



A.0

APPENDIX A - ACKNOWLEDGEMENTS

ACKNOWLEDGEMENTS

The Green Streets consulting team would like to acknowledge the contributions of the following individuals:

GSTG Working Group

- City Planning
Alka Lukatela, Jane Welsh, Kristina Reinders & Lara Tarlo
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- Toronto Parking Authority
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GSTG Technical Advisory Group

- City of Mississauga
Muneef Ahmad
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- Toronto and Region Conservation Authority
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- DeepRoot
Mike James



B.0

APPENDIX B - GREEN INFRASTRUCTURE OPTIONS

B.1 LONG LIST OF GREEN INFRASTRUCTURE OPTIONS

At the outset of this project, the Green Streets Team spent several weeks reviewing precedent manuals and guidelines from across North America to establish a comprehensive list of potential Green Infrastructure options that would be suitable for application in the City of Toronto, given geographical and climatic conditions. The precedent study produced a comprehensive 'Long List' of 40 potential Green Infrastructure options that would be feasible. As part of the long list, each Green Infrastructure option was described and the ancillary benefits of each was outlined. The suitability of each for various applications within Complete Street typologies was also considered. The following matrices set out the long list of Green Infrastructure options.

B.2 LONG LIST OF GREEN INFRASTRUCTURE OPTIONS

A Short List of Green Infrastructure options was distilled from the Long List as a result of an analysis of each option. The Short Listed options in the following section form the foundation (and 'y'-axis) of the Green Infrastructure Selection Tool.



