



# SOURCE TO STREAM

## 2023 Conference

Canada's Premier  
Stormwater and Erosion  
and Sediment Control  
Conference

*Thank you to our sponsors!*

### EXECUTIVE SPONSORS



Canadian Society for  
Civil Engineering



Société canadienne  
de génie civil



### OPPORTUNITIES SPONSOR



### MEDIA SPONSORS



### HOSTS

Presented by:



In association with:



# Improving conditions for Street Trees: Challenges, Opportunities and New City of Toronto Standards



Source to Stream Conference  
March 23, 2023

Presenters:

Diane Leal  
Forest Policy & Planning  
Urban Forestry

Abe Mouaket  
Operational Policy and Innovation  
Transportation Services

Kristina Hausmanis  
Asset Management, Green Streets  
Transportation Services

# Policy Drivers Leadership



*...to develop "green infrastructure" standards for the public right-of-way for implementation in Transportation Services and Toronto Water capital projects...*

Council Direction  
October 2013, (PW25.7)

October 2 and 3, 2019: City Council declared a **climate emergency** for the purpose of naming, framing, and deepening our commitment to protecting our economy, our ecosystems and our community from climate change.

# Importance of Street Trees and Green Streets

## 2018 Canopy Study



# Importance of Street Trees

## 2018 Canopy Study



**5.4%**  
of Toronto's  
TOTAL TREE POPULATION



**173,355 Tonnes**  
GROSS CARBON STORAGE  
Associated Value of \$19.882 Million  
15.8% of total carbon stored



**2,877.9 Tonnes**  
ANNUAL CARBON SEQUESTRATION  
Associated Value of \$330,750  
8% of annual carbon sequestration



**331,745 m<sup>3</sup>**  
ANNUAL AVOIDED RUNOFF  
Associated Value of \$771,300  
16% of total avoided runoff volume

# Importance of Street Trees

## Challenges

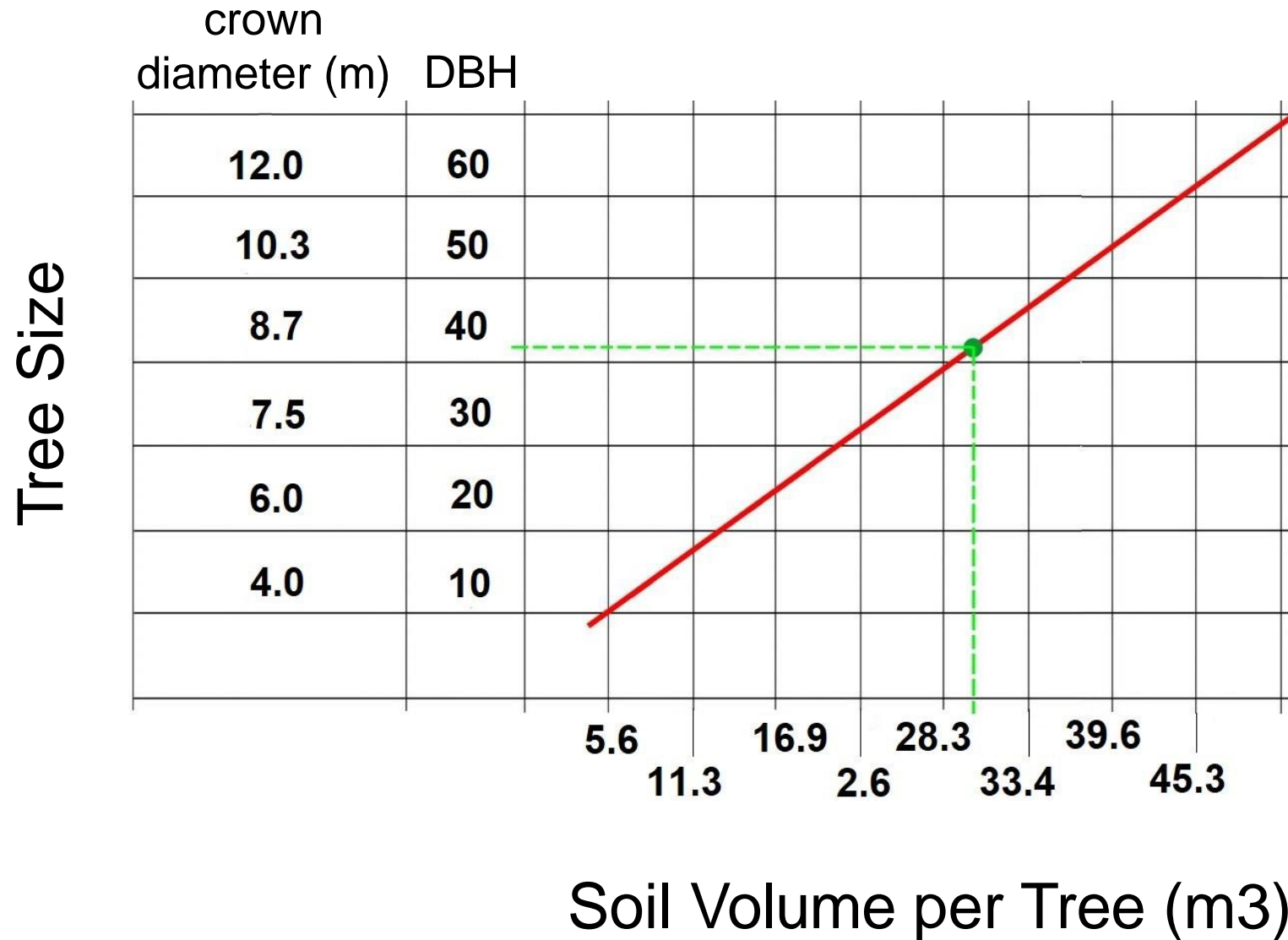


# Importance of Street Trees



# Boulevard Growing Conditions

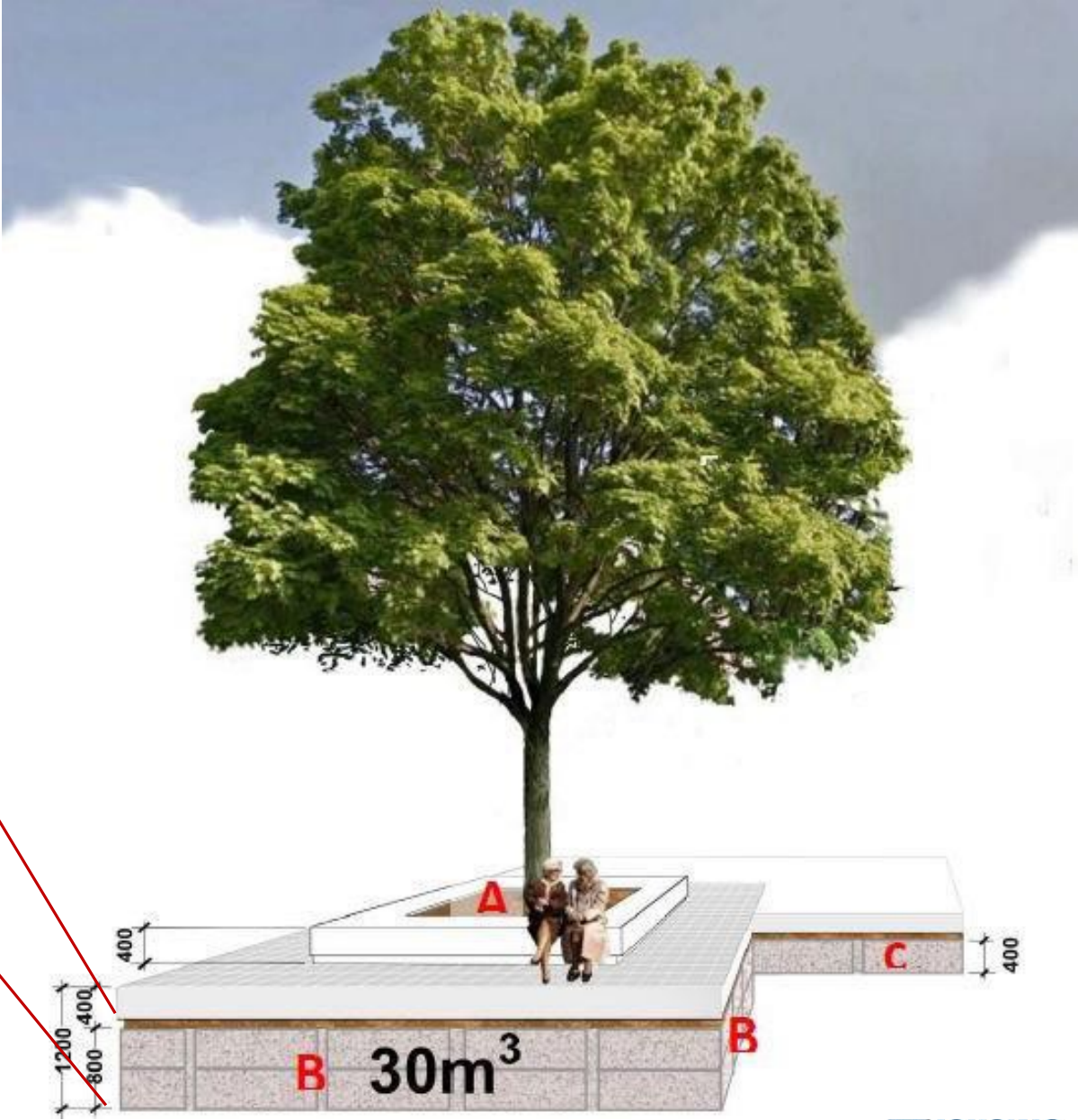
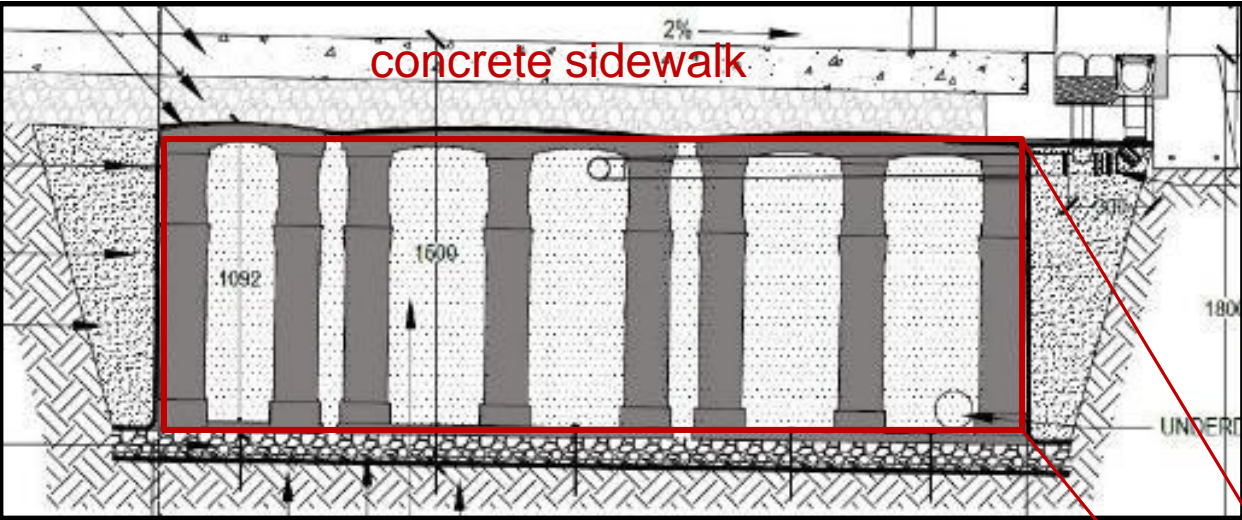
## Soil Volume





