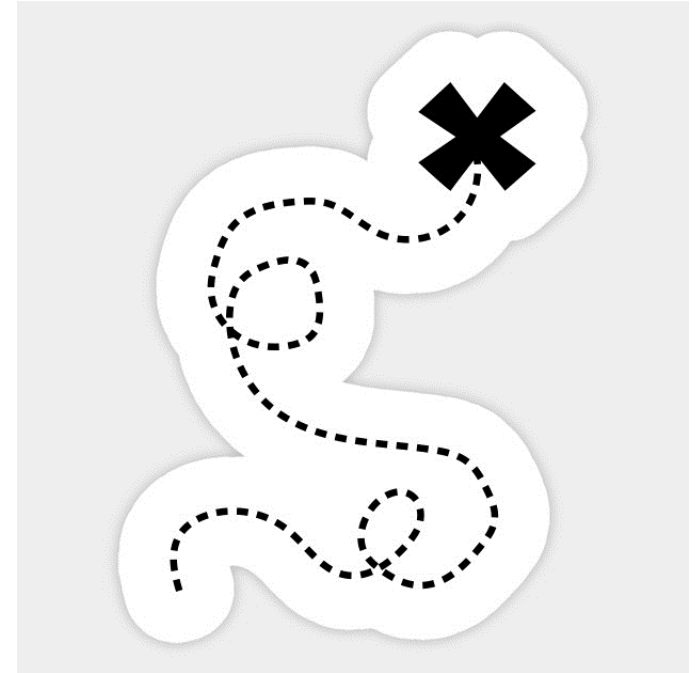
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# Leak Detection Toolbox

## Noise Survey

- After a potential leak is located - narrow down location by sounding other valves or curb stops.
- Once a smaller location is determined - conduct ground listening.



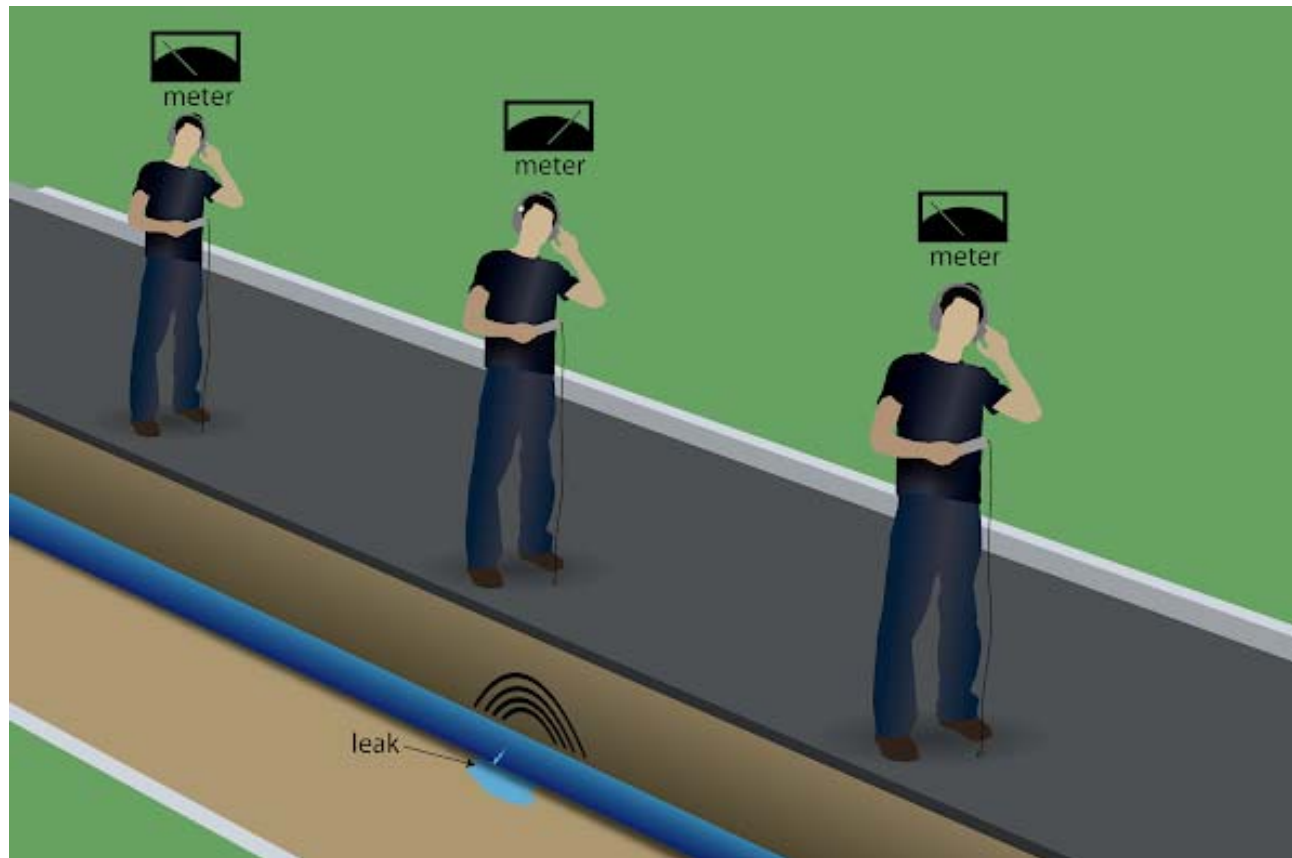
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# Leak Detection Toolbox

## Ground Listening



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# Leak Detection Toolbox

You found a leak – now what?