C.0

APPENDIX C - GUIDELINE DRAWINGS

GREEN INFRASTRUCTURE OPTIONS - TECHNICAL DRAWINGS - INDEX

	Number	Name	Applications
ECOLOGICAL	E-1	Natural Canopy - Tree Planting	
	E-2	Native Herbaceous Planting	
	E-3	Ecopassages (TRCA)	
	E-4	Light Limitation	
AIR QUALITY	AQ-1	Green Walls (MS)	Bridges
	AQ-2	Street Trees	
	AQ-2A	Trees in Soil Cells	Frontage Zones, Furnishing / Planting Zones/Parking Lay-Bys, Medians
	AQ-2B	Trees in Open Tree Planter	Frontage Zones, Furnishing / Planting Zones, Medians
	AQ-2C	Planter Box / Moveable Planters (MS)	Frontage Zones, Furnishing / Planting Zones, Medians
	AQ-2D	Precast Tree Planters (MS)	Frontage Zones, Furnishing / Planting Zones, Medians
	AQ-3	Photocatalytic Paving (MS)	On-Street Parking Lanes / Cycling Infrastructure / Sidewalks / Decorative Paving
GHG & ENERGY EFFICIENCY	GHG-1	LED Lights (MS)	Street Lights/Decorative Lighting
	GHG-2	Solar Photovoltaic Panels (MS)	Street Lights/Decorative Lighting / Parking Meters / Vehicle Charging Stations /Decorative Paving
	GHG-3	Solar Roads (MS)	Sidewalks / Cycling Infrastructure / Crosswalks / On-Street Parking Lanes
	GHG-4	Solar Paver Lights (MS)	Cycling Infrastructure / Sidewalks / Crosswalks
	GHG-5	Photo-luminising Road Markings (MS)	Vehicle Lanes / Cycling Infrastructure / Crosswalk
	GHG-6	Wind Energy (MS)	Street Lights
	GHG-7	Cool Pavements (MS)	All Paved Surfaces
WATER QUALITY, QUANTITY AND EFFICIENCY	WQ-1.1	Bioretention - Planters	Furnishing / Planting Zones / Bridges / Medians - Islands - R-A
	WQ-2.1	Stormwater Planters	Frontage Zones / Bridges
	WQ-3.1	Bioretention - Curb Extensions	Intersections / Mid-block / Transit Stops
	WQ-4.1	Bioretention - Cells	Furnishing / Planting Zones / Medians - Raised Islands
	WQ-5.1	Rain Gardens	Furnishing / Planting Zones / Medians - Raised Islands
	WQ-6.1	Enhanced Grass Swales	Furnishing / Planting Zones / Bridges / Medians - Raised Islands
	WQ-7.1	Dry Swales/Bioswales	Furnishing / Planting Zones / Furnishing / Planting Zones / Bridges / Medians - Raised Islands
	WQ-7.2	Bioswales with Stone Well	Furnishing / Planting Zones / Medians - Raised Islands /Bridges
	WQ-8.1	Green Gutters	Edge Zone / Dedicated LRT
	WQ-9.1	Filter Strips / Buffer Strips	Furnishing / Planting Zones
	WQ-10.1	Drainage Wells	Vehicle Lanes
	WQ-11.1	Perforated Pipe Systems	Vehicle Lanes / Furnishing / Planting Zones
	WQ-12.1	Soakaways	Vehicle Lanes / On-Street Parking Lanes / Parking Lay-Bys / Cycling Infrastructure / Furnishing / Planting Zones / Medians - Raised Islands / Bridges
	WQ-13.1	Infiltration Trenches	Vehicle Lanes / On-Street Parking Lanes / Parking Lay-Bys / Cycling Infrastructure / Furnishing / Planting Zones / Medians - Raised Islands / Bridges
	WQ-14.1	Infiltration Chambers	Vehicle Lanes / On-Street Parking Lanes / Parking Lay-Bys / Cycling Infrastructure / Furnishing / Planting Zones / Medians - Raised Islands / Bridges
	WQ-15.i	Permeable Pavement - Pervious Concrete	On-Street Parking Lanes / Parking Lay-Bys / Cycling Infrastructure / Sidewalks
	WQ-15.ii	Permeable Pavement - Porous Asphalt	Vehicle Lanes / On-Street Parking Lanes / Parking Lay-Bys / Cycling Infrastructure
	WQ-15.iii	Permeable Pavement - Interlocking Precast Concrete Pavers	Vehicle Lanes / On-Street Parking Lanes / Parking Lay-Bys / Cycling Infrastructure
	WQ-16.1	Stormwater Tree Pits	Furnishing / Planting Zones / Medians - Raised Islands / Bridges
	WQ-17.1	Stormwater Tree Trenches	Furnishing / Planting Zones / Medians - Raised Islands / Bridges
WQ-18.1	Rainwater Cistern	Frontage Zones	