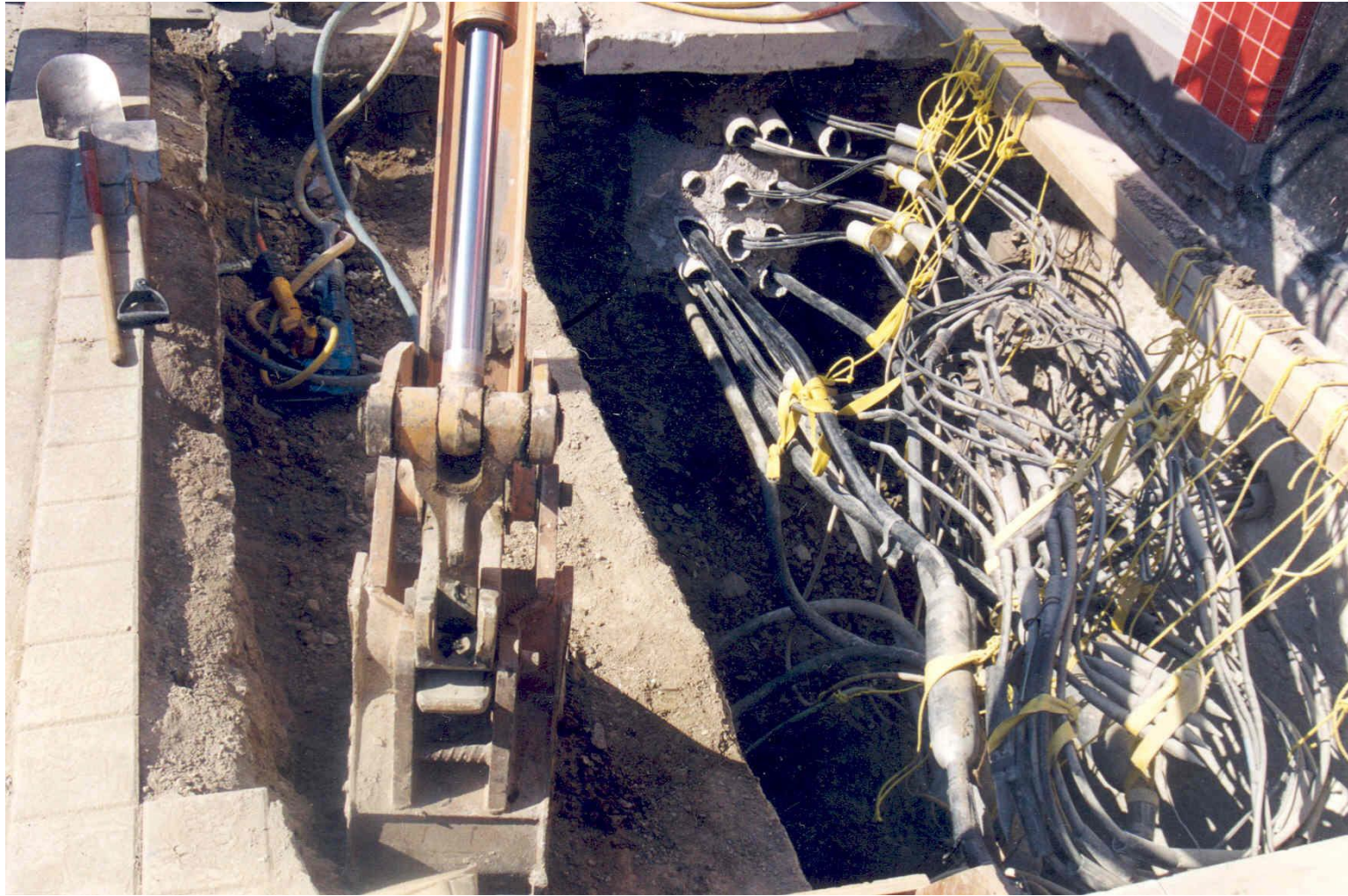
# Soil Volume

## Making space for Soil



# Utilities

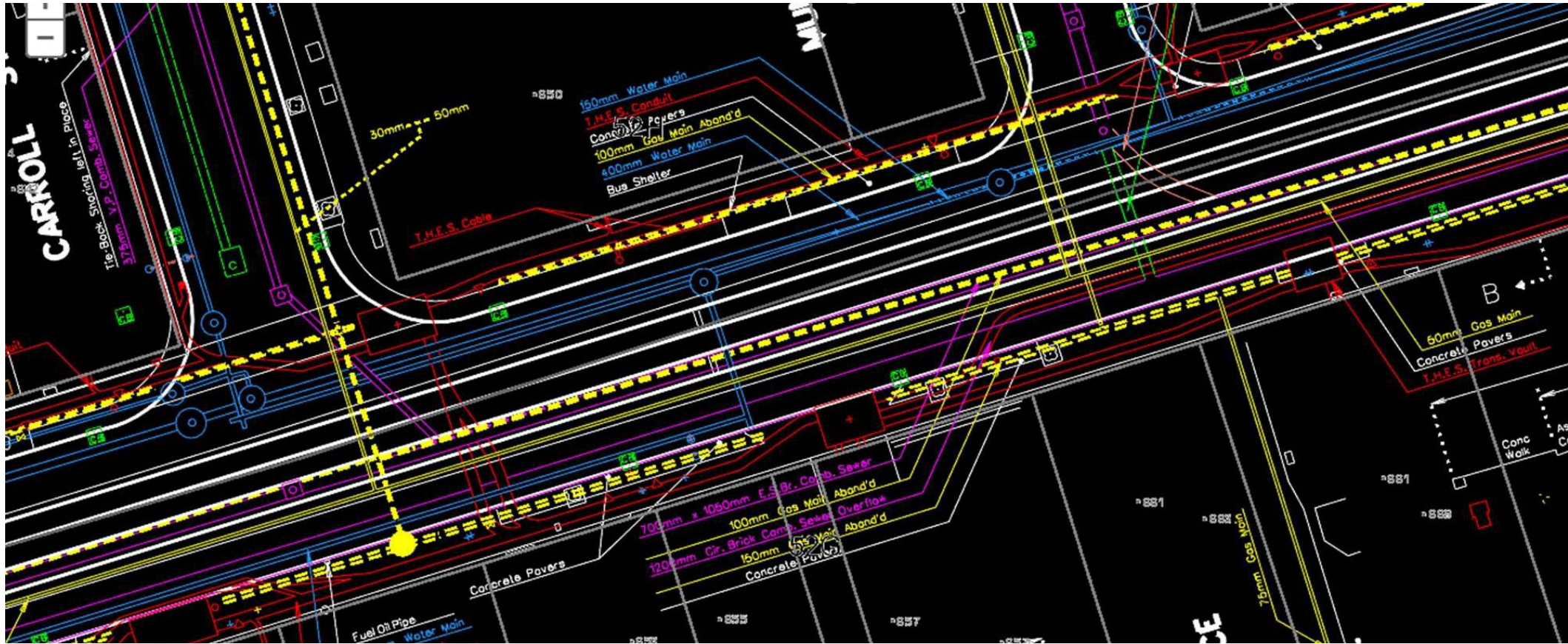
## Making space for Soil



Bloor St. W., near Bathurst St., Toronto

# Collaboration is the Key

## Changing Development Requirements



Excerpt from a Public Utilities Plan. Utility data quality and data unknown.

# Collaboration is the Key

## Changing Development Requirements



Dundas St. W., Toronto - present



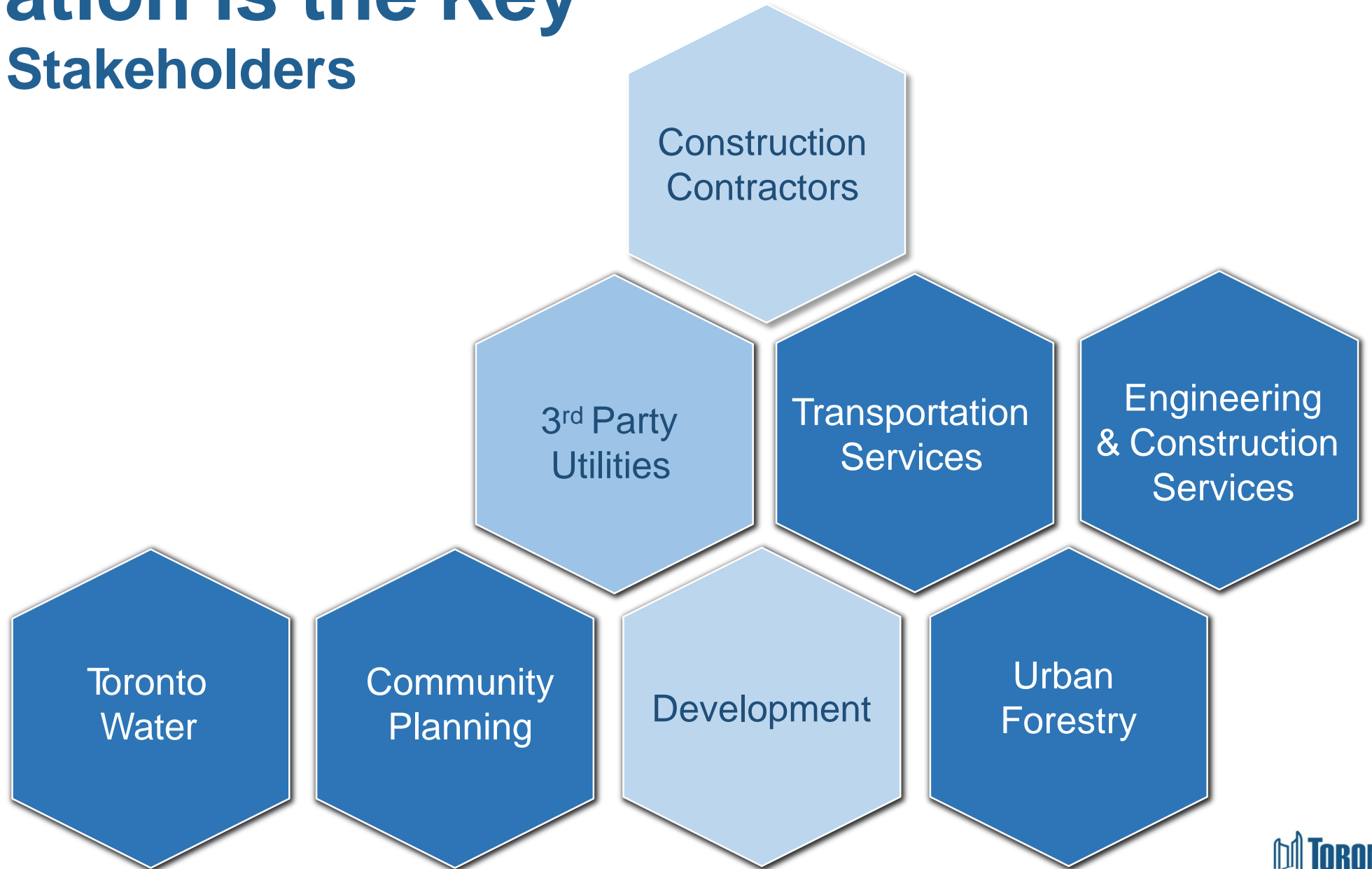
Dundas St. W., Toronto - 2009



King St. W.