- Leak Report – location of leak
- Notify Owner – Municipality or Private
- Repair Leak

It's not finished

- Repair Report
- Recheck area – one leak could mask / hide another one

Documentation!

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# Leak Detection Toolbox - Advanced

What Tools or Techniques are available?

## Advanced

1. Noise Loggers
2. Leak Noise Correlator
3. Step Testing
4. System Build Out
5. District Metered Areas

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# Leak Detection Toolbox – Noise Loggers

## 1.) Noise Loggers

- Sensors installed on watermains or valves to listen for leak noise
- Sensors “listen” for a pre-defined period to determine if there is a possible leak, usually early morning 2 – 4 am.



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# Leak Detection Toolbox – Noise Loggers

## Installations

- Permanent – monitored via fixed system or drive by;
- Temporary – Lift and Shift, moved around system.

## Types

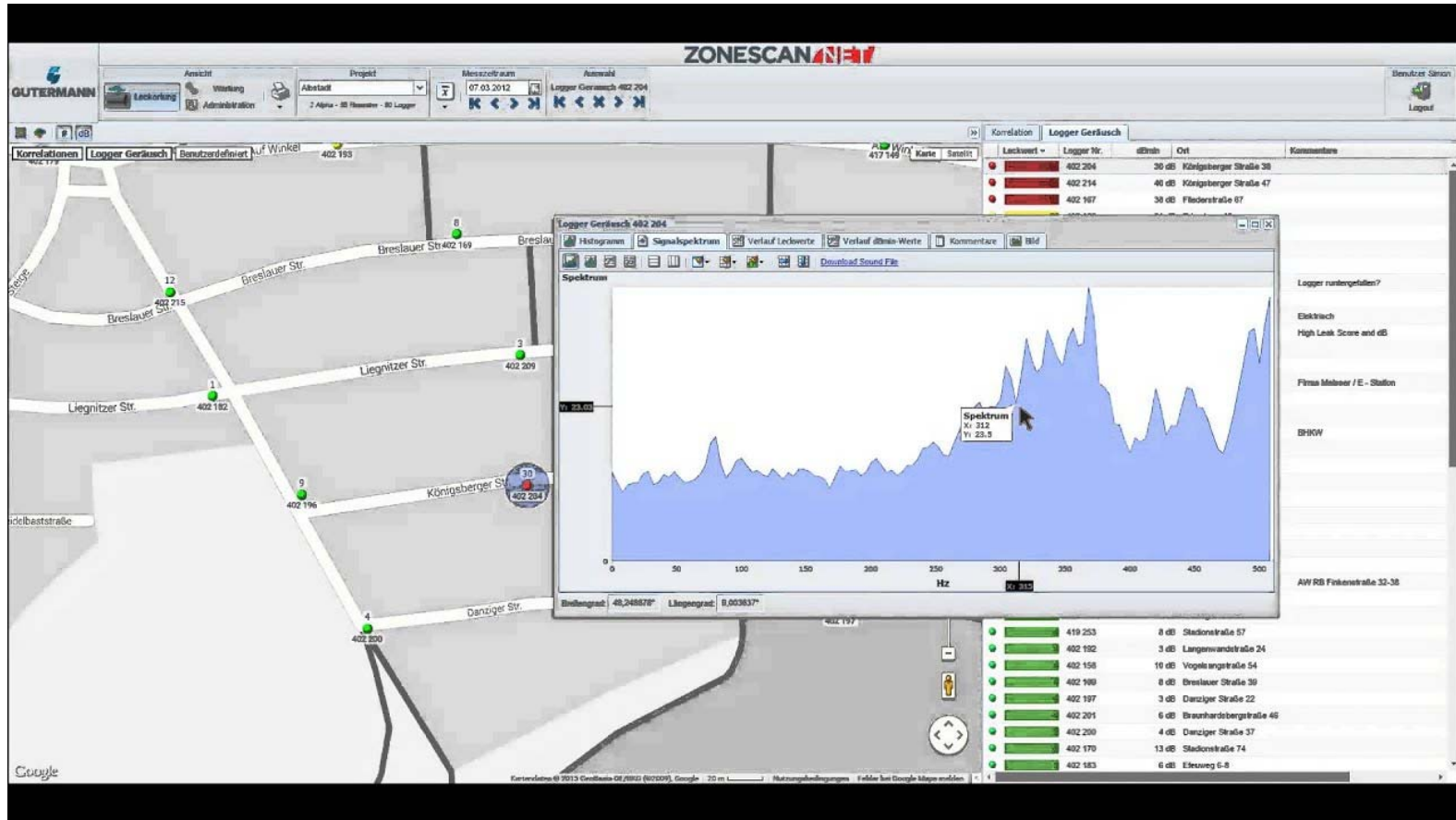
- Noise Logger – provide indication of sound;
- Correlating Logger – provide indication of sound and approx. location.