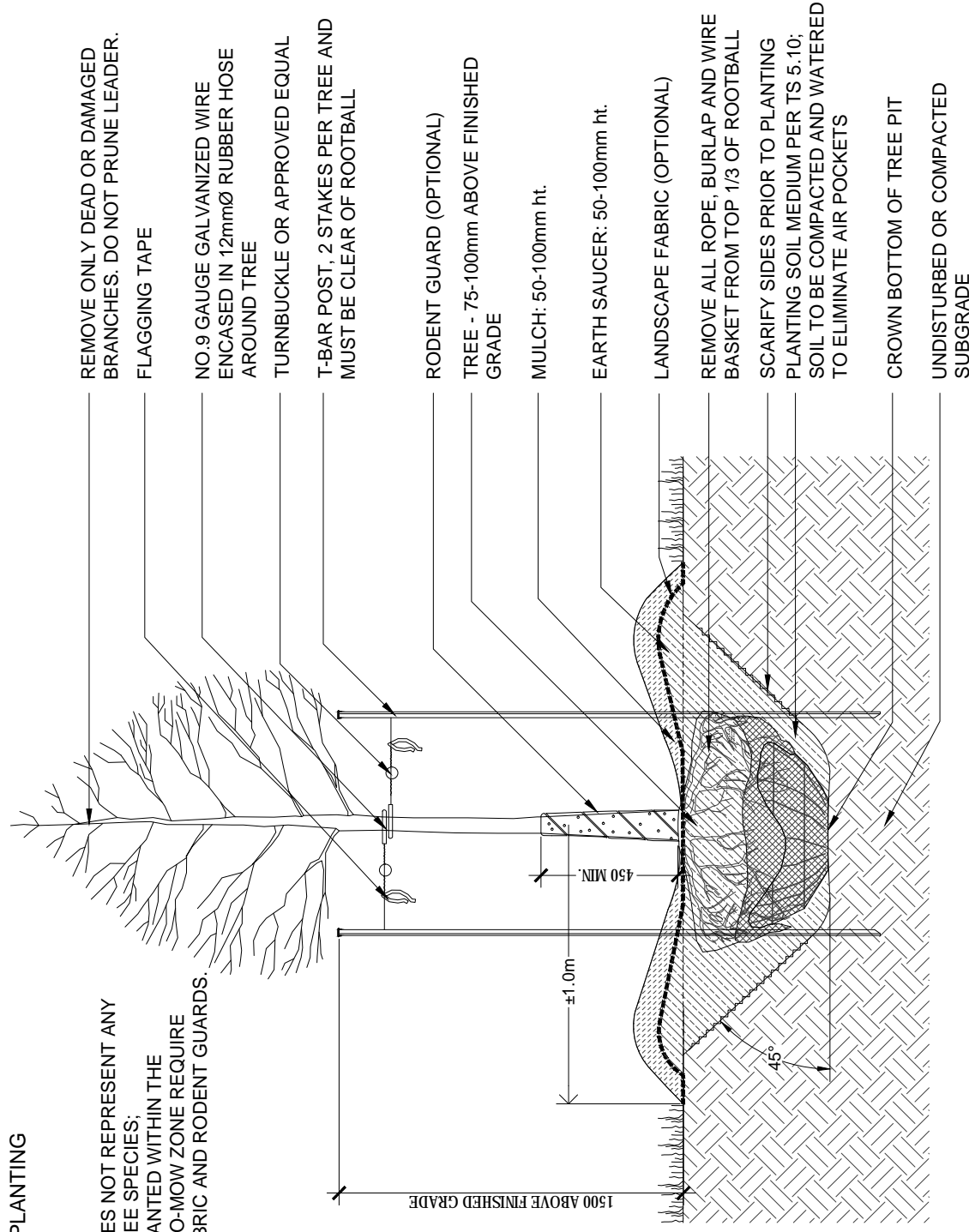
*(MS) - Multiple options - Refer to Manufacturer's Specifications

*(TRCA) - Refer to TRCA Crossing Guideline for Valley and Stream Corridors

DECIDUOUS TREE PLANTING

NOTES:

1. THIS DETAIL DOES NOT REPRESENT ANY PARTICULAR TREE SPECIES;
2. ONLY TREES PLANTED WITHIN THE NATURALIZED/NO-MOW ZONE REQUIRE LANDSCAPE FABRIC AND RODENT GUARDS.