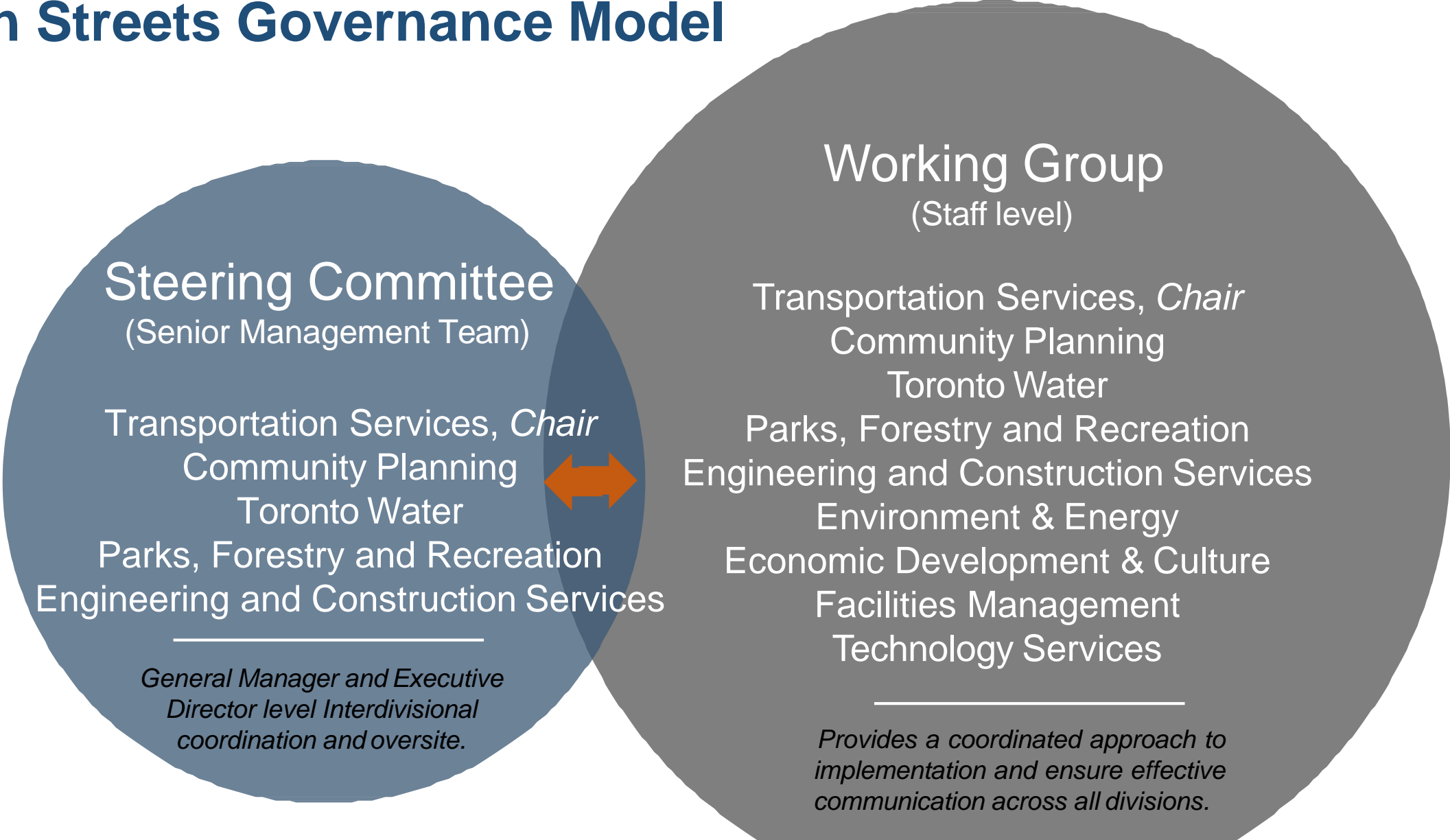
# Collaboration is the Key

## Many ROW Stakeholders



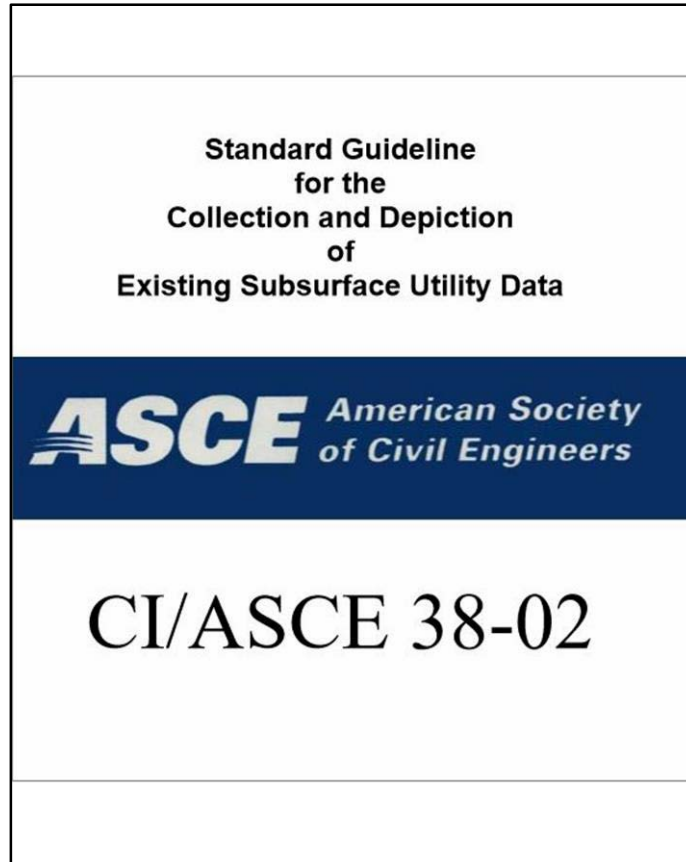
# Collaboration is the Key

## Green Streets Governance Model



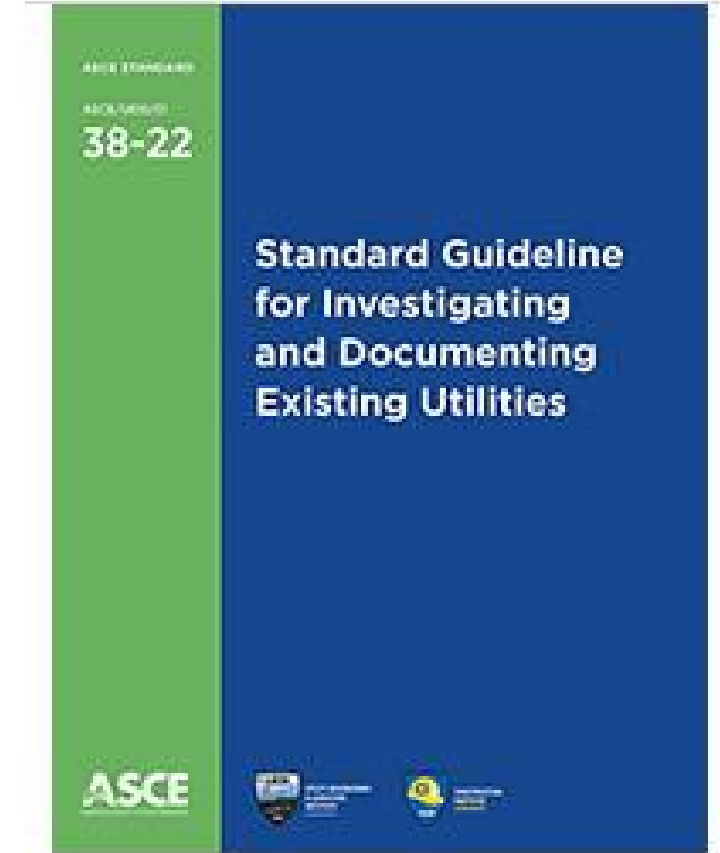
# Collaboration is the Key

## Changing Development Requirements



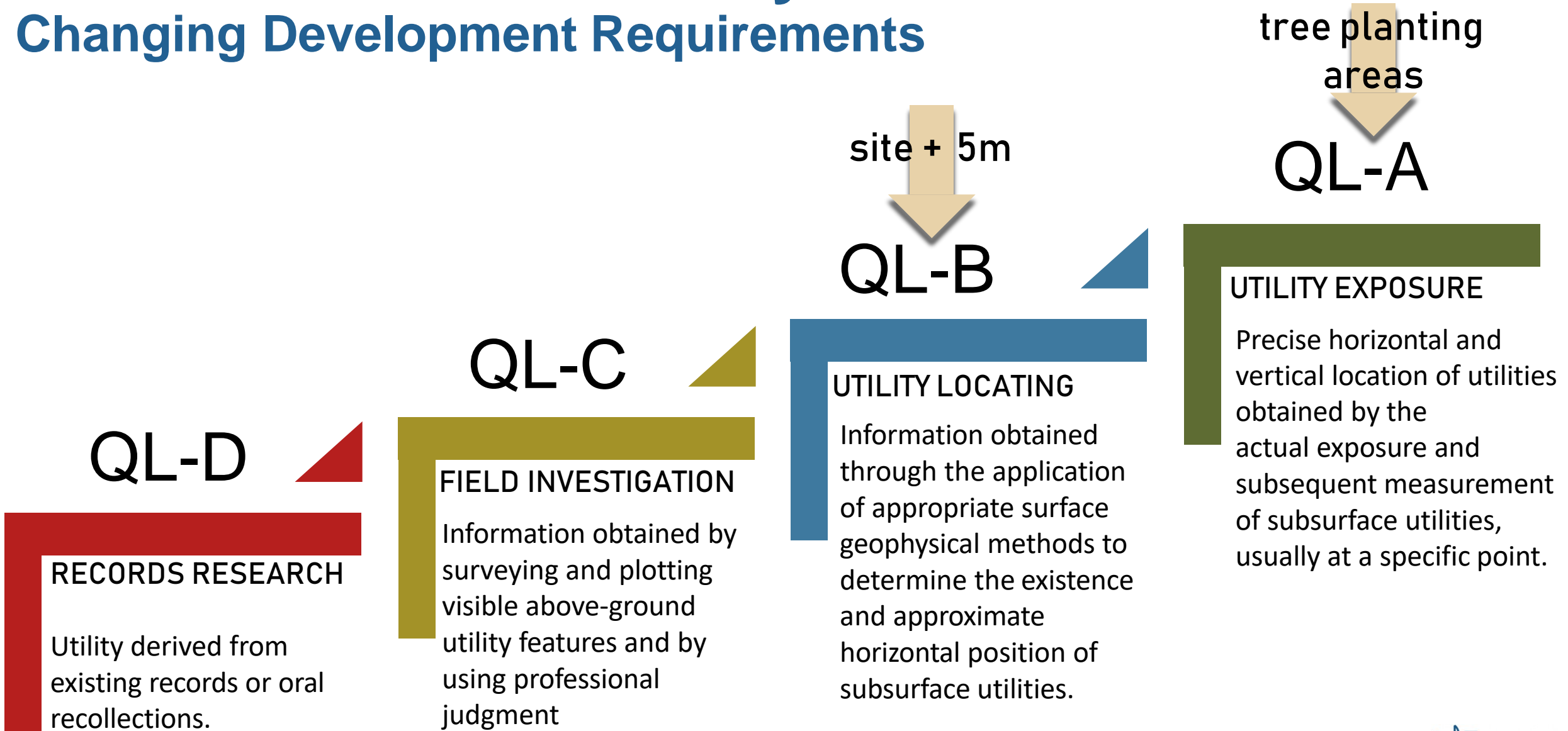
4.1.12 Place a note on the plans explaining the different utility “quality levels.”

4.1.12 Affix an engineer’s stamp on the plans that depict existing subsurface utility data at the indicated quality levels”