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# Leak Detection Toolbox – Noise Loggers



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# Leak Detection Toolbox – Noise Loggers

## General

- Noise Loggers typically replace hydrant surveys;
- Can also be used in “noisy” areas;
- Or high traffic areas.

## Results

- Narrow down leak locations;
- Field investigation required to “pin-point” leak.

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# Leak Detection Toolbox – Leak Correlator

## 2.) Leak Correlator

- A system comprised of sensors, transmitters, receiver and software program to determine the location of a water leak.
- System utilizes noise from the leak and pipe properties to determine leak location.



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# Leak Detection Toolbox – Leak Correlator

## System

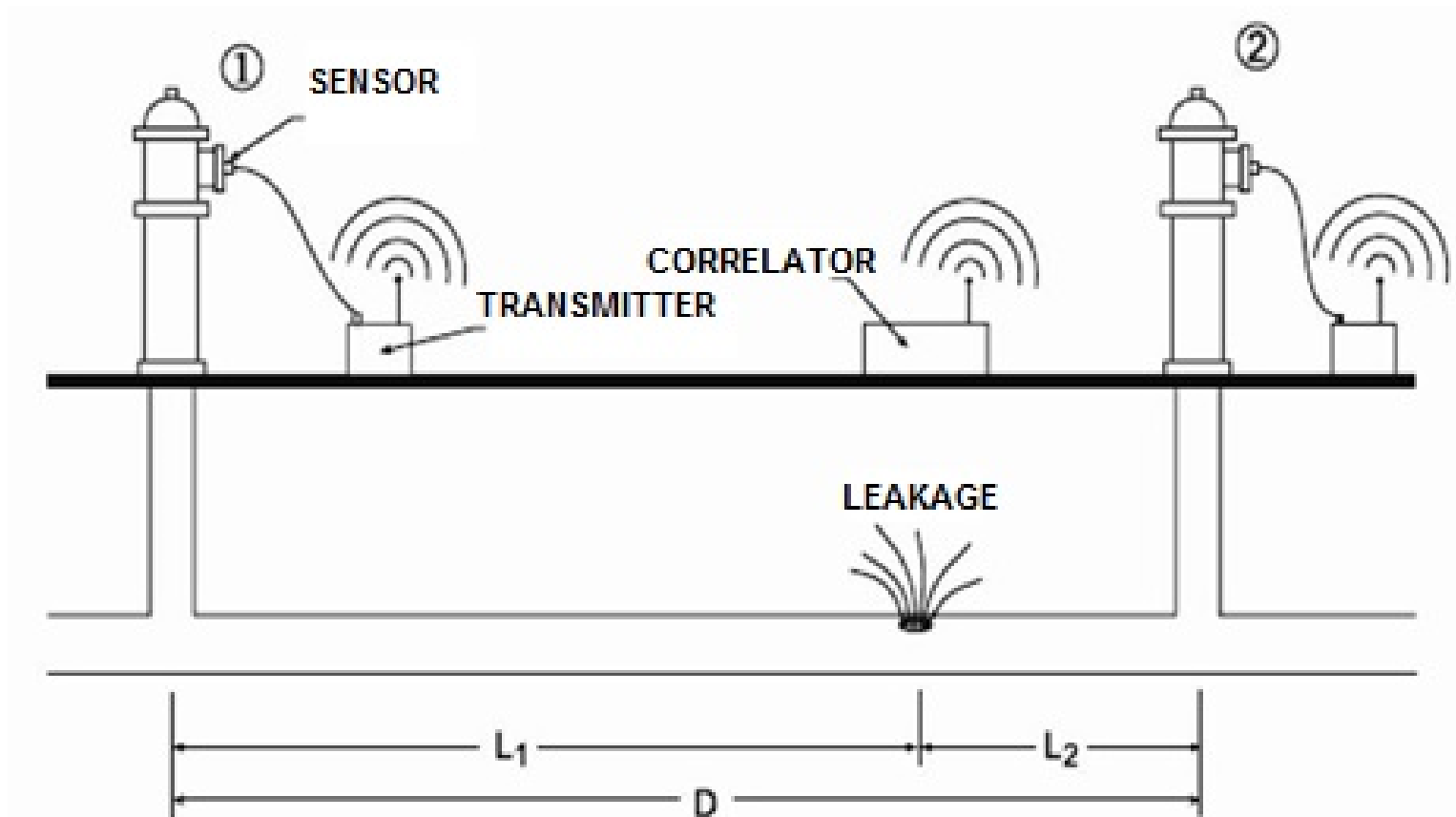
- Sensors can be installed directly on watermain, valves, hydrants, services or any other access point.
- Easier to use, requires pipe diameter, pipe material and distance between sensors.
- Results are indicated as a distance from each sensor



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# Leak Detection Toolbox – Leak Correlator



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# Leak Detection Toolbox – Leak Correlator

## General

- Leak Correlators typically replace ground sounding to find leaks;
- Primarily used on metallic water components;
- Can be used on mains or services.

## Results

- Pin-Point Leak Locations;
- Ground listening recommended to verify leak location.

