An overview of Canada’s water, wastewater and storm water sectors

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2013 Municipal Buried Infrastructure Survey

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Building Sustainable Buried Infrastructure for the Future

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About CATT

Established in 1994 at the University of Waterloo, the Centre for Advancement of Trenchless Technologies (CATT) helps municipalities to address their water and wastewater buried infrastructure challenges. Since its inception, CATT has achieved significant success and recognition as a leader in education and research related to trenchless technologies and water infrastructure asset management.

CATT offers high quality technical workshops and customized training on topics related to trenchless planning, design, construction, risk management, quality assurance and quality control. CATT has developed industry based research collaborations and has been successful in securing competitive research grants from national and international organizations that include NSERC (Natural Sciences and Engineering Research Council), Canada, OCE (Ontario Centres of Excellence), and Water Research Foundation, USA. Some of the current research initiatives include the development of: (1) an innovative rehabilitation technology for watermains; (2) watermains’ condition grading and rehabilitation/replacement optimization system; (3) next-generation tools for buried infrastructure asset management and infrastructure finance; and (4) testing and development of new lining products and design procedures for water and wastewater networks.

CATT always welcomes new members and actively seeks opportunities to contribute to the betterment of municipalities through education, research and technology transfer programs. To get involved in CATT and to get more information, please visit www.catt.ca.
The operation, management and renewal of water, wastewater, and storm water networks are issues of strategic importance and have strong environmental, economic and social implications. Canadian municipalities and water utilities are required to provide safe, secure and reliable water supply along with wastewater and storm collection services to domestic, industrial and institutional consumers. They are also subjected to ever increasing legislative and regulatory requirements to become financially self-sustainable and accountable. According to the RBC 2014 Canadian Water Attitudes Study, Canadians rank drinking water supply to be the third highest priority for government funding after hospitals and green energy.

The first Canadian Infrastructure Report Card 2012 (CIRC 2012) reports that the water, wastewater and storm water systems account for about 68% of the urban infrastructure owned by the Canadian municipalities (see Figure 1). The CIRC 2012 estimates the total replacement cost of drinking water systems to be $68.6 billion out of which water distribution and transmission pipelines account for 73% of the replacement value (see Figure 2). The replacement value for the wastewater collection system is estimated to be $70 billion out of which pipelines account for about 79% of the replacement value (see Figure 3).

To assess market conditions related to construction, renewal, and financing of water, wastewater and storm water pipelines, the Centre for Advancement of Trenchless Technologies (CATT) conducted the first Canadian Municipal Infrastructure Survey from February through May 2013. In total, 124 municipalities from Alberta, British Columbia, Manitoba, New Brunswick, Nova Scotia, and Ontario voluntarily participated in the survey. This document provides a broad-based aggregated summary and analysis of the survey results. Responses are also analyzed by categorizing the respondents into small (population less than 50,000), medium (population from 50,000 to 300,000), and large (population greater than 300,000) municipalities. Aggregated results are also presented except when marked differences in responses from small, medium and large municipalities occur.

The respondents attributed increased number of failures (i.e. pipelines’ collapses, watermain breaks, sewer overflows, flooding of streets and properties, and contamination of underground and surface waters) to pipe age as well as declined investments in the renovation of existing buried infrastructure. In case of watermains, 70% of the respondents considered reducing leakage and breaks and improving water quality as critical or very critical issues. For wastewater systems, 75% of the respondents reported inflow/infiltration as a critical or very critical issue. Other major issues facing wastewater systems, reported by 40% of the respondents, include pipe surcharging, pipe collapses, and flow capacity. For storm water systems, about 50% of the respondents considered flow capacity, surcharging, pipe collapses and inflow/infiltration as a critical or very critical issue. These findings are in line with the RBC Canadian Water Attitudes
where the respondents considered water pollution, safety and state of water supply systems as the greatest water issues. Furthermore, the RBC 2014 report categorized water pricing, treatment costs, deteriorating water and sewage infrastructure, and emergency preparedness as serious issues.