# Collaboration is the Key

## Changing Development Requirements

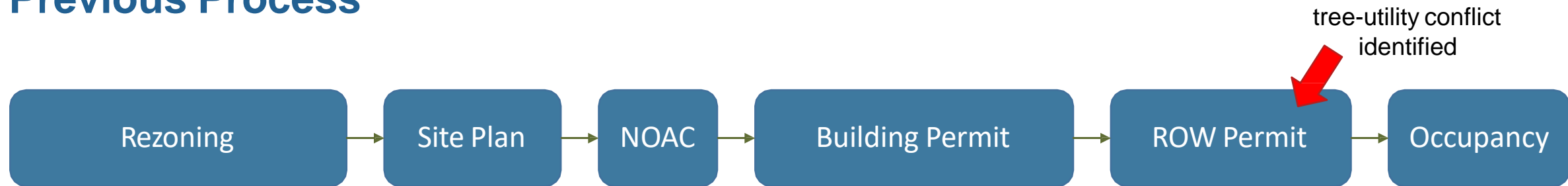




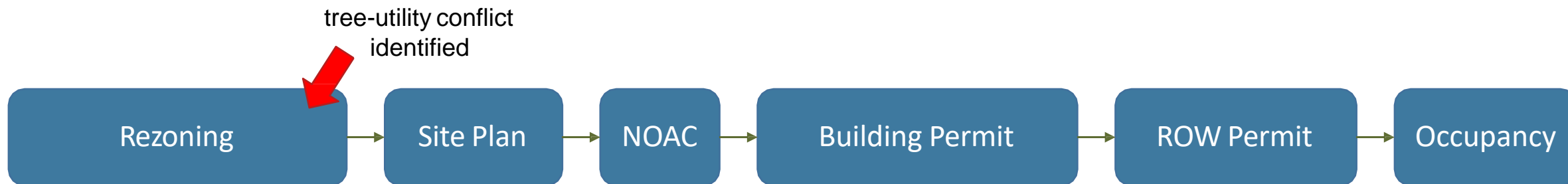
# Collaboration is the Key

## Changing Development Requirements

### Previous Process

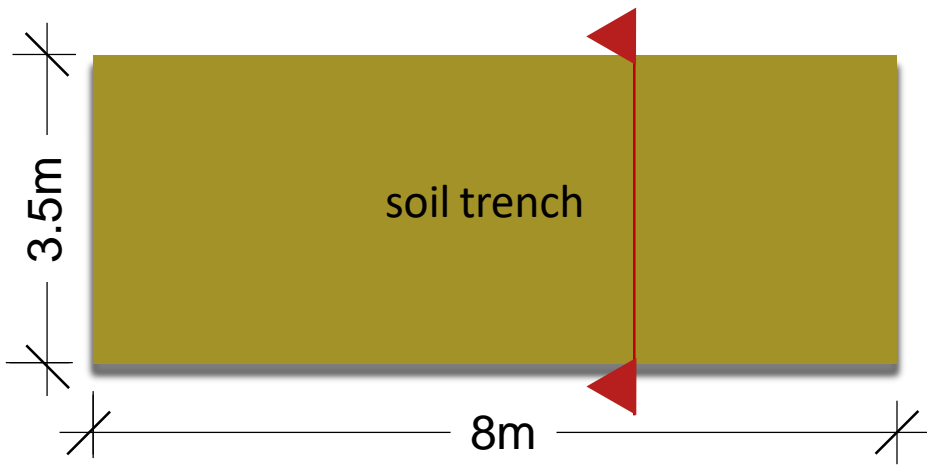
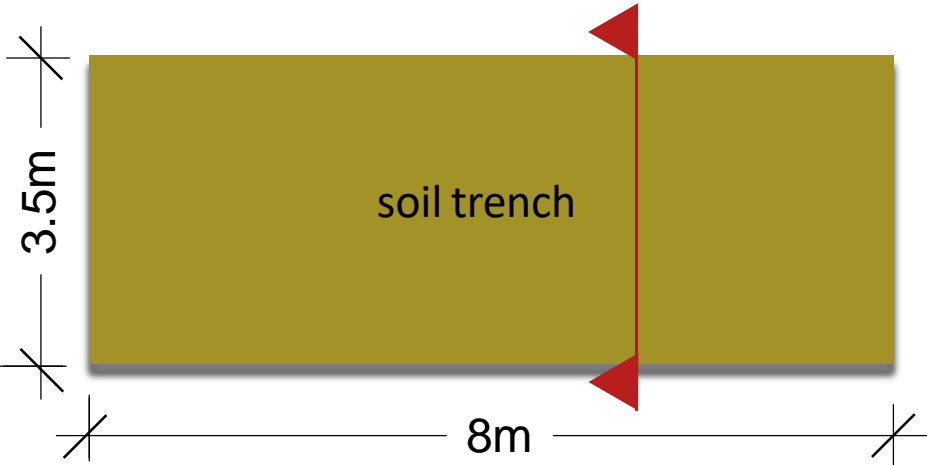
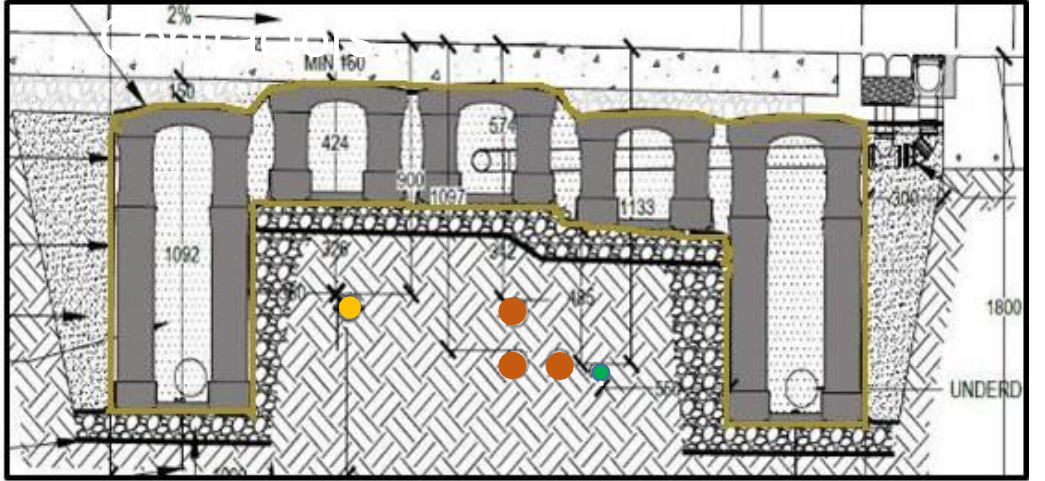
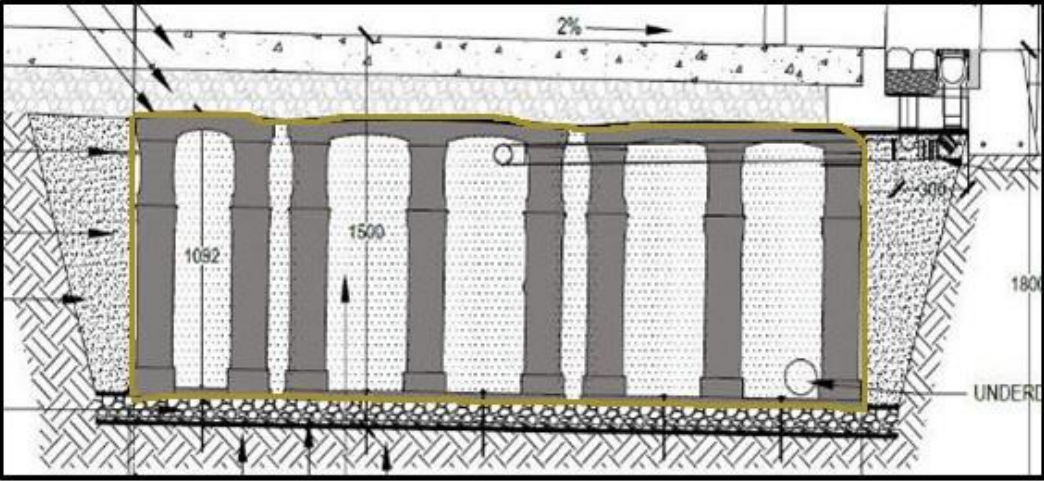


### New Process (since Jan 2022)



# Collaboration is the Key

## Changing Development Requirements



# Soil Cell Evaluation

## Utility Repair & Restoration



Utility repair, backfilling with unshrinkable fill



Temporary Restoration



# Soil Cell Evaluation

## Key Objectives

- Evaluate soil volume accommodation, constructability and access & restoration requirements for 4 soil cell products
- Document challenges, costs and lessons learned from proximity of soil cells to buried infrastructure
- Explore innovations to access and restoration processes
- Inform development of a City of Toronto Soil Cell Specification, update TS 4.60 Access and Restoration specification and process, TS 5.10 Growing Medium revisions.



# Soil Cell Evaluation

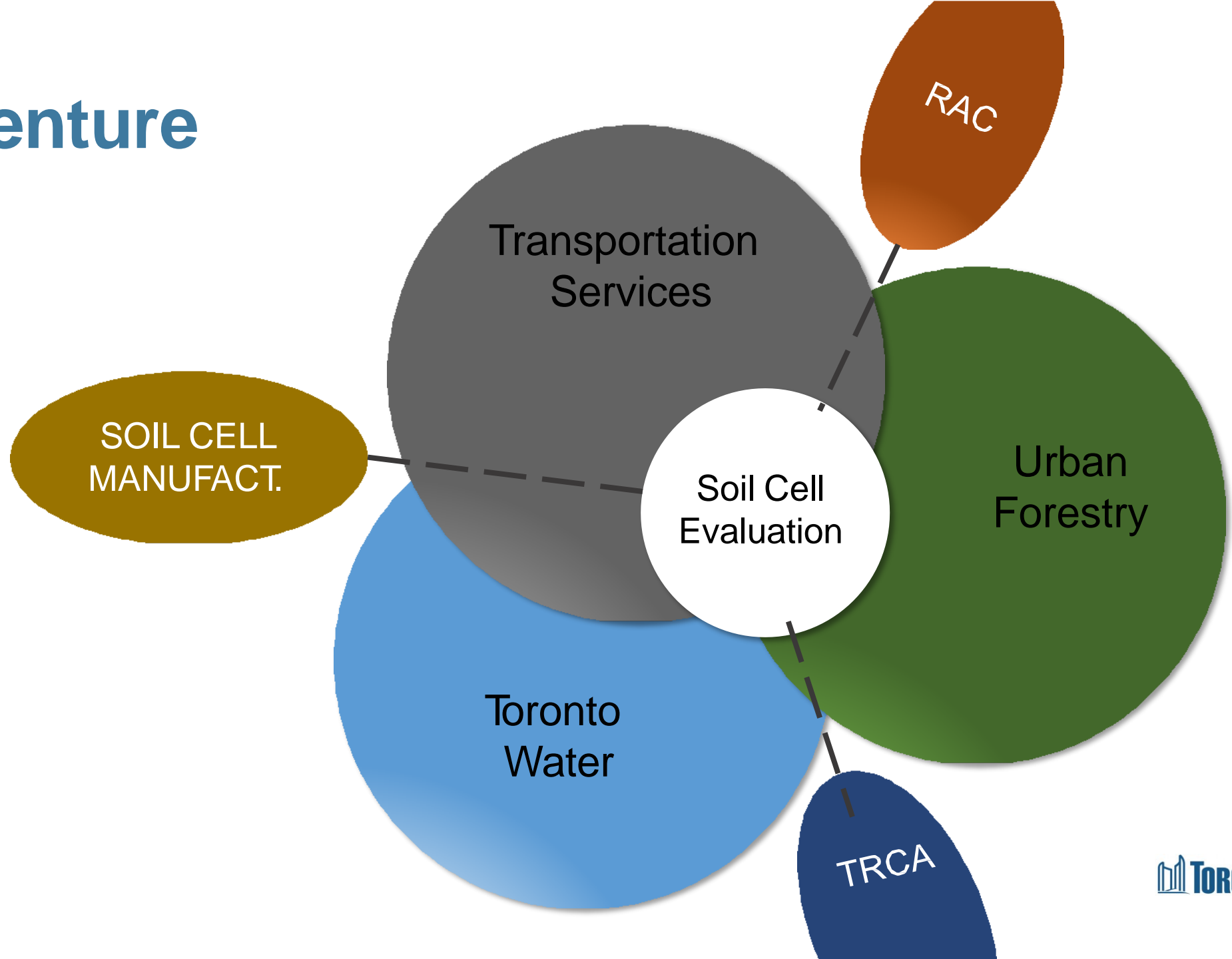
## Experimental Design



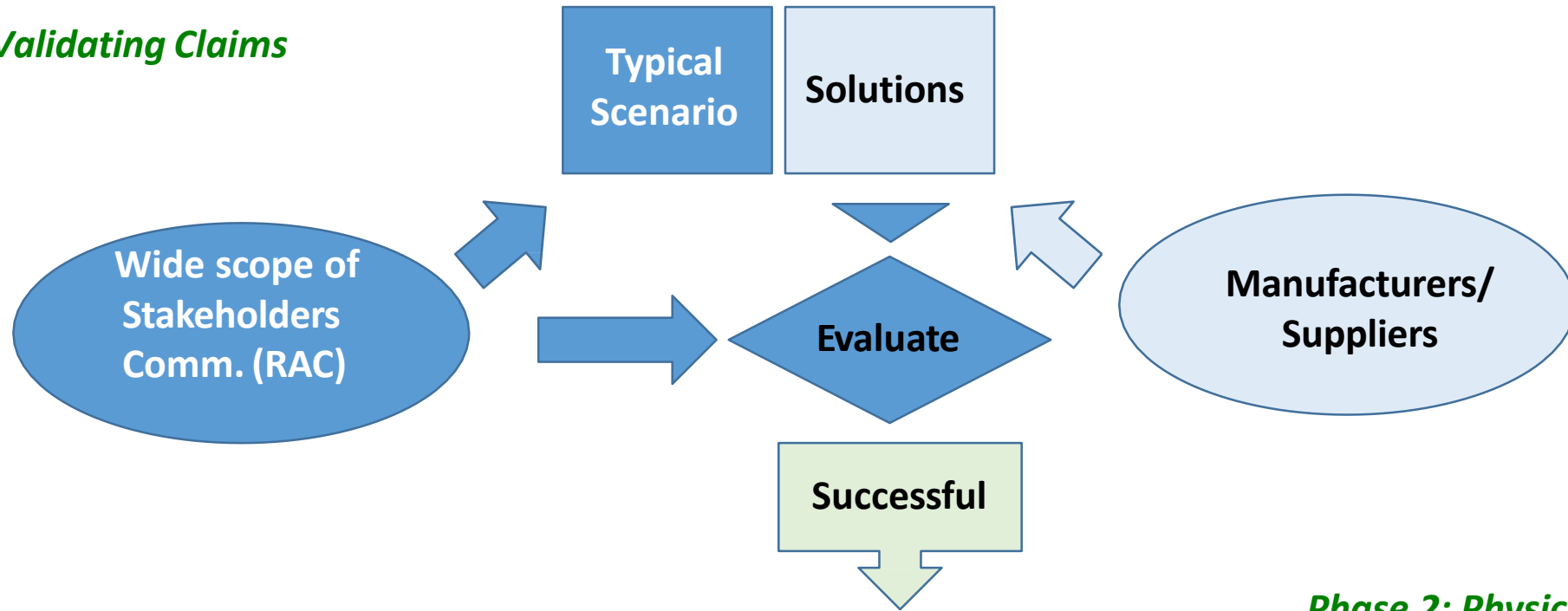
Installation of a Rootspace Plot, Soil Cell Evaluation