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# Leak Detection Toolbox - Advanced

## 3.) Step Testing:

- A method of determining areas of potential leakage through a process of isolating sections of the water distribution system for short periods of time.
- Requires a defined area in which all water is metered – these are typically district metered areas.

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# Leak Detection Toolbox – Step Testing

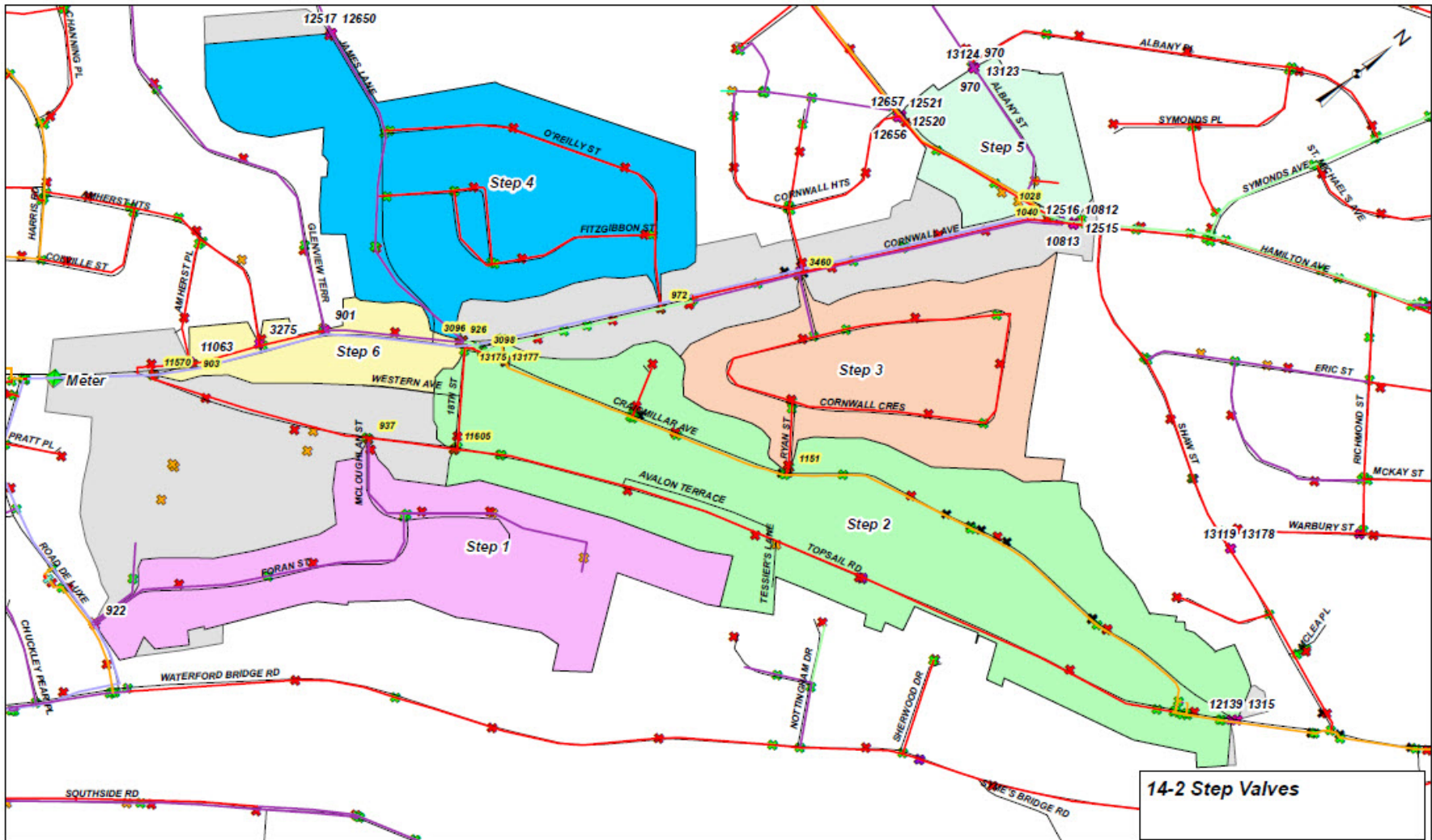
## Procedure - Steps:

- Confirm boundary – ensure that there is only one supply for the area, for example partially open boundary valve.
- Locate and close step valves, record time valves were opened and closed.
- Leave the step valves closed for 5-10 minutes.
- Record data from flow meter - initial flow, lowest flow and total drop/change
- During this process the high point (or critical point) within the area is monitored to ensure that the pressure does not drop below 20 psi.
- If pressure drops quickly it may indicate a large usage or leak – reopen valves.