The majority of survey respondents (about 80%) expect an increase in government grants to address buried infrastructure operation, management and renewal challenges. Given the enormous size of the infrastructure deficit across Canada, governments’ current financial deficits, economic uncertainty, and federal and provincial governments downloading of services, it is highly unlikely that governments will provide additional grants to address infrastructure deficit. The 17th Annual Municipal Survey (http://www.undergroundconstructionmagazine.com/17th-annual-municipal-survey), conducted by the Underground Technology (UCT) magazine in the USA, also reported serious challenges and concerns in raising additional funds from the federal and state governments.

About 71% of the respondents considered trenchless technologies to be cost-effective and efficient methods for installation and rehabilitation of deep pipelines and pipelines crossing roads, railway tracks, rivers, and other inaccessible and environmentally sensitive areas. In the USA, according to UCT, 52.7% of the time respondents preferred trenchless solutions compared to 24.3% for open-cut. However, as expected, open-cut is still reported to be the predominant method of pipelines’ rehabilitation and installation both in Canada and the USA. This means there is still lots of room for growth in the use and adoption of trenchless rehabilitation and construction methods. Some of the major issues hindering the trenchless industry include the availability of contractors and lack of knowledgeable consultants. In fact, only 11% of the respondents reported to be “very satisfied” with their consultants’ performance. About 25% of the respondents were “very satisfied” with contractors’ performance. Survey respondents also recognized the need for better training and education of their staff but allocated little funds for this purpose. Thus, there is a need for education and training programs to advance the trenchless industry.

The respondents considered new legislative and regulatory requirements to be effective tools for better operation and management of buried infrastructure systems. Despite the proven benefits of over 20 years of trenchless technology use, it still remains the most under rated and under used tool for pipeline condition assessment, rehabilitation and installation of new pipelines. Through good engineering and design, trenchless technologies are proven to save up to 40% of cost as compared to open-cut while reducing up to 100% greenhouse gas emissions. They also cause significantly less disturbance to the public. This is a triple win – a win for the rate payers, a win for the public, and a win for the environment. Better education of consulting engineers, increased contractors’ availability, and the development of bigger programs and changing regulations will increase the number of trenchless projects.
Key Findings

Critical Issues

Watermains
70% of the respondents reported reducing leakage and breaks, and improving water quality as critical or very critical.

Wastewater Pipelines
75% of the respondents categorized inflow/infiltration as a critical or very critical issue. About 40% reported surcharging, pipe collapses and flow capacity issues as critical or very critical.

Storm Water Pipelines
About 50% of the respondents reported flow capacity, surcharging, pipe collapses, and inflow/infiltration as the critical or very critical issues.

Addressing Critical Issues

Rate Increase
70% of the respondents consider that rate increase is important or very important.

Government Grants
An overwhelming 80% of the respondents consider access to government grants as critical or very critical.

Long-term Financing
50% of the respondents find long-term financing to be useful or very useful.

Education
52% of the participants consider public education to be important or very important.

Public-Private Partnerships
21% of the respondents think public-private partnerships to be useful or very useful.

Government Regulations
60% consider regulatory requirements to be useful or very useful.

Asset Management

Small Municipalities (population <50,000)
About half of the responding organizations do not have a separate asset management group.

Medium (population 50,000 to 300,000) and Large (population > 300,000) Municipalities
About 80% of the responding municipalities have separate asset management group.

Staff Training
About 50% of respondents consider staff training to be very important. However, 40% of the respondents reported a training budget of less than $5,000.

Reliance on government funding solely will not help the municipalities to address buried infrastructure issues.

Asset management is becoming more prevalent in medium and large municipalities with 80% of the respondents reported to have separate asset management group in their organizations.

80% of the respondents consider staff training to be important or very important but do not allocate adequate budget.
Key Findings (cont’d)

Trenchless Technologies

Cost Effectiveness
71% of the respondents reported trenchless construction to be cost effective or very cost effective.