- Diverse staff expertise, representing interests of several City divisions when problem solving
- Staff were involved in all stages from planning, design, construction and restoration. Allowed for gaps and inconsistencies to be identified
- The 4 different products had to address the same scenario

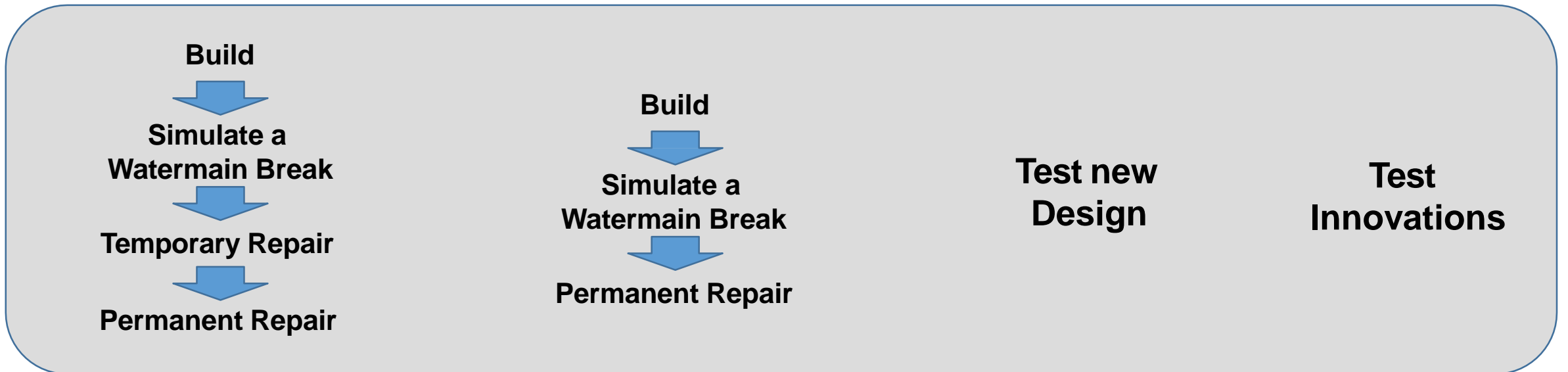
# Joint Venture



**Phase 1: Validating Claims**



**Phase 2: Physical Testing**







# Cell Construction

Contractor work requiring massive administrative and technical coordination;

Challenges: winter weather,  
COVID at peak  
site was a fill-soil,  
contractor familiar with only two types of soil cells,  
ground sloping in two directions

**Dec '19 – Mar '20**



# Temporary Repairs

A team effort led by Toronto Water.

It involved installation of water mains, flooding the cells, access and repair water leak, and temporarily restore serviceability.

**August 2020**

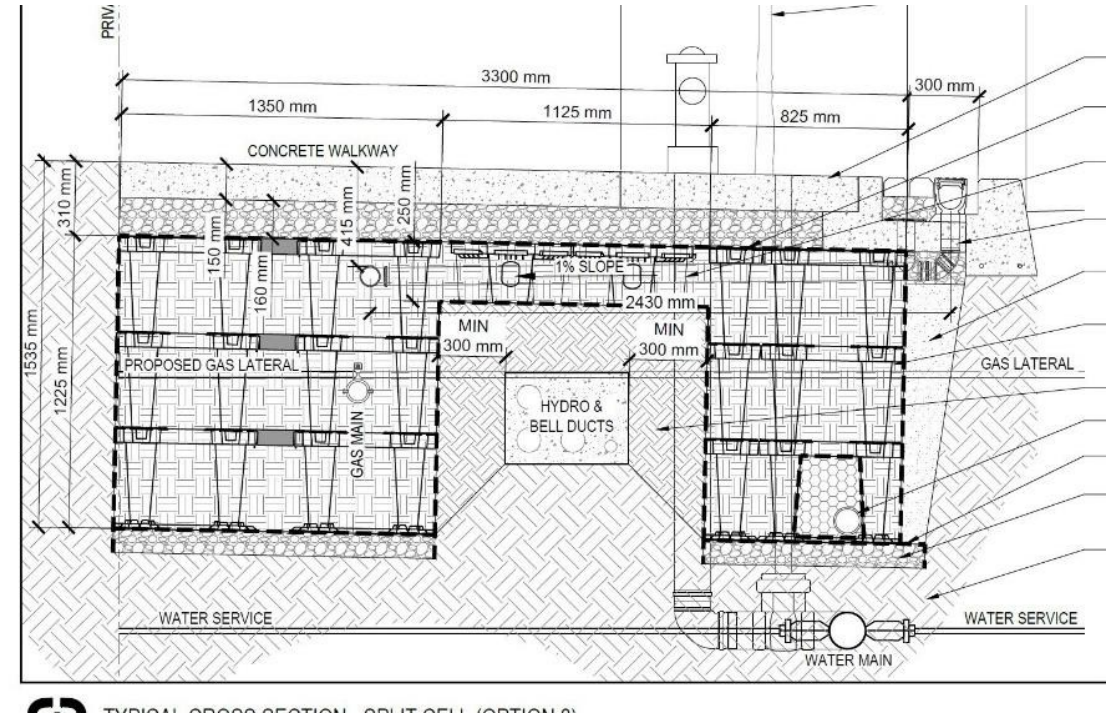
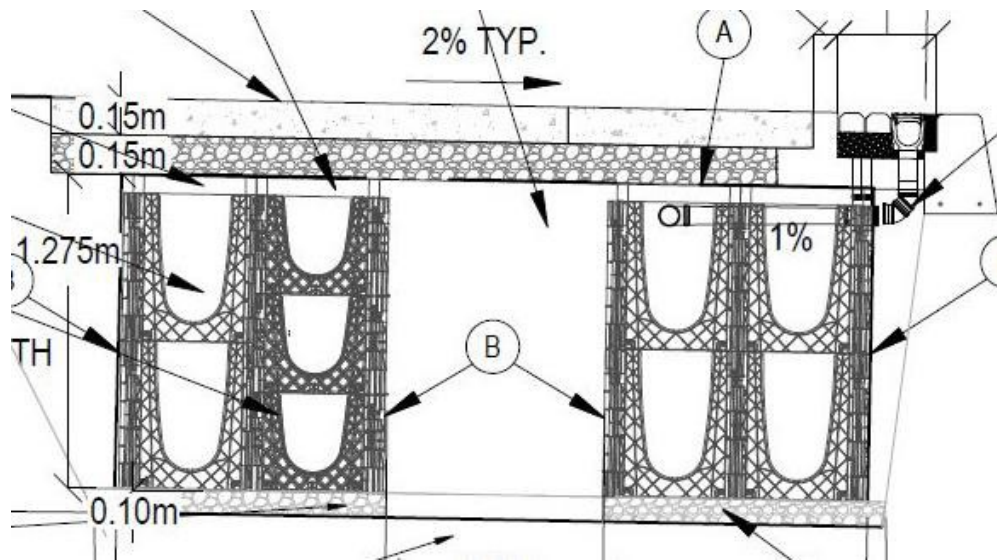


# Permanent Repairs (Restoration)

November 2020

# Soil Cell Evaluation

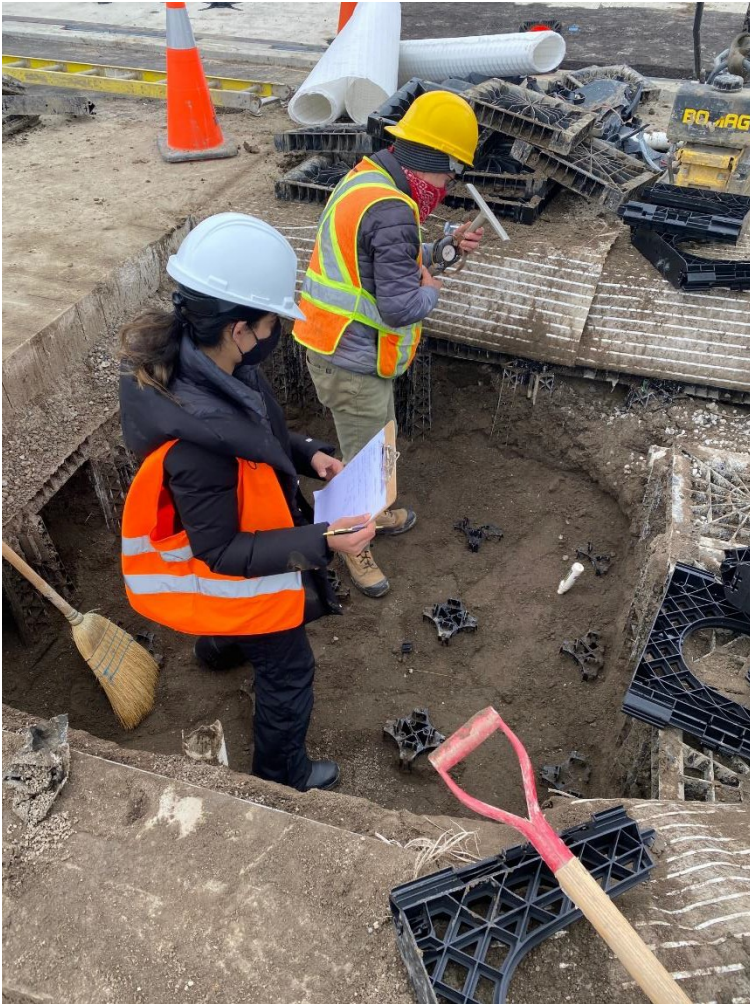
## Lessons Learned



- Importance of Training and Inspection
- Soil cells not interchangeable
- Mapping system for Soil Cells

