Canopy Size and Climate Change

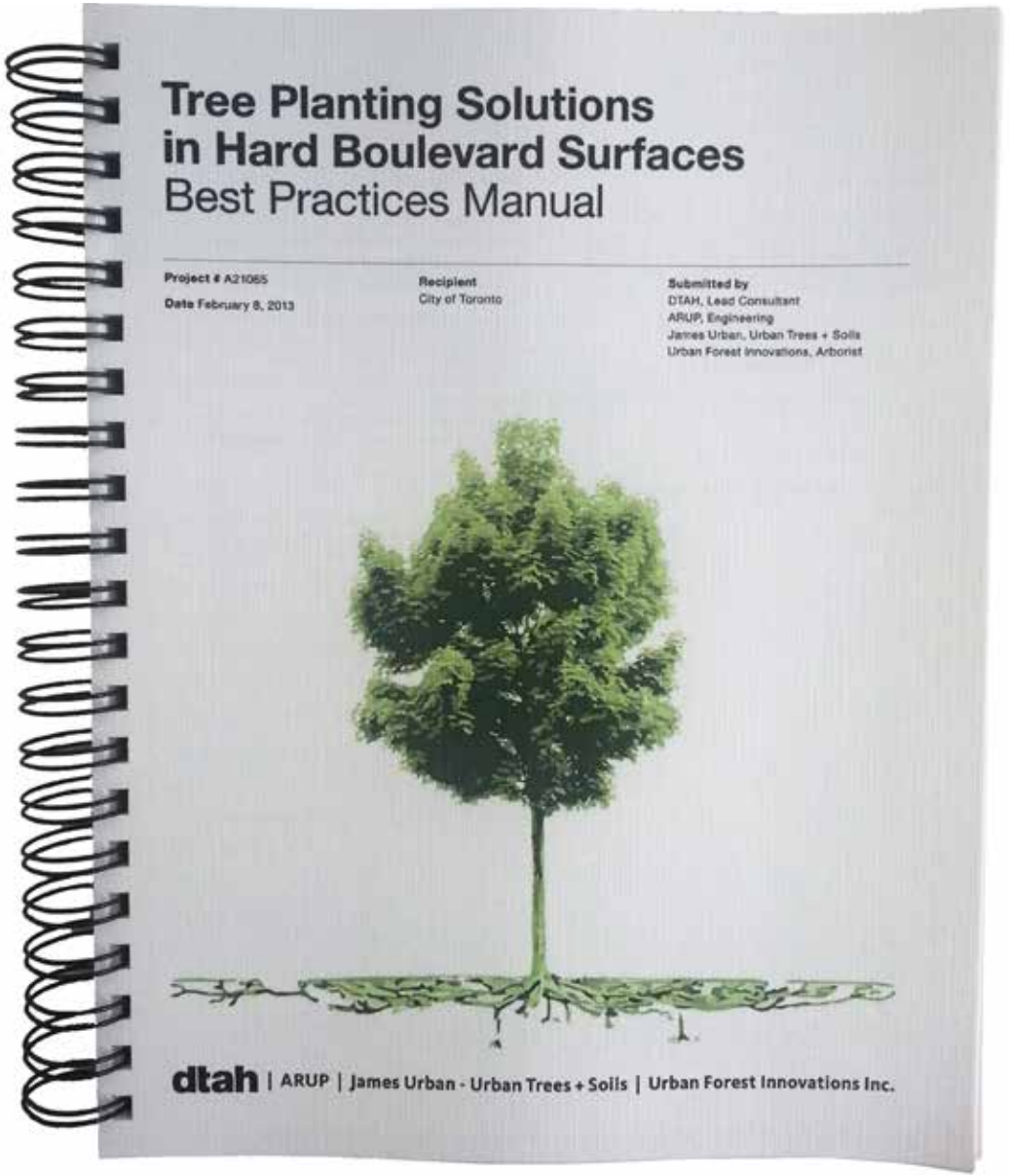
Growing Trees in City Sidewalks

Presented by Clara Kwon OALA CSLA

dtah

Tree Planting Solutions in Hard Boulevard Surfaces

Best Practices Manual City of Toronto



http://www1.toronto.ca/city_of_toronto/parks_forestry__recreation/urban_forestry/files/pdf/TreePlantingSolutions_BestPracticesManual.pdf

Tree Planting Solutions in Hard Boulevard Surfaces
Best Practices Manual City of Toronto

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ACO Steven Tonaj

Gro-bark

Earthco Soil Mixtures

Tree Planting Solutions in Hard Boulevard Surfaces

Rationale

GOAL:

Grow large-canopy trees: **40 year** life span, **40cm** dbh

BECAUSE:

Large-canopy trees can reduce the impacts of **climate change**

HOWEVER:

Existing tree planting standard cannot support large-canopy trees

Existing standard is expensive

Toronto has approximately 10.2 million trees

6.1million (60%) on private property

4.1million (40%) on public property

600,000 (6%) are street trees

150,000 (1.5%) are street trees with a diameter greater than 30cm

Average Urban Tree Age

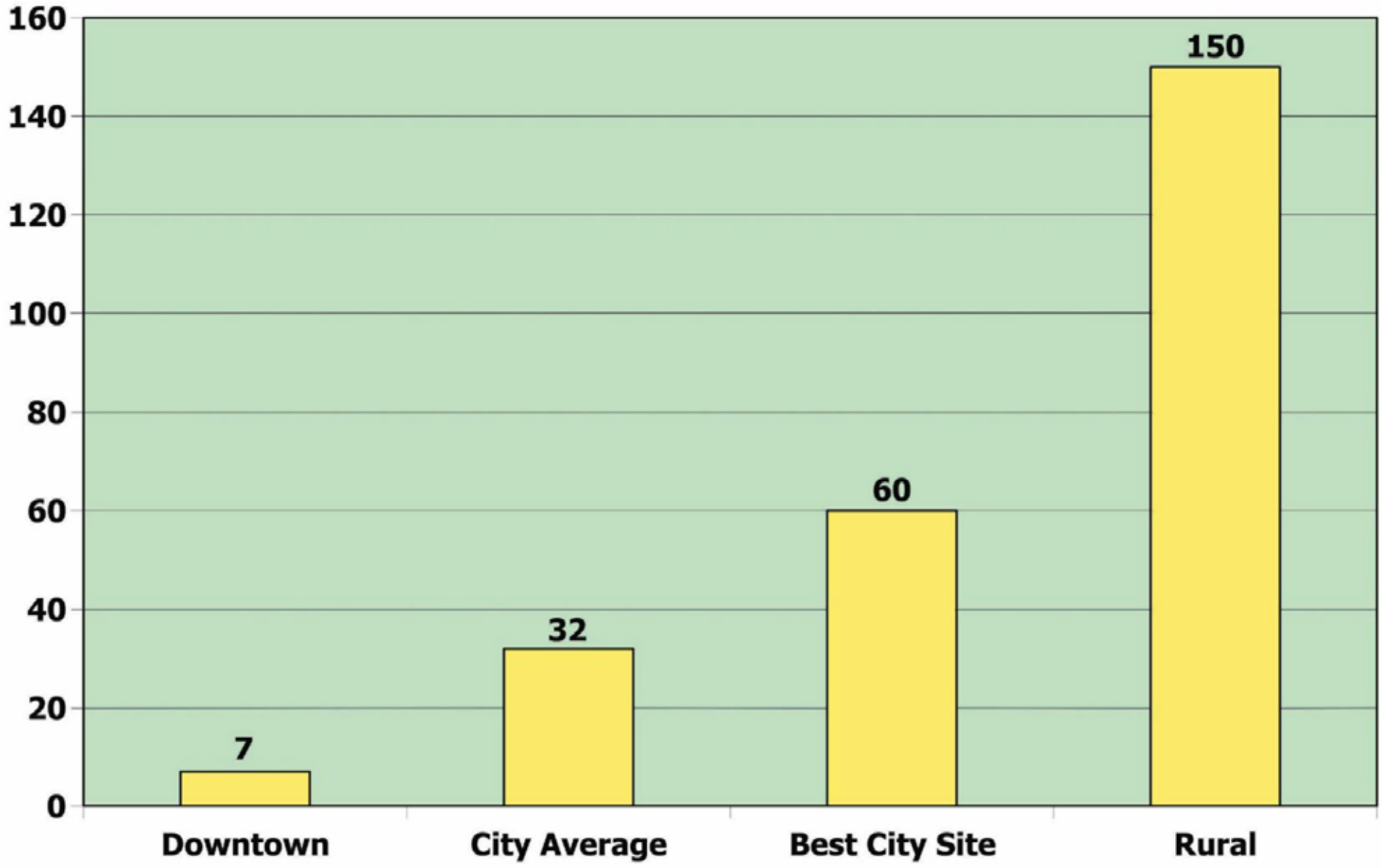


Figure 1: Average Urban Tree Age in Years: The average values are based on urban-trees in the United States (Adapted from: Moll, 1995, p.14).