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# Leak Detection Toolbox – Step Testing



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# Leak Detection Toolbox – Step Testing

City of St John's - District Meter Areas					
Step Testing					
DMA	14-2	CORNWALL			
Date					
Step No	Valve Operation				Valve Location
	Close	Time	Open	Time	
Valving					
<b>Step 1</b>					
1	922	<input type="text"/>			Close Foran St at Road De Luxe
	Verify Valve is Closed by Sounding				<input type="text"/>
2	937	<input type="text"/>			Close McLoughlan St at Topsail Rd
	Verify Valve is Closed by Sounding				<input type="text"/>
3	Start Leak Test - Time			<input type="text"/>	
4	End Leak Test - Time			<input type="text"/>	
5			922	<input type="text"/>	Open Foran St at Road De Luxe
6			937	<input type="text"/>	Open McLoughlan St at Topsail Rd
<b>Step 2</b>					
1	11605	<input type="text"/>			Close Topsail Rd #221 near 18 Stre
	Verify Valve is Closed by Sounding				<input type="text"/>

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# Leak Detection Toolbox – Step Testing

## Review Results:

- Compare measured drop in flow to expected drop.
- Areas with large drops could be subdivided in smaller sections and then additional steps completed.
- Conduct sounding or other method of leak detection in the area of interest to locate water leak or source of water usage.

## Summary:

- Useful to determine areas of potential leakage – could replace noise or hydrant surveys;
- Requires knowledge of water distribution system and experienced operators;
- Requires a flow meter;
- Need to be careful not to drain or de-pressurize the system.

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# Leak Detection Toolbox - Advanced

## 4.) System Build-Out:

- Opposite of Step Testing;
- A method of determining areas of potential leakage through a process of adding sections of the water distribution system over a defined period;
- Requires a defined area in which all water is metered – these are typically district metered areas; **AND**
- A second water supply to the area.

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# Leak Detection Toolbox – System Build-Out

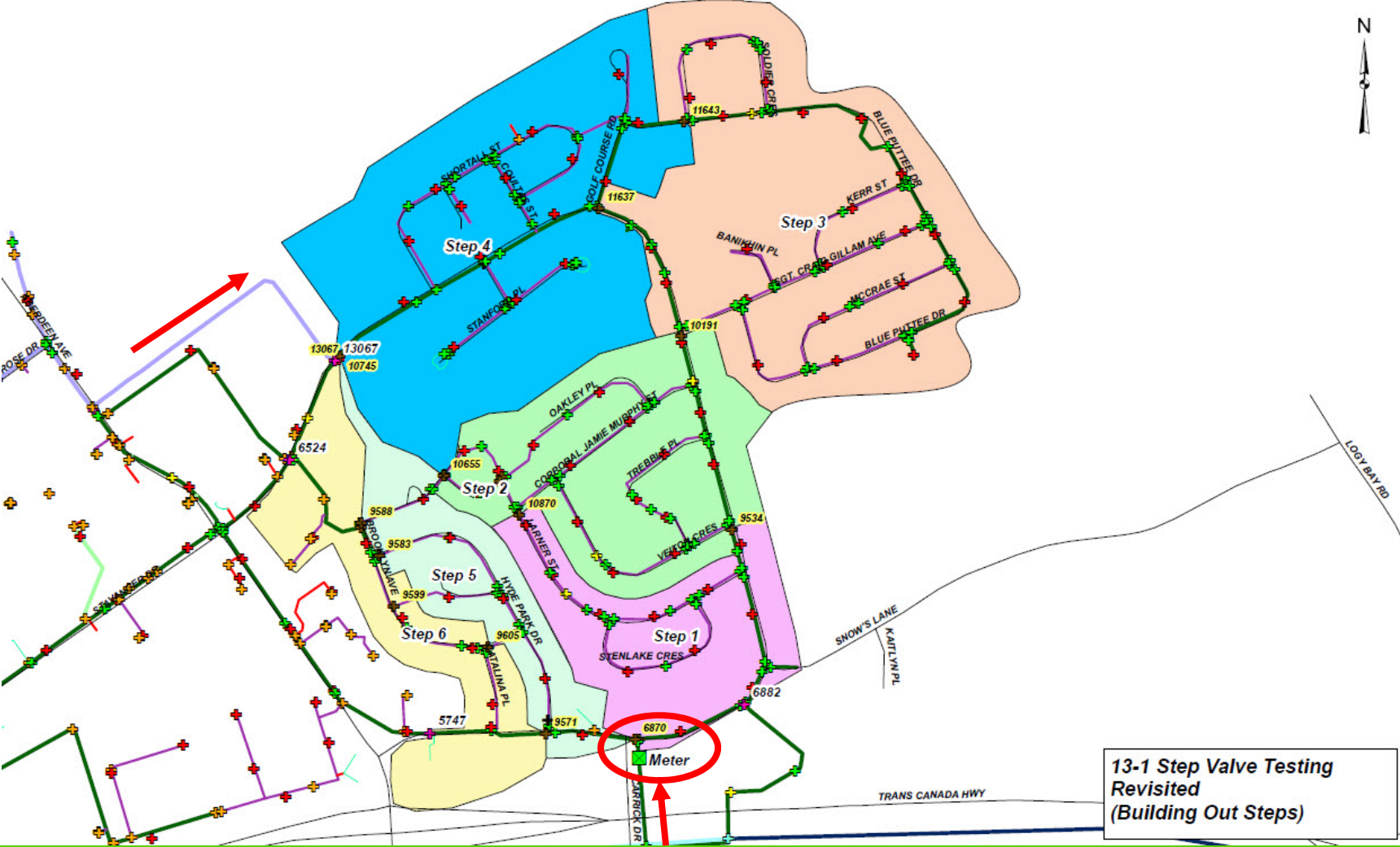
## Procedure for Buildout:

- Open alternate water supply for area;
- Isolate water meter from area – flow should be zero;
- Locate and open/close boundary valves to increase service area for flow meter.
- Leave the boundary valves closed for 5-10 minutes.
- Record data from flow meter - initial flow, average flow and total increase/change in flow;
- Continue to increase service area in pre-defined steps.