# Soil Cell Evaluation

## Next Steps



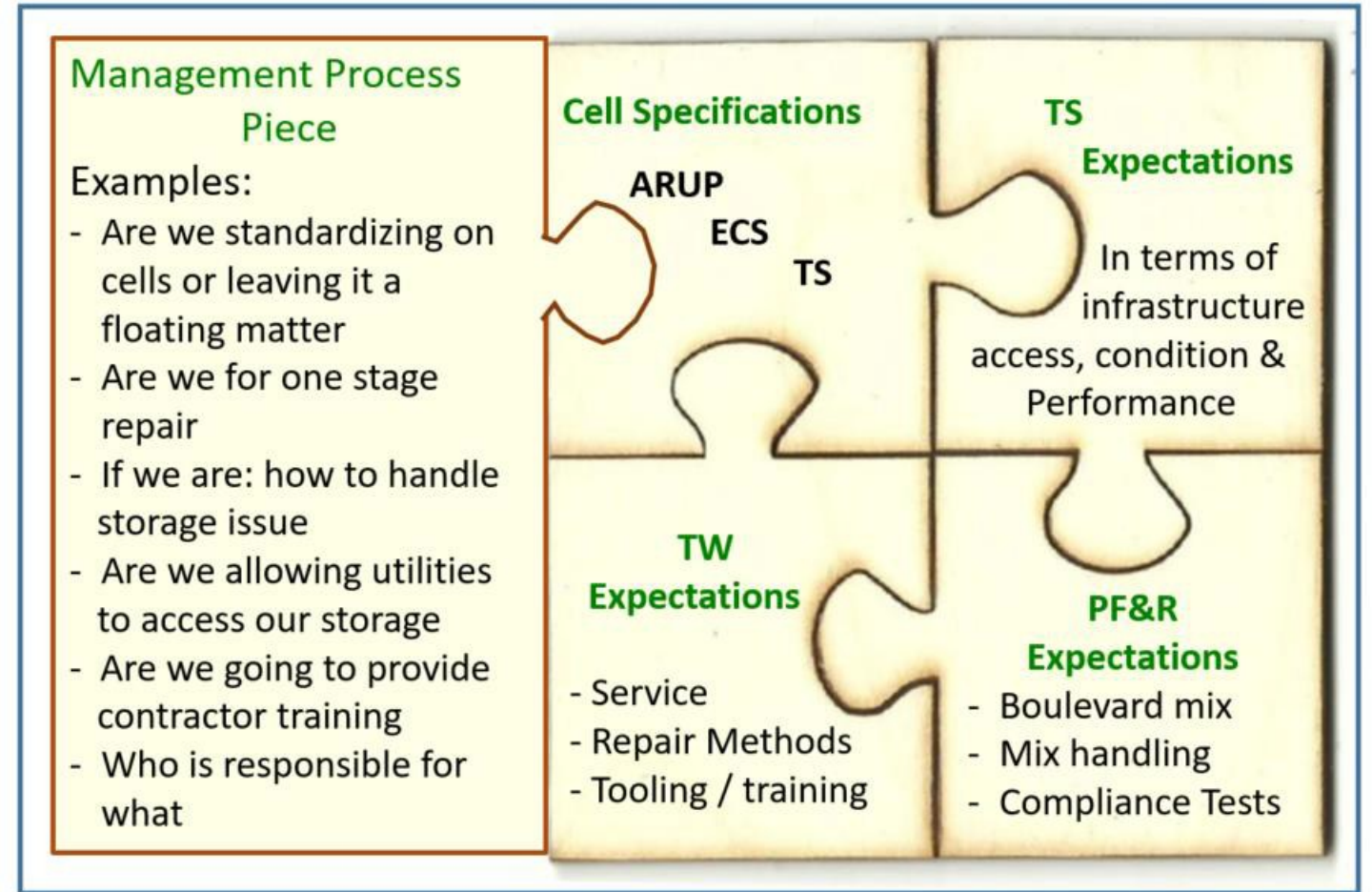
- TRCA developing a training and certificate program for design and construction of continuous soil trenches with soil cells.
- Examine options for permanent restoration
  - dedicated City team, external contract with prequalification?
  - Structural soil as an alternative to ufil?
- Asset ownership & lifecycle cost funding

Measuring soil moisture & compaction, Soil Cell Evaluation

# Soil Cell Evaluation

## Next Steps

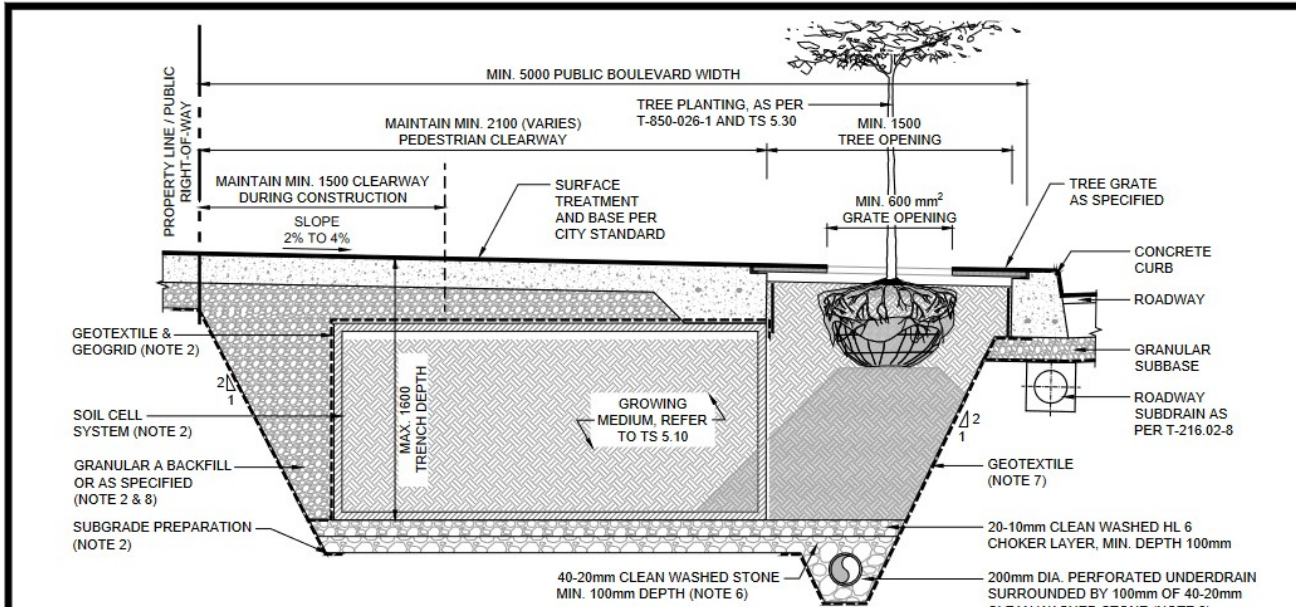
- Comprehensive Policy Development for use of Soil Cells in the Right Way.
- Access and Restoration updated process and requirements.
- Management framework.





# Details & Specifications

## Continuous Soil Trench with Soil Cells



- NOTES:
1. SOIL VOLUME SHALL BE 30m<sup>3</sup> MINIMUM PER TREE.
  2. SEE MANUFACTURER'S DETAILS AND SPECIFICATIONS FOR SOIL CELL SYSTEM, GEOTEXTILE, GEOGRID, TRENCH AND SUBGRADE PREPARATION, AND BACKFILL MATERIALS.
  3. UNDERDRAIN SHALL BE 200mm DIA. SMOOTH INTERIOR WALLED PERFORATED PIPE, INSTALLED 100mm MIN. ABOVE BASE OF EXCAVATION.
  4. FOR STORMWATER DISTRIBUTION DETAILS REFER TO T-850.184-1 AND T-850.184-2.
  5. FOR TREE HEALTH, LOCATE INLETS AWAY FROM ROOT BALLS TO MINIMIZE POTENTIAL DAMAGE. FOR INLET DETAILS, REFER TO T-850-104.
  6. GRAVEL USED FOR DRAINAGE LAYER TO BE 40-20mm UNIFORMLY GRADED, CLEAN (MAXIMUM WASH LOSS OF 0.5%), CRUSHED ANGULAR STONE THAT HAS A POROSITY OF 0.4.
  7. THE ENGINEER SHALL SPECIFY GEOTEXTILE REQUIREMENTS FOR FULL COMPATIBILITY WITH SOIL CELL MANUFACTURER'S DETAILS AND SPECIFICATIONS, IN ALL CASES ENSURING PROTECTION OF THE GROWING MEDIUM AND DRAINAGE LAYERS FROM FINE CONTAMINATION FROM IN-SITU SOILS.
  8. WHERE POSSIBLE, SOIL TRENCHES SHALL BE DESIGNED TO ALLOW SHARED SOIL VOLUME WITH ADJACENT PROPERTIES.
- All dimensions are in millimetres unless otherwise shown.

	ENGINEERING & CONSTRUCTION SERVICES STANDARD DRAWING	REV 0	APR 2022
	<b>CONTINUOUS SOIL TRENCH WITH SOIL CELLS</b>	<b>T-850.183-2</b>	
	WITH TREE GRATE		
	TYPICAL SECTION AT TREE OPENING	1:30	SHEET 1



### Construction Specification for Continuous Soil Trench with Trees for New Construction

#### Table of Contents

TS 850.01	SCOPE	4
TS 850.02	REFERENCES	4
TS 850.03	DEFINITIONS	5
TS 850.04	DESIGN AND SUBMISSION REQUIREMENTS	6
TS 850.04.01	General	6
TS 850.04.02	Submittals	6
TS 850.04.02.01	Shop Drawings	7
TS 850.04.02.02	Samples	7
TS 850.04.02.03	Soil Cell Quality Control	7
TS 850.04.02.04	Manufacturers Product Data	8
TS 850.04.02.05	Incremental Installation of first 30 m <sup>2</sup> Section	8
TS 850.04.03	Sequencing and Scheduling	9
TS 850.04.03.01	Weather Limitations	9
TS 850.04.04	Product Delivery, Storage and Handling	9
TS 850.04.05	Project Conditions	10
TS 850.05	MATERIALS	11
TS 850.05.01	Concrete	11
TS 850.05.02	Precast Structural Concrete Panels	11
TS 850.05.02.01	Reinforcement	11
TS 850.05.02.02	Concrete Void Form	12
TS 850.05.03	Granular Material	12
TS 850.05.04	Granular Base (Choker Layer)	12
TS 850.05.05	Granular Sub-base (Drainage Layer)	13
TS 850.05.06	Backfill Material	13
TS 850.05.07	Geotextile Fabric	13
TS 850.05.08	Geogrid	14
TS 850.05.09	Root Barrier	14
TS 850.05.10	Soil Cells	14
TS 850.05.11	Passive Irrigation Distribution Pipe	15
TS 850.05.12	Passive Irrigation Distribution Pipe Inlet	15
TS 850.05.13	Underdrain	15
TS 850.05.14	Pipe Riser and Cleanout	15
TS 850.05.15	Tree Opening	16





