

An aerial photograph of Toronto, Canada, showing the city skyline, the CN Tower, and the waterfront. The image is used as a background for the presentation slide.

Integrating Green Infrastructure in Constrained Urban Sites

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Design Project Manager, Public Realm

Waterfront Toronto

NOVEMBER 4, 2021

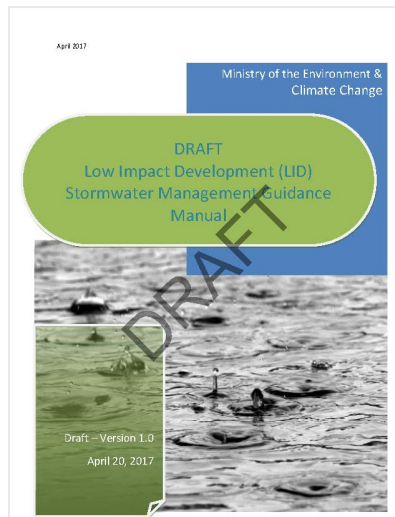
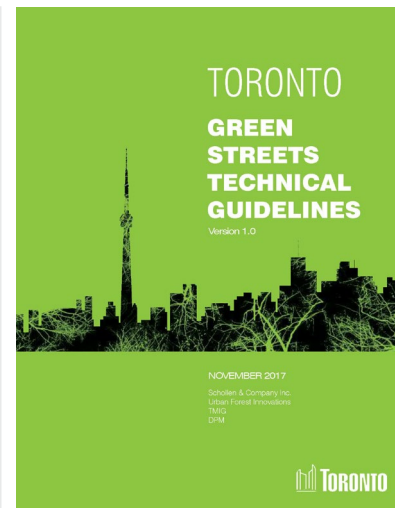
Integrating Green Infrastructure in Constrained Urban Sites

1. Policy Frameworks
2. Opportunities for Green Infrastructure Integration
3. Urban and Waterfront Constraints
4. Waterfront Street Projects:
 - Lake Shore Public Realm Pilot Project - *retrofit*
 - Queens Quay East & Waterfront East LRT Extension – *retrofit & new build*
 - Cherry St. & the Port Lands Roads – *new build*
5. Strategies & Questions for Further Research

Green Infrastructure Policy Frameworks

Managing stormwater through Green Infrastructure and Nature-Based Solutions is becoming increasingly integrated into policy, but difficult to implement in practice.

- Green Streets Technical Guidelines & Standards
- Toronto Green Standard v3
- Wet Weather Flow Masterplan
- MOE SWM Guidelines



Green Infrastructure & LID Guidance Resources

There is no shortage of resources and guidance for Green Infrastructure freely available.

Wiki.sustainabletechnologies.ca/wiki/Main_Page

Apps UNIQUE Home — National L... Sign in to your acco... Toronto Historical L... Toronto Waterfront... Imported From IE Employee Health Sc... Climate Positive De... EBF08-06 Queens... Dashboard — Finan... Other bookmarks Reading

English Log in

MAIN PAGE READ VIEW HISTORY Search LID SWM Planning and Design Guide

LOW IMPACT DEVELOPMENT STORMWATER MANAGEMENT PLANNING AND DESIGN GUIDE

Selected articles

We have many more articles. If you don't see what you're looking for, please check the [contents](#) page or use the search bar

Tools

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LID BMP Fact Sheets

Better site design

Bioretention

Cost analysis resources

Curb inlets

Green roofs

Infiltration Chambers

Infiltration testing

Inspections and Maintenance

Low Impact Development Treatment Train Tool

Permeable pavements

Plants

Site assessment

Notices

Welcome reviewer! We have been looking forward to your arrival.

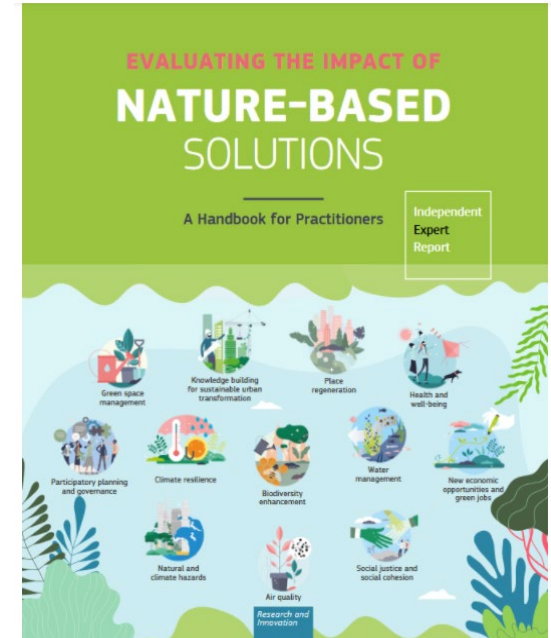
In anticipation we have prepared a short printable form to help direct your critique of the wiki.

[Download pdf feedback form](#)

If you have a shorter comment or observation please use the anonymous feedback box at the bottom of every page.

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- What is low impact development?
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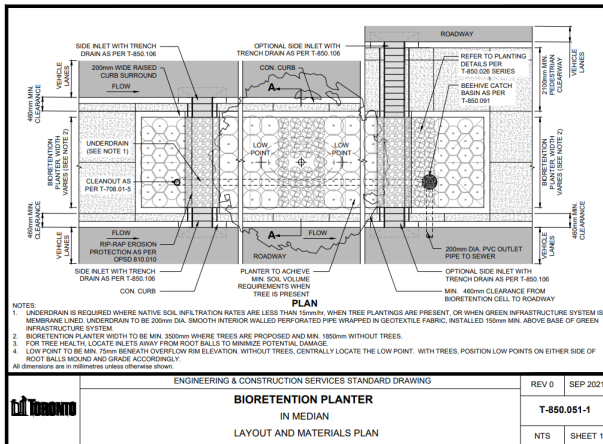


We finally even have approved standards in Toronto for GI.

Share Print

In This Section	
Standards for Designing and Constructing City Infrastructure	—
Archived Construction Specifications	
Archived Drawings	
Archived Revision Information Sheets	
Capital Construction Signage	
Construction Specifications and Drawings for Green Infrastructure	
Construction Specifications and Drawings for Road Works	
Construction Specifications and Drawings for Sewers and Watermains	
Construction Specifications and Drawings for Traffic Control Devices	
Development Infrastructure Policy & Standards (DIPS)	

Robert Klimas, P.Eng., Senior Engineer,
Business Improvement & Standards



Waterfront Toronto Policy Frameworks

Waterfront Toronto's mandate to build sustainable communities leading with landscape is well aligned with the objective to integrate nature-based solutions in the public realm.

- Resilience and Innovation Framework for Sustainability
- Minimum Green Building Requirements (MGBRs) V3, aligned with TGS Tier 3



Opportunity for Green Infrastructure Integration



The Opportunity



Port Lands

Keating
Precinct

East Harbour

East
Bayfront

300+ hectares of new infrastructure and development will be built on the eastern waterfront and the Port Lands in the next few decades.

Will it continue business as usual or integrate green infrastructure and nature based solutions?

Why isn't there more GI implemented in the public realm? What are the barriers?

City of Toronto Constraints:

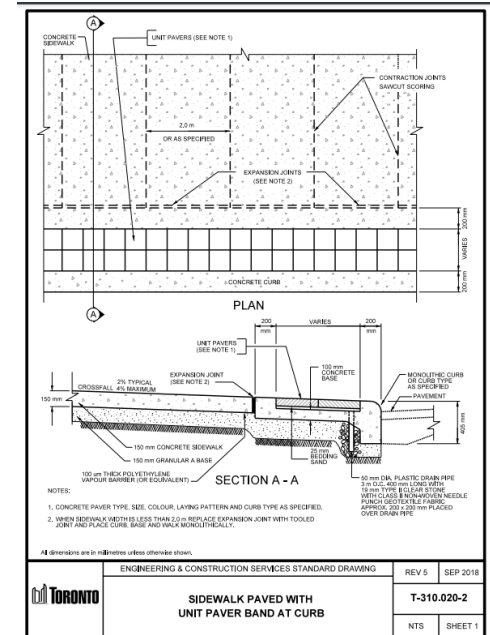
- Densely packed utilities
- Strict Standards for road and transit ROWs
- Heavy Salting in Winter
- Unclear maintenance responsibilities for planting and GI in ROW

Waterfront Constraints

- High & variable groundwater
- Variable lake levels
- Contaminated soils and groundwater
- Stormwater flooding due to widespread hardscape

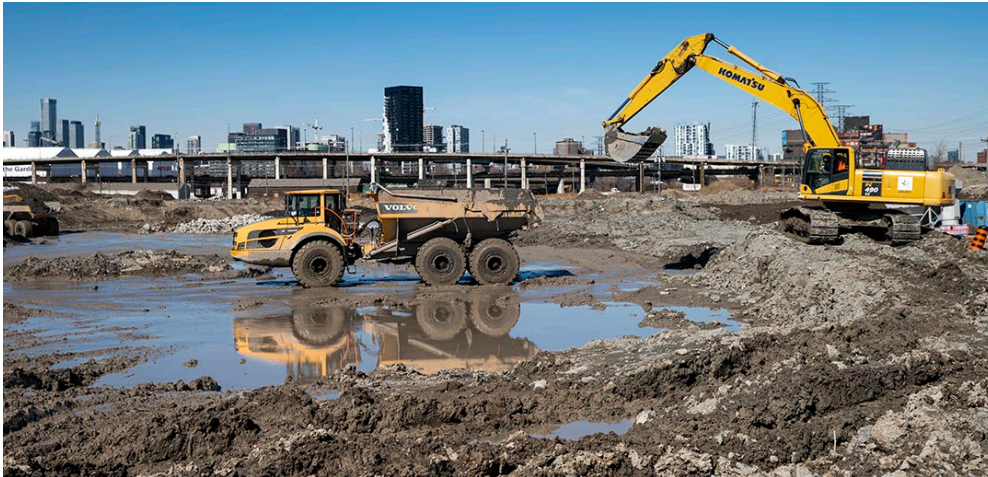
Urban Challenges

- Densely packed utilities
- Strict Standards for road and transit ROWs
- Heavy Salting in Winter
- Unclear maintenance responsibilities for planting and GI in ROW