Urban Street Tree Planting
Current Practices in Toronto

Quality nursery stock - questionable

Room for canopy growth - maybe

Trunk flare - none

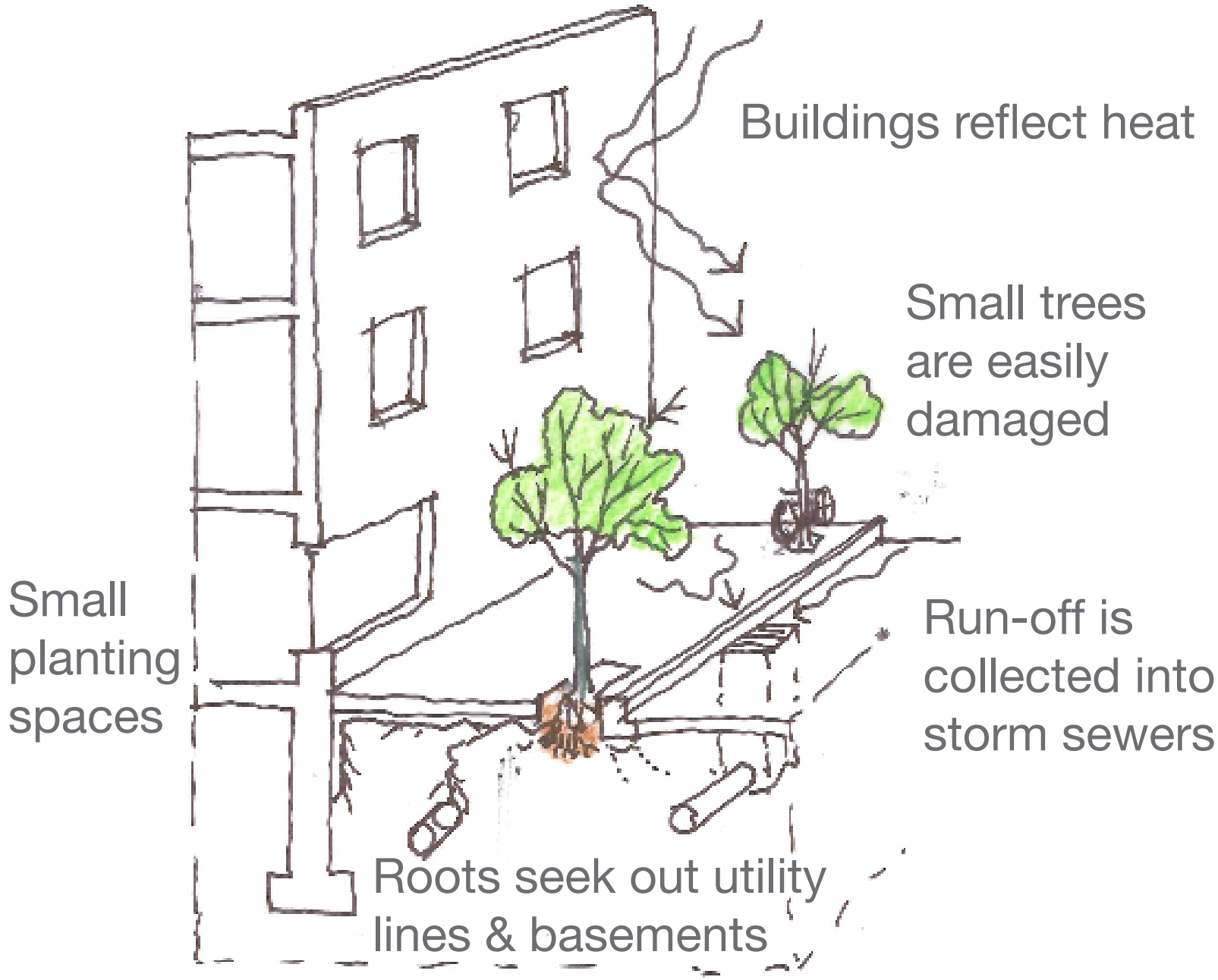
Zone of rapid root taper - none

Water in / water out - none

Sufficient soil volume - unlikely

Urban Street Tree Planting

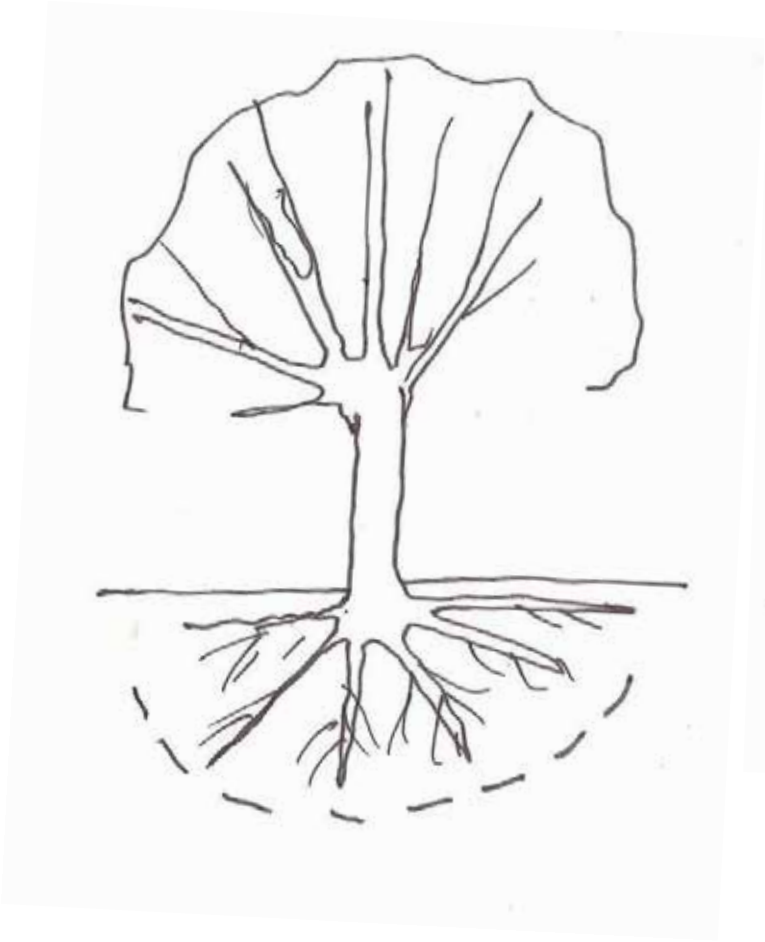
Current Practices in Toronto



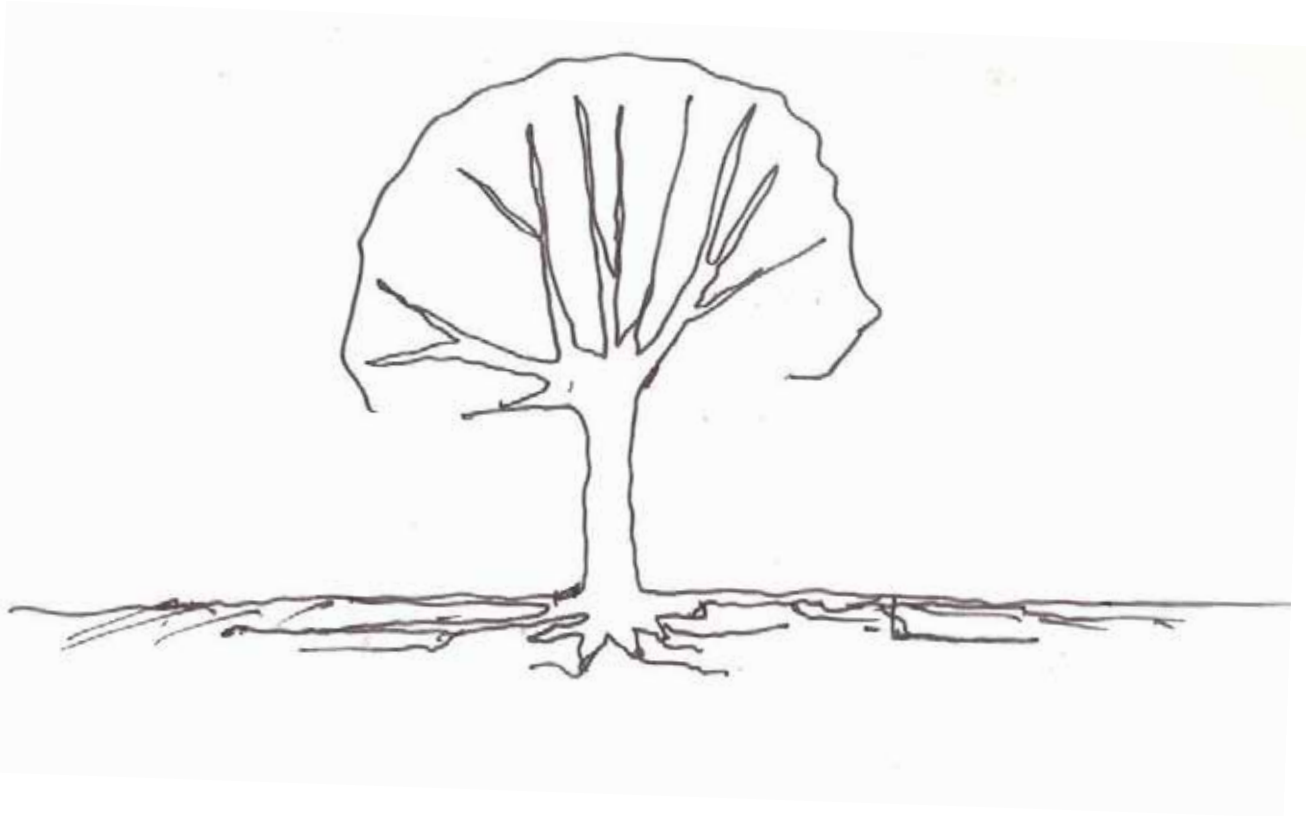
Urban Street Tree Planting

Big Urban Trees Are Possible

How Do Trees Grow?



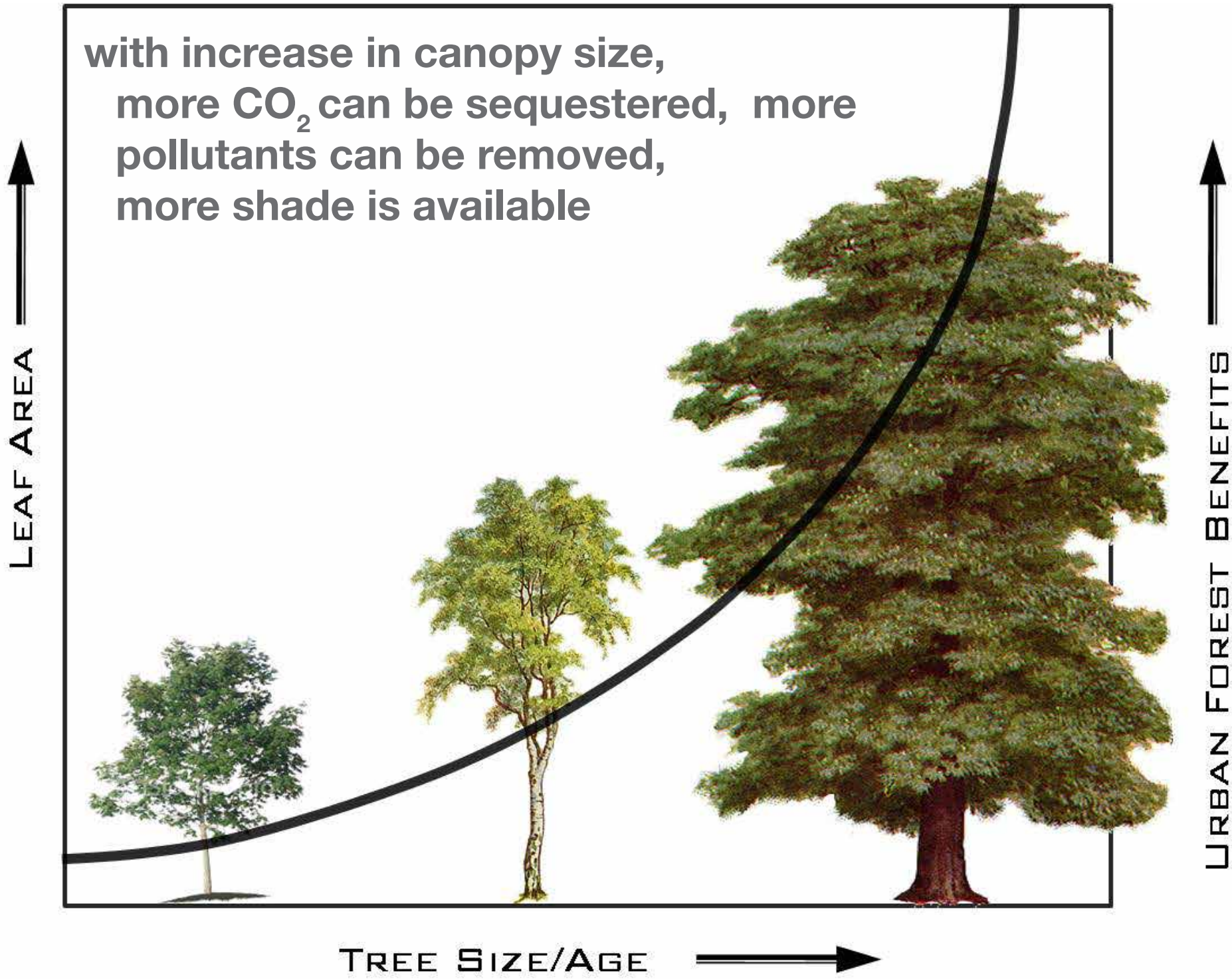
Previous Understanding



Current Understanding







with increase in canopy size,
more CO_2 can be sequestered, more
pollutants can be removed,
more shade is available
Leaf Area
Urban Forest Benefits
Tree Size/Age