Deep Pipelines
67% of the respondents found trenchless construction to be useful or very useful for deep pipelines.

Urban Congestion
67% of the respondents categorized trenchless methods to be useful or very useful in congested urban settings.

Environment:
73% of the respondents consider trenchless construction to be useful or very useful in environmentally sensitive areas.

Barriers to the Use of Trenchless Technologies

Contractors’ Availability
62% of the respondents reported the lack of contractors’ availability as the major hindrance for specifying trenchless renovation/construction methods.

Consultants’ Lack of Knowledge
52% of the respondents reported consultants lack of knowledge as a major issue.

Cost
68% of the respondents consider cost as barrier to the use of trenchless technologies.

Contractors’ Performance

Open-cut
89% of the respondents reported that they were satisfied or very satisfied.

Trenchless
75% of the respondents reported to be satisfied or very satisfied.

Project Management
47% of the respondents were in the satisfied or very satisfied category.

Innovation
45% of the respondents were satisfied or very satisfied with innovative designs and solutions.

Consultants’ Performance

Open-cut
71% of the respondents were satisfied or very satisfied with the consultants performance.

Trenchless
48% of the respondents were satisfied or very satisfied with the consultants’ performance.

Project Management
46% of the respondents were in the satisfied or very satisfied category.

Innovation
38% of the respondents were satisfied or very satisfied with innovative designs and solutions.

Lack of information and knowledge on part of city engineers and council is also a hindrance to the adoption of trenchless and other innovative technologies.”

Level of satisfaction with consultants’ performance was higher in case of open-cut construction as compared to trenchless methods.

Trenchless technologies are useful and cost-effective in case of deep installations, congested and environmentally sensitive inaccessible areas.
Survey Participants

In total, 124 municipalities from Alberta, British Columbia, Manitoba, New Brunswick, Nova Scotia, and Ontario participated in the survey. About 90% of the respondents were from Ontario. 57% of the respondents were from municipalities with population less than 50,000.

Based on the population, the responding municipalities were categorized into the following three categories:
Small: Population < 50,000
Medium: Population 50,000 to 300,000
Large: Population > 300,000

Note: The Appendix provides the charts where there are marked differences in the responses from small, medium and large municipalities.
Watermains

Average Age
21% of the watermains are older than 50 years at the responding municipalities. For small and medium size municipalities this percentage is about 32% whereas for large size municipalities about 18% are older than 50 years. About 58% of the networks at the responding municipalities are 30-50 years old whereas for large size municipalities this percentage is about 70%.

Budget for Capital Works
Majority of the small municipalities (about 60% of the respondents) allocated less than $500,000 for capital works. For medium size municipalities, majority of the respondents (about 47%) reported budget allocation between $2-$4 million for watermain capital works. About 60% of the respondents from large municipalities have budget allocation of $4-$6 million.

Water Networks’ Issues
About 70% of the respondents categorized improving water quality, ensuring pipe integrity, and reducing leaks and breaks as critical or very critical issues.

Primary Construction Methods
Over 93% of the respondents report open-cut renovation/construction for watermain followed by directional drilling (35% respondents) and CIPP (29% respondents).
Watermains (cont’d)

Renovation/Construction using Trenchless and Open-cut

Open-cut is the predominant method for watermain renovation/construction work. 66% of the respondents carried out less than 0.5 Km of renovation/construction using trenchless methods, whereas 9% of the respondents used trenchless technologies for 3-4 Km of watermains’ renovation/construction work.

Trenchless Methods in Practice and Benefits

Use: 36% of the respondents used CIPP, followed by horizontal directional drilling (27%) and sliplining (15%). Cement mortar and spray-on methods were used by 12% and 7% of the respondents, respectively.

Benefits: Amongst the various trenchless methods, about 65% of the respondents found horizontal directional drilling to be beneficial or very beneficial. For CIPP and Tunneling, about 45% and 33% of the respondents found them beneficial or very beneficial.
Wastewater Collection Networks

Average Age
24% of the wastewater collection pipelines are older than 50 years at the participating municipalities. For large municipalities this percentage is about 29%. The majority of the networks are in the 30-50 years category.