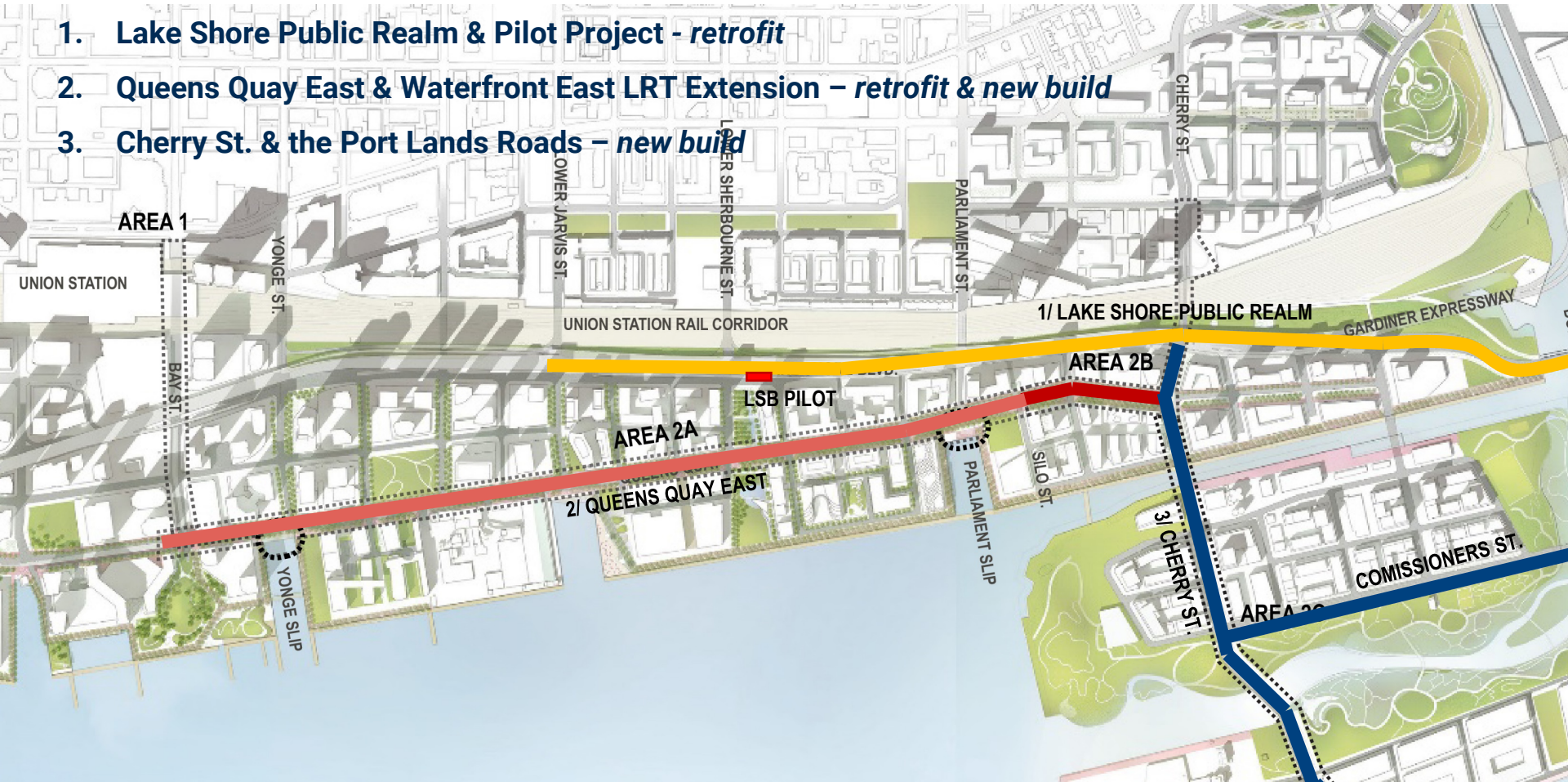
Additional Waterfront Challenges

- Variable lake level and flooding
- High and variable groundwater
- Stormwater flooding due to widespread hardscape
- Soil and groundwater contamination due to previous industrial uses



Waterfront Streetscape & Transit Projects

1. Lake Shore Public Realm & Pilot Project - *retrofit*
2. Queens Quay East & Waterfront East LRT Extension – *retrofit & new build*
3. Cherry St. & the Port Lands Roads – *new build*



Lake Shore Boulevard East – Existing Conditions



ZONE 1 - GRITTY
JARVIS STREET TO BONNYCASTLE



ZONE 2 - NARROW
BONNYCASTLE TO CHERRY



ZONE 3 - INFRASTRUCTURAL/NATURAL
CHERRY TO DON ROADWAY



ZONE 4 - URBAN
DON ROADWAY TO CARLAW AVENUE



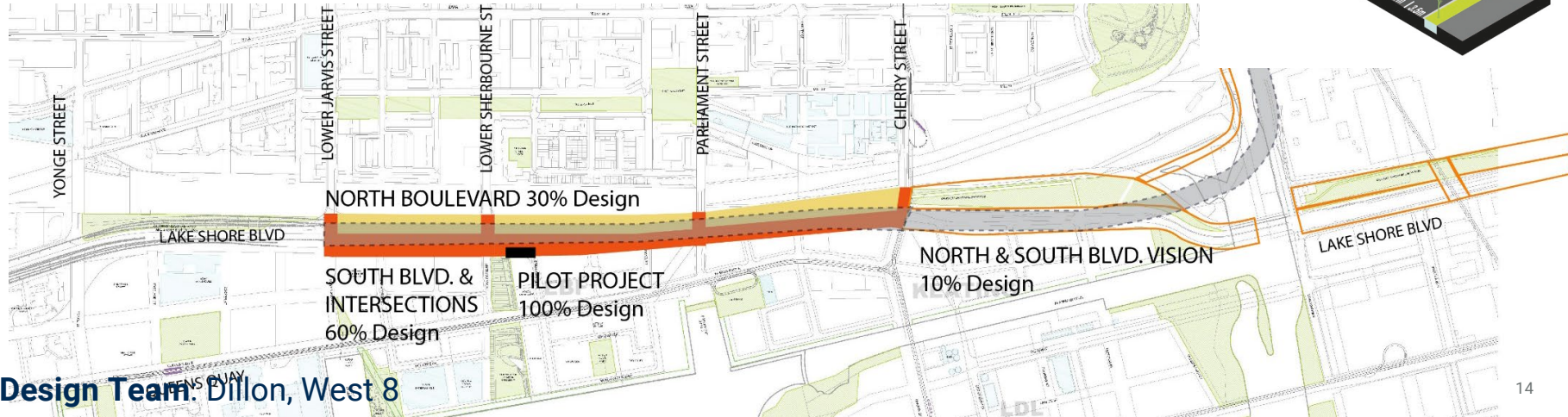
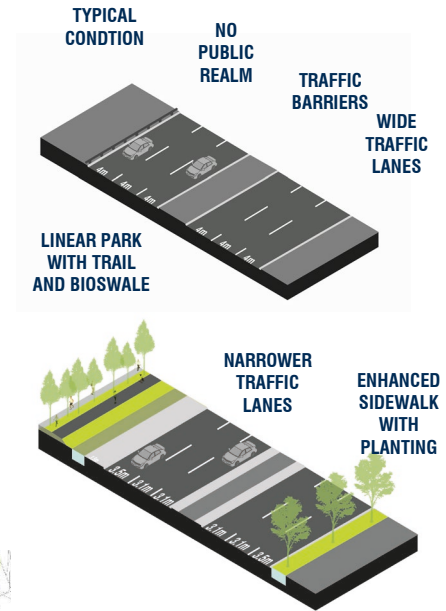
Gardiner & Lake Shore Blvd. East Public Realm