Tree Planting Solutions in Hard Boulevard Surfaces

Objectives

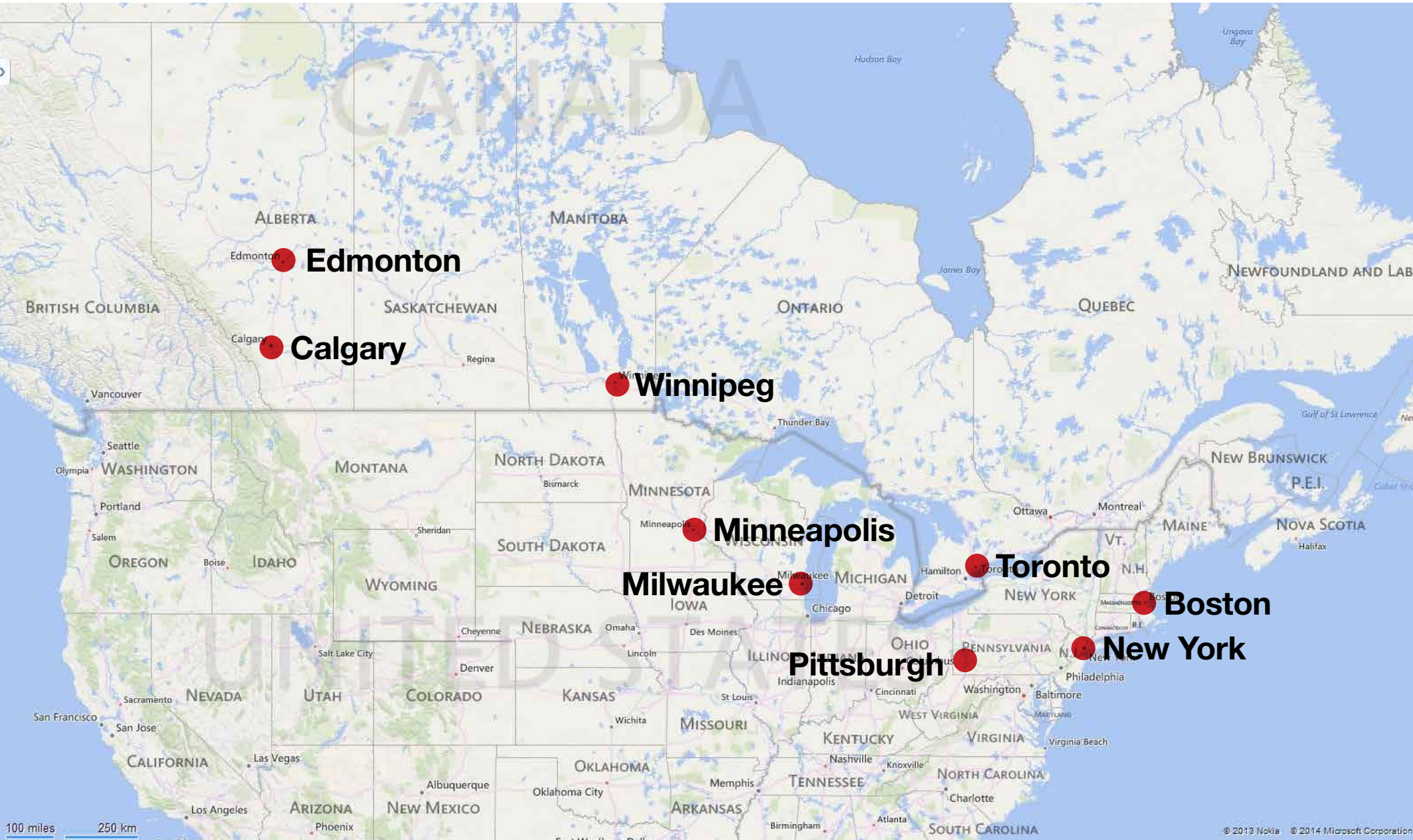
Improve sidewalk tree planting standards so that **trees grow to maturity** (min. 40 year life span, 40cm dbh)

Design for **tree growth & health** in sidewalks while also accommodating **utilities, furniture & safety**

Design **cost-effective** tree planting details

Tree Planting Solutions in Hard Boulevard Surfaces

Context Review & Precedent Analysis of Toronto & Other Municipalities



Tree Planting Solutions in Hard Boulevard Surfaces
Best Practices Manual

4 Guiding **Principles**

3 Sidewalk **Typologies**

Component Parts

2 Utility Repair **Mockups**

Horticultural Recommendations

Guiding Principles

Growing Trees in City Sidewalks

1) More Soil
2) Larger Pavement Openings
3) Integrate Utilities Into Root Zones
4) Strategic, Cost-effective Design

Guiding Principles

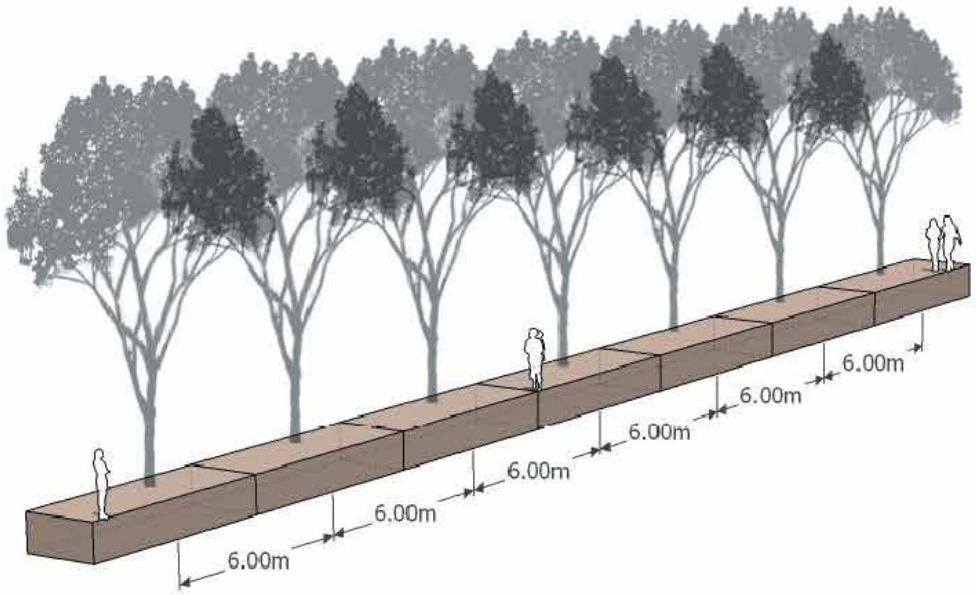
More Soil

Existing standard

6m³ to **10m³** soil per tree

= 2.5m dia. canopy

= 6m to 7m spacing

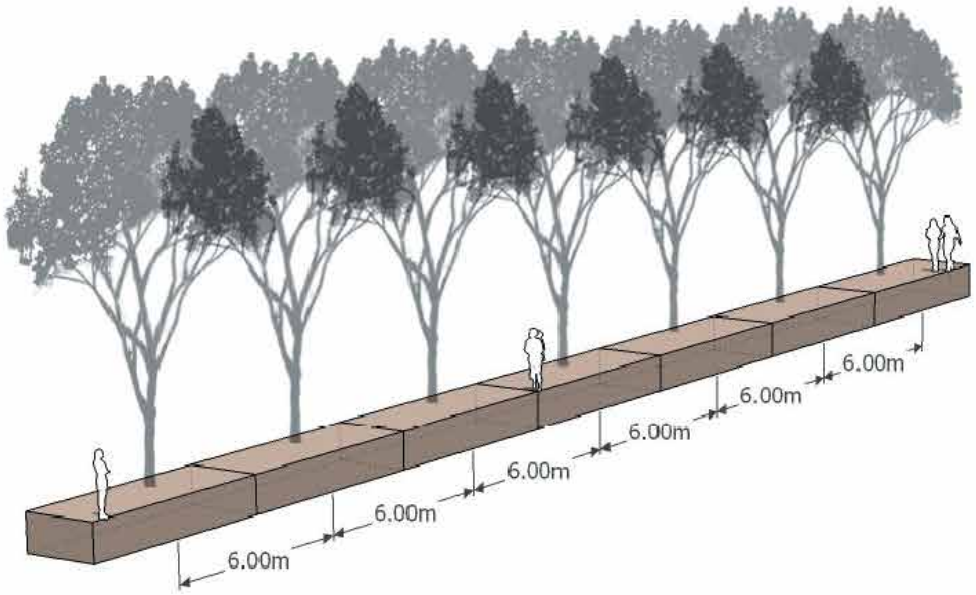


Guiding Principles

More Soil

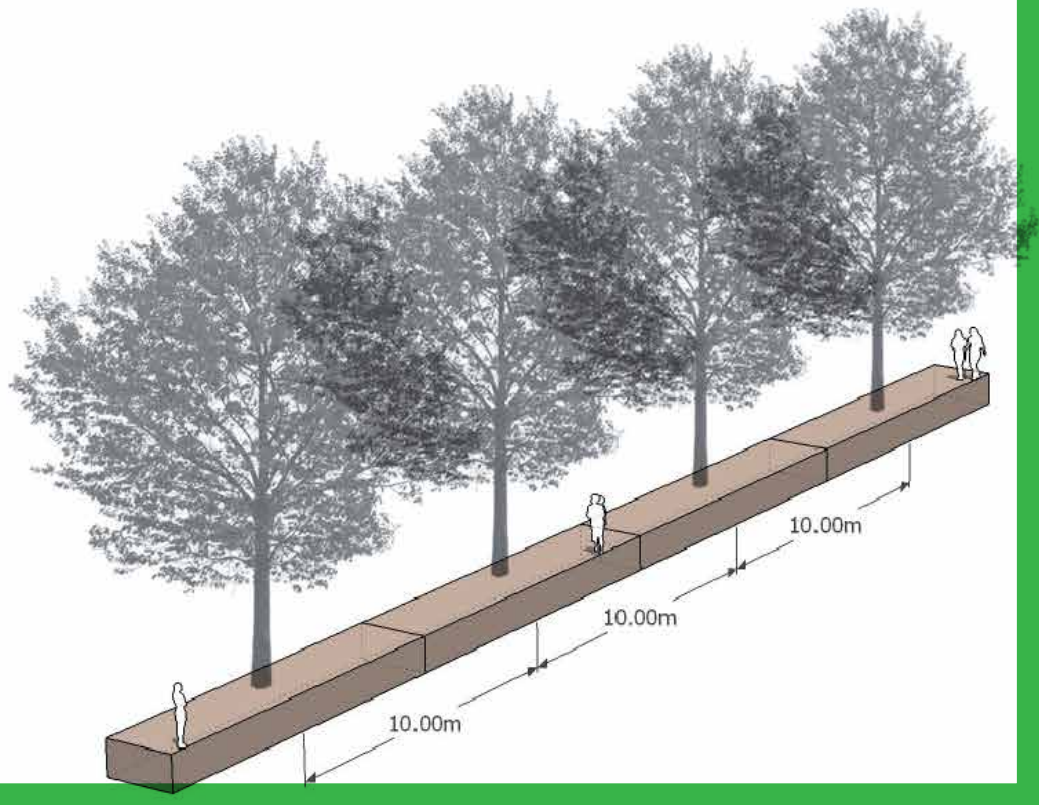
Existing

9m³ soil per tree
= 2.5m dia. canopy
= 6m to 7m spacing



Proposed

20m³ to **30m³** soil per tree
= 5m dia. canopy
= 10m spacing



Guiding Principles

Larger Pavement Openings

Existing

Precast **cover**

1.25m square opening

Guiding Principles

Larger Pavement Openings

Proposed

1.5m min. square opening

Opening provides room for

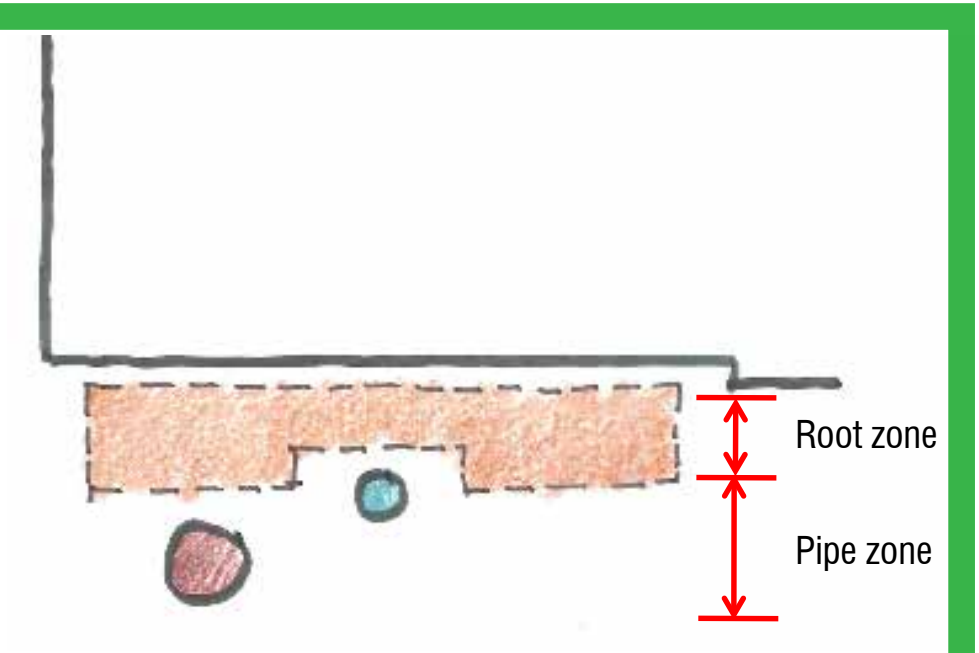
- Rootball
- Water infiltration
- Air exchange
- Root collar
- Trunk flare
- Maintenance