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# Leak Detection Toolbox – System Build-Out



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# Leak Detection Toolbox – System Build-Out

City of St John's - District Meter Areas						
Step Testing						
DMA	13-1	CLOVELLY (DMA REVISITED)				
Date						
<b>Note:</b>	This DMA will be revisited with steps being built out. This is contrary to previous step testing methodology where steps were independently isolated and analyzed. See sequencing below.					
Step No	Valve Operation					Valve Location
	Close	Time	Open	Time	Valving	
<i>Prior to Step 1</i>			13067		Open	Stavanger Dr behind Walmar
			Note: This valve was opened to provide an alternative water source for the remainder of the DMA prior to Step 1 being isolated. This boundary valve will be closed in Step 6.			
<u>Step 1</u>						
1	6870				Close	Stavanger Dr west of #370
	Verify Valve is Closed by Sounding					Opened in Step 5
2	9534				Close	Stavanger Dr at Veitch Cres
	Verify Valve is Closed by Sounding					
3	10870				Close	Larner St at Corporal Jamie M
	Verify Valve is Closed by Sounding					
4	Start Leak Test - Time					
5	End Leak Test - Time					

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# Leak Detection Toolbox – System Build-Out

## Review Results:

- Compare measured increase in flow to expected increase.
- Areas with large increases could be subdivided in smaller sections and then additional steps completed.
- Conduct sounding or other method of leak detection in the area of interest.
- Locate water leak or source of water usage.

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# Leak Detection Toolbox – System Build-Out

## Summary:

- Opposite of Step Testing;
- Useful to determine areas of potential leakage – could replace noise or hydrant surveys;
- Requires knowledge of water distribution system and experienced operators;
- Requires a flow meter and a second supply;
- No risk of draining or de-pressurizing the system.

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# Leak Detection Toolbox - Advanced

## 5.) 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.

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# Leak Detection Toolbox - DMAs

## DMA Concept

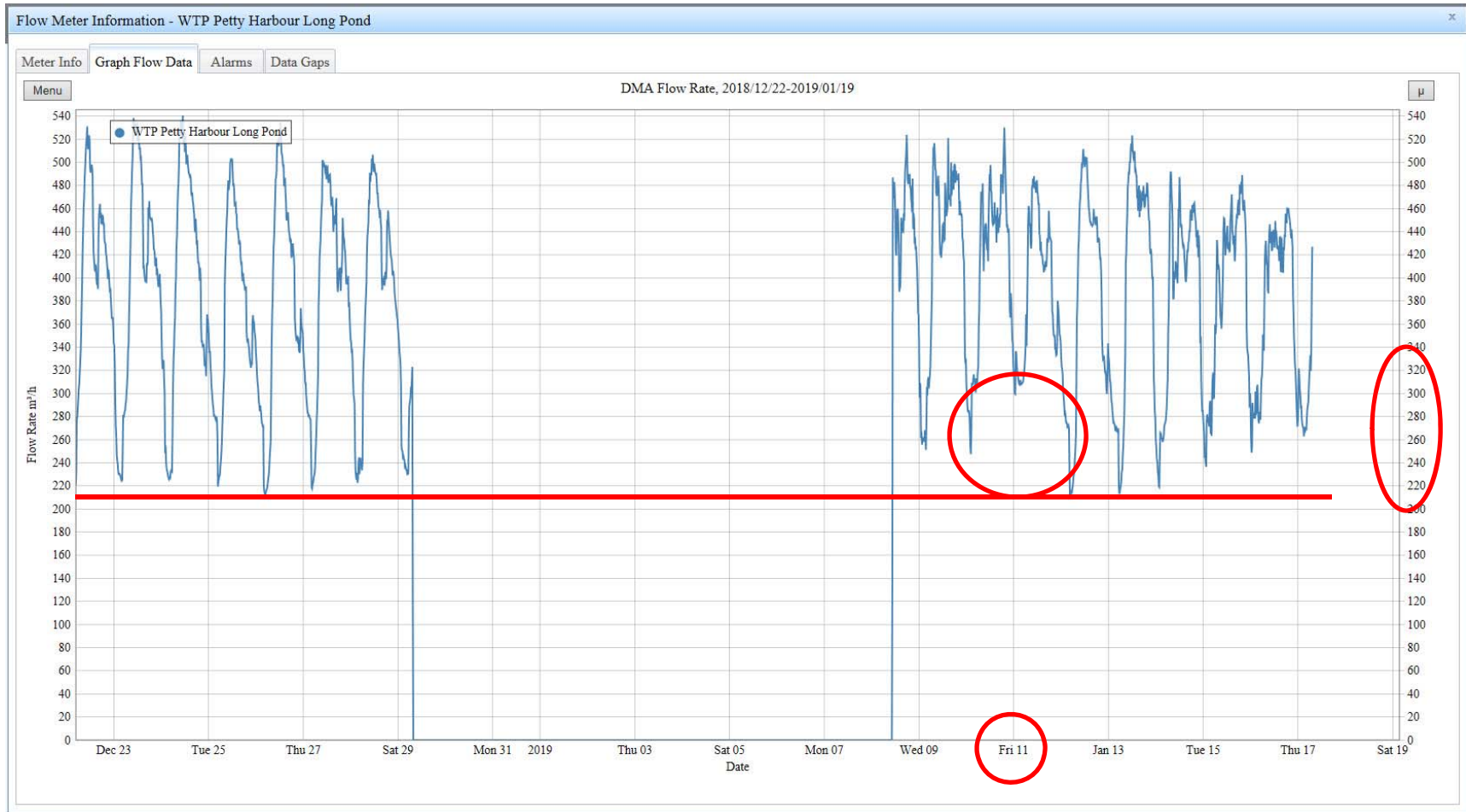
- Minimum night time flow is calculated, leak detection completed to achieve minimum night flows (typically greater than theoretical calculated result).
- Flow data is monitored daily and minimum night flow is compared to actual flow
- Variance in flows = leak(s) or usage