Budget for Capital Works
47% of the responding municipalities reported a budget allocation of less than $500,000 for capital works. This percentage is higher (65%) for small municipalities. 50% of the respondents from large municipalities reported a budget of $4-$6 million for capital works.

Wastewater Networks’ Issues
85% of the respondents categorized infiltration as critical or very critical issue followed by inflow (76% respondents), flow capacity (48%) and roots intrusion (47%).

Primary Construction Methods
Open cut is the most prevalent renovation/construction method reported by over 80% of the respondents followed by CIPP (47% respondents), and directional drilling (23% respondents).
Renovation/Construction using Trenchless and Open-cut
66% of the respondents carried out less than 0.5 Km of renovation/construction using trenchless methods, whereas 9% of the respondents used trenchless technologies for 3-4 Km of wastewater pipelines' renovation/construction.

Trenchless Methods in Practice and Benefits
Use: Cured-in-place-pipe (CIPP) is the most widely used trenchless method reported by 36% of the respondents followed by directional drilling (27% respondents), tunneling and sliplining (15% respondents), and grout-in-place-pipe (8% respondents).

Benefits: Amongst the various trenchless methods, about 64% of the respondents found CIPP to be beneficial or very beneficial followed by directional drilling (53% respondents), sliplining (34% respondents) and tunneling (33% respondents).
Storm Water Collection Networks

Average Age
About 70% of the storm water collection pipelines are in the 30-50 years age range whereas about 13% of the pipelines are older than 50 years. Large municipalities reported less than 10% of their storm water network in “<30 years” category.

Budget for Capital Works
56% of the respondents allocated less than $500,000 for capital works. This percentage is higher (i.e., about 85%) for small municipalities. About 46% of the respondents from large municipalities reported an allocation of $4-$6 million for storm water pipelines’ renovation/construction. In comparison, only 2% respondents from small municipalities and 13% from large municipalities budgeted $4-$6 million for renovation/construction. It is to note that some large municipalities budgeted $6-$20 millions for capital works.

Storm Water Network Issues
64% of the respondents categorized flow capacity as critical or very critical issue followed by surcharging (55% respondents), pipe collapse (53% respondents), and infiltration (52% respondents).

Primary Construction Methods
Open cut is the dominant renovation/construction method reported by 59% of the respondents.

Flow capacity, surcharging, pipe collapses and infiltration have been reported as critical or very critical issues.

Open cut is the predominant renovation/construction method followed by CIPP and directional drilling.
Renovation/Construction using Trenchless and Open-cut

Open-cut is the predominant method for storm water pipelines’ renovation/construction. 78% of the respondents carried out less than 0.5 Km of renovation/construction using trenchless methods, whereas 3% of the respondents used trenchless technologies for 3-4 Km of storm water pipelines’ renovation/construction. One of the respondents reported 10-20 Km of CIPP rehabilitation and 0.5-1 Km of replacement using open-cut.

Trenchless Methods in Practice and Benefits

Use: 34% of the respondents used cured-in-place-pipe (CIPP) followed by horizontal directional drilling (HDD) (26%) and tunneling (21%). Sliplining and grout-in-place methods were used by 13% and 6% of the respondents, respectively.

Benefits: Amongst the various trenchless methods, about 43% of the respondents found CIPP to be beneficial or very beneficial. 39% of the respondents found HDD beneficial or very beneficial.
Survey Participants

In what province or territory are you located?