Guiding Principles

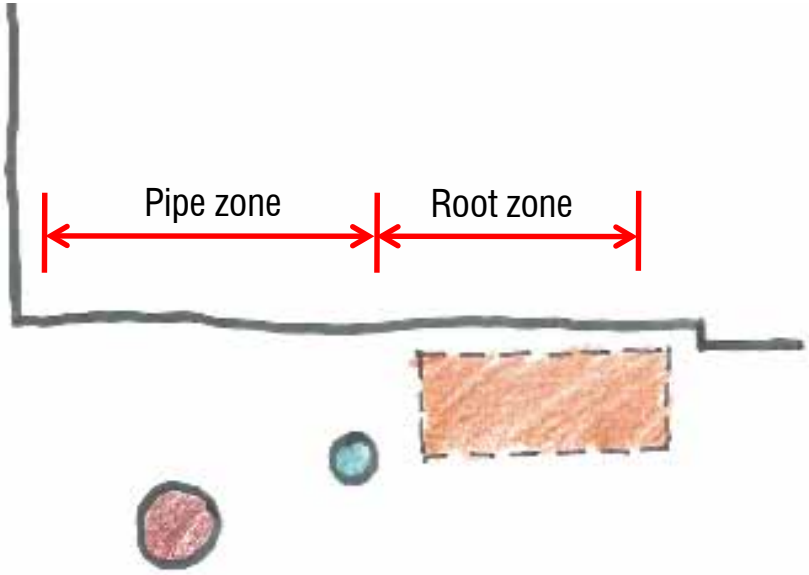
Utility & Root Zone Integration

Utilities should be permitted to **run through root and soil zones**

For utility setbacks, consider **vertical zoning** rather than horizontal zoning



Proposed
Vertical Zoning
Increases Soil Volume



Current
Horizontal Zoning
Limits Soil Volume

Guiding Principles

Strategic Cost-Effective Design

Use **fewer components**

Assume **structural sidewalk loads for mid-size service vehicles** (Kubota), not firetrucks

Open planter is the cheapest option, if there is enough space

Invest in **fewer trees with larger soil volumes**; increase the chance for trees to reach maturity