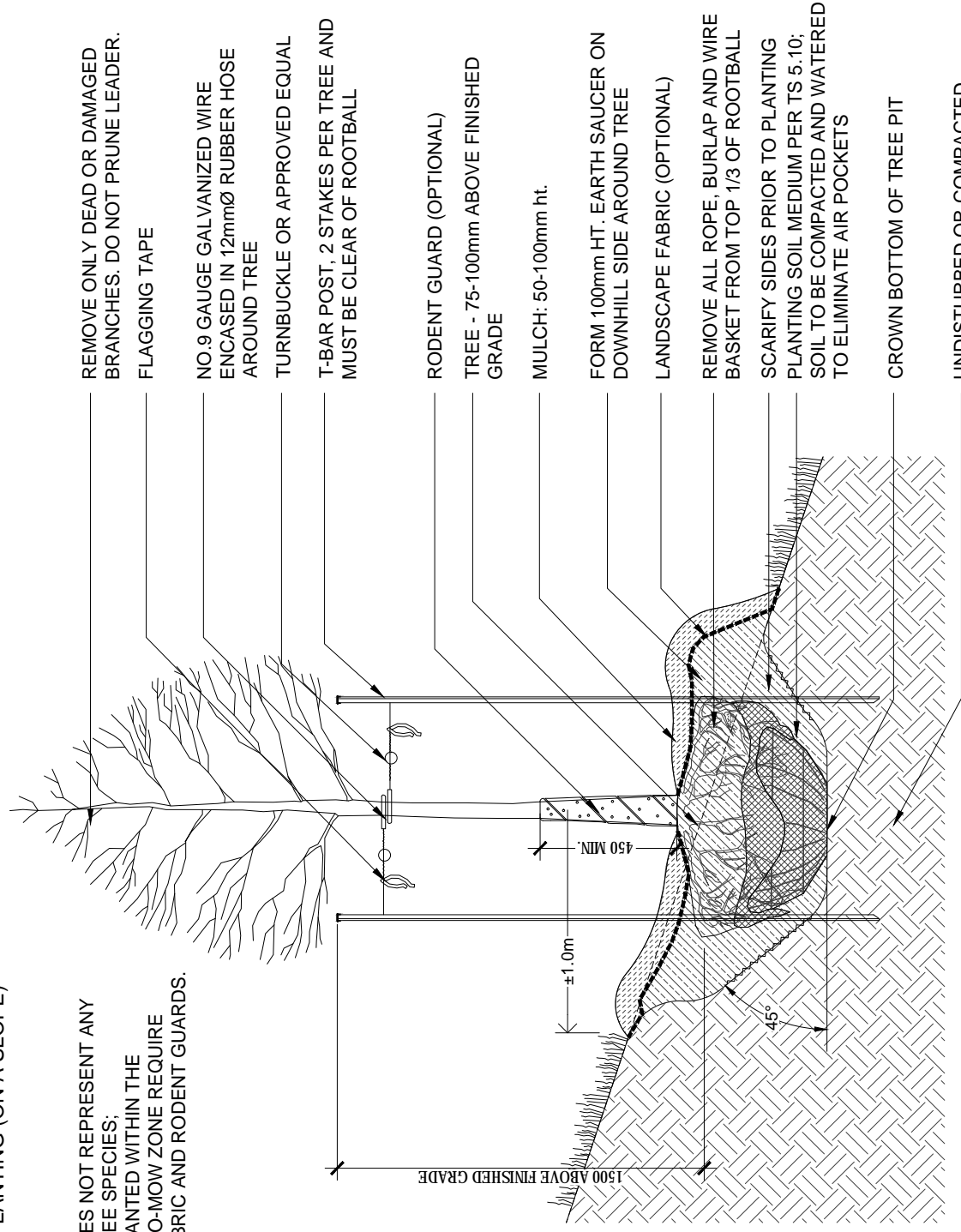


- REMOVE ONLY DEAD OR DAMAGED BRANCHES. DO NOT PRUNE LEADER.
- FLAGGING TAPE
- NO.9 GAUGE GALVANIZED WIRE ENCASED IN 12mmØ RUBBER HOSE AROUND TREE
- TURNBUCKLE OR APPROVED EQUAL
- T-BAR POST, 2 STAKES PER TREE AND MUST BE CLEAR OF ROOTBALL
- RODENT GUARD (OPTIONAL)
- TREE - 75-100mm ABOVE FINISHED GRADE
- MULCH: 50-100mm ht.
- EARTH SAUCER: 50-100mm ht.
- LANDSCAPE FABRIC (OPTIONAL)
- REMOVE ALL ROPE, BURLAP AND WIRE BASKET FROM TOP 1/3 OF ROOTBALL
- SCARIFY SIDES PRIOR TO PLANTING
- PLANTING SOIL MEDIUM PER TS 5.10; SOIL TO BE COMPACTED AND WATERED TO ELIMINATE AIR POCKETS
- CROWN BOTTOM OF TREE PIT
- UNDISTURBED OR COMPACTED SUBGRADE

DECIDUOUS TREE PLANTING (ON A SLOPE)

NOTES:

1. THIS DETAIL DOES NOT REPRESENT ANY PARTICULAR TREE SPECIES;
2. ONLY TREES PLANTED WITHIN THE NATURALIZED/NO-MOW ZONE REQUIRE LANDSCAPE FABRIC AND RODENT GUARDS.



