National Water and Wastewater Conference

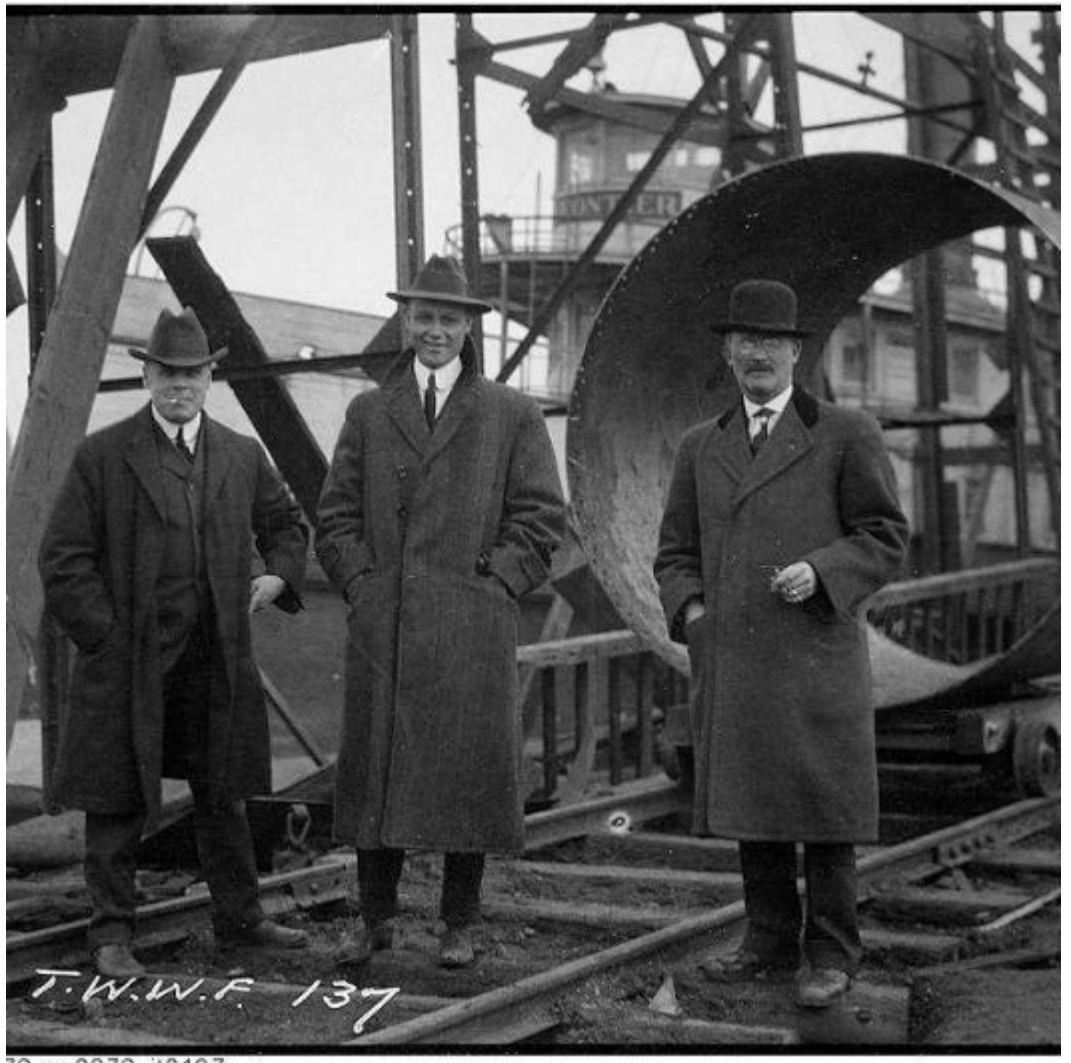
Extending the Life of Transmission Mains

Presented by Stewart Dickson, P. Eng

Extending the Life of Transmission Mains

Outline

- Introduction
- Transmission Main Condition Assessments
  - Challenges
  - Overview – AWWA M77
  - Tools Available
  - Case Study - City of Toronto Riveted Steel Watermain
- Rehabilitation
  - Case Study – Town of New Tecumseth
  - Case Study – City of Toronto



72_ss0072_it0137

ABOUT RVA

We're a community of thinkers, innovators, and collaborators who combine human ingenuity with technology and experience to deliver sustained outcomes that make a difference.

75 Years of Engineering Excellence in Canada

Canadian company founded in 1948

Employee owned and operated

#ONERVA

One company. One team. One-stop-shop.

Transmission Main Condition Assessments

Challenges

- Transmission mains are the backbone of the water distribution system
- Often lack redundancy and therefore can't be taken out of service
- High demand season is often a No Go for taking pipes offline
- Access – no Maintenance Holes to get in the pipe
- Need to maintain potability – often challenging to disinfect and "recommission" once it's been dewatered
- Limited as-constructed details for older systems