Sidewalk Typologies

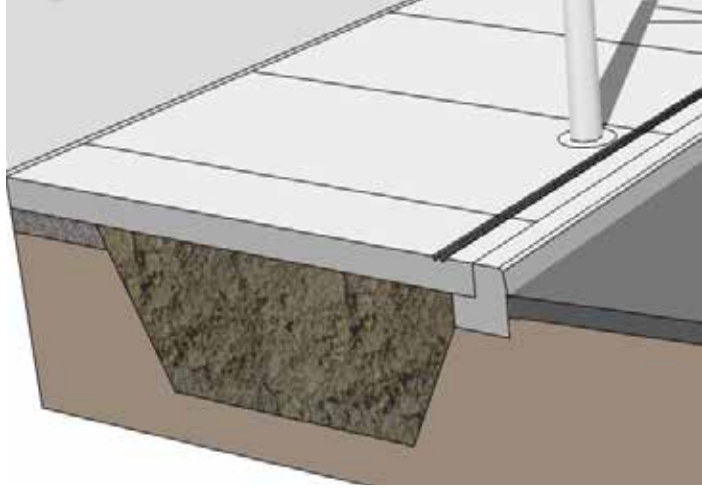
3 + Hybrids + Retrofits

Type-1: Pavement Bridge

Type-2: Soil Cells

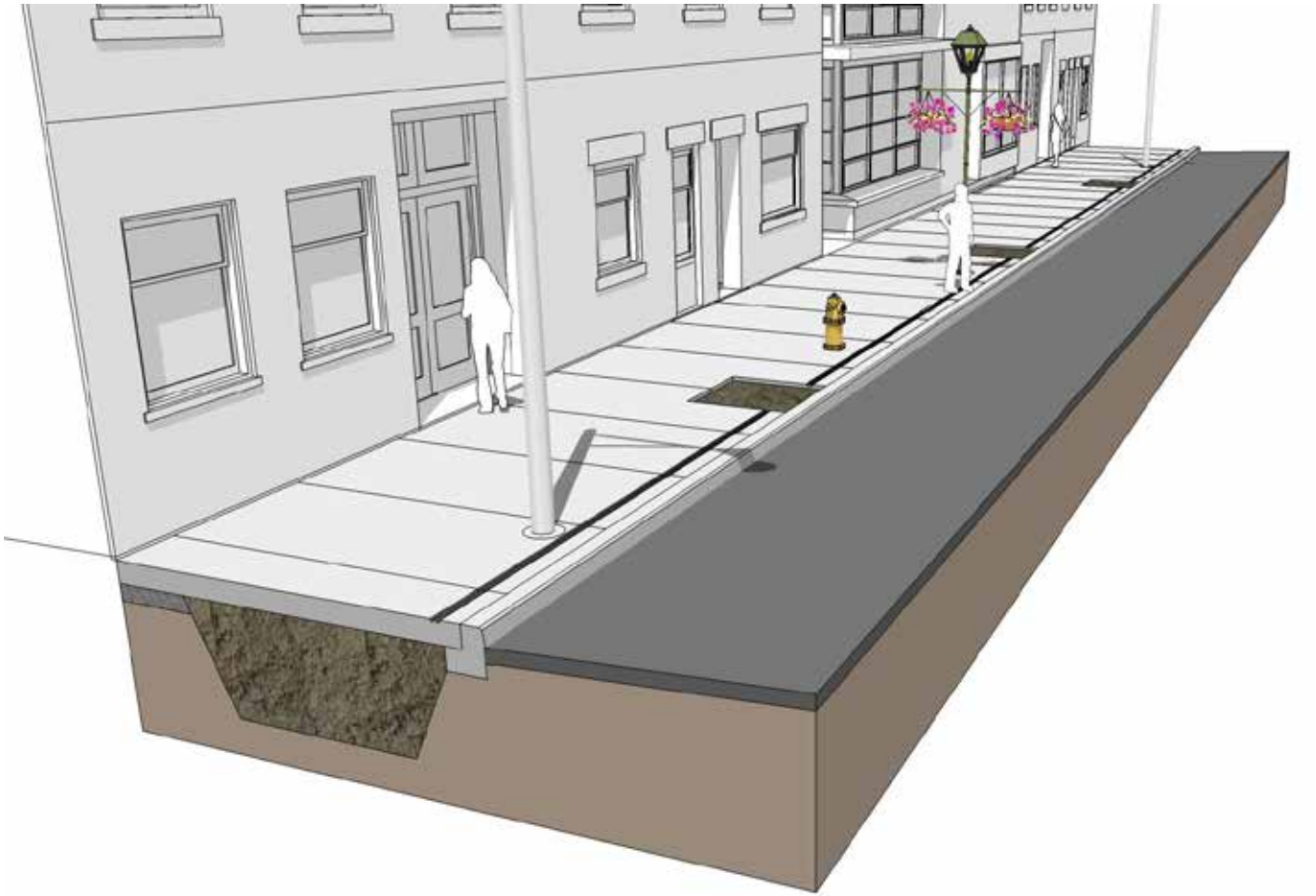
Type-3: Open Planter

Hybrids & Retrofits



Sidewalk Typologies

T-1A Pavement Bridge: CIP Structural Concrete



Minimum sidewalk width for this option is **3.5m**

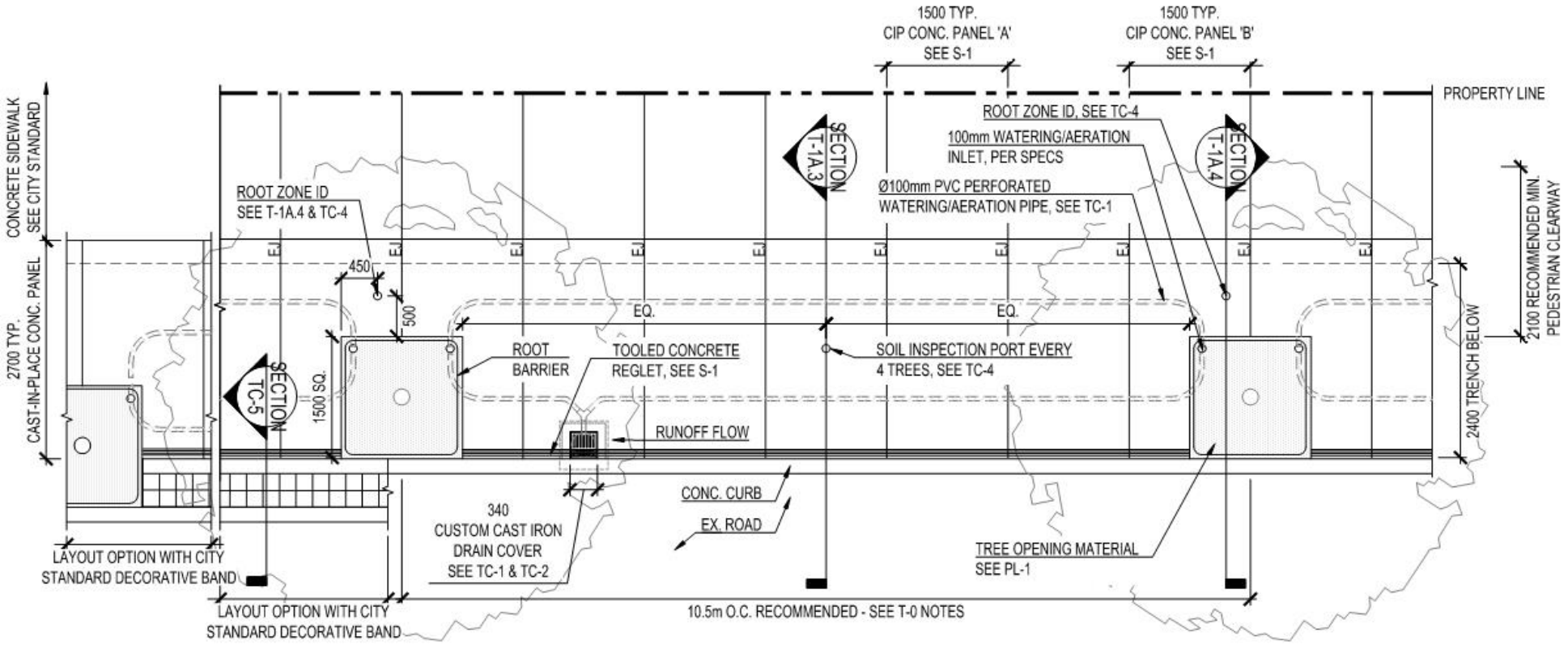
10m tree spacing

$8,700 per tree

Sidewalk Typologies

Detail Plan

Available in Best Practices Manual online

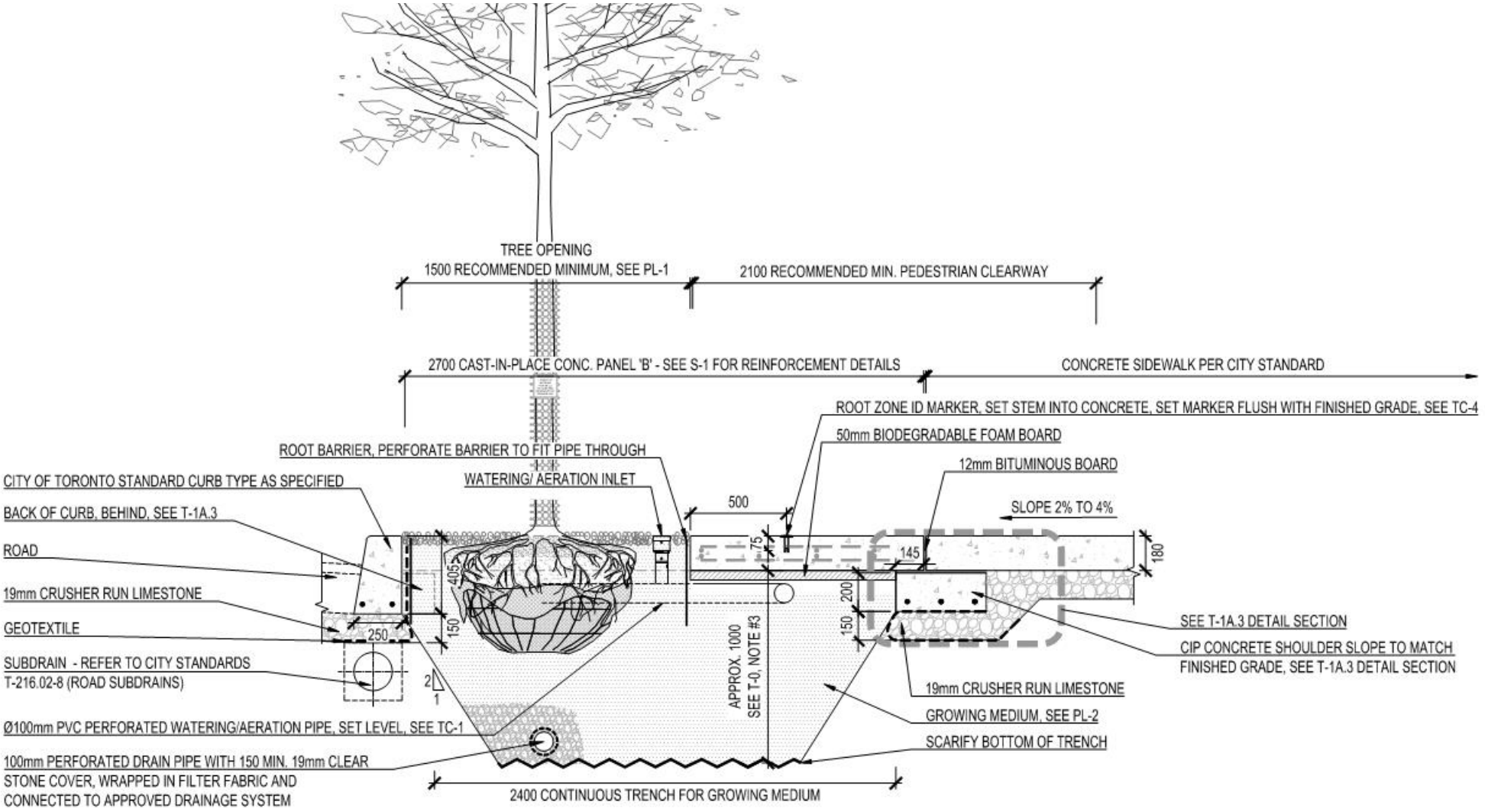


LAYOUT & MATERIALS PLAN: CAST-IN-PLACE STRUCTURAL CONCRETE PANELS OVER CONTINUOUS GROWING MEDIUM TRENCH

Sidewalk Typologies

Detail Sections

Available in Best Practices Manual online

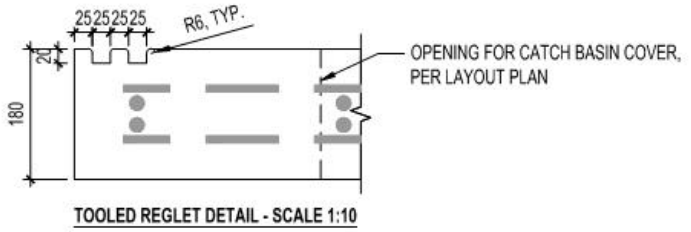


TYPICAL SECTION THROUGH CAST-IN-PLACE CONCRETE PANEL 'B' @ TREE OPENING

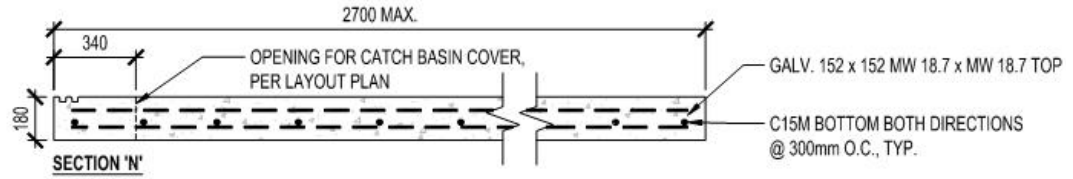
Sidewalk Typologies

Structural Panel Details

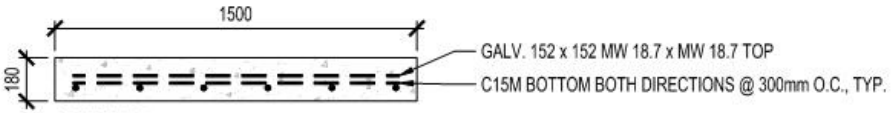
Available in Best Practices Manual online



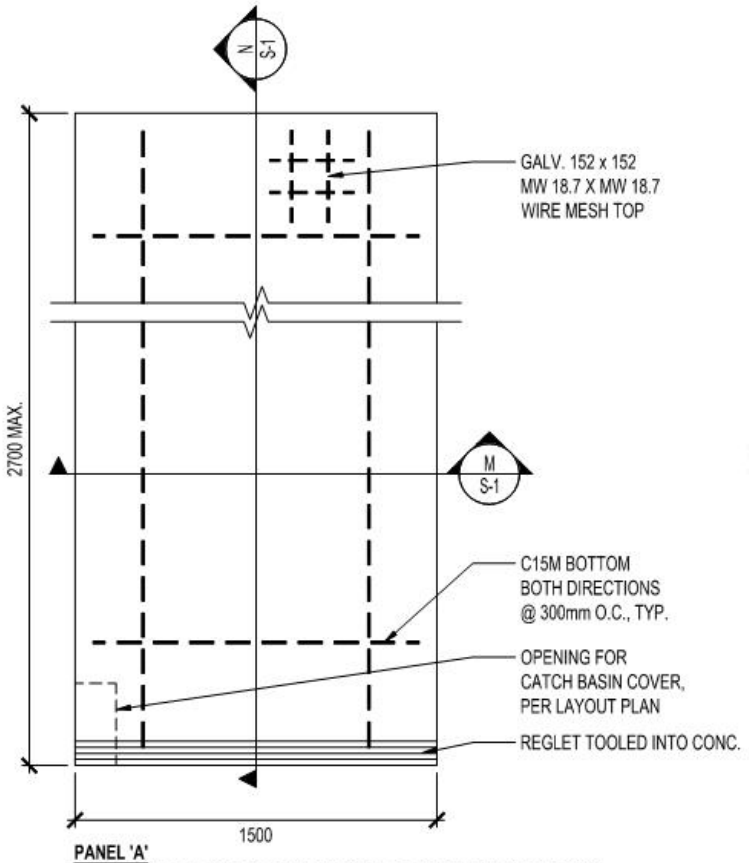
TOOLED REGLET DETAIL - SCALE 1:10



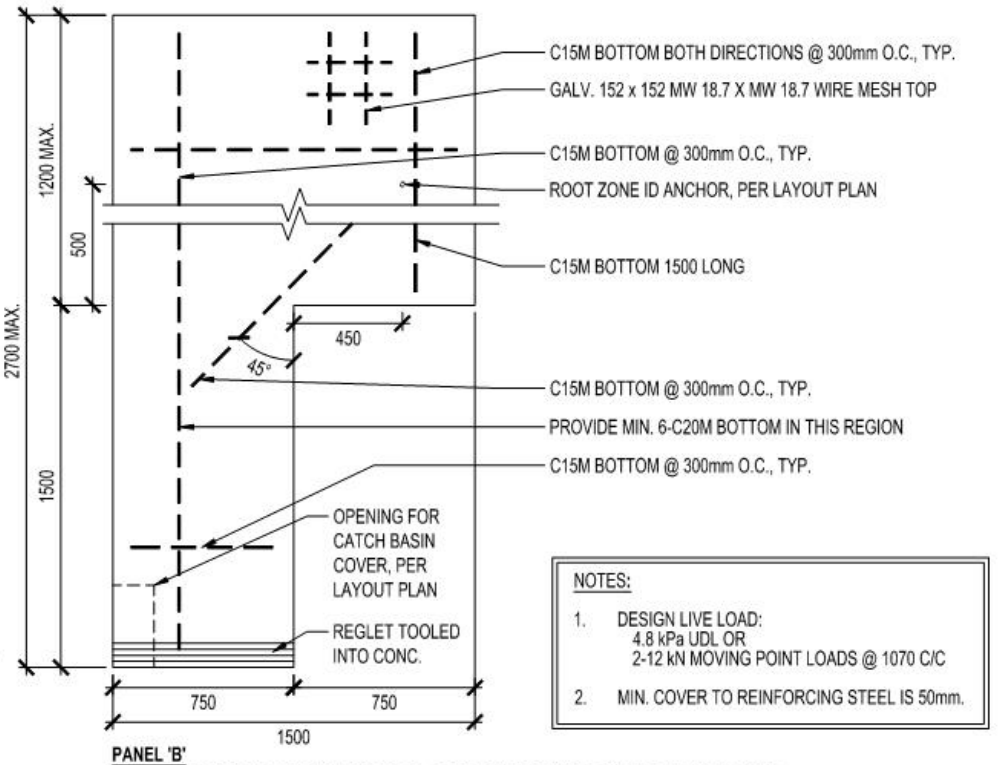
SECTION 'N'



SECTION 'M'



PANEL 'A'
TYP. PLAN: CAST-IN-PLACE STRUCTURAL CONCRETE TRENCH COVER



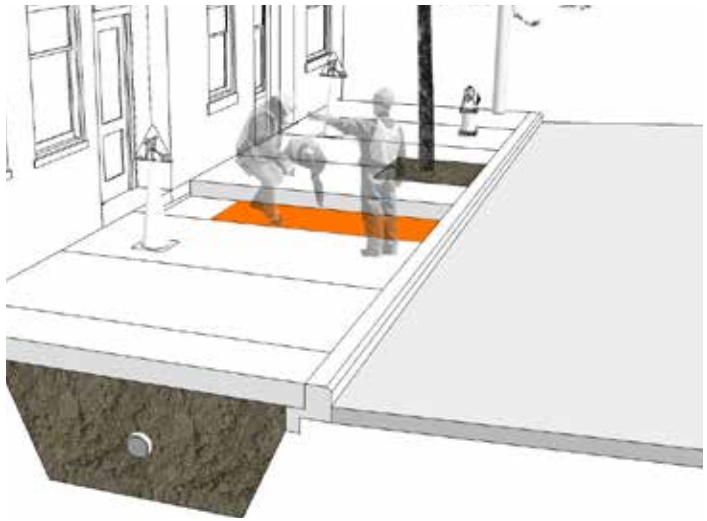
NOTES:

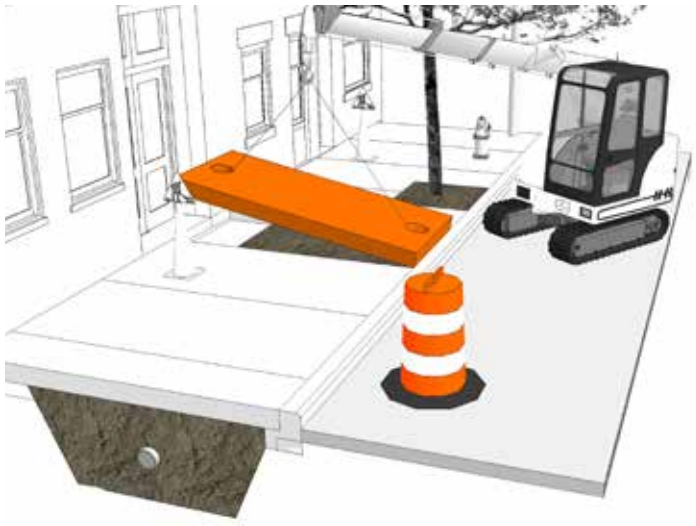
1. DESIGN LIVE LOAD:
   4.8 kPa UDL OR
   2-12 kN MOVING POINT LOADS @ 1070 C/C
2. MIN. COVER TO REINFORCING STEEL IS 50mm.