Small Municipalities
- Ontario, 97.0%
- British Columbia, 1.5%
- Alberta, 1.5%

Medium Municipalities
- Ontario, 77.3%
- British Columbia, 4.5%
- New Brunswick, 4.5%
- Nova Scotia, 4.5%
- Alberta, 2.6%

Large Municipalities
- Ontario, 88.6%
- British Columbia, 3.8%
- Manitoba, 3.8%
- New Brunswick, 0.9%
- Nova Scotia, 0.9%

All Municipalities
- Ontario, 90.6%
Pipelines’ Age

What is the average age of watermains, wastewater, and storm water pipes in your jurisdiction?
What are the lengths of the watermains, wastewater, and storm water pipes in your jurisdiction?
Pipelines’ Diameter

What is the approximate percentage of pipe diameters in your network?

Watermains

Wastewater Collection Pipes

Storm Water Collection Pipes
Open-cut vs. Trenchless

What total length of watermains was replaced/renovated in your network, using open-cut or trenchless methods?
Open-cut vs. Trenchless

What total length of wastewater pipes was replaced/renovated in your network, using open-cut or trenchless methods?
Open-cut vs. Trenchless

What total length of storm water pipes was replaced/renovated in your network, using open-cut or trenchless methods?
Benefits of Trenchless Technologies

How beneficial are the following trenchless methods in watermain construction/renovation?
Benefits of Trenchless Technologies

How beneficial are the following trenchless methods in wastewater pipe construction/renovation?
Benefits of Trenchless Technologies

How beneficial are the following trenchless methods in storm water pipe construction/renovation?
Critical Issues

What are the critical issues in watermain networks?
Critical Issues

What are the critical issues in wastewater pipe networks?
Critical Issues

What are the critical issues in storm water pipe networks?

[Charts showing percentage of responses for different issues in small, medium, large, and all municipalities, with categories such as infiltration, inflows, encrustation, surcharging, pipe collapse, flow capacity, roots, and other.]
Construction/Renovation Markets

In what pipe networks are the following methods used most often?

**Watermain Construction/Renovation**

- **Small Municipalities**
  - Open Cut: 57.8%
  - Directional Drilling: 4.7%
  - Trenchless: 11.3%
  - Cut in Place Pipe: 3.0%
  - Grout in Place Pipe: 3.3%

- **Medium Municipalities**
  - Open Cut: 36.4%
  - Directional Drilling: 18.2%
  - Trenchless: 18.3%
  - Cut in Place Pipe: 0.1%
  - Grout in Place Pipe: 9.2%

- **Large Municipalities**
  - Open Cut: 24.0%
  - Directional Drilling: 18.3%
  - Trenchless: 18.3%
  - Cut in Place Pipe: 3.0%
  - Grout in Place Pipe: 9.2%

- **All Municipalities**
  - Open Cut: 53.8%
  - Directional Drilling: 22.6%
  - Trenchless: 11.3%
  - Cut in Place Pipe: 7.5%
  - Grout in Place Pipe: 6.0%

**Wastewater Construction/Renovation**

- **Small Municipalities**
  - Open Cut: 21.9%
  - Directional Drilling: 4.7%
  - Trenchless: 7.6%
  - Cut in Place Pipe: 21.9%
  - Grout in Place Pipe: 4.7%

- **Medium Municipalities**
  - Open Cut: 16.7%
  - Directional Drilling: 30.0%
  - Trenchless: 10.0%
  - Cut in Place Pipe: 4.5%
  - Grout in Place Pipe: 3.3%

- **Large Municipalities**
  - Open Cut: 29.5%
  - Directional Drilling: 18.3%
  - Trenchless: 6.8%
  - Cut in Place Pipe: 4.5%
  - Grout in Place Pipe: 4.5%

- **All Municipalities**
  - Open Cut: 47.7%
  - Directional Drilling: 21.9%
  - Trenchless: 11.3%
  - Cut in Place Pipe: 5.8%
  - Grout in Place Pipe: 4.5%

**Stormwater Construction/Renovation**

- **Small Municipalities**
  - Open Cut: 72.5%
  - Directional Drilling: 0.0%
  - Trenchless: 7.8%
  - Cut in Place Pipe: 12.7%
  - Grout in Place Pipe: 13.9%