Transmission Main Condition Assessment

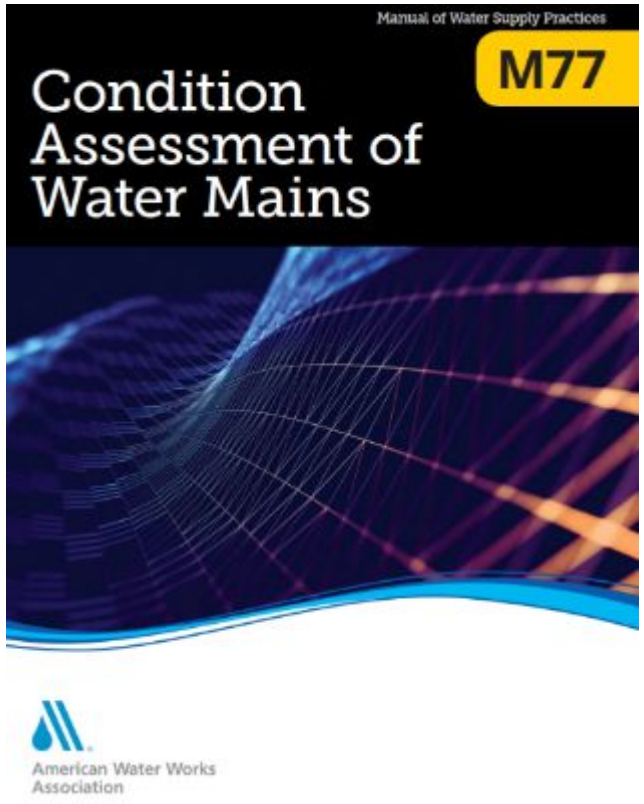
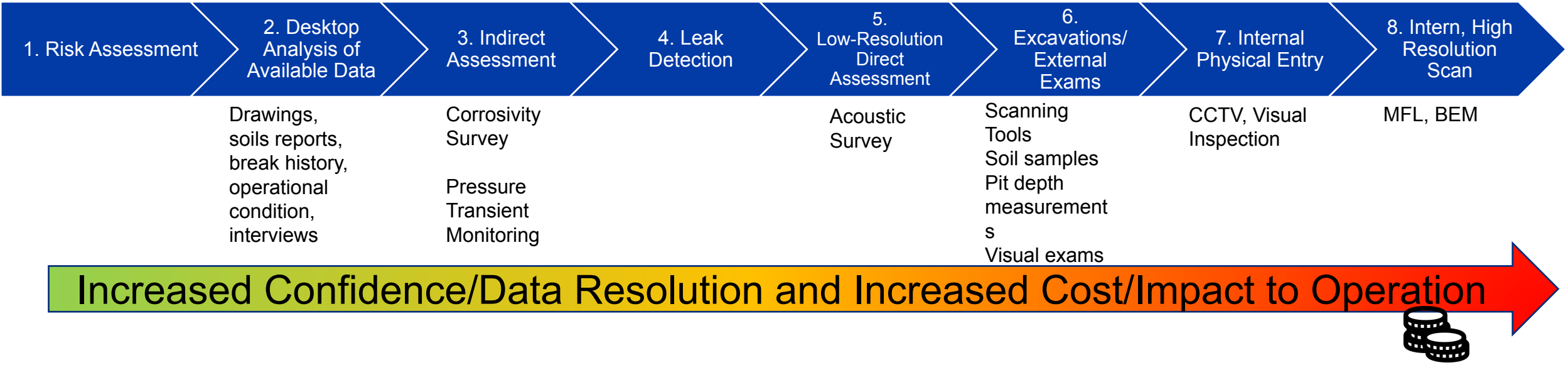