# Growing Medium

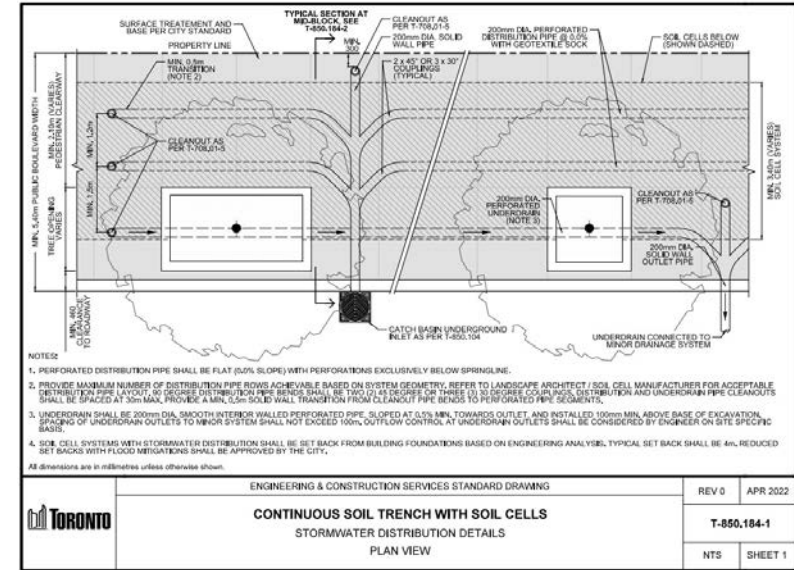
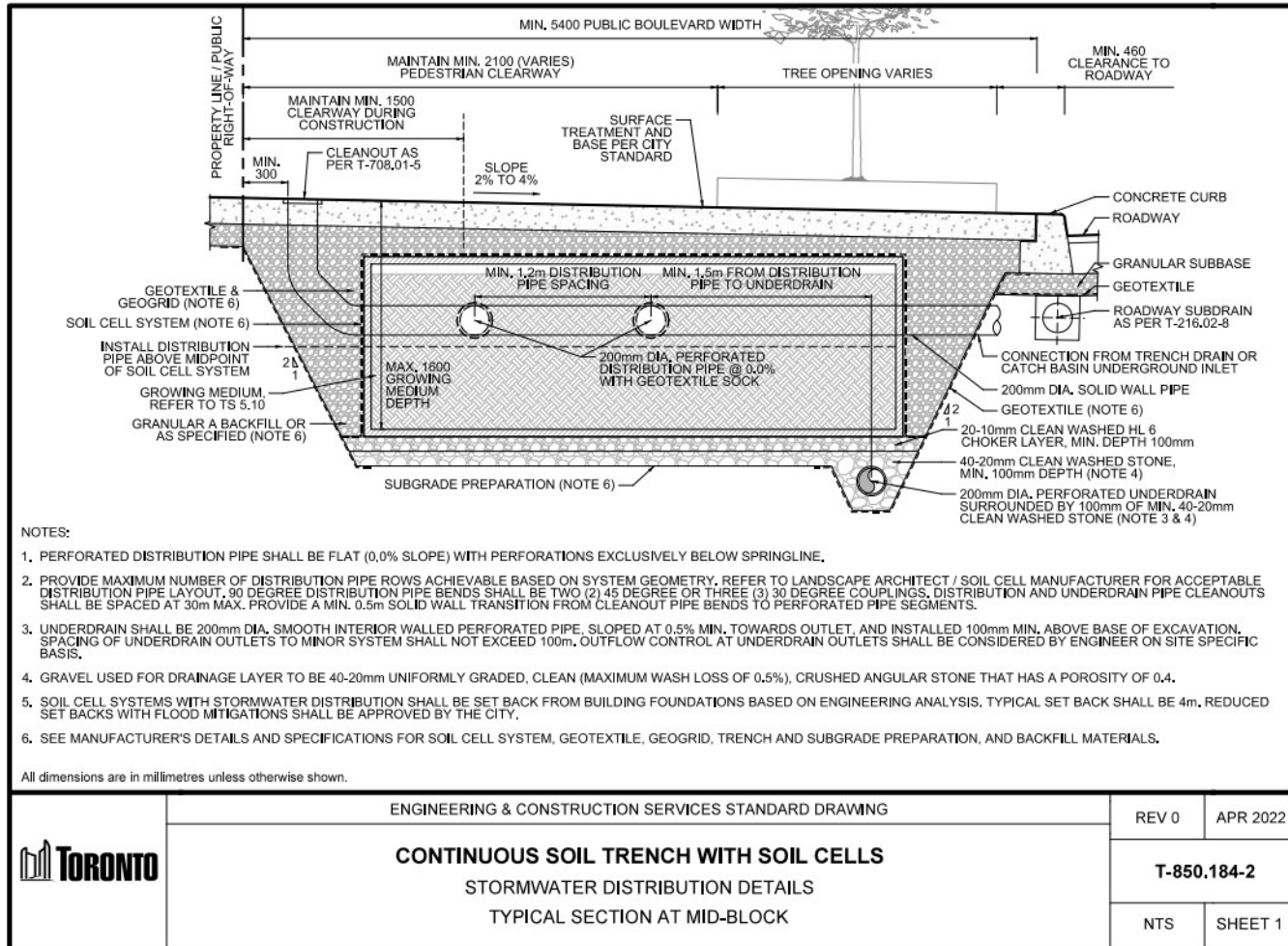
## TS 5.10 Construction Specification

- Updated 2021, largely based on industry SMEs and experience from Soil Cell Evaluation.
- Updates:
  - Cost-effective (local materials)
  - Broadened the ranges of chemical properties where possible
  - Allowance of & guidance for use of Soil Slingers
  - Incorporation of new Bioretention Media
  - Provide more detail in the Protection during Construction and Repair of Settled Growing Medium sections
  - New! Aeration in In-situ Growing Medium around Existing Trees section



# Details & Specifications

## Stormwater Distribution Details



### Chapter 6 – Green Infrastructure System Design Criteria

#### Chapter 6 – Green Infrastructure System Design Criteria

The following chapter discusses GI system applications and design considerations for specific parameters for the following GI: stormwater tree trenches, bioretention, bioswale, enhanced grass swale, green gutter, filter strip, permeable pavement, and infiltration trench.

When reading the following sections, designers should ensure that the GI system includes elements that are required based on the nature of the selected siting location, but do not include additional engineered items – for instance, a redundant underdrain – to avoid higher capital costs, maintenance costs, and additional infrastructure in the right-of-way.

#### Continuous Soil and Stormwater Tree Trenches

A continuous soil trench (CST) is a structure designed and built to contain an adequate volume of continuous growing media to support tree growth to maturity under a paved boulevard.

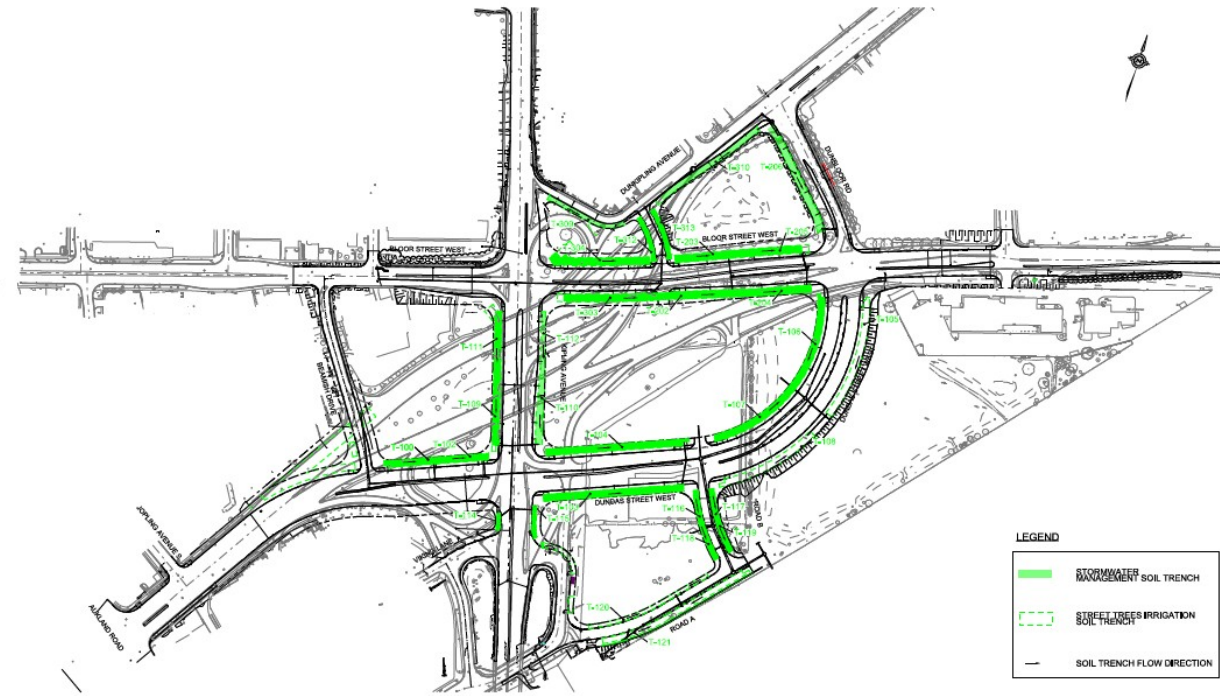
Within constrained urban conditions, achieving individual volumes can be challenging and continuous trench design can be implemented to augment or connect to adjacent soil resources, thereby maximizing the inherent benefits, and minimizing cost. CSTs include both covered trenches with trees in pavement, and open planters that can either be raised or flush with surrounding pavements.

Within the right-of-way some of the tree planting areas are supported by additional infrastructure in order to purposefully manage stormwater runoff. Examples range from trench drain inlets, to growing medium mixes that promote drainage, to stormwater tree trenches. A CST that is purposefully designed and constructed to capture, infiltrate and filter stormwater runoff from a drainage area beyond the footprint of the trench is referred to as a Stormwater Tree Trench (STT).

All trees are considered GI and the priority when designing CST and STT should always be the establishment and growth of large growing shade trees to maturity.

# Stormwater Tree Trenches

## Six Points Interchange Reconfiguration



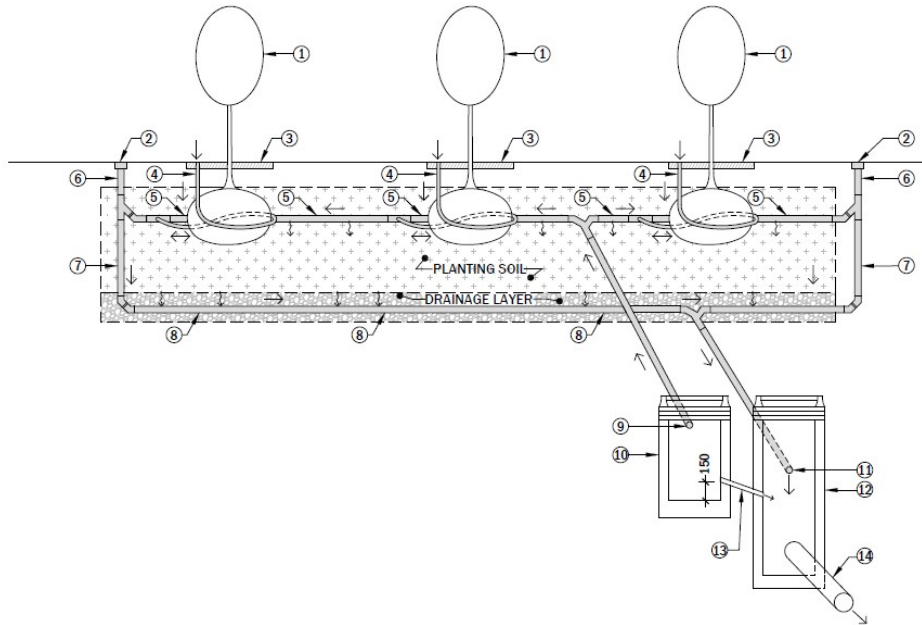
### Green Infrastructure Summary:

- Stormwater Tree Trenches
- Site Assumed Fall 2022
- Monitoring program through STEP
- Considerations for pre-treatment



# Stormwater Tree Trenches

## Wellington Street Reconstruction (Yonge to Church St)



- ① NEW TREES
- ② NEW MAINTENANCE CLEANOUT (CLEANOUT LOCATION SHOWN FOR WITHIN PIT (LEFT) OR BEYOND PIT (RIGHT))
- ③ TREE GRATES
- ④ NEW SUPPLEMENTAL TREE WATERING SYSTEM: 75 DIAMETER FLEXIBLE PERFORATED PIPE CONNECTED TO TREE GRATE AND PASSIVE IRRIGATION SYSTEM
- ⑤ PASSIVE IRRIGATION DISTRIBUTION PIPE IN TREE PIT: USE 150 DIAMETER PERFORATED PIPE C/W FILTER SOCK (PERF. ALL SIDES)

- ⑥ CONNECT CLEANOUT AND PASSIVE IRRIGATION PIPE AND SUBDRAIN LINES WITH 150 DIAMETER PIPE
- ⑦ CONNECT PASSIVE IRRIGATION PIPE AND PLANTING PIT SUBDRAIN LINES WITH 150 DIAMETER PIPE
- ⑧ PLANTING PIT SUBDRAIN: USE 150 DIAMETER FLEXIBLE, PERFORATED DRAIN PIPE C/W FILTER SOCK (PERF. ALL SIDES)
- ⑨ OUTFLOW TO DISTRIBUTION PIPES NEAR TOP OF PUP CATCH BASIN PROVIDE PERFORATED CAP WITH OPENING LESS THAN 8mm

- ⑩ NEW PUP CATCH BASIN WITH SUMP PER CIVIL
- ⑪ CONNECT SUBDRAIN TO CATCH BASIN; IF HEIGHT FROM SUBDRAIN CONNECTION TO OUTLET TO STORM SEWER EXCEEDS 900mm, PROVIDE DROP STRUCTURE PER DETAIL T-1003.01-2 (USE 100mm DIAMETER PIPE)
- ⑫ NEW CATCH BASIN PER CIVIL
- ⑬ CONNECT PUP CATCH BASIN AND CATCH BASIN PER CIVIL
- ⑭ STORM SEWER CONNECTION PER CIVIL