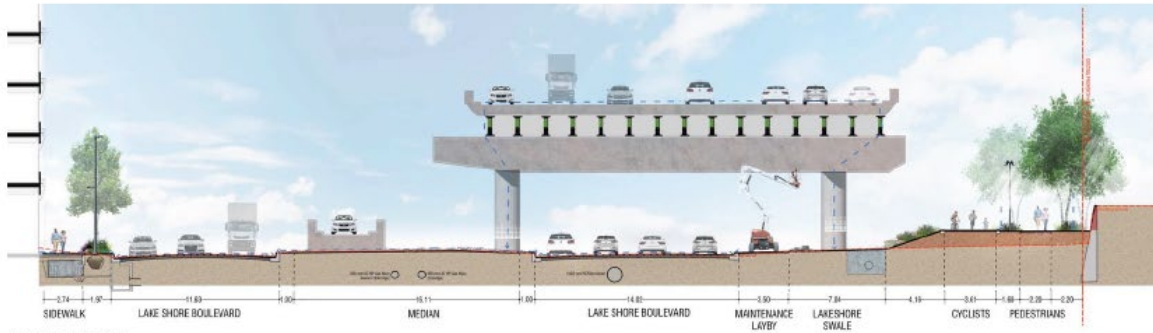
SOUTH SIDEWALK & BIORETENTION PLANTER



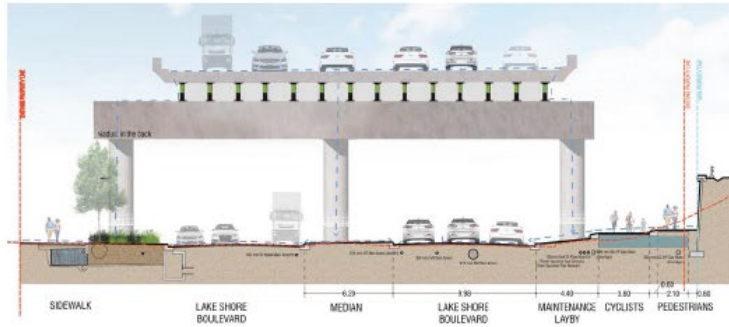
NORTH LANDSCAPED TRAILS & BIOSWALE



Gardiner & Lake Shore Public Realm - Typical Sections



ZONE 1 - GRITTY
JARVIS STREET TO BONNYCASTLE







ZONE 2 - NARROW
BONNYCASTLE TO CHERRY






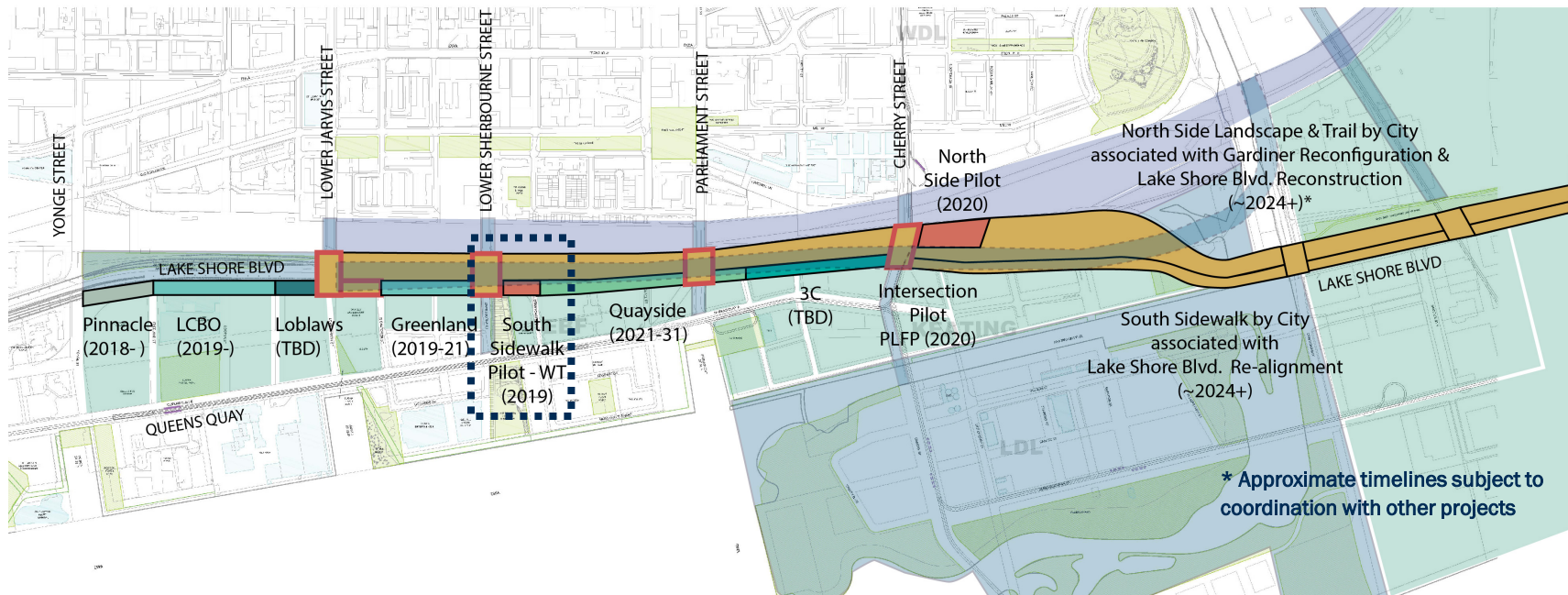
ZONE 3 - INFRASTRUCTURAL/NATURAL
CHERRY TO DON ROADWAY

Phasing & Implementation Strategy

LEGEND Design Deliverable (DELIVERY AGENT)

-  Linear Park & Streetscape Master Plan (BY CITY)
-  Quick Start Intersection Guidelines & Ultimate Intersections Design (BY CITY)
-  Pilot Projects 100% Design (BY CITY / WT)
-  Design Guidelines (BY VARIOUS DEVELOPERS)

-  Metrolinx Projects
-  City / WT Infrastructure Projects
-  Private Development



South Sidewalk Design Guidelines

SPECIES DIVERSITY AND SALT TOLERANCE



Mid-block Trees
Shade and disease tolerant Elm varieties

Ulmus americana "Homestead"
Ulmus japonica x Wilsoniana
"Morton"
Ulmus americana "Princeton"
Ulmus americana "Valley Forge"



Diversity at Intersections
Tulip Trees and Oaks

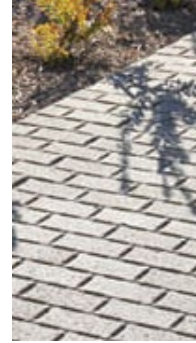
Liriodendron tulipifera
Quercus bicolor
Acer rubrum



Groundcover planting
Salt and shade tolerant perennial species

Astilbe chinensis "Visions in White"
(Chinese astilbe)
Astilbe "Delft Lace" (Delft Lace astilbe)
Euribia macrophyllus (native aster)
Solidago flexicaulis (goldenrod)
Deschapsia cespitosa (tufted hair grass)

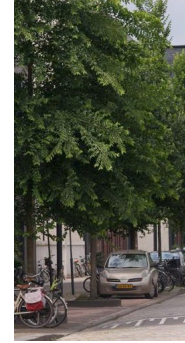
Permeable
concrete unit
pavers



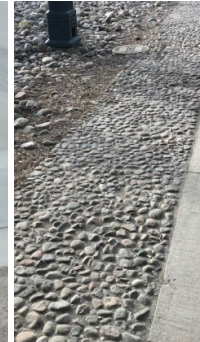
Typical concrete
curbs on
medians



Climate resilient
planting



Stabilized stone
as median edge



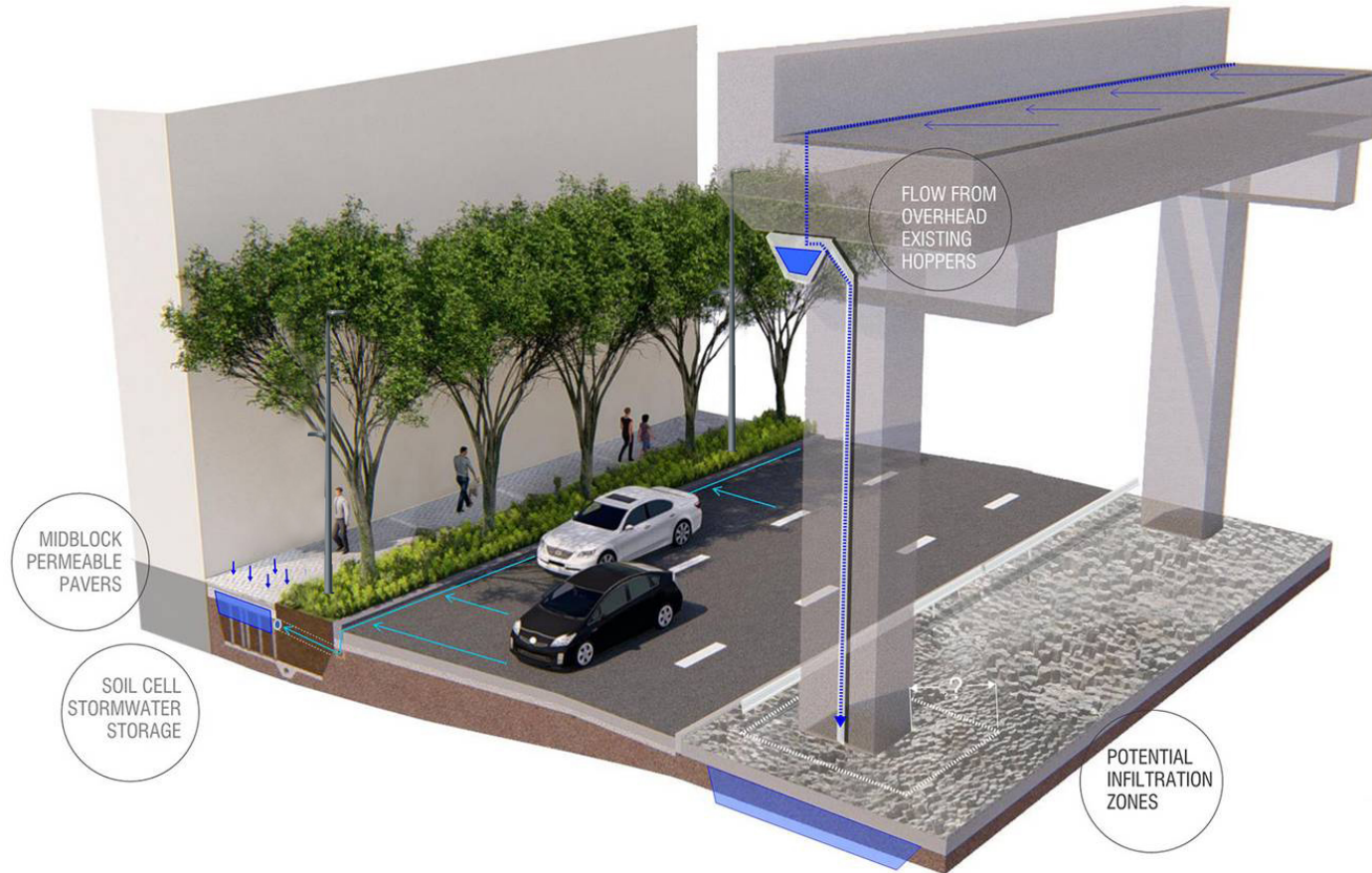
Granite curbs
along south side
developments