Table of Contents

Chapter 3: Planning a Condition Assessment Project



Your problem statement is going to determine how far to go

Transmission Main Condition Assessment Tools

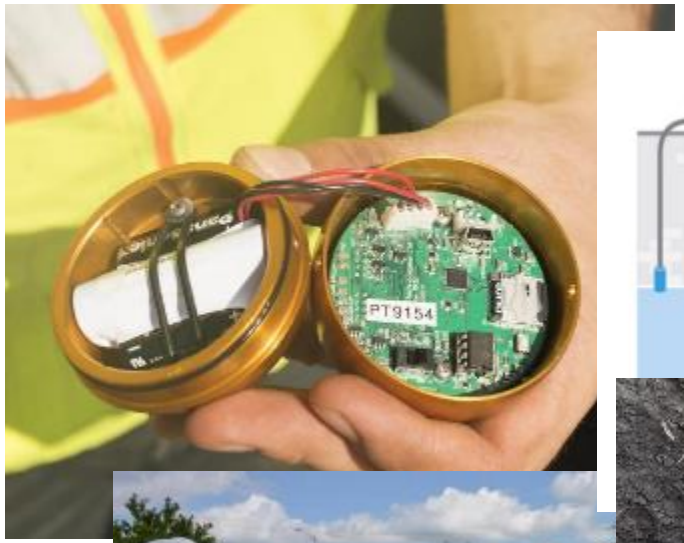
4. Leak Detection

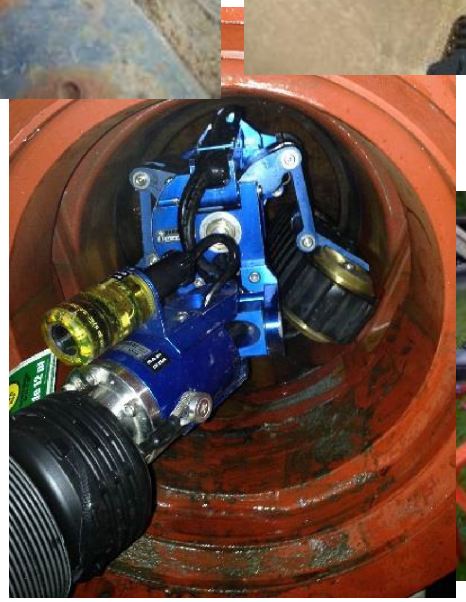
5. Low-Resolution Direct Assessment

6. Excavations/ External Exams

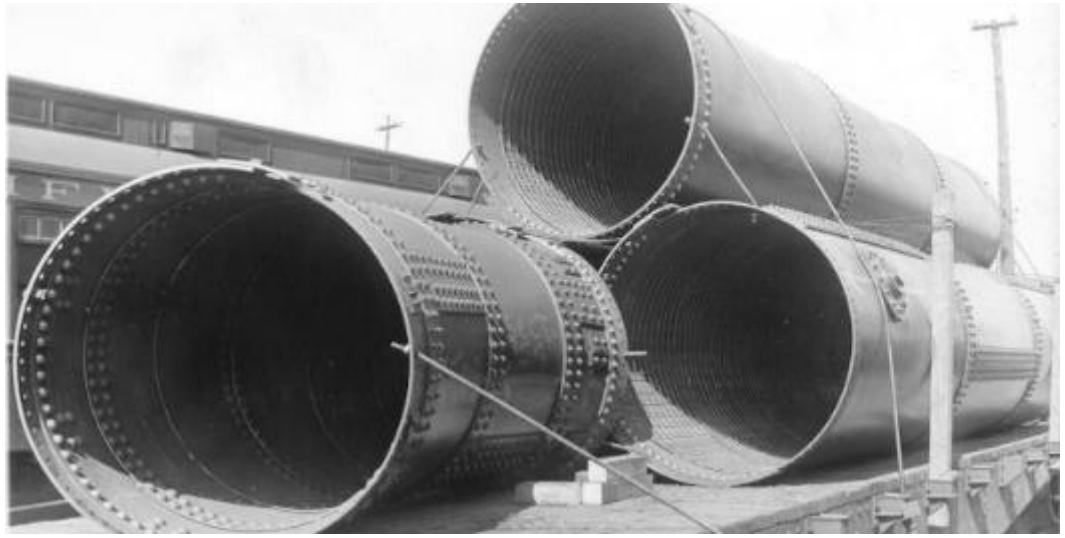
7. Internal Physical Entry

8. Intern, High Resolution Scan





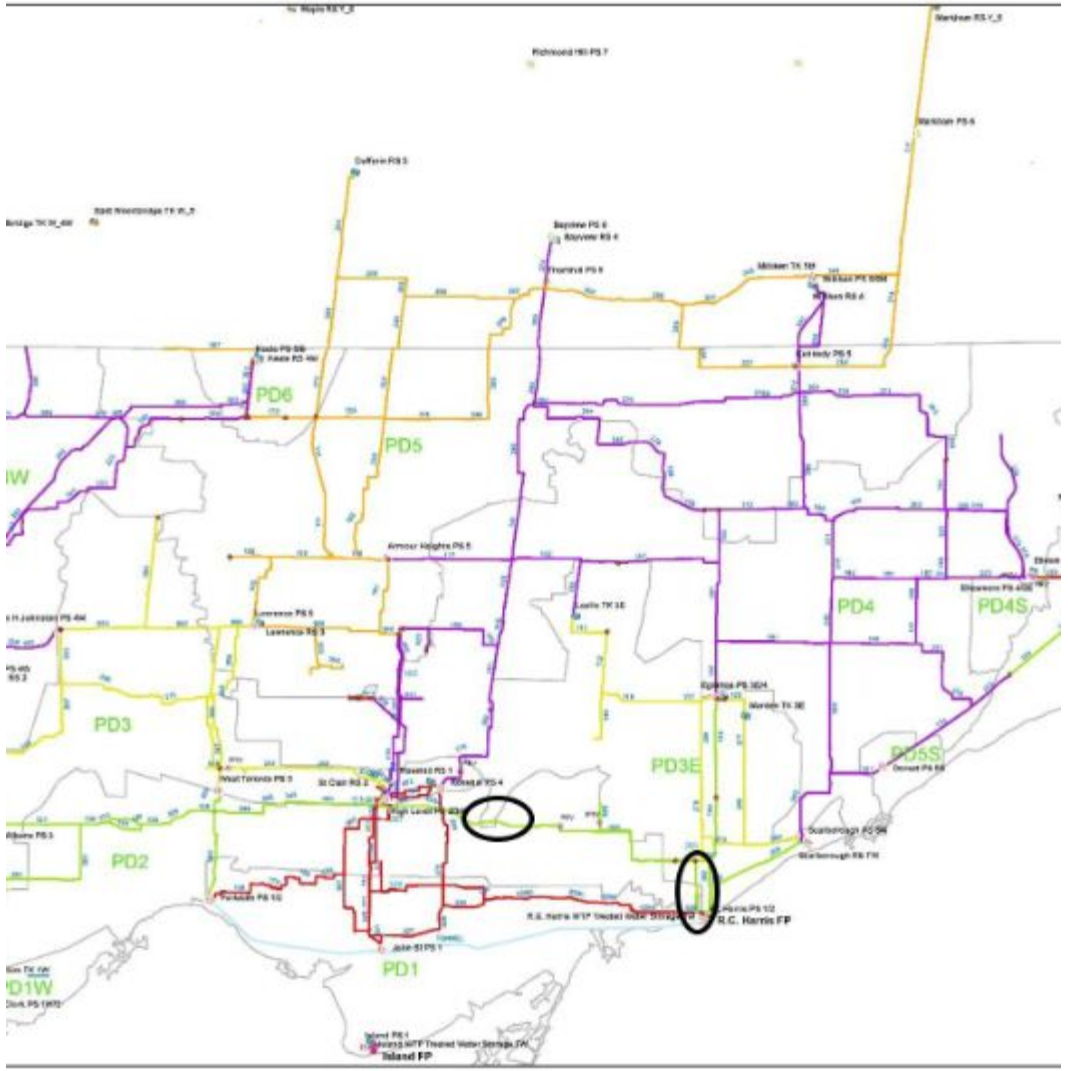
CASE STUDY – Toronto Riveted Steel Watermains