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# Leak Detection Toolbox - DMAs



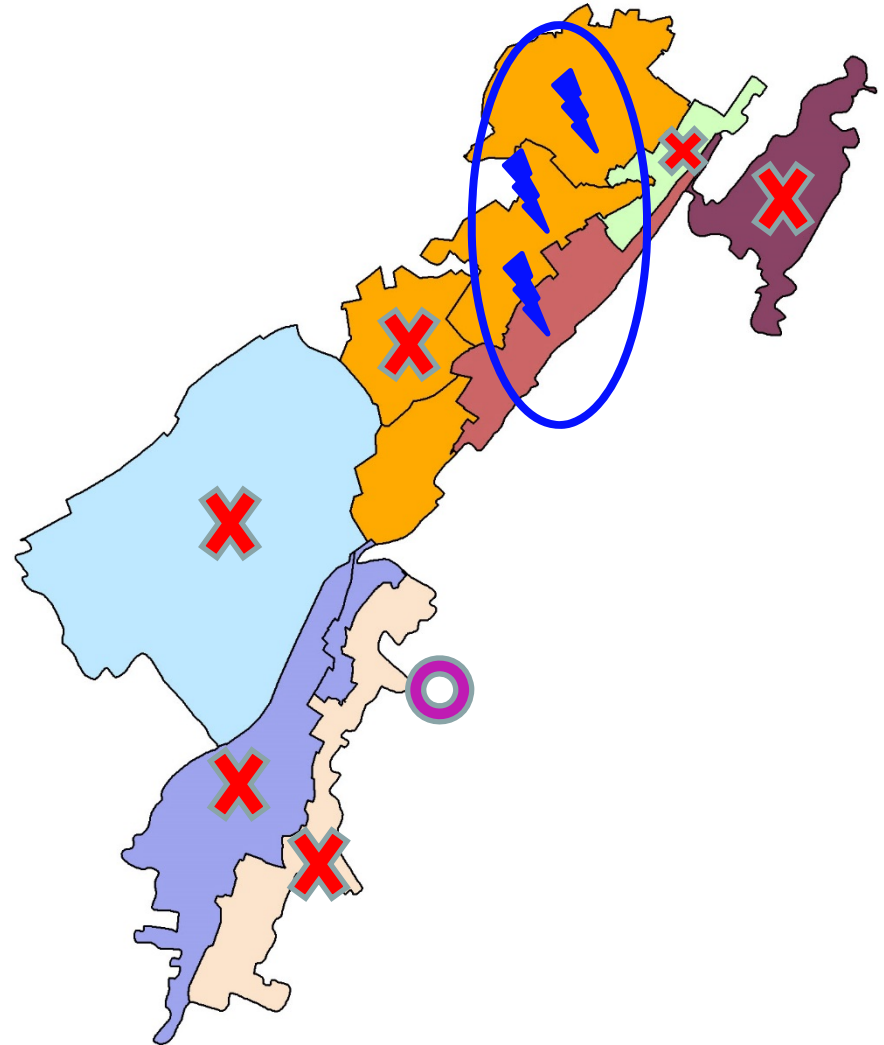
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# Leak Detection Toolbox - DMAs