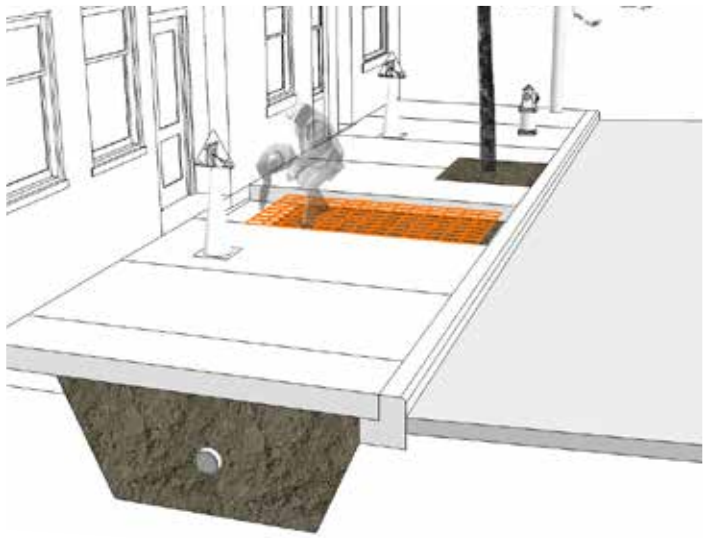
PANEL 'B'
TYP. PLAN: CAST-IN-PLACE STRUCTURAL CONCRETE TRENCH COVER @ TREE OPENING

Sidewalk Typologies

T-1A Pavement Bridge: CIP Structural Concrete







Type 1A is **NOT recommended with utilities that require emergency repairs**:

- pressurized water mains;
- gas (main or lateral);
- bare conduit (lighting, phone, etc.)

Sidewalk Typologies

T-1B Pavement Bridge: Precast Structural Concrete

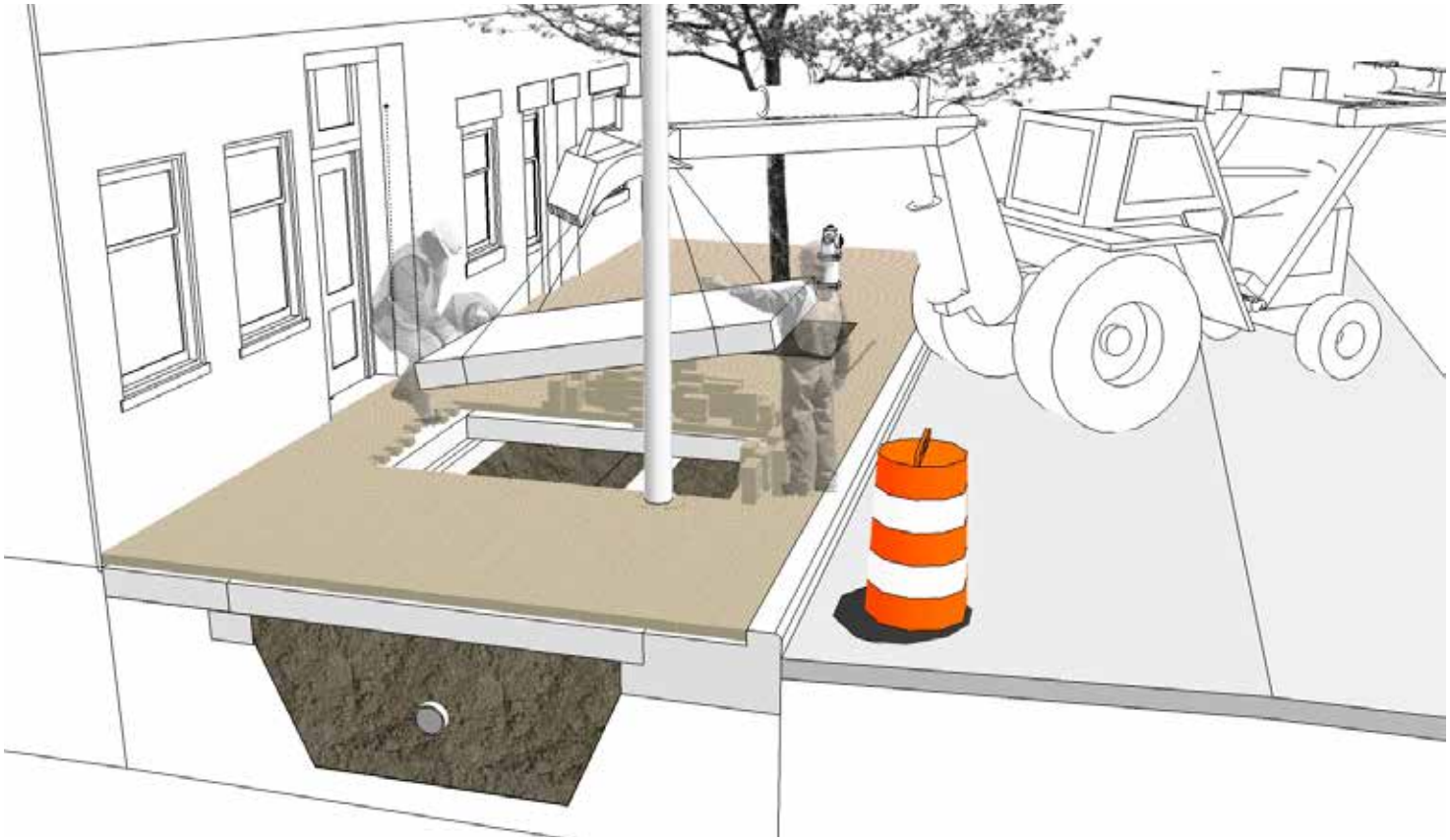
Minimum sidewalk width for this option is **3.5m**

10m tree spacing

$15,190 per tree

Sidewalk Typologies

T-1B Pavement Bridge: Precast Structural Concrete



Compatible with all utilities

Sidewalk Typologies

T-2 Soil Cell System

Minimum sidewalk width for this option is **3.5m**

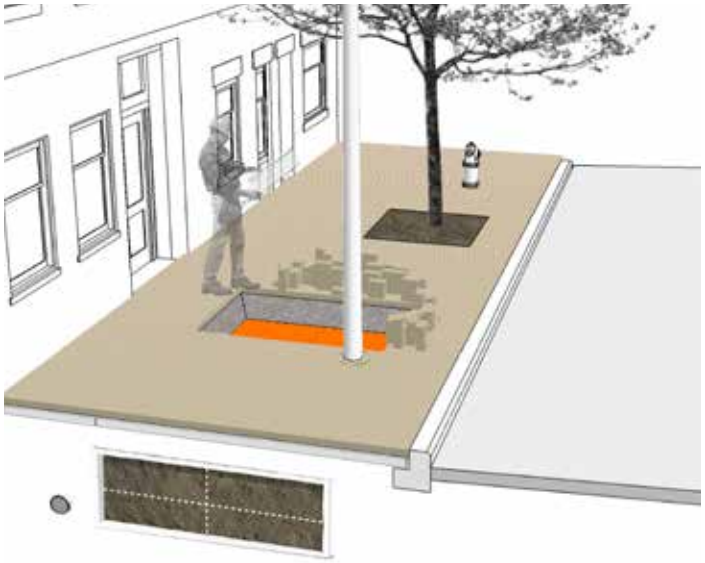
10m tree spacing

$17,000 per tree with concrete paving

$21,000 per tree with unit paving

Sidewalk Typologies

T-2 Soil Cell System



Compatible with all utilities

Shallow utilities (hydro & gas) could be laid within the root zone, with permission of the utility

Sidewalk Typologies

T-3 Open Planter

Minimum sidewalk width for this option is **5.7 m**

10m spacing

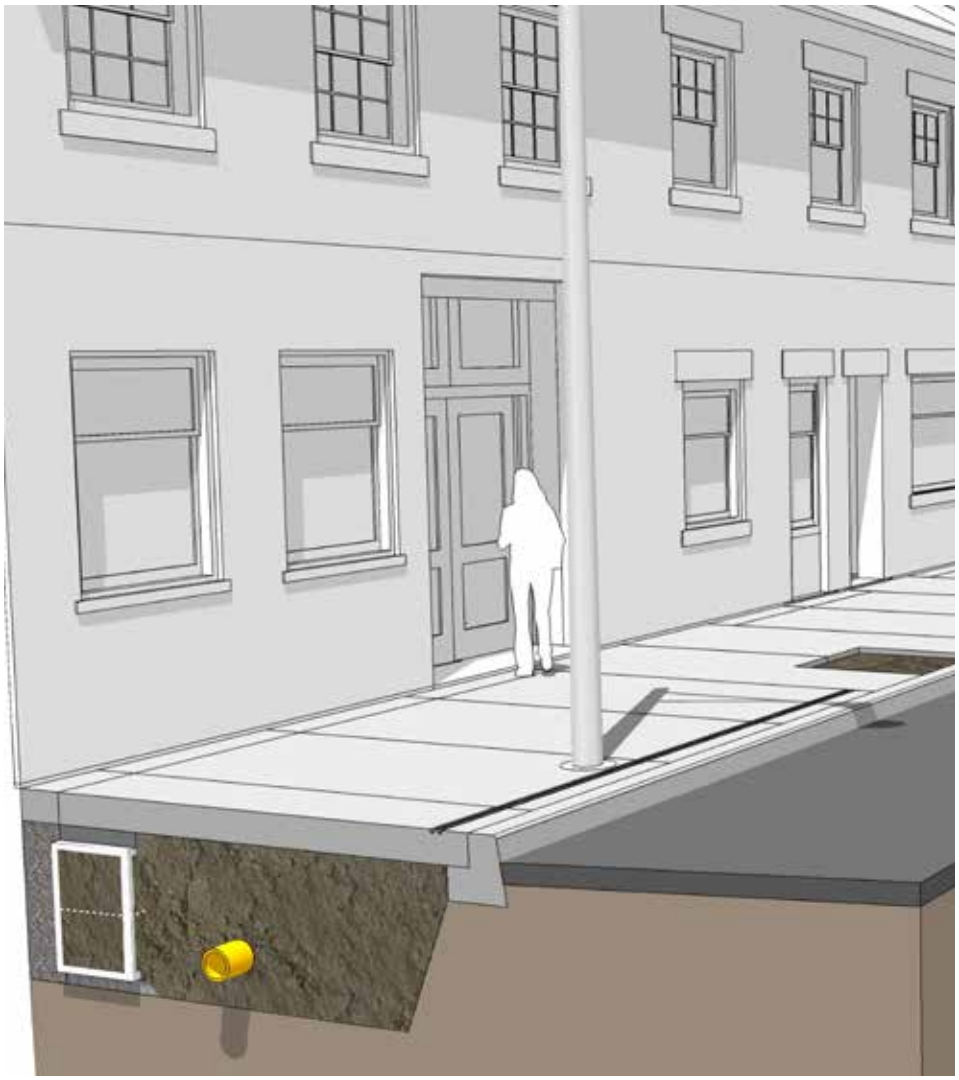
Curb Wall Planter

$6,300

Seat Wall Planter

$7,100

Sidewalk Typologies
Hybrids



Sidewalk Typologies
Retrofits

Mockups

Toronto Water Emergency Repair Scenario

PURPOSE:

To test if the Silva cell system was an impediment to accessing a burst water main

Mockups

Toronto Water Emergency Repair Scenario

CONCLUSION:

Toronto Water was able to easily access the pipe using the same methods they currently have in place for planned and emergency repair scenarios.

Mockups

Enbridge Gas Lateral Line & Riser Installation

PURPOSE:

To test whether Silva cells would pose any obstructions to the installation of a gas lateral and riser.

Mockups

Enbridge Gas Lateral Line & Riser Installation

CONCLUSION:

The soil cells posed no impediment to the lateral and riser installation. Enbridge Gas found it easier to install than the typical condition because of the loose soil in the Silva cells.