Rough Natural
Stone Aggregate
2-4cm Dia. and
10-20cm Dia

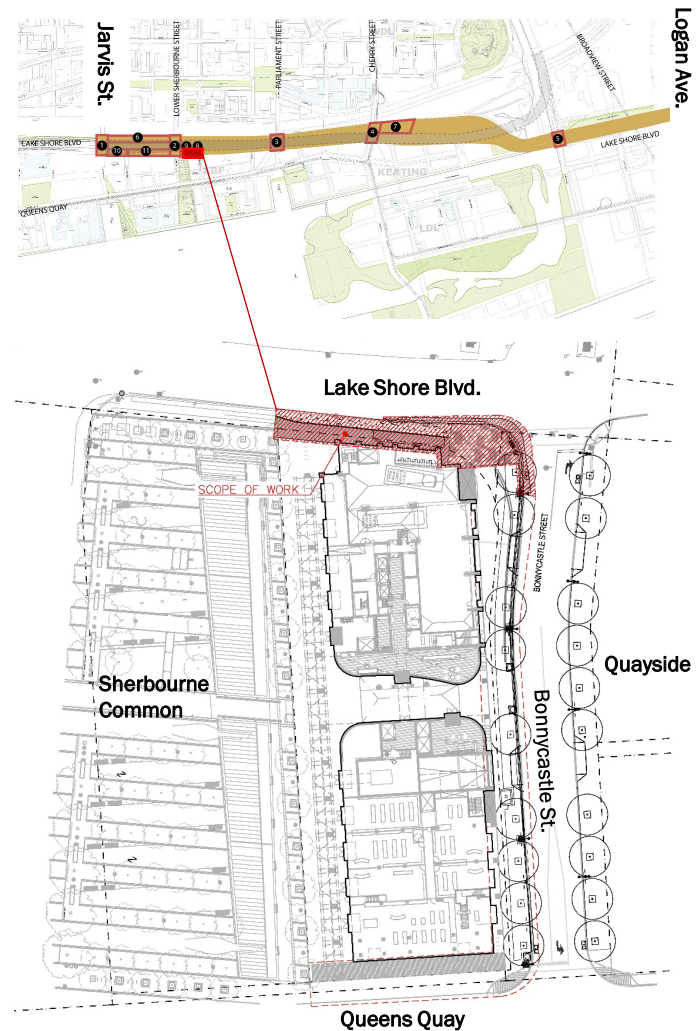


Stormwater Management through Green Infrastructure

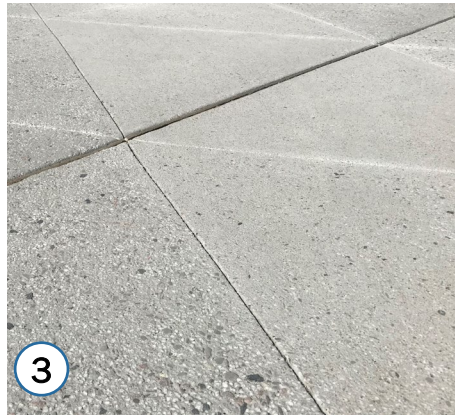
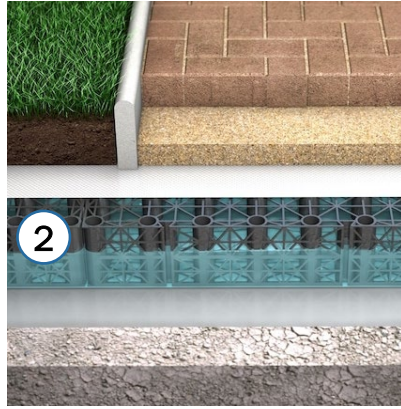
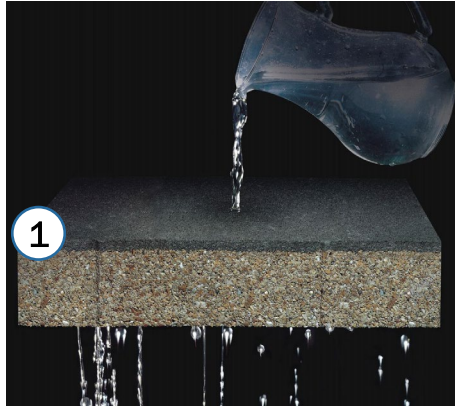


Lake Shore Public Realm Pilot Project

- In partnership with City of Toronto Green Streets, we are **conducting a pilot project to test innovative materials** that can achieve low-impact development (LID) design standards.
- The goal of this pilot project is to evaluate how well these materials improve the **sustainability of our street plantings and management of stormwater**.
- The results will inform the detailed design of Lake Shore Boulevard East corridor and the City's Green Street standards.



Testing New Non-Standard Materials & Innovations in SWM

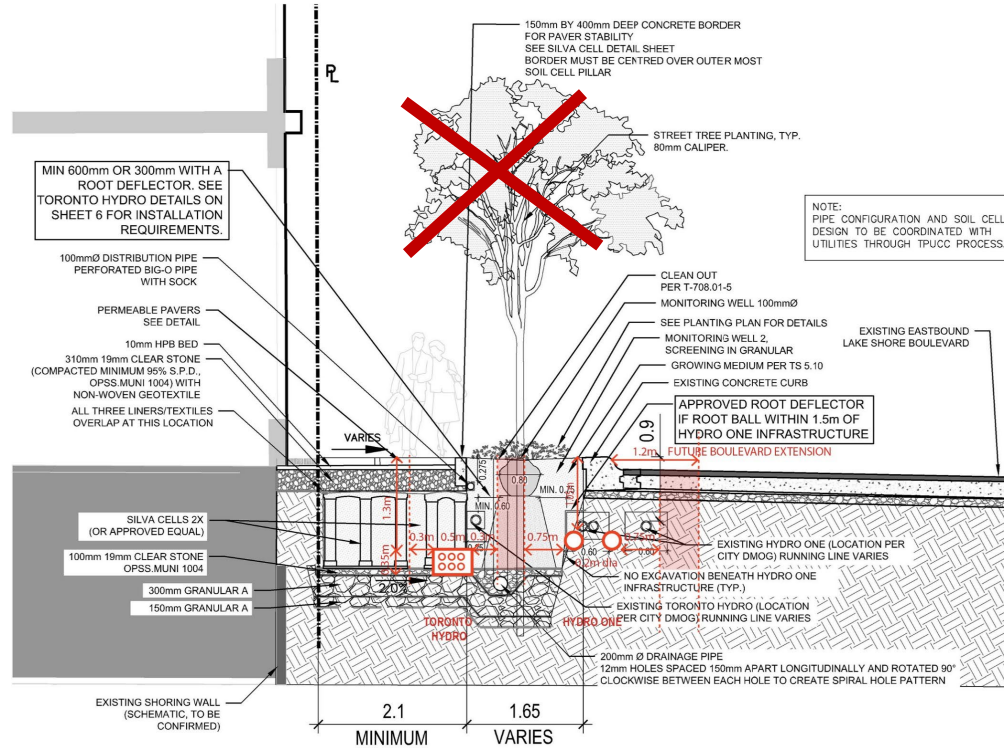


1. **HydroPavers** – **Permeable unit pavers** made of recycled ceramics
2. **Permavoid sub-base** to store stormwater for passive irrigation of planting
3. **Sandblasted and sawcut concrete** with exposed granite aggregate
4. **Salt-remediating plants** – *Armeria maritima* (sea thrift) to take up winter salt out of the soil

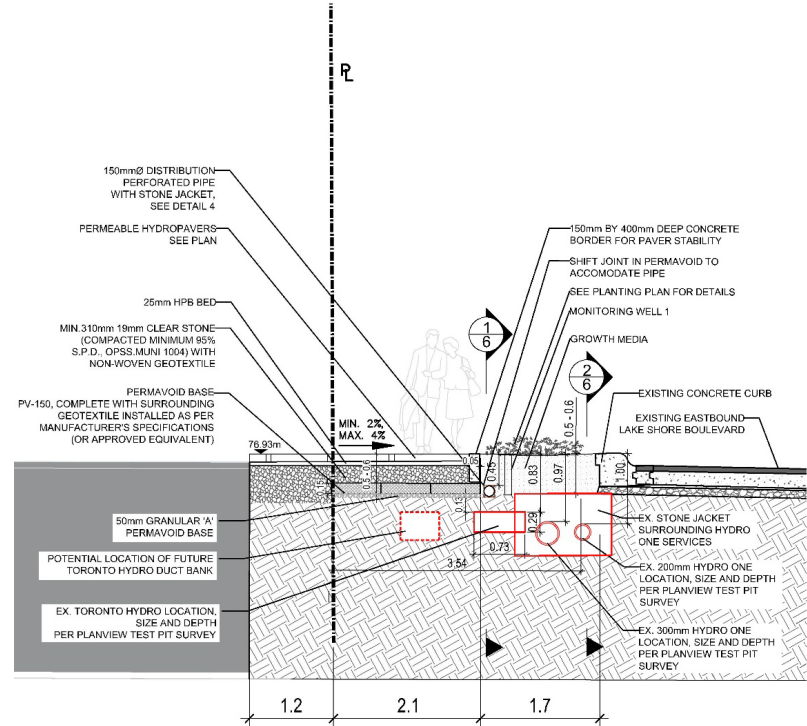
The project will be **monitored by TRCA Sustainable Technologies Evaluation Program** to evaluate:

- stormwater retention and quality improvements
- health and reduced maintenance of roadside plantings irrigated with stormwater
- performance of non-standard permeable pavers and base

Utility Constraints & Required Offsets



Original South Sidewalk Design



Adapted South Sidewalk Pilot Design

Lake Shore Public Realm Pilot Project

LAKE SHORE BOULEVARD EAST SOUTH SIDE PILOT Existing Planting Palette



Zig-Zag Goldenrod
Salt tolerance : Tolerant
Light : Sun and part-shade



Big Leafed Aster
Salt tolerance : Tolerant
Light : Sun and part-shade



Tufted Hair Grass
Salt tolerance : Tolerant
Light : Sun and part-shade and shade



Lindley's aster
Salt tolerance : ?
Light : Sun and part-shade



Delft Lace Astilbe
Salt tolerance : Intolerant
Light : Small sun, shade and heavy shade



Chinese Astilbe (White)
Salt tolerance : Intolerant
Light : Small sun, shade and heavy shade



Liriope muscari
Salt tolerance : Tolerant
Light : Sun and part-shade

Salt Remediation Plants Halophytes



X

**NOT
AVAILABLE
IN ONTARIO**

+

Sea Lavender
Limonium vulgare



Sea Thrift
Armeria maritima

Site Photos – Construction



Summer to Fall 2020

Lake Shore Boulevard Public Realm Pilot Project

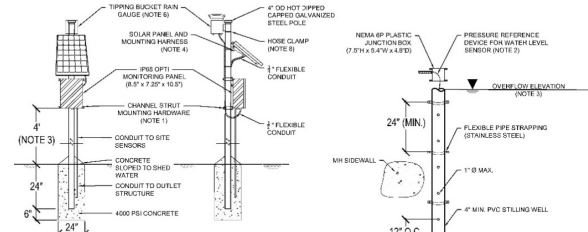
Lake Shore Pilot Project at 12 Bonnycastle St. was completed in Sep. 2020.