CASE STUDY – Toronto Riveted Steel Watermains

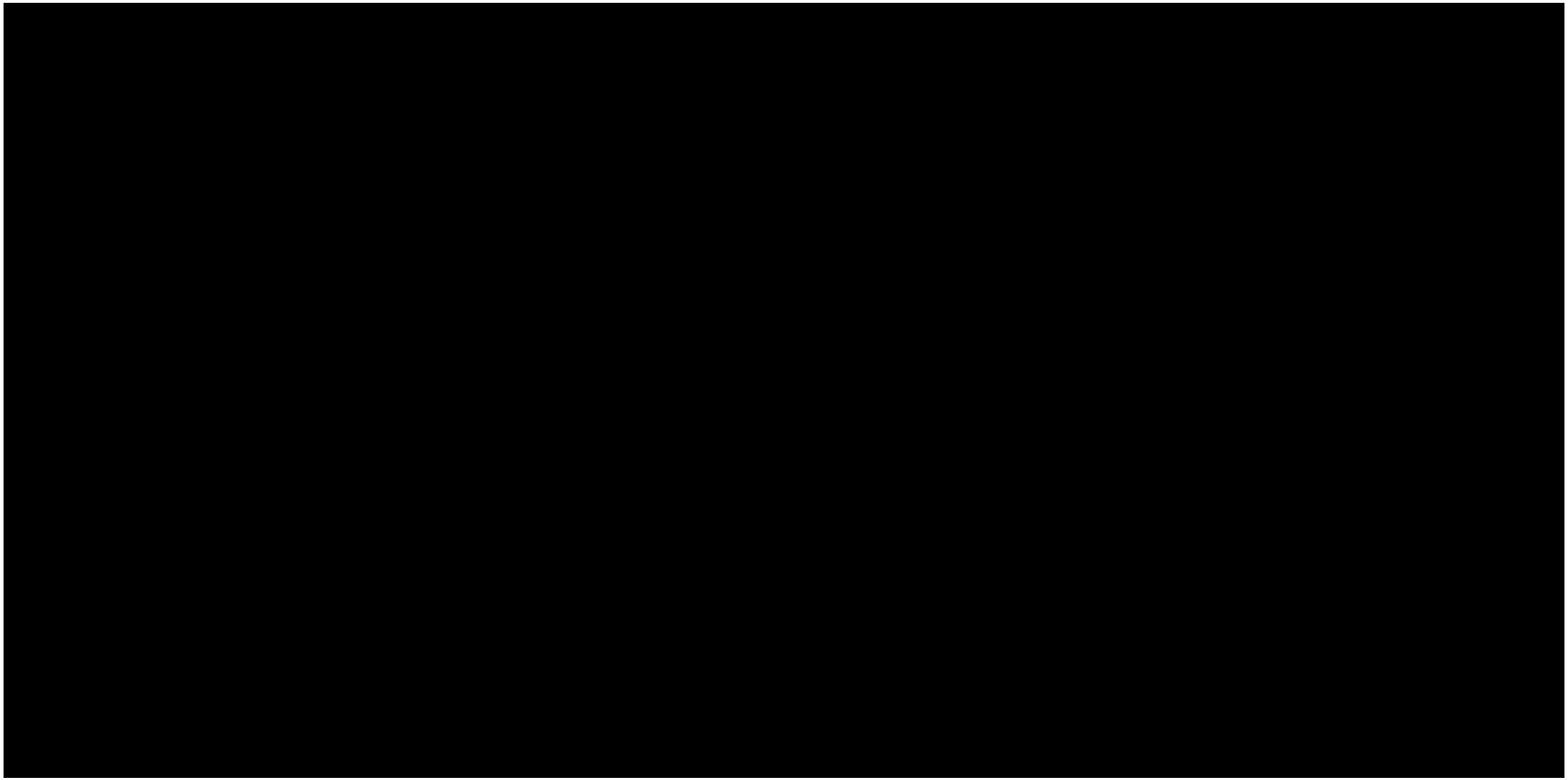
Scope of Assessment

- Desktop study
  - TM-1: RSW Original Wall thickness
  - TM-2 : RSW Failure Mechanisms and Modes
  - TM-3 : RSW Deterioration Rates
  - TM-4 : RSW Failure Thickness
  - TM-5 : RSW Failure Predictions
- Boreholes
- Pipe Excavation and Concrete cores
- Coupon sampling (not completed)
- CCTV Inspection
- Final Report and Recommendations