- **Medium Municipalities**
  - Open Cut: 54.5%
  - Directional Drilling: 18.2%
  - Trenchless: 9.1%
  - Cut in Place Pipe: 9.1%
  - Grout in Place Pipe: 9.1%

- **Large Municipalities**
  - Open Cut: 42.4%
  - Directional Drilling: 12.2%
  - Trenchless: 12.2%
  - Cut in Place Pipe: 8.1%
  - Grout in Place Pipe: 0.0%

- **All Municipalities**
  - Open Cut: 59.5%
  - Directional Drilling: 12.1%
  - Trenchless: 12.1%
  - Cut in Place Pipe: 8.1%
  - Grout in Place Pipe: 2.0%
Trenchless Technology Market

In what pipe networks are the following trenchless methods used most often?

Watermain Construction/Renovation

Wastewater Construction/Renovation

Stormwater Construction/Renovation
General Perception

What are the barriers to using trenchless methods in your pipe networks?

In what areas do you expect consultants to help you?
General Perception

What are the critical issues that need to be addressed to reduce backlog within your network?
General Perception

How useful are trenchless technologies from the following perspectives?

![Bar charts for Small, Medium, Large Municipalities, and All Municipalities showing the percentage of responses (0-100) for cost effectiveness, depth of pipeline, urban congestion, and environment. The charts indicate varying levels of usefulness across different perspectives.]
Consultants’ Performance

How satisfied are you with consultants’ performance?

- **Small Municipalities**
  - Open cut: Very satisfied 15%, Very unsatisfied 55%
  - Trenchless: Very satisfied 5%, Very unsatisfied 40%
  - Project management: Very satisfied 5%, Very unsatisfied 35%
  - Innovative design/solutions: Very satisfied 0%, Very unsatisfied 5%

- **Medium Municipalities**
  - Open cut: Very satisfied 15%, Very unsatisfied 55%
  - Trenchless: Very satisfied 5%, Very unsatisfied 40%
  - Project management: Very satisfied 5%, Very unsatisfied 35%
  - Innovative design/solutions: Very satisfied 0%, Very unsatisfied 5%

- **Large Municipalities**
  - Open cut: Very satisfied 15%, Very unsatisfied 55%
  - Trenchless: Very satisfied 5%, Very unsatisfied 40%
  - Project management: Very satisfied 5%, Very unsatisfied 35%
  - Innovative design/solutions: Very satisfied 0%, Very unsatisfied 5%

- **All Municipalities**
  - Open cut: Very satisfied 15%, Very unsatisfied 55%
  - Trenchless: Very satisfied 5%, Very unsatisfied 40%
  - Project management: Very satisfied 5%, Very unsatisfied 35%
  - Innovative design/solutions: Very satisfied 0%, Very unsatisfied 5%
Contractors’ Performance

How satisfied are you with contractors’ performance?

**Small Municipalities**

- Open cut: 33% very satisfied, 5% unsatisfied
- Trenchless: 72% very satisfied, 8% unsatisfied
- Project management: 30% very satisfied, 8% unsatisfied
- Innovative design/solutions: 22% very satisfied, 10% unsatisfied

**Medium Municipalities**

- Open cut: 22% very satisfied, 2% unsatisfied
- Trenchless: 23% very satisfied, 8% unsatisfied
- Project management: 33% very satisfied, 9% unsatisfied
- Innovative design/solutions: 15% very satisfied, 3% unsatisfied

**Large Municipalities**

- Open cut: 21% very satisfied, 1% unsatisfied
- Trenchless: 24% very satisfied, 9% unsatisfied
- Project management: 15% very satisfied, 5% unsatisfied
- Innovative design/solutions: 15% very satisfied, 5% unsatisfied

**All Municipalities**

- Open cut: 12% very satisfied, 1% unsatisfied
- Trenchless: 24% very satisfied, 5% unsatisfied
- Project management: 13% very satisfied, 4% unsatisfied
- Innovative design/solutions: 23% very satisfied, 4% unsatisfied