Component Parts
Typical Details

Tree Opening Surface Options

Tree Protection

Water

Root Zone ID

Component Parts

Tree Opening Surface Options

Existing practices that DO NOT WORK and divert funds from increasing soil volume

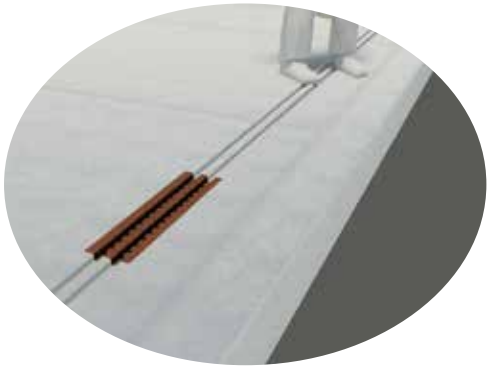
Component Parts

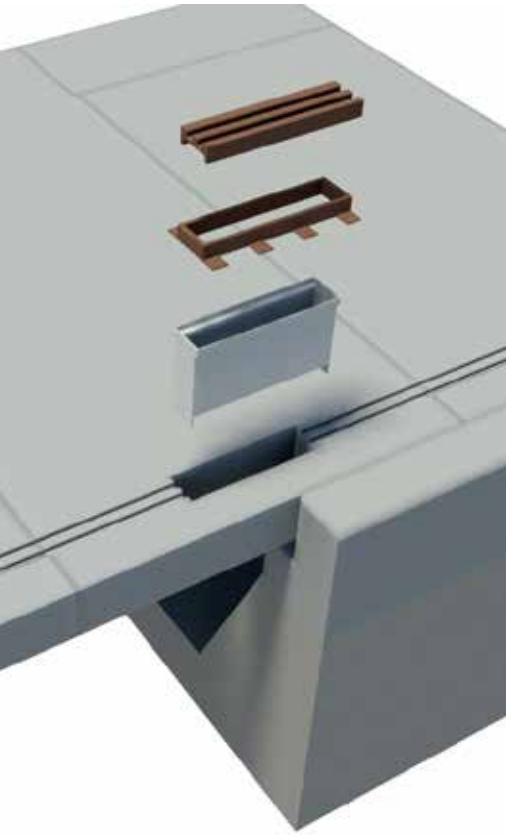
Tree Opening Surface Options

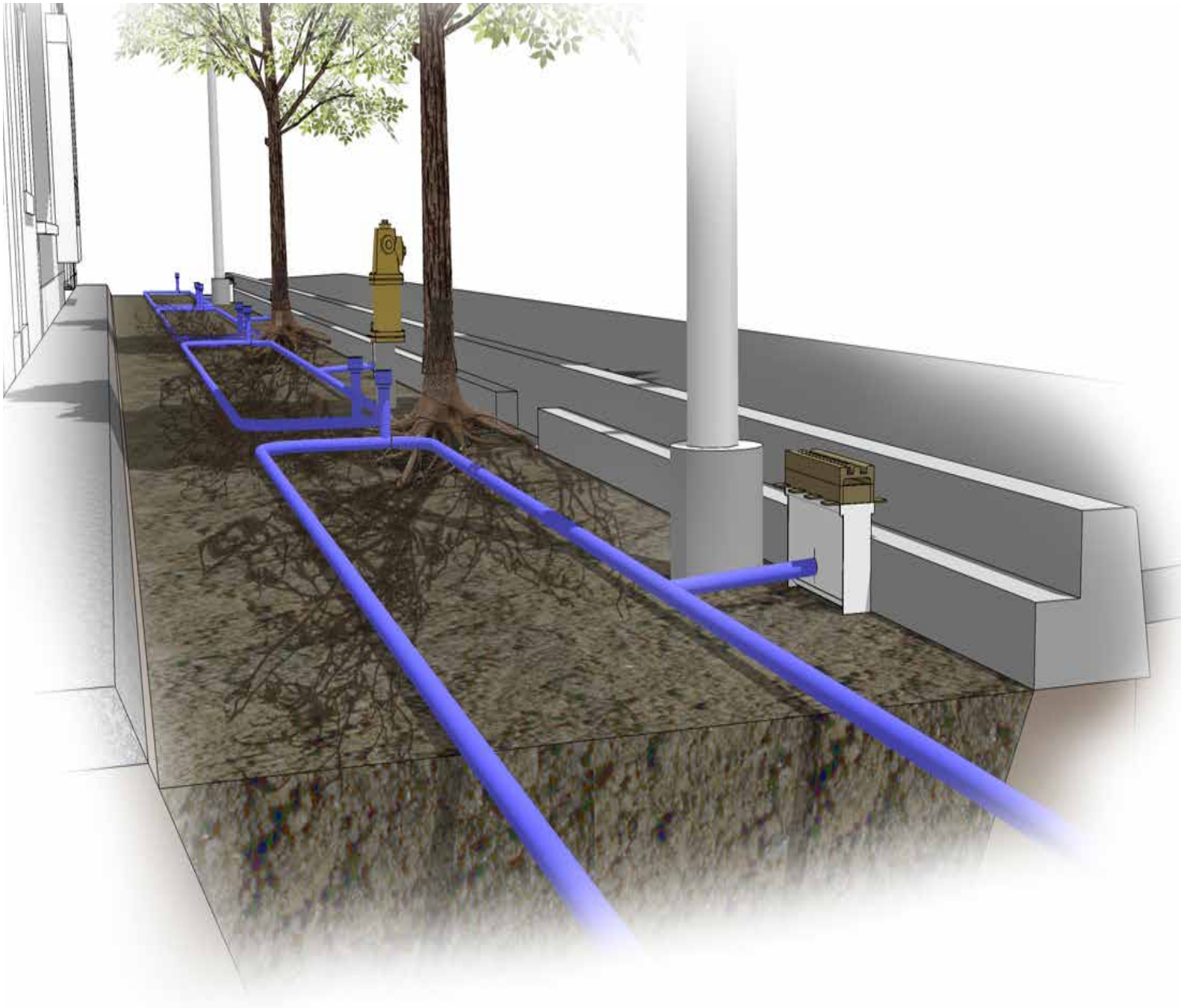
Bark/granite **mulch** or **groundcover planting** is recommended ie. **loose, permeable** material that allows the tree to grow

Component Parts

Passive Irrigation by Rainwater Harvesting







Component Parts

Root Zone ID

Horticultural Recommendations
Best Practices

Nursery stock quality

Tree installation

Tree maintenance

Tree species suitability list

Growing medium

Tree preservation

Horticultural Recommendations

Nursery Stock Quality

Reject poor nursery stock!

Horticultural Recommendations

Tree Species List

Tree Selection Chart

Botanical Name	Common Name	Origin	General Attributes / Comments	Potential Issues / Limiting Factors	Suitable Locations	Height Range[1] (metre)	Ideal pH
Ostrya virginiana	Ironwood	S. Ontario	Urban tolerant. Mid-sized. Few pests and diseases. Winter interest. Good for birds. Should be utilized more.	Few issues. Salt-sensitive and does not thrive in wet soils.	CT, OP, OL	8-12	4.2-7.6 [2]
Phellodendron amurense	Amur cork-tree	Asia	Fairly urban tolerant and hardy. Virtually pest and disease-free.	Male cultivars should be used to avoid messy fruit. Potentially invasive. Needs adequate soil volume to be truly urban tolerant. Pruning required for good structure.	OP, OL	10-15	6.0-8.0
Platanus occidentalis	Sycamore	S. Ontario (limited)	Urban tolerant. Visual interest. Good canopy form. Prefers moist and will tolerate quite poor soils. Dense shade.	Susceptible to several diseases and pests.	CT* (due to spreading roots), OP, OL	20-25	4.9-6.5 [2]
Platanus x acerifolia	London plane-tree	Europe	Urban tolerant. Visual interest. Good canopy form. Drought tolerant. More pest and disease tolerant than Sycamore.	Aggressive root system; provide adequate opening to accommodate planting in hard boulevard conditions.	CT* (due to spreading roots), OP, OL	20-25	3.7-8.2 (6.5[2] for var. 'Blood-good')
Quercus bicolor	Swamp white oak	S. Ontario (ltd.)	Under-utilized and not tested, but a promising urban tolerant tree. Tolerates wet, compacted soils. Does not tolerate alkaline soils.	As most oaks, susceptible to a number of pests and diseases. Untested in urban areas. Transplant in spring.	CT*, OP, OL	15-20	4.3-6.5 [2]
Quercus macrocarpa	Bur oak	S. Ontario	Urban tolerant. Large-growing. Visual interest. Good form and strong wood. Drought tolerant and adaptable to a wide range of soils.	Like most oaks, difficult to transplant. Spring planting. Requires ample soil volume to avoid root/sidewalk conflicts.	CT, OP, OL	20-25	4.5-7.5 [2]
Quercus muehlenbergii	Chinkapin oak	S. Ontario (ltd.)	Urban tolerant. Mid-sized. Well suited for streetscapes. Highly under-utilized and difficult to procure, should be utilized far more frequently. Few pest and disease problems. Adaptable to most soils.	Few issues. Difficult to procure. Spring planting.	CT, OP, OL	12-15	6.5-8 [2]

1 In optimal growing conditions. Difficult sites often result in shorter trees.

2 Ensure that growing medium pH is acceptable for species. The Growing Medium Specification that accompanies this report defines the acceptable pH range as 6.0 to 7.8. Where species require less alkaline soil, the pH maximum should be lowered to an appropriate level for those plants. Note that lower pH growing medium will cost more due to the lack of availability of lower pH components.

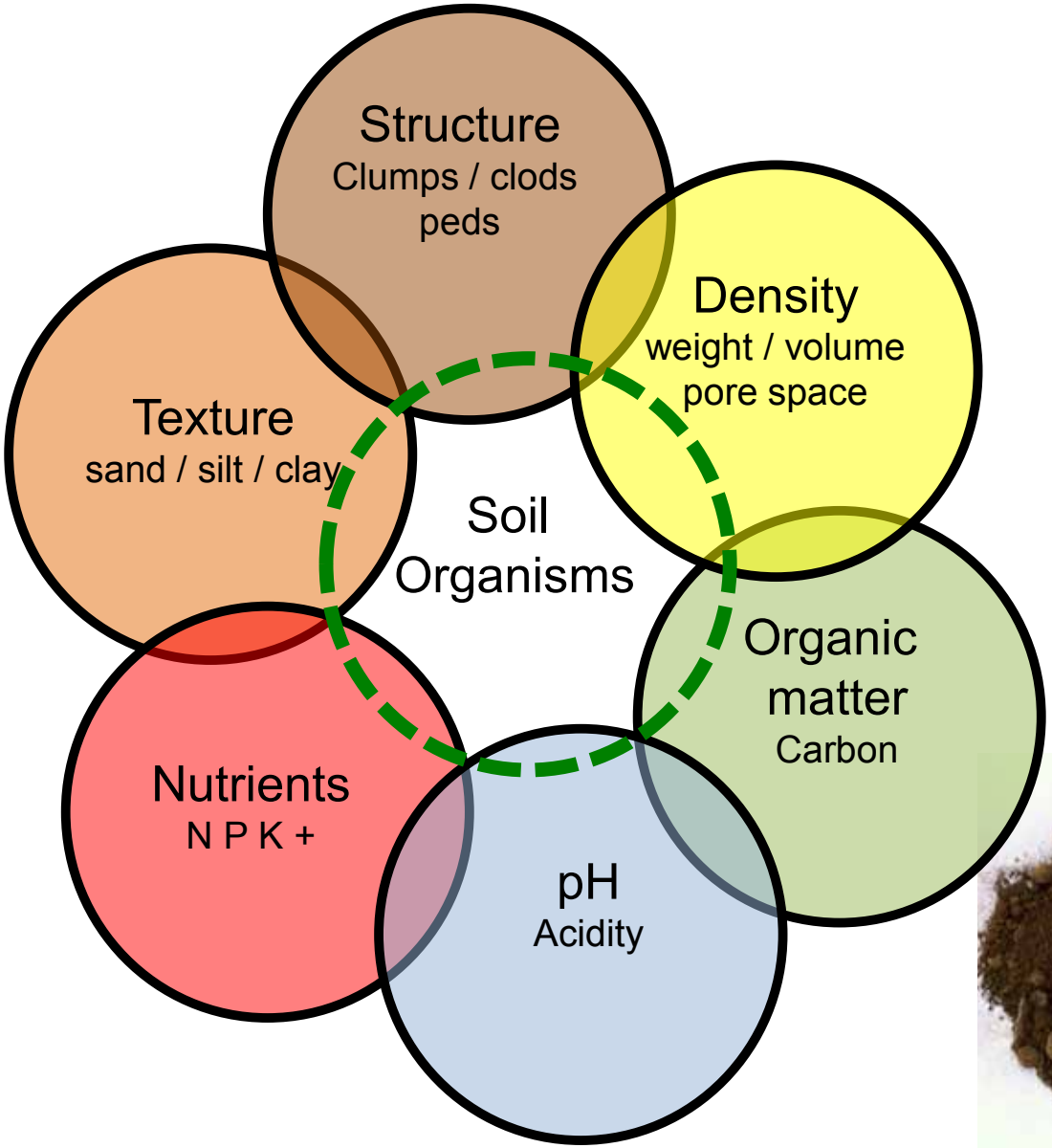
30+ street tree species for City of Toronto