CASE STUDY – Toronto Riveted Steel WM

CASE STUDY – Toronto Riveted Steel WM



CASE STUDY – Toronto Riveted Steel WM

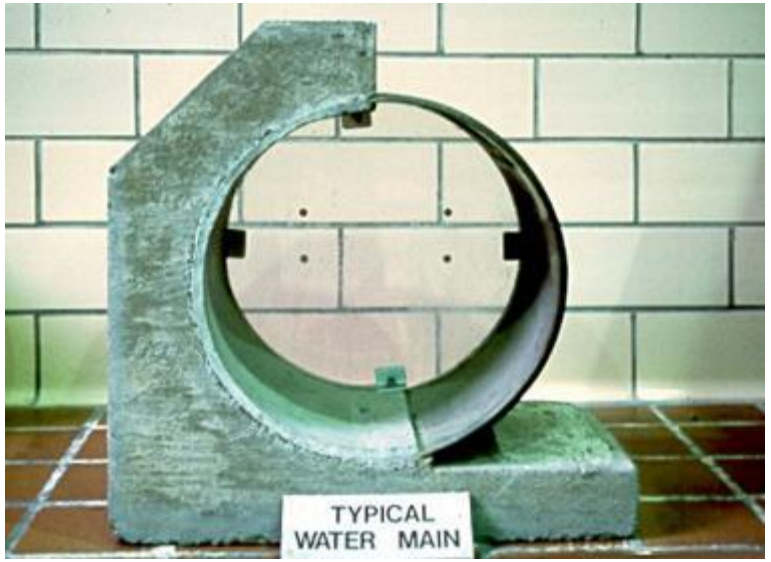
Main #	Length (m)	Diameter (mm; inch)	Year installed (age in 2017) Pipe material	Inspection date	Remaining life / next inspection at age (years)	Structural assessment (risk factor; (FS))	Concrete encasement compressive strength (MPa)	Coefficient of chloride diffusion (cm2/year)	Chloride content (initial; exposed face; %)
M29	6,985	1200 mm (48")	1936 (81) Riveted steel	April 2019 & Oct 2019	115 / 112	0.5 – 0.7; (FS: 2 – 1.43)	60.8	7×10^{-2}	0.0070; 0.0114
M29B	990	1350 mm (54")	1931 (86) Riveted steel	-	> 200 / 92	0.16 – 0.32; (FS: 6 – 3)	-	7.69×10^{-2}	-
M18	460	1050 mm (42")	1948 (69) Riveted steel	Oct. 2019	> 200 / 73	0.44 – 0.6; (FS: 2.3 – 1.67)	36.2	-	0.1225; 0.2551
M28	732	1125 mm (45")	1950 (67) Riveted steel	-	> 200 / 73	0.32 – 0.48; (FS: 3.1 – 2.1)	-	-	-
M7	4,938	900 mm (36")	1951 (66) Welded steel. & Pit cast iron	-	> 200 / 91	0.24 – 0.36; (FS: 4.1 – 2.8)	40.9 – 57.6	3.28×10^{-2} – 23.1×10^{-2}	0.0115 – 0.0709; 0.0672 – 0.2228

CASE STUDY – Toronto Riveted Steel WM

Summary

- City had limited information on the condition of this specific type of pipe in their system
- Desktop review provided theoretical analysis on pipe design and failure mechanisms
- Collection of data for actual pipe locations allowed us to refine the analysis and provide specific data
- CCTV provided the visual pictures to ease the client's mind

A Rolls Royce it is!!



CASE STUDY – New Tecumseth

Problem and Investigations

- Existing 400mm diameter (14”) HDPE DR 13.5 watermain
- Originally Installed via HDD in 2010
- Sink hole had developed near drain chamber (5 m deep)
- Pipeline deep under the river
- Watermain was drained and inspected
- Found a leaking joint in HDPE pipe (butt fusion welded)