Improvements include:

- Bioretention planting with stormwater passive irrigation
- Permeable paver and base sidewalk
- Exposed aggregate concrete with sawcut pattern at intersection corner

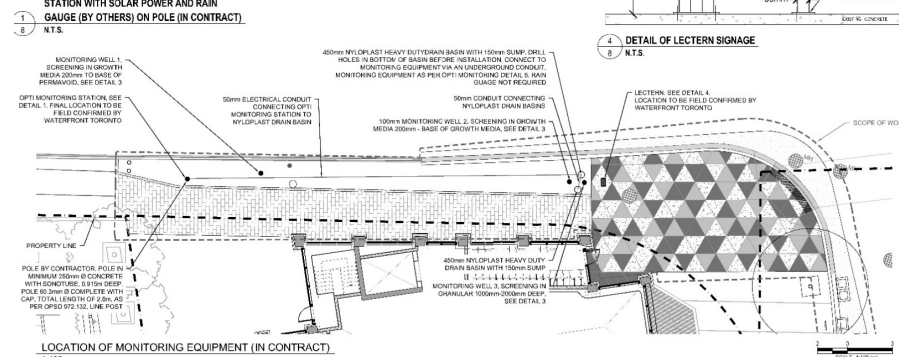


TRCA STEP Monitoring & Problem-Solving



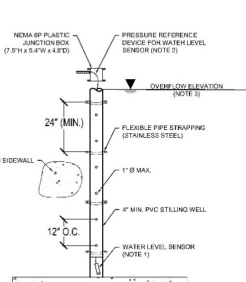
- NOTES:**
1. BOLT ENCLOSURE TO SUPPORT POLE USING STAINLESS STEEL MOUNTING HARNESS PROVIDED BY OPTIS.
 2. ALL CONDUIT PENETRATIONS ARE TO BE PERFORATED.
 3. MONITORING PANEL SHOULD BE MOUNTED HIGHER THAN THE EXPECTED HIGH WATER LEVEL.
 4. SOLAR PANEL AND MOUNTING HARNESS FROM AMERISOL SOLAR (EXAMPLE: PART 15-589).
 5. LEAVE MINIMUM OF 1' FOOT SPARE CABLE NEATLY COILED IN JUNCTION BOXES FOR FUTURE MAINTENANCE OR SYSTEM MODIFICATIONS.
 6. MOUNT TIPPING BUCKET RAIN GAGE PER MANUFACTURER'S INSTRUCTIONS. TIPPING BUCKET CAN BE MOUNTED WITH WORM DRIVE HOSE CLAMPS TO FIT ANY SIZE POLE. ALTERNATIVELY, CHANNEL STRUT OR 90 DEGREE METAL BRACKET CAN SUPPORT THE BUCKET FROM UNDERNEATH. THE BUCKET MUST BE MOUNTED LEVEL.
 7. RAIN GAGE SHOULD BE SITED SUCH THAT SURROUNDING OBJECTS ARE NO CLOSER THAN TWO TIMES THEIR HEIGHT ABOVE THE GAGE.
 8. USE HOSE CLAMPS OR EQUIVALENT FOR SECURING FLEXIBLE CONDUIT TO POLE.
 9. CONTRACTOR TO SUPPLY AND INSTALL POLE. SEE DETAILS IN PLAN BELOW.

DETAIL OF OPTI LIGHTING MONITORING STATION WITH SOLAR POWER AND RAIN GAUGE (BY OTHERS) ON POLE (IN CONTRACT)



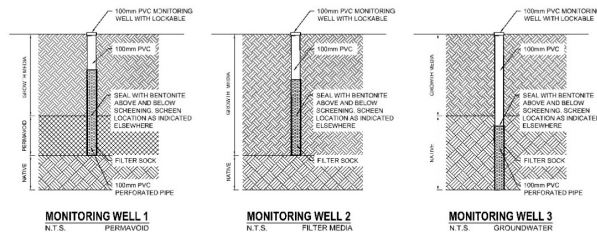
LOCATION OF MONITORING EQUIPMENT (IN CONTRACT)

1-100



- NOTES:**
1. WATERLEVEL SENSOR WITH HEIGHT INSTALLED WITHIN STILLING WELL (PVC PIPE) WITH SENSOR AT BOTTOM OF STRUCTURE.
 2. PENETRATIONS INTO ALL EQUIPMENT AND CONNECTIONS WITHIN JUNCTION BOXES MUST BE PERFORATED. INSTALLATION OF ELECTRICAL COMPONENTS MUST BE IN ACCORDANCE TO OPTIC SPECIFICATIONS.
 3. BOTTOM OF JUNCTION BOX SHALL BE MOUNTED AT LEAST 4" ABOVE ELEVATION OF OVERFLOW WEIR.

DETAIL OF WATER LEVEL SENSOR IN STILL WELL (BY OTHERS)

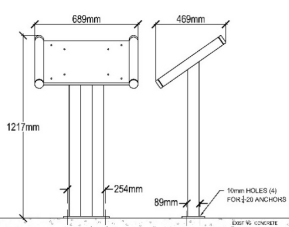


MONITORING WELL 1 N.T.S.

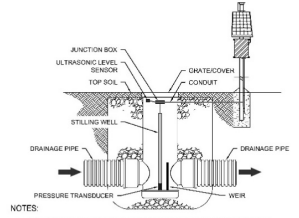
MONITORING WELL 2 N.T.S.

MONITORING WELL 3 N.T.S.

DETAILS OF MONITORING WELLS N.T.S.



DETAIL OF LECTERN SIGNAGE N.T.S.



- NOTES:**
1. BASIN DUCT BY CONTRACTOR. ALL COMPONENTS WITHIN AND ADJACENT BY OTHERS.
 2. THE BACKFILL MATERIAL SHALL BE CRUSHED STONE OR OTHER GRANULAR MATERIAL, MEETING THE REQUIREMENTS OF CLASS 1, CLASS 2 OR CLASS 3 MATERIAL, AS DEFINED IN ASTM D2021. BEDDING AND BACKFILL FOR SURFACE DRAINAGE INLETS SHALL BE PLACED AND COMPACTED UNIFORMITY IN ACCORDANCE WITH ASTM D2021.

CROSS SECTION OF THE NYLOPLAST DRAIN BASIN (IN CONTRACT) & EQUIPMENT (BY OTHERS)

No.	DATE	REVISIONS	INITIAL	SCALE
1	2020/10/10	PROPOSED CHANGE	10/10/20	10/10/20
2	2020/10/10	REVISED FOR COMMENTS	10/10/20	10/10/20
3	2020/10/10	FINAL CLIENT REVIEW	10/10/20	10/10/20
4	2020/10/10	REVISED FOR COMMENTS	10/10/20	10/10/20
5	2020/10/10	REVISED FOR COMMENTS	10/10/20	10/10/20
6	2020/10/10	REVISED FOR COMMENTS	10/10/20	10/10/20



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LAKE SHORE BOULEVARD EAST SOUTH SIDE PILOT PROJECT

LOWEST IN DRAINAGE STREET TO ADJACENT STREET

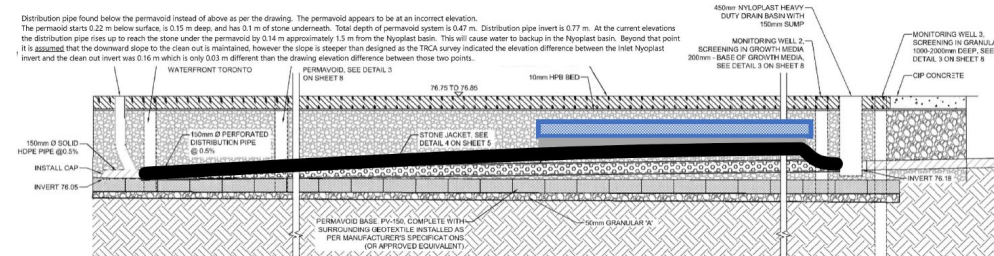
DESIGN	BY	DATE	REVISIONS	BY	DATE	SCALE	SHEET	OF
DESIGN	BY	DATE	REVISIONS	BY	DATE	SCALE	SHEET	OF
DESIGN	BY	DATE	REVISIONS	BY	DATE	SCALE	SHEET	OF



TRCA STEP Monitoring & Problem-Solving



Distribution pipe found below the permavoid instead of above as per the drawing. The permavoid appears to be at an incorrect elevation. The permavoid starts 0.22 m below surface, is 0.15 m deep, and has 0.1 m of stone underneath. Total depth of permavoid system is 0.47 m. Distribution pipe invert is 0.77 m. At the current elevations the distribution pipe rises up to reach the stone under the permavoid by 0.14 m approximately 1.5 m from the Nyoplast basin. This will cause water to backup in the Nyoplast basin. Beyond that point it is assumed that the downward slope to the clean out is maintained, however the slope is steeper than designed as the TRCA survey indicated the elevation difference between the inlet Nyoplast invert and the clean out invert was 0.16 m which is only 0.03 m different than the drawing elevation difference between those two points.



Pipes were not installed per the design slopes due to utility obstructions, so the system was not functioning properly to distribute water to the bioretention planter.

TRCA STEP Monitoring & Problem-Solving



Lake Shore Public Realm Pilot **Phase 2** will test:

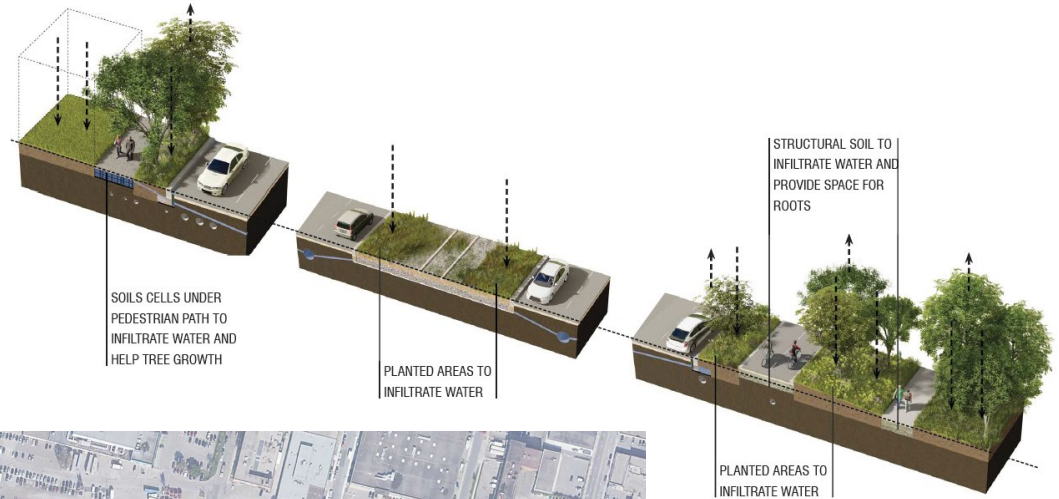
-



Lake Shore East of River – Under Construction

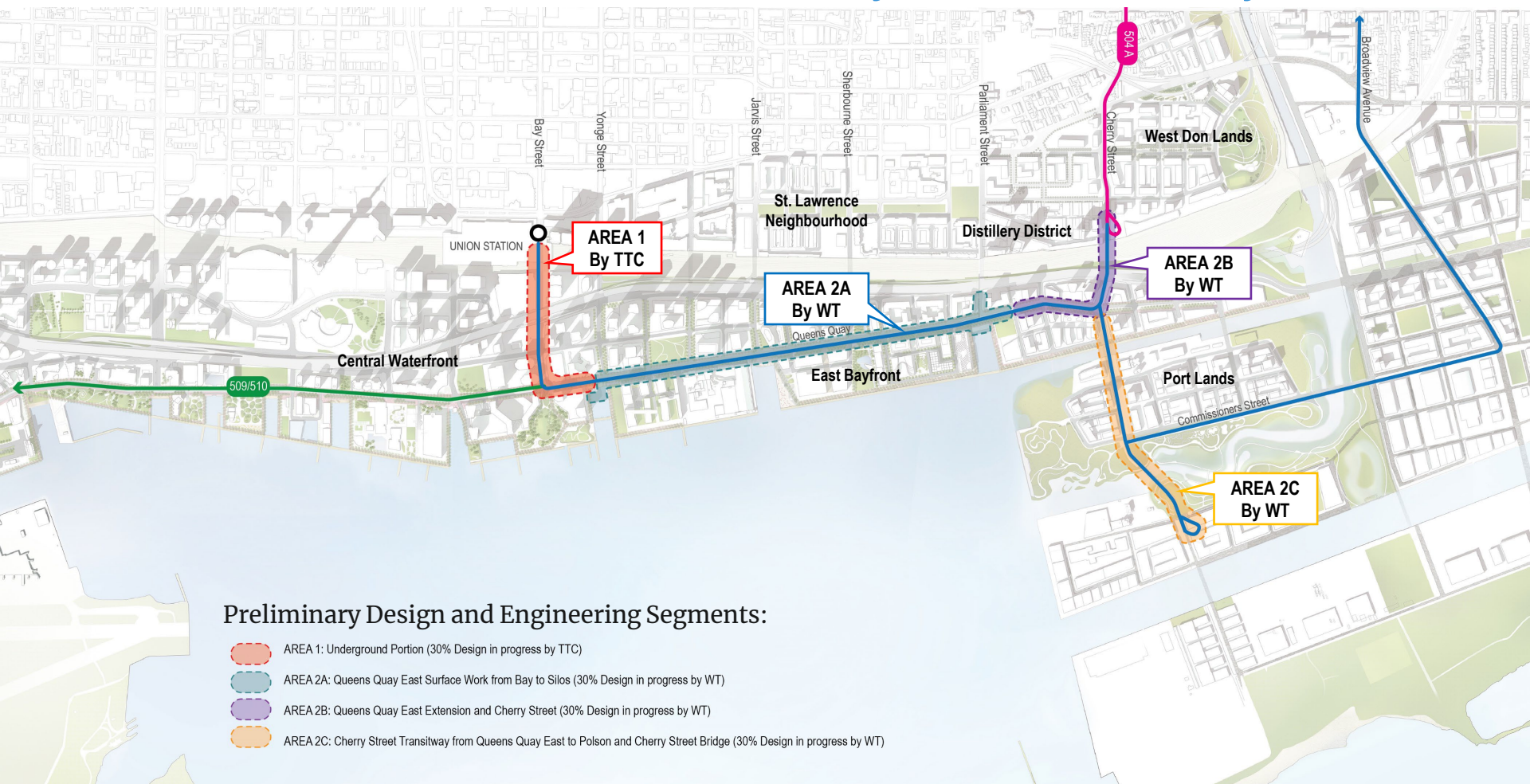


Maximize Infiltration and Delay Entry into Existing Storm System



Design Team: Entuitive, West 8, Planning Partnership, Planmac

2/ Waterfront East LRT : Queens Quay East and Cherry St.



Preliminary Design and Engineering Segments:

- AREA 1: Underground Portion (30% Design in progress by TTC)
- AREA 2A: Queens Quay East Surface Work from Bay to Silos (30% Design in progress by WT)
- AREA 2B: Queens Quay East Extension and Cherry Street (30% Design in progress by WT)
- AREA 2C: Cherry Street Transitway from Queens Quay East to Polson and Cherry Street Bridge (30% Design in progress by WT)

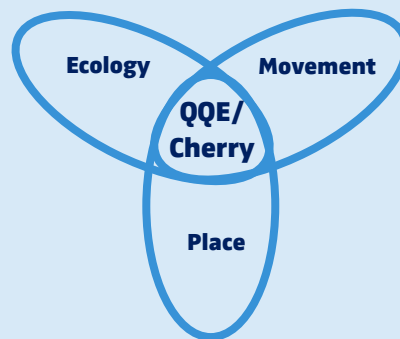
Design Brief for Queens Quay East

Vision

Queens Quay is Toronto's **primary lakefront boulevard** connecting its existing and emerging precincts, parks and public spaces and **establishing a strong cohesive character across the waterfront**. Building on the successful revitalization of the western section, Queens Quay East will further integrate **urban ecology, active transportation, and place-making** to create a street that is resilient to future change.

Core Objectives:

1. Integrating with Urban Ecology
2. Moving People
3. Building a Destination



Design Brief for Queens Quay East

1/ Integrating with Urban Ecology: Design for **ecological performance**

- Expanded tree canopy and planting
- Integrated green infrastructure
- More permeable ground surface
- Enhanced user comfort
- Habitat and eco-corridors for biodiversity
- Resilient species selection for waterfront
- Customized details for variable lake levels
- Low-maintenance landscape
- Monitoring and adaptive maintenance

2/ Moving People: Design for **safety, convenience and flexibility**

- Improve clarity at intersections
- Improve pedestrian crossings
- Safe intermodal interactions
- More convenient cycling environment
- Accommodate new micro-mobility
- Flexibility to accommodate new trends
- Performance review & adaptive management

3/ Building a Destination: Design for **character and experience**

- Continuity of design language with QQW
- Greater coherence of paving materials
- Durable materials and craftsmanship
- Slips and intersections as destinations
- Flexibility for closures & programming
- Consistent palette of furniture, lighting, etc.
- Integrated infrastructure for programming
- Encourage social interaction

Queens Quay West



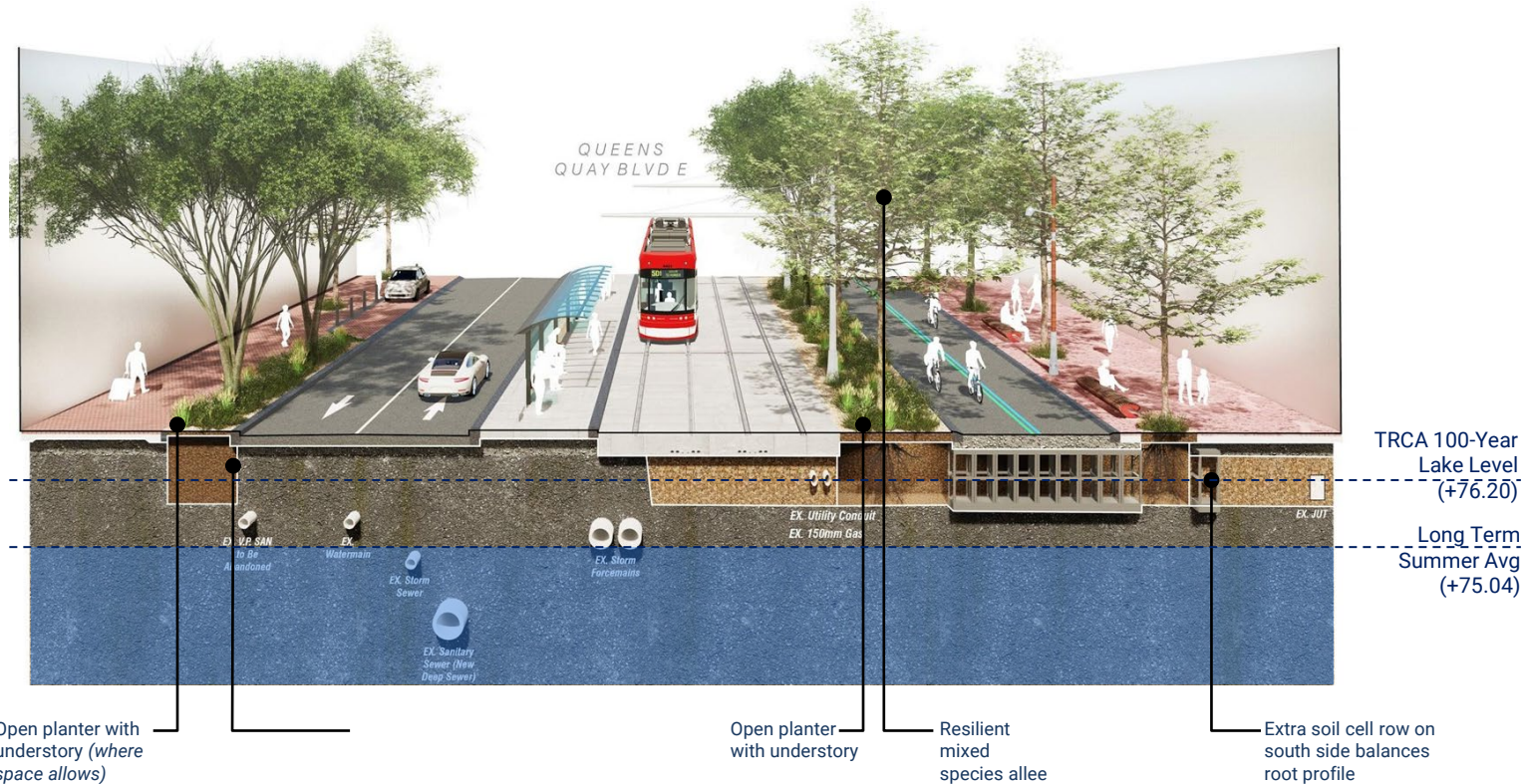
Design Team: West 8/DTAH JV, Arup, WSP

Queens Quay East at East Bayfront



Design Team: West 8/DTAH JV, Arup, WSP

Waterfront East LRT Area 2A – Queens Quay East and Cherry St.