## District Metered Areas

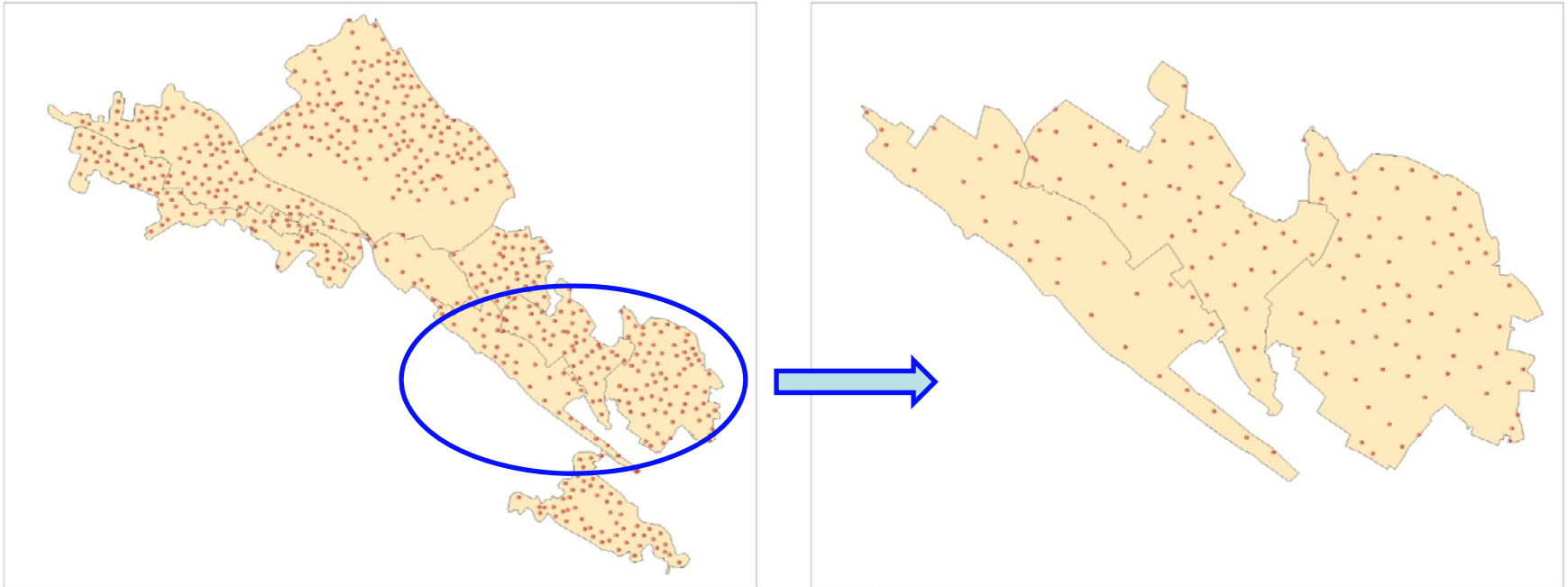
- Source Meter – Increase Flow
- Bay Bulls – NC
- Densmore – NC
- Waterford Bridge – NC
- Topsail West – NC
- Topsail East – UP
- Road DeLuxe – UP
- Craigmillar / Shea Heights – NC



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# Leak Detection Toolbox - DMAs



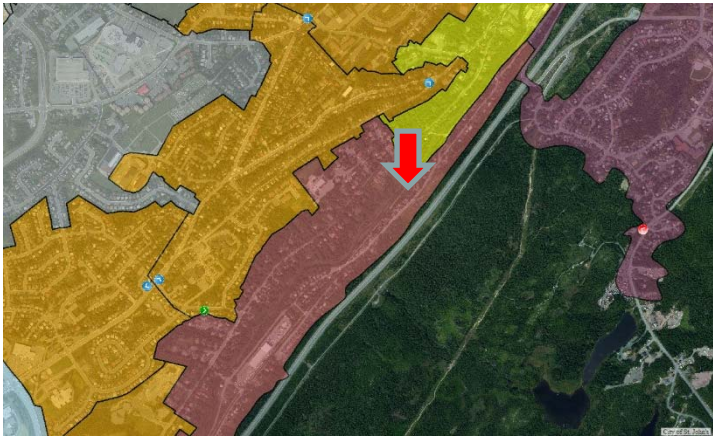
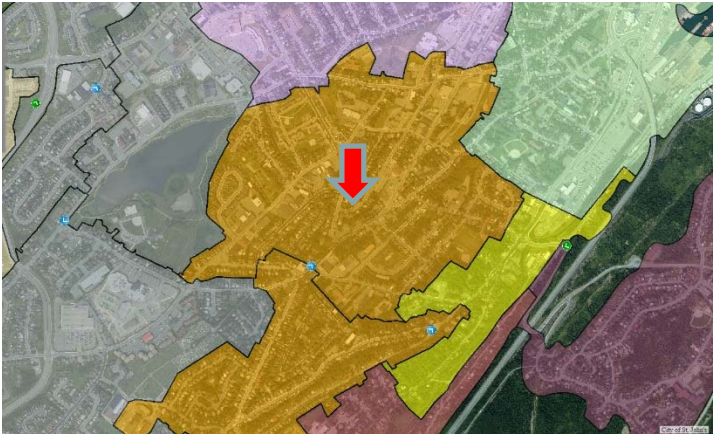
581 Hydrants

155 Hydrants

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# Leak Detection Toolbox - DMAs



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# Leak Detection Toolbox

## Summary:

- Leak Detection can be done using relatively inexpensive tools;
- Leak Detection can improve and become more efficient with the use of electronic / computer equipment;
- Not one tool for Leak Detection – know the tools available in your Toolbox.

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A nighttime photograph of St. John's, Newfoundland, showing the city lights and harbor. The city is illuminated with warm yellow and orange lights, reflecting on the water. The harbor is filled with boats and structures, and the city extends up a hillside in the background. The sky is a deep blue.

Thank You

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