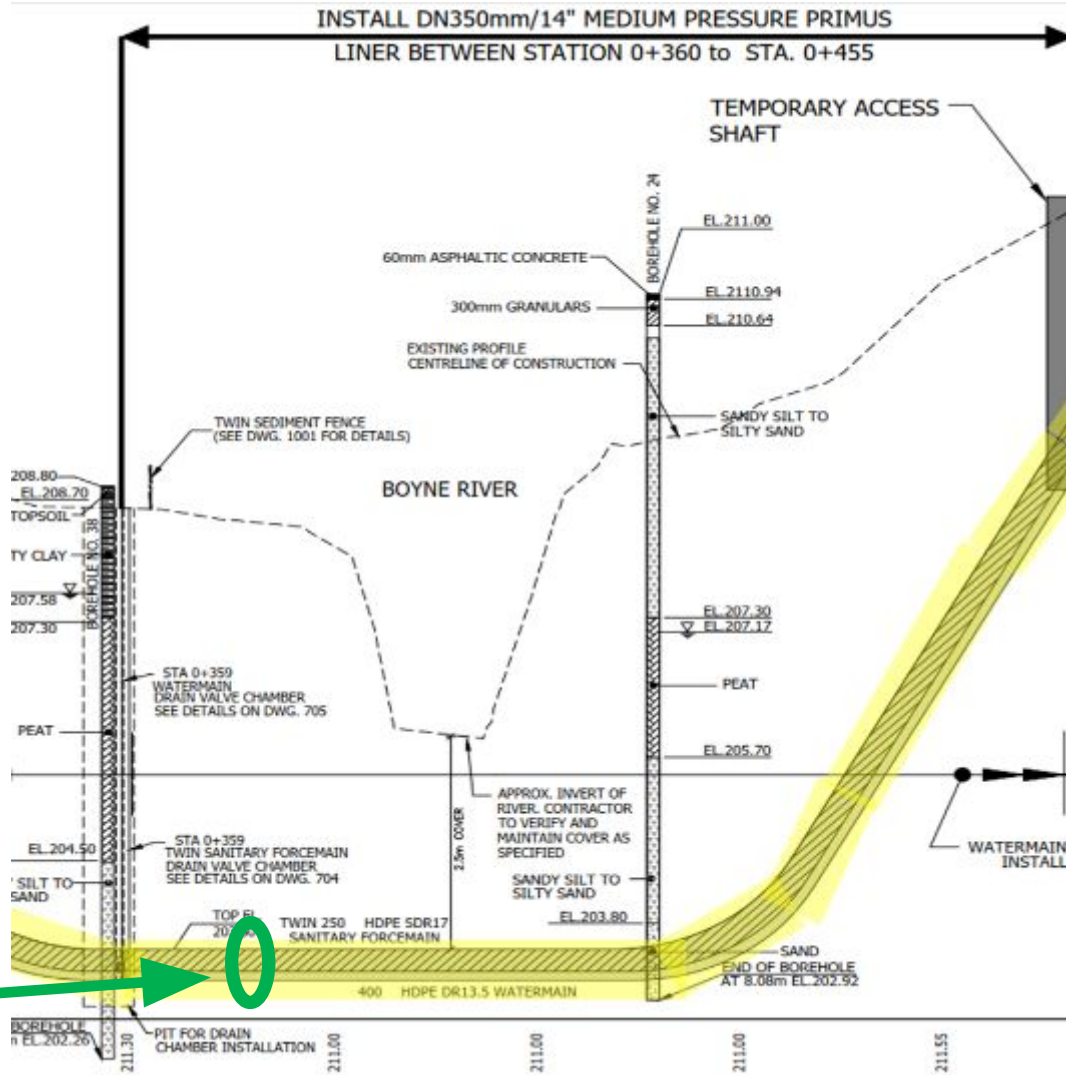
CASE STUDY – New Tecumseth

Alternatives and Preferred Solution

- Excavate at location of leak
- Replace pipe across the river (underground or on bridge)
- Installation of internal repair sleeve
- Line a section of the pipe

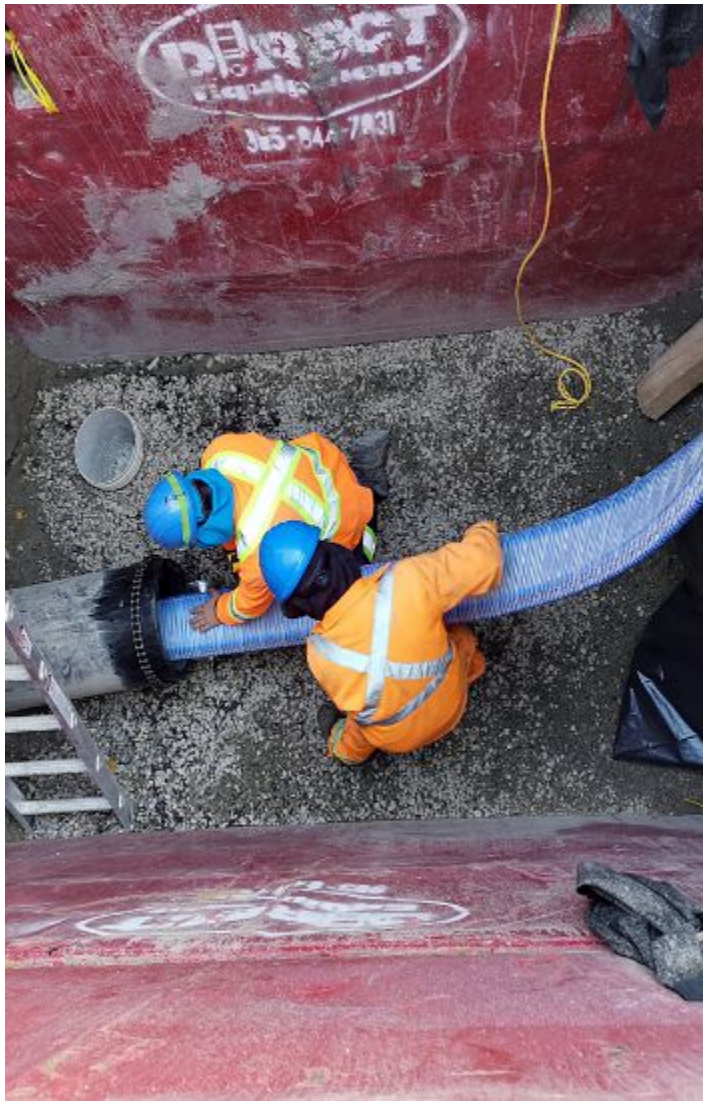
Install Primus Liner (350mm diameter) across the valley (95 metres) from drain chamber to temp access shaft