Waterfront Challenges: High Lake Level

Challenges

- Low grades in relation to High Lake level and susceptibility to high groundwater
- Utilities
- Transit standards
- Public Realm Standards

2020 Regulatory 100-year High Water Level, TRCA,

76.20 2019 Regulatory High Water Level, TRCA, 76.08

2019 Record High Water 75.93

2017 Record High Water 75.88

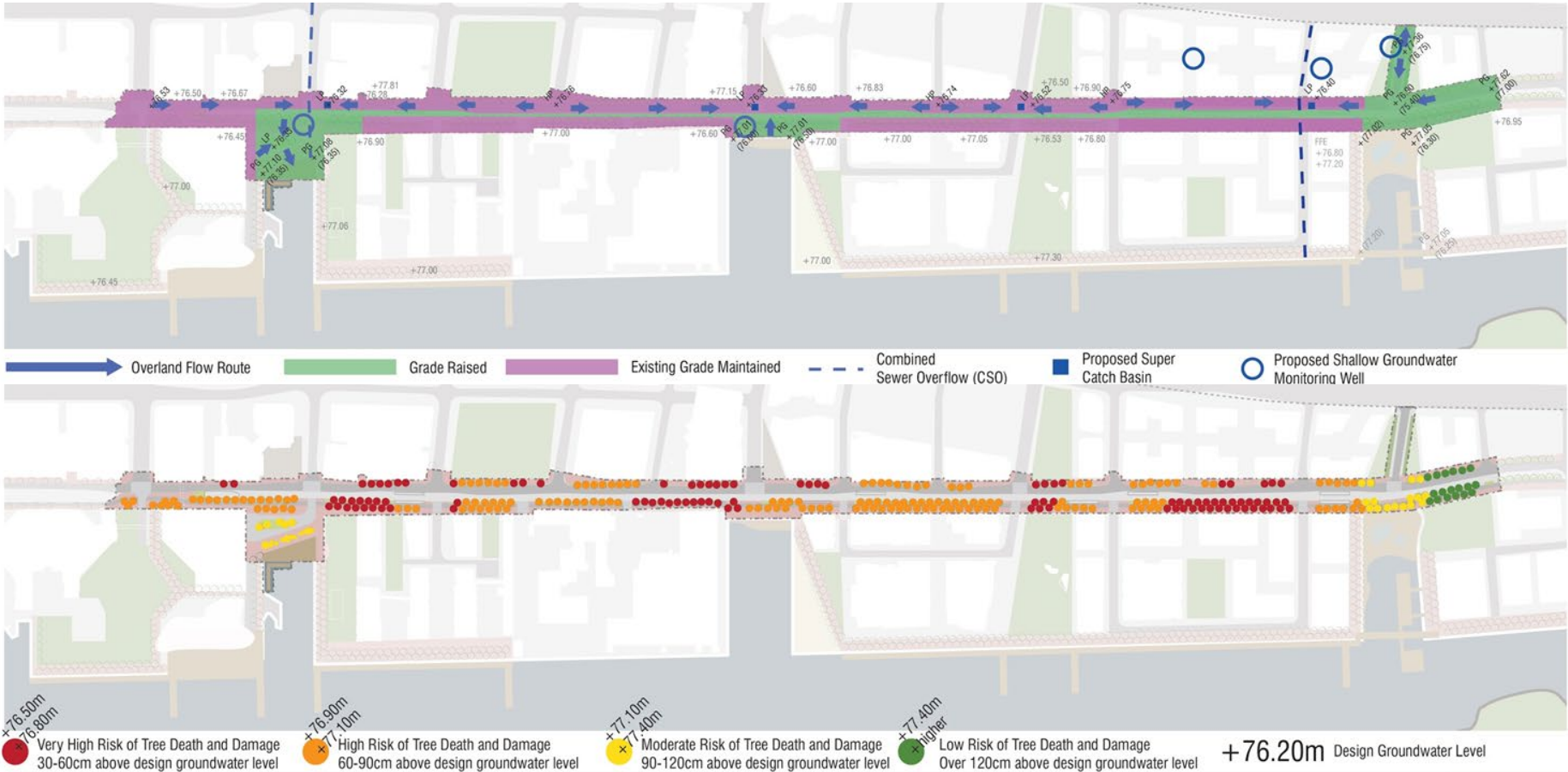
1952 Record High Water 75.82

Long Term Summer Average, measured since 1918, 75.07

Lake Ontario: Two record high water events in last four years



Growing Healthy Trees vs. Stormwater Management



Growing Healthy Trees – Diversity

BROADLEAF TYPOLOGY



FINELY TEXTURED TYPOLOGY



YONGE SLIP

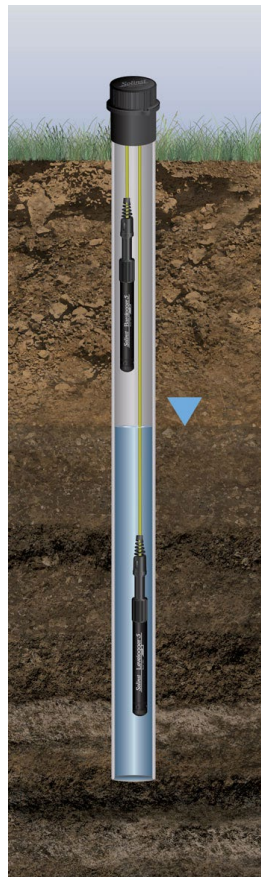


Broadleaf Textured Tree Canopy - Mid-Block Condition Finely Textured Tree Canopy - Parks, Slip Heads Planting Character of Adjacent Park or Plaza



Sample Planting Plan - Bay to Yonge

Active Groundwater Monitoring & Adaptive Management



WT will install six shallow groundwater monitoring wells with groundwater dataloggers to monitor correlation of groundwater to fluctuating lake levels, and to inform groundwater benchmarks for green infrastructure and grading design.

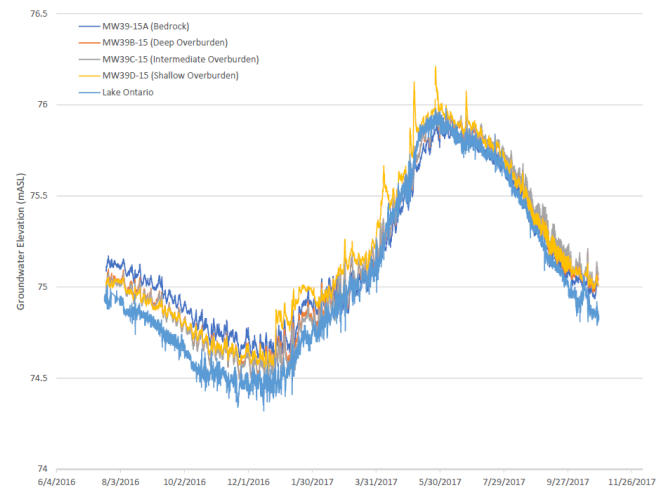
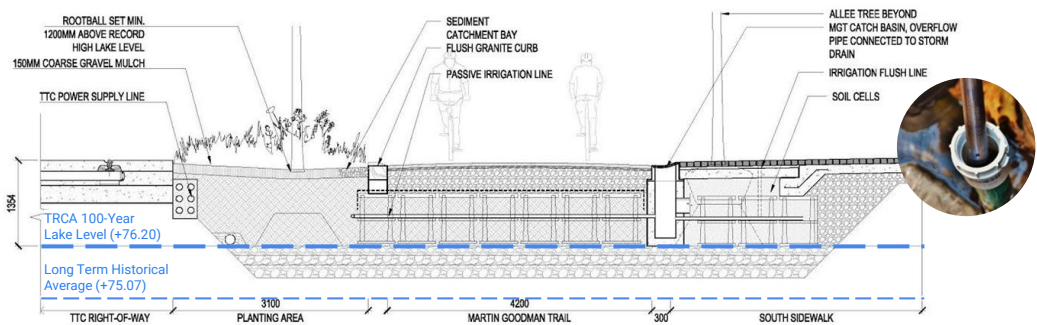


Figure B-6
MW39 Well Nest Hydrographs
Waterfront Toronto
Toronto, Ontario

Green Infrastructure Design to be Informed by Monitoring

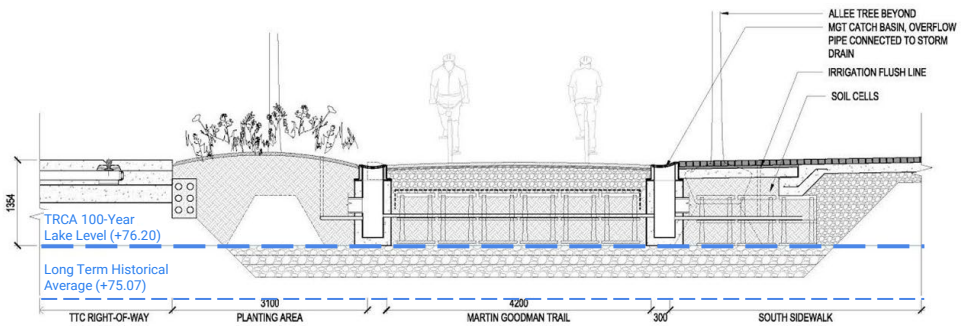
Stormwater management and planting concepts to be revisited at Detailed Design with outcome of groundwater monitoring program



Option 1: Bioswale, Perennial and Stormwater Focused



Green to Grey, Sheffield



Option 2: Raised Beds, Tree focused














Buffalo Niagara Campus

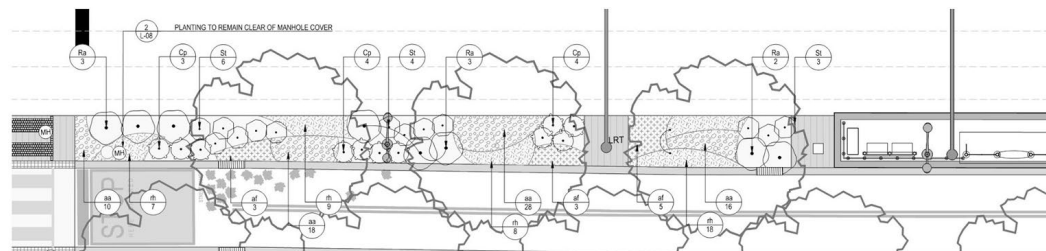
Planting Pilot in Queens Quay West

to be Constructed next year

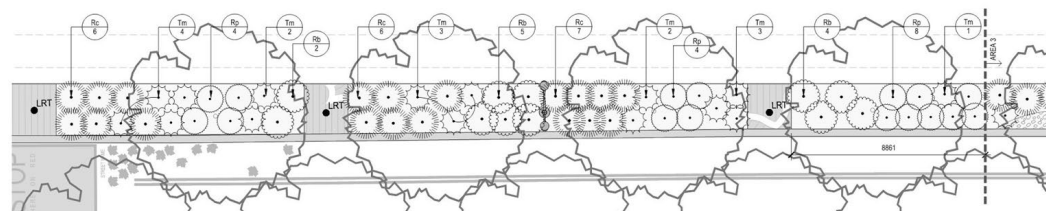
PLANT LIST

SHRUBS	CODE	BOTANICAL NAME	COMMON NAME
	Cp	Ceanothus x pallidus 'Marie Simon'	Marie Simon New Jersey Tea
	Ra	Rhus aromatica 'Gro-Lo'	Fragrant Sumac
	Rb	Rosa blanda	Smooth Rose
	Rc	Rosa carolina	Carolina Rose
	Rp	Rosa palustris	Swamp Rose
	St	Spiraea tomentosa	Steeplebush
	Tm	Taxus x media 'Wardii'	Ward Yew