NOTE:  
 - AT TERMINATION OF PIPE WITH FILTER SOCK; FILTER SOCK SHALL BE TIED-OFF  
 - WHERE PIPE WITH FILTER SOCK CONNECTS TO PIPE WITHOUT FILTER SOCK, FILTER SHALL BE CUT WITH EXTRA



# Green Streets Implementation

## Morningside Avenue Extension

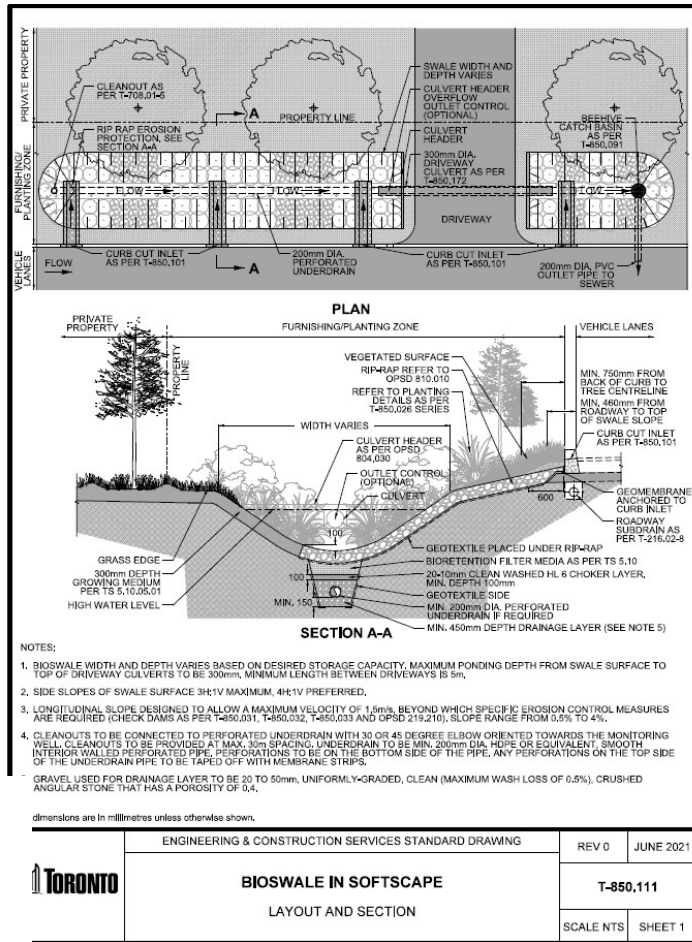


### Green Infrastructure Summary:

- Bioswales (left) and Stormwater Tree Trenches with soil cells under multiuse pathway (right)
- Construction completion Fall 2022

# Detail & Specifications

## Green Infrastructure in the Right-of-Way



	Engineering & Construction Services Division Standard Specifications for Road Works	TS 857 September 2021
<b>Construction Specification for Inlets in Green Infrastructure</b>		
<b>Table of Contents</b>		
TS 857.01	SCOPE .....	3
TS 857.02	REFERENCES .....	3
TS 857.03	DEFINITIONS .....	3
TS 857.04	DESIGN AND SUBMISSION REQUIREMENTS.....	4
TS 857.04.01	General .....	4
TS 857.04.02	Materials .....	4
TS 857.05	MATERIALS .....	4
TS 857.05.01	Concrete for Curb Cuts .....	4
TS 857.05.02	Reinforcement.....	4
TS 857.05.03	Concrete Sediment Pad .....	5
TS 857.05.04	Leveling Course .....	5
TS 857.05.05	Gabion Wall .....	6
TS 857.05.06	Open-Graded Stone.....	6
TS 857.05.07	Expansion Joints .....	6
TS 857.05.08	Granular Base and Backfill .....	6
TS 857.05.09	Catch Basin .....	6
TS 857.05.10	Pipe .....	6
TS 857.05.11	Modular Trench Drain System.....	6
TS 857.05.12	Concrete Trench Drain Cover .....	6
TS 857.05.13	Side Inlet.....	7
TS 857.06	EQUIPMENT .....	7
TS 857.07	CONSTRUCTION .....	7
TS 857.07.01	Excavation .....	7
TS 857.07.02	Curb Cut Inlet and Outlet .....	7
TS 857.07.03	Sediment Pad .....	7
TS 857.07.04	Catch Basin Inlet to Green Infrastructure .....	7
TS 857.07.05	Modular Trench Drain System.....	7
TS 857.07.06	Concrete Trench Drain .....	8

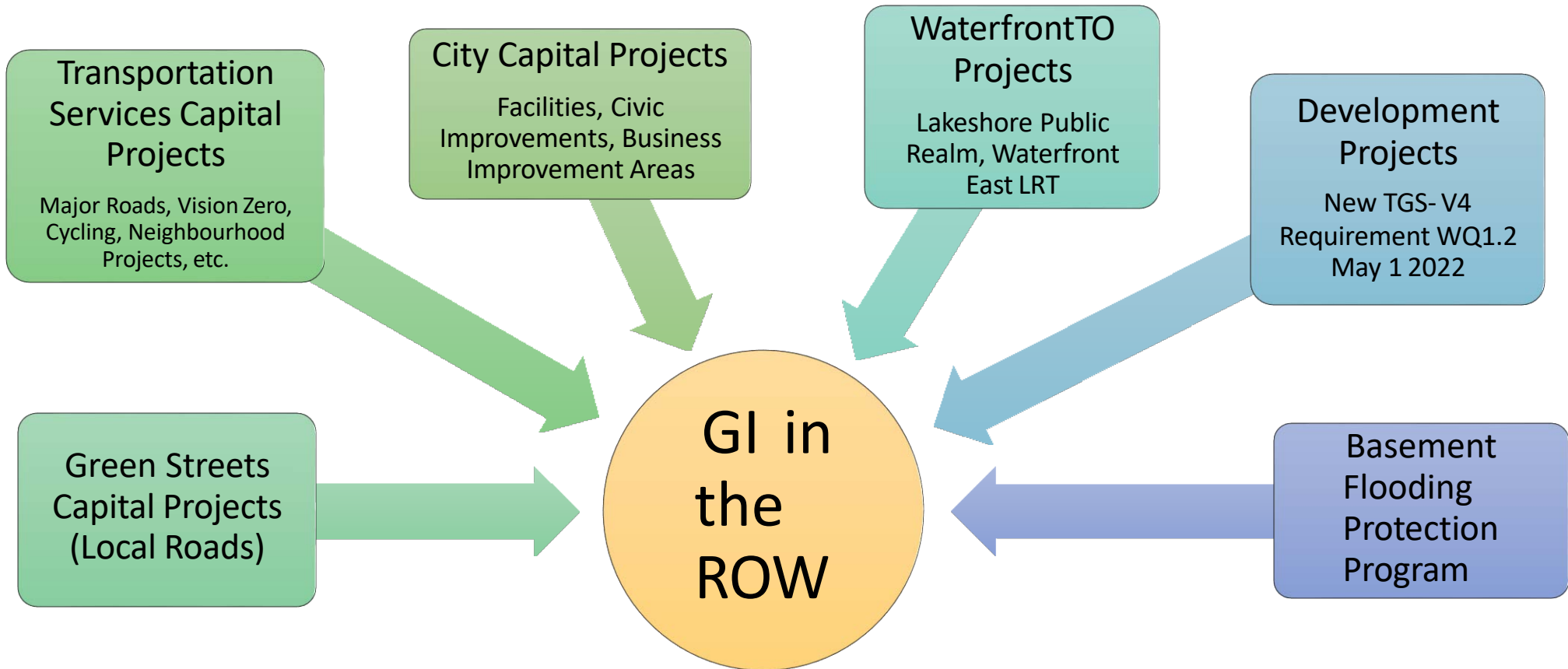
Documents developed to date:

- **55** Standard Drawings
- **8** Construction Specifications
- **3** Guidelines:
  - Design Criteria Guideline
  - Lifecycle Activities Guideline
  - Public Notification & Engagement

In progress:

- Retrofit Design Options
- Construction Specification for Retrofit Construction Around Existing Trees (TS 182)
- Additional Green Infrastructure Standards (2024)

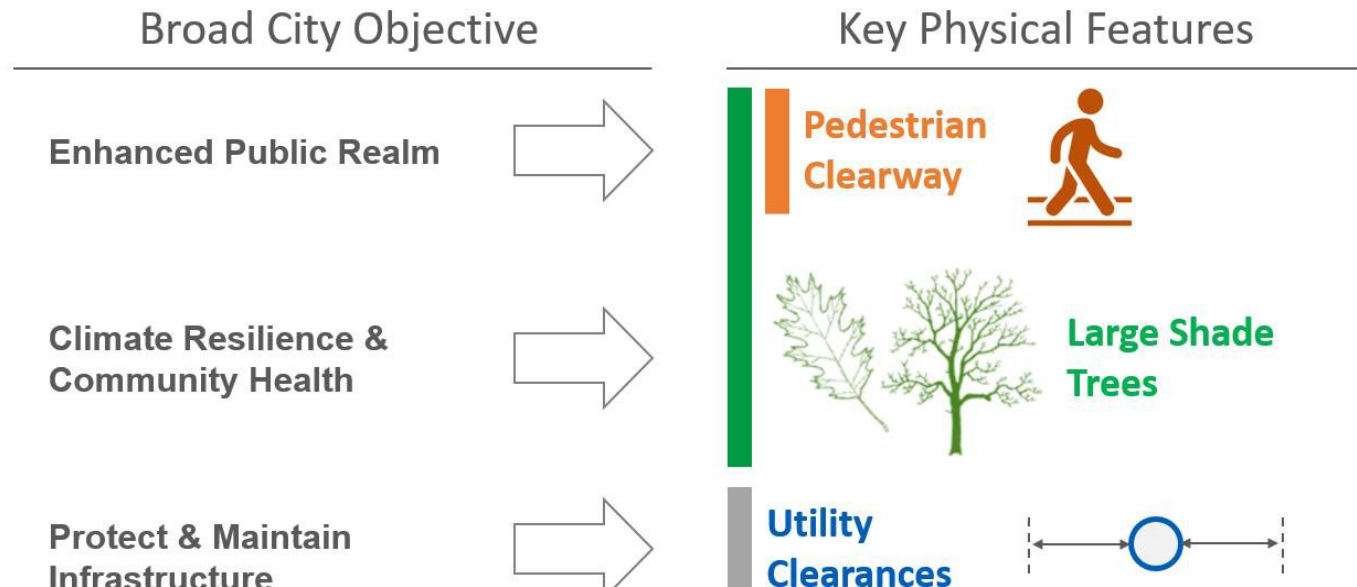
# Implementing Green Streets Opportunities



# Work in Progress

## “There’s no rest...” for those who want to expand Green Streets

- Growing Green Streets
  - Objective: Expand GI and Street Tree implementation by identifying vulnerable Priority Neighbourhoods while balancing feasibility of coordinating work with Capital Programming & Development
  - Updates to Municipal Consent Requirements (Appendix O offsets)
  - Updates to Development Infrastructure Policy & Standards (DIPS)





# Improving conditions for Street Trees: Challenges, Opportunities and New City of Toronto Standards



Contact Information:

[Diane.Leal@Toronto.ca](mailto:Diane.Leal@Toronto.ca)

[Abe.Mouaket@Toronto.ca](mailto:Abe.Mouaket@Toronto.ca)

[Kristina.Hausmanis@Toronto.ca](mailto:Kristina.Hausmanis@Toronto.ca)



# SOURCE TO STREAM

# 2023 Conference

Canada's Premier  
Stormwater and Erosion  
and Sediment Control  
Conference

*Thank you to our sponsors!*

## EXECUTIVE SPONSORS



Canadian Society for  
Civil Engineering



Société canadienne  
de génie civil



Our reason is water.™

## OPPORTUNITIES SPONSOR

# AECOM

## MEDIA SPONSORS

# WATER CANADA



CUPOLEX®  
ENGINEERING SOLUTIONS INC.



## HOSTS



let nature do it!



DOWN TO EARTH BUSINESS

GEO

MORPHIX™

Presented by:



Toronto and Region  
**Conservation**  
Authority



NEXT STORM



Sustainable  
Technologies  
EVALUATION PROGRAM

In association with:



Lake Simcoe Region  
conservation authority



Credit Valley  
Conservation  
inspired by nature