Approximate location of leak



CASE STUDY – New Tecumseth

CASE STUDY – New Tecumseth

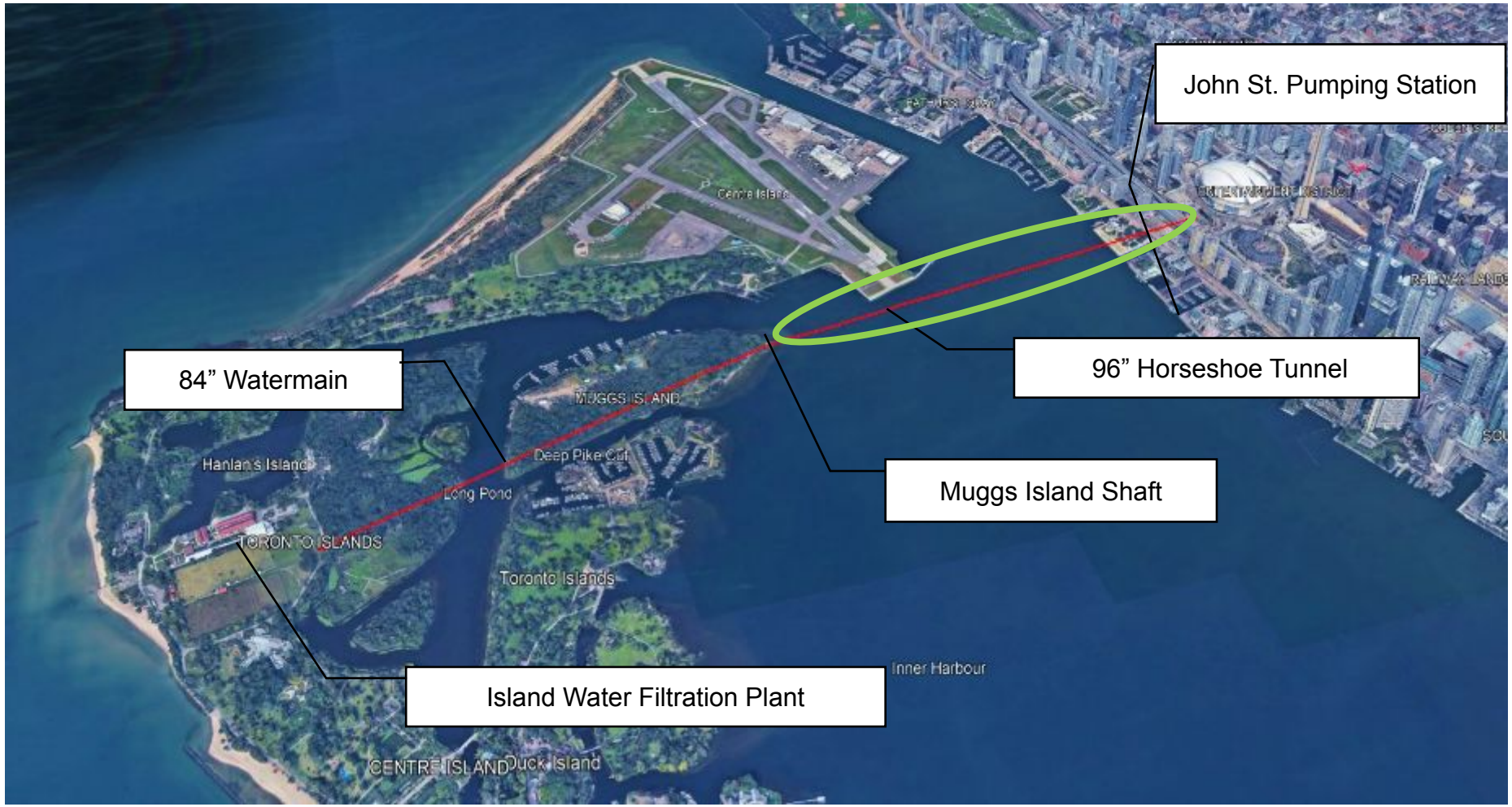


CASE STUDY – New Tecumseth

Summary

- Condition Assessment Inspection Tools needed to find the leak
- Since leak was not due to pipe failure, full replacement was not required
- Pipe relatively new, therefore structurally still adequate
- PrimusLine provided an economical, non-structural solution
- Installed from drain chamber to access shaft excavated where more accessible
- Leak detected in April 2020 and pipe back together in service in October 2020