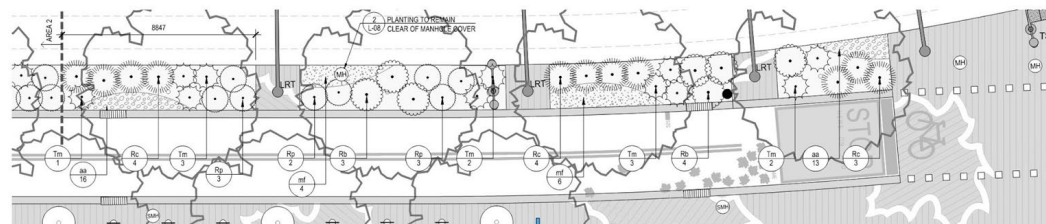
PERENNIALS	CODE	BOTANICAL NAME	COMMON NAME
	af	Agastache foeniculum 'Blue Fortune'	Anise Hyssop
	aa	Aruncus aethusifolius	Dwarf Goat's Bean
	mf	Monarda fistulosa	Bergamot
	rh	Rudbeckia hirta 'Cherry Brandy'	Cherry Brandy Gloriosa Daisy



1 AREA 1 PLANTING PILOT - POLLINATOR PALETTE



2 AREA 2 PLANTING PILOT - BIRD BIOTOPE PALETTE



3 AREA 3 PLANTING PILOT - HYBRID PALETTE

Waterfront East LRT Area 2B – Queens Quay East

The Fight for Space: Emergency, fire, car lanes, laybys, bus replacement service, BRT phasing scenarios



Design Team: Stantec & Public Work

Greening the Transitway: green track

Water Capture and Drainage

Extensive vegetation systems: retain 50% of precipitation



Green Track Embodied Carbon

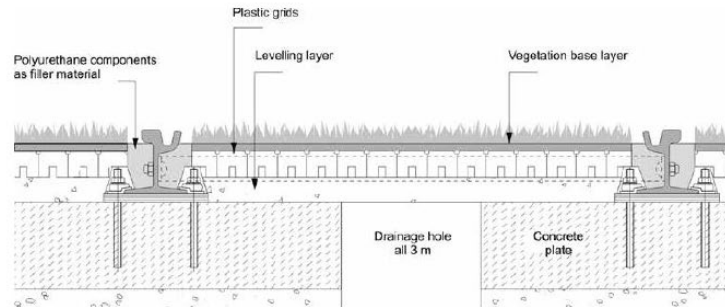
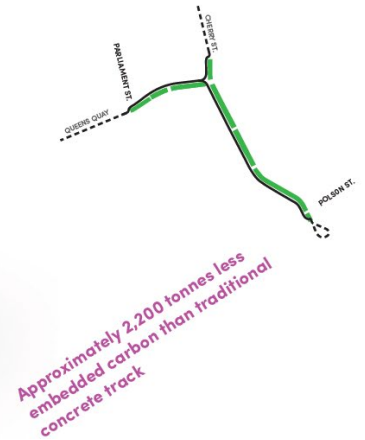
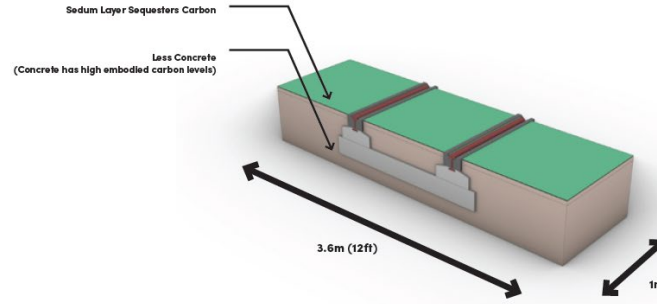
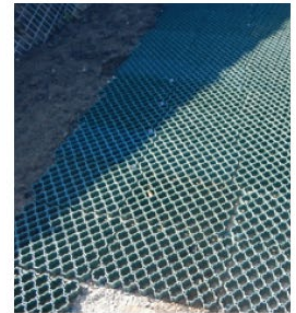


Image: Cross section of an accessible Grass Track using a plastic grass grid system



Waterfront East LRT Area 2B/C – Cherry St.



Port Lands Roads



Port Lands Roads

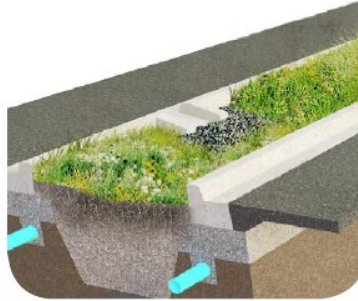


Green Infrastructure Types

Challenges & Adaptations :

- High variable groundwater at low points – resilient tree species, no soil cells etc.
- Phasing with BRT, then no BRT, then no GI on east side – deferred to future phase

Enhanced Grass Swale
777 m²



Bioswale
1,458 m²



Open Planter
914 m²



Open Planter + Passive Irrigation
258 m²



Treed Boulevard
5,385 m²



Temporary Landscape
13,084 m²



LANDSCAPE TYPES	
Enhanced Grass Swale	<ul style="list-style-type: none"> • Vegetated open channels with trees, shrubs and herbaceous planting • Located in narrow medians ranging from 2.0m to 2.7m wide
Bioswale	<ul style="list-style-type: none"> • Vegetated open channels with trees, shrubs and herbaceous planting • Located in medians and boulevards that exceeds 3.0m in width
Open Planter	<ul style="list-style-type: none"> • Open planter with trees, shrubs and herbaceous planting • Soil cell system under pavement to: <ul style="list-style-type: none"> - provide adequate planting soil volume - support planter structure - support pavement above planting soil volume
Open Planter with Subsurface Passive Irrigation	<ul style="list-style-type: none"> • Similar to Open Planter noted above • Additional rainwater catchment into a catchbasin and distributed to planting soil under pavement
Treed Boulevard	<ul style="list-style-type: none"> • Typical City standard boulevard with short-medium native grass & forbs planting
Temporary Landscape	<ul style="list-style-type: none"> • Planted with tall shrubs and herbaceous planting where future development is anticipated

Maintenance Manual– Cherry St. & PLFP Roads

PORT LANDS FLOOD PROTECTION AND ENABLING INFRASTRUCTURE (PLFPE)

GREEN INFRASTRUCTURE OPERATION + MAINTENANCE MANUAL FOR:

NEW CHERRY STREET COMMISSIONERS STREET DON ROADWAY



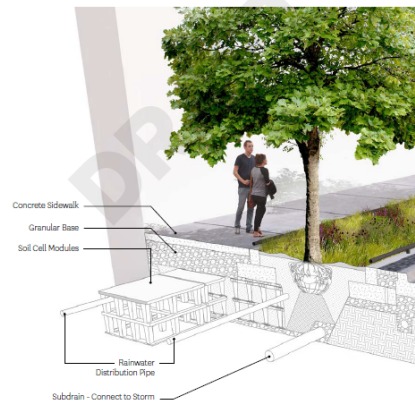
3.4 Open Planter with Soil Cells and Subsurface Passive Irrigation

Overview/Description

These open planters are similar to the previously described facility in Section 3.3 - Open Planter with Soil Cells. The difference lies in the site grading and subsurface components:

- The facilities receive surface runoff from adjacent sidewalk and Martin Goodman Trail.
- Surface runoff from Martin Goodman Trail is channelled and collected in a nearby catchbasin. The catchbasin is connected to a 100mmØ perforated irrigation pipe where rainwater is distributed to soils in the soil cell system.
- They are only present on the west side of New Cherry Street between Villiers Street North and South.

Key components of open planters are: curb planter walls flush with adjacent pavements, soil cells system, filter media beds, vegetation, perforated irrigation pipe and perforated pipe subdrains.



Illustrative diagram of open planter with soil cells and subsurface passive irrigation

PLFPE GREEN INFRASTRUCTURE OPERATIONS AND MAINTENANCE MANUAL | 21

Operations and Maintenance Protocols

Perform routine maintenance tasks as outlined below.

OPEN PLANTER WITH SOIL CELLS AND SUBSURFACE PASSIVE IRRIGATION		Frequency				Notes
Components	Maintenance Task	Bi-weekly	2x/year	3x/year	Others	
1 Filter Bed	Remove trash		X			
	Remove accumulated sediment when > 50mm depth				As needed	
	Re-grade and restore cover over any animal burrows, sunken areas when > 100mm depth and erosion rills when > 300mm in length				As needed	
	Add wood mulch to maintain 100mm depth cover, as indicated in the detail drawings and specifications				Every 2 years	
2 Vegetation	Watering during first two months after planting	X				Modify schedule in periods of wet
	Watering for the remainder of the first two (2) growing seasons (i.e. May to September) after planting or until vegetation is established				As needed	
	Watering for the remainder of the facility's lifespan				during drought conditions	Drought conditions classified by Agriculture and Agri-Food Canada's Canadian Drought Monitor as severe (D2) or higher
	Remove undesirable vegetation (e.g. tree seedlings, invasives/weeds)		X			
	Replace dead/diseased plants to maintain a minimum of 80% vegetation cover			X		
	Prune shrubs and trees			X		
	Cut back spent plants			X		
	Divide or thin out overcrowded plants			X		
	Soil flushing to remove road salts		X			Perform soil flushing in early spring before buds begin to open into leaves. See the following page for additional information on soil flushing
3 Soil Cell System					As needed	Refer to Appendix 4.3
4 Subdrain	Flush out accumulated sediment with hose or pressure washer			X		

22 | DTAH + WSP

PLFP Construction



How can we maximize ecological performance while balancing infrastructure requirements and site constraints?

Challenges:

- Densely packed utilities
- Strict Standards for road and transit ROWs
- Heavy Salting in Winter
- Unclear maintenance responsibilities for planting and GI in ROW
- High & variable groundwater
- Variable lake levels
- Contaminated soils and groundwater
- Phasing scenarios and implementation strategies

Strategies for integrating GI in constrained urban sites

- Develop shallow GI systems, maximize areas of permeable surfaces
- Select resilient, robust, and diverse tree and planting species
- Pilot new ideas and technologies to solve problems
- Monitoring & Adaptive Management
- Develop additional standards for GI - Permeability & Low Carbon
 - Permeable base & pavers
 - Permeable road bed
 - Reinforced green track
 - Low carbon, permeable concrete
 - Shallow SWM storage
 - Rules and reasonable offsets for planting around utilities
- Streamlined Process for approvals to incentivize adoption of Green Infrastructure
- Find allies and collaborate across disciplines and sectors

Questions for Further Research

- Is it worthwhile to integrate green infrastructure into difficult constrained sites despite the many obstacles?
- How do you design for resilience to the worst case scenario while not losing the opportunities of everyday conditions? – i.e. variable lake levels
- How can we maximize ecological performance while balancing all the technical requirements and standards regulating urban infrastructure and the public realm?

Questions?

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