Includes **native & non-native** species

Horticultural Recommendations

Growing Medium

AIR
+
WATER
+



HEALTHY
= GROWING
MEDIUM

Horticultural Recommendations

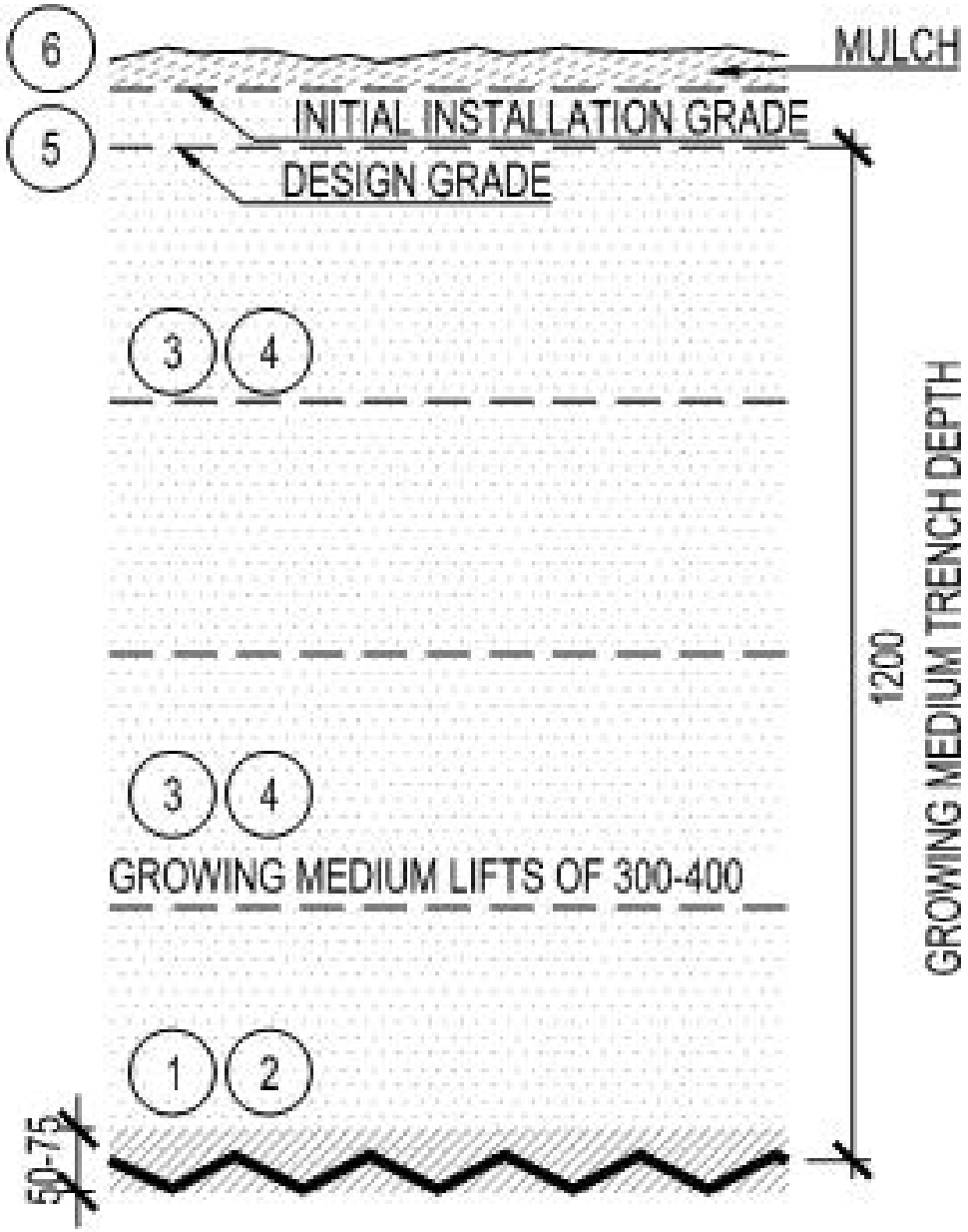
Growing Medium

Preserve soil structure

Install soil in lifts of 300 to 400mm

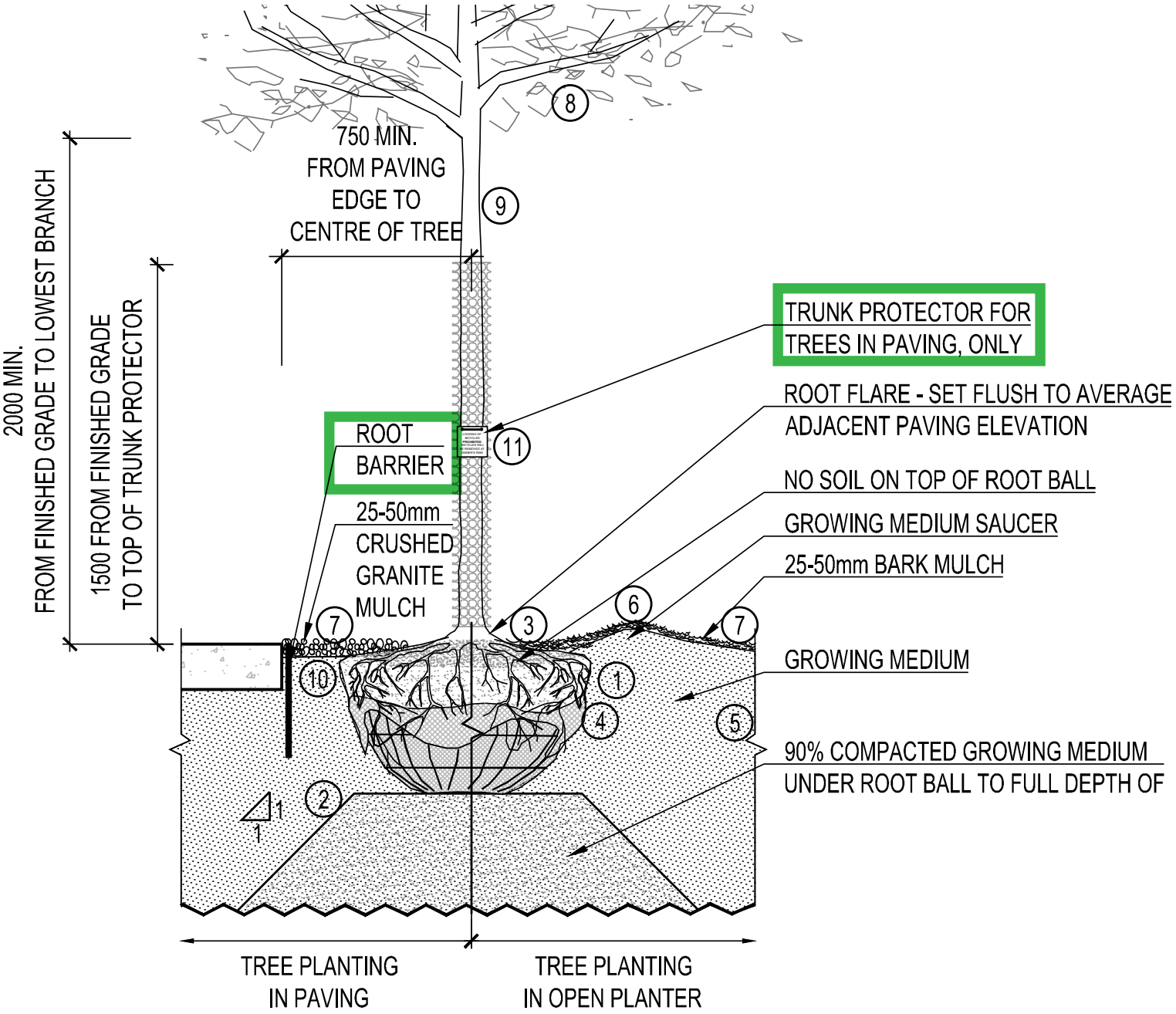
Lightly compact each lift

Do not blow soil into the bed!



Horticultural Recommendations

Tree Planting



Canopy Size and Climate Change

Growing Trees in City Sidewalks

To conclude:

Many different ways to plant trees but stick to the guiding principles

- **More Soil** (20-30m^3)
- **Larger Pavement Openings** (1.5m x 1.5m minimum)
- **Utility and Root Zone Integration** (vertical zoning)
- **Strategic, Cost-efficient Design** (fewer components)

Parks, Forestry & Recreation

- Recreation Programs & Registration
- Parks & Trails
- Trees & Ravines
  - Toronto Tree Information
  - Ravines & Natural Features
  - Forest Health Care & Pests
  - Urban Forestry Operations
- Permits & Rentals
- Community Involvement
- Partnerships
- Accessibility
- Jobs

Tree Details & Drawings

Listed below are a set of detail drawings available for viewing, printing or downloading.

Get ADOBE READER

You will need to have the latest version of the FREE Acrobat Reader on your computer to view this PDF document.

Details and Drawings

- Decorative Tree Lighting Details (TL-1) PDF

Tree Planting Specifications:*

- "Planting Detail for Balled and Burlapped Trees in Turf", Detail (PD-101) PDF
- Continuous Soil Trench: Open Planting Bed and Concrete Sidewalk (T-1A) 4.5mb (PDF)
- Continuous Soil Trench: Raised Planter and Concrete Sidewalk (T-2A) 3.9mb (PDF)
- Continuous Soil Trench: Precast Concrete Planter Cover and Concrete Sidewalk (T-3A) 3.6mb (PDF)
- Trees In Soft Landscape (sL): Planting Between Curb and Sidewalk (T-sL1) PDF
- Trees in Soft Landscape (sL): Planting Between Sidewalk and Property Line (T-sL2) PDF
- Trees in Soft Landscape (sL): Planting Double Row of Trees (T-sL3) PDF

* Revising the Streetscape Manual Tree Planting Details:

In 2011 the City commissioned a study to make recommendations for best practices for ways to increase the size and lifespan of trees growing in hard surfaces. The results of this study are outlined in Tree Planting Solutions in Hard Boulevard Surfaces: Best Practices Manual, finalized in February, 2013.

This document provides the structural details and construction specifications that will form the basis of the next generation of the Streetscape Manual's Tree Planting Details.

A number of projects have already been approved and have been constructed on the basis of these details.

Before the end of this year this web site will have available a complete set of standard design drawings based on the Best Practices Manual (BPM): Tree Planting Details.

The complete Best Practices Manual is also available below as a reference to help inform future tree planting solutions.

Two important points to remember when developing a tree planting solution:

1. Only use the 'BPM: Tree Planting Details' as a reference document for the structural and construction specifications. Design solutions must be specific to the site while being consistent with the performance requirements outlined in the 'BPM: Tree Planting Details' document.

2. All design solutions must include the location and integration of any utility infrastructure

- Tree Planting Solutions in Hard Boulevard Surfaces Best Practices Manual (63 mb) PDF
- Best Practices Manual - Tree Planting Details (6 mb) PDF

Related Information

- Urban Forestry: By-laws & Policies
- Urban Forestry: Forms
- Tree Planting
- City Owned Trees
- Urban Design Streetscape Manual
- City Street Tree By-law (Article II of Chapter 813) PDF
- Tree Protection Policy and Specifications for Construction Near Trees (PDF)

Canopy Size and Climate Change

Growing Trees in City Sidewalks

Presented by Clara Kwon OALA CSLA

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