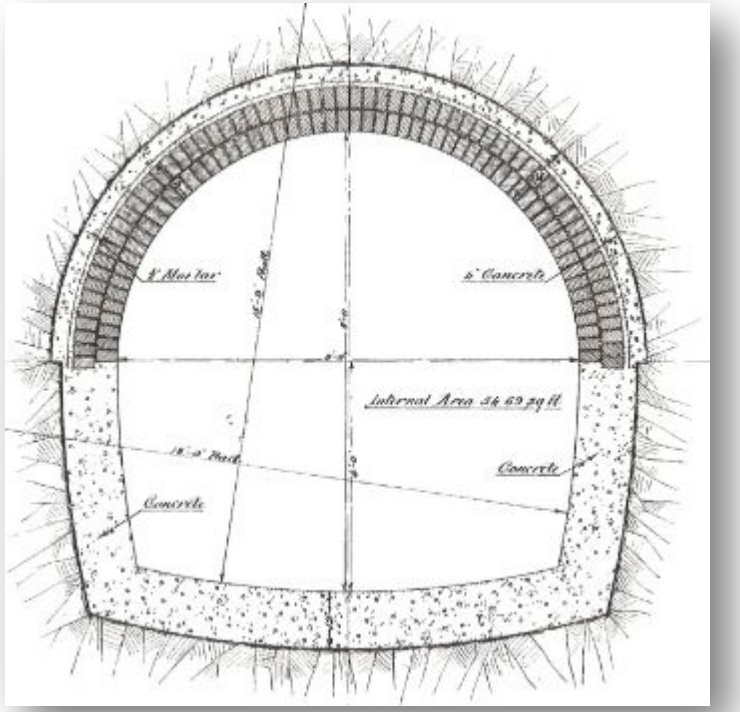
CASE STUDY – City of Toronto



CASE STUDY – City of Toronto

Pipeline History

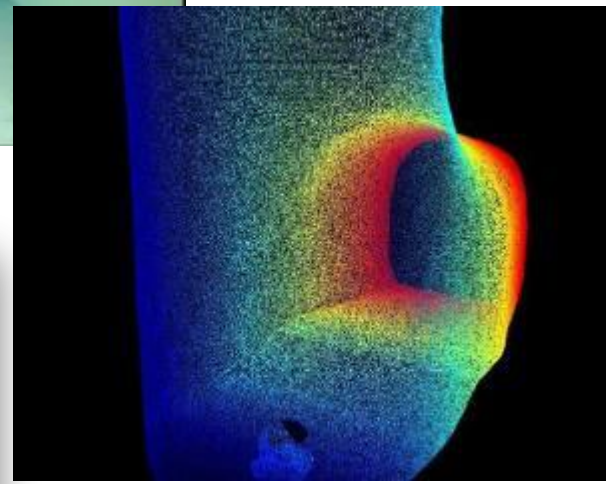
- Construction completed in 1906
- Dewatered and inspected in 1978 – measurements were smaller than on initial drawings
- ROV inspection completed in 2018 – showed sections failing and in immediate need of rehabilitation

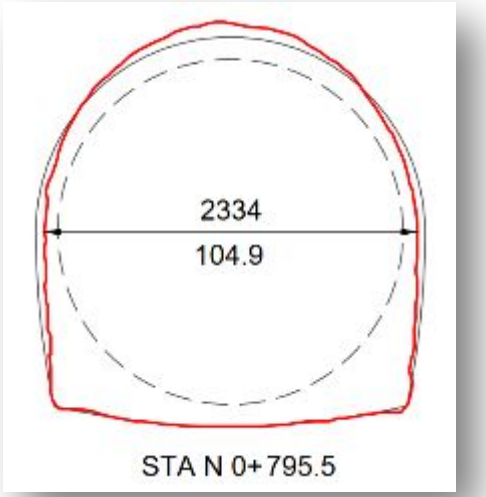


CASE STUDY – City of Toronto

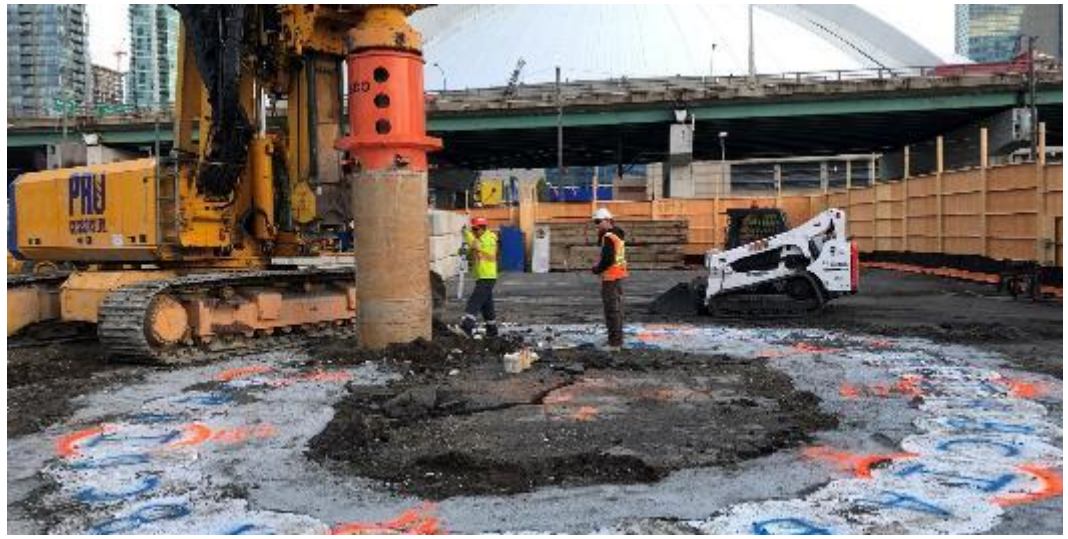
Rehabilitation Design

- ROV with 3D sonar survey
  - Established extent of deformation and precise tunnel profile
- Reviewed constructability challenges and options
  - Identified access shaft locations
- Reviewed hydraulics and transients
  - Confirm minimum new inner diameter
- Reviewed several options for new tunnel liner:
  - Hobas/FRP pipe
  - Shotcrete
  - Concrete pressure pipe
  - CIP concrete
  - Steel pipe with cement mortar lining - Preferred





CASE STUDY – City of Toronto



CASE STUDY – City of Toronto

CASE STUDY – City of Toronto

Summary

- Limited Condition Assessments completed on this critical main
- 2018 Inspection indicated it was failing badly and needed immediate rehabilitation
- Full Structural solution was required due to condition of tunnel
- Due to gravity nature of the pipe, hydraulics was very important
- Cement lined pipe sliplined into the horeshoe shaped watermain provided fastest, most economical solution
- Entirely completed during winter/low demand timeline

SUMMARY

- Knowing the condition of your Transmission Mains is critical to managing your water system
- Condition Assessment is a formal process that helps you understand the state of your infrastructure
- Consult AWWA M77
- Have a problem statement in mind
- Utilize the tools available to piece the jigsaw puzzle together
- Rehabilitate your mains based on the conditions found and analysis completed

QUESTIONS?

Stewart Dickson, P.Eng.
Associate Vice President and Principal
R.V. Anderson Associates Ltd.
sdickson@rvanderson.com