- REMOVE ONLY DEAD OR DAMAGED BRANCHES. DO NOT PRUNE LEADER.
- FLAGGING TAPE
- NO.9 GAUGE GALVANIZED WIRE ENCASED IN 12mmØ RUBBER HOSE AROUND TREE
- TURNBUCKLE OR APPROVED EQUAL
- T-BAR POST, 2 STAKES PER TREE AND MUST BE CLEAR OF ROOTBALL
- RODENT GUARD (OPTIONAL)
- TREE - 75-100mm ABOVE FINISHED GRADE
- MULCH: 50-100mm ht.
- FORM 100mm HT. EARTH SAUCER ON DOWNHILL SIDE AROUND TREE
- LANDSCAPE FABRIC (OPTIONAL)
- REMOVE ALL ROPE, BURLAP AND WIRE BASKET FROM TOP 1/3 OF ROOTBALL
- SCARIFY SIDES PRIOR TO PLANTING
- PLANTING SOIL MEDIUM PER TS 5.10; SOIL TO BE COMPACTED AND WATERED TO ELIMINATE AIR POCKETS
- CROWN BOTTOM OF TREE PIT
- UNDISTURBED OR COMPACTED SUBGRADE

All dimensions are in millimetres unless otherwise shown.

CITY OF TORONTO GUIDELINE DRAWING



**TREE PLANTING
DETAIL**

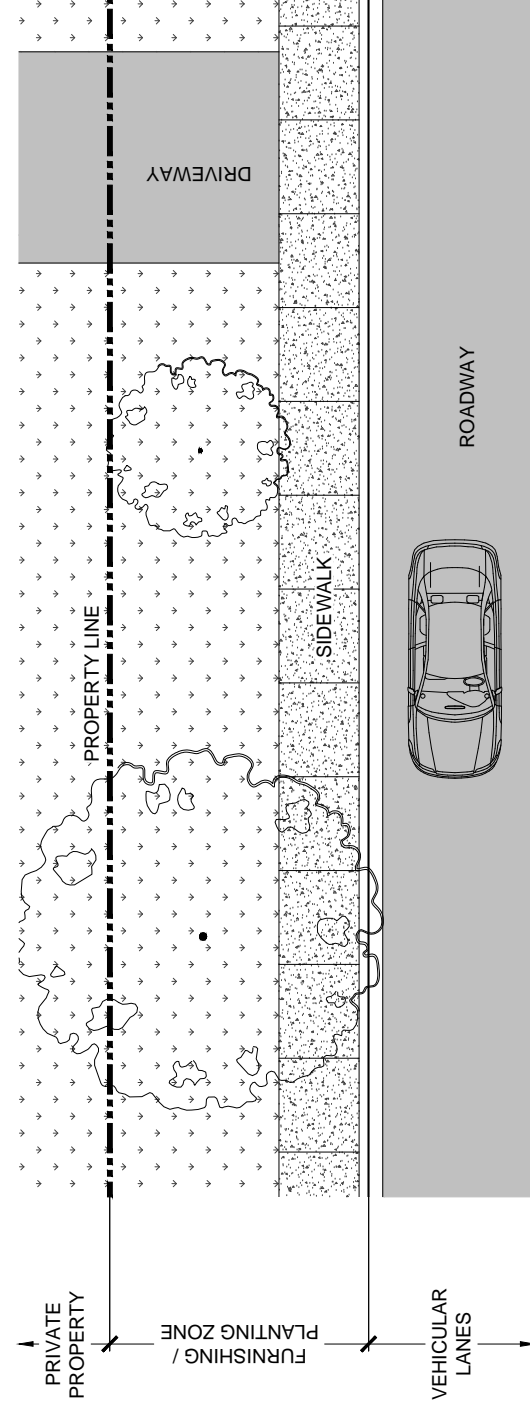
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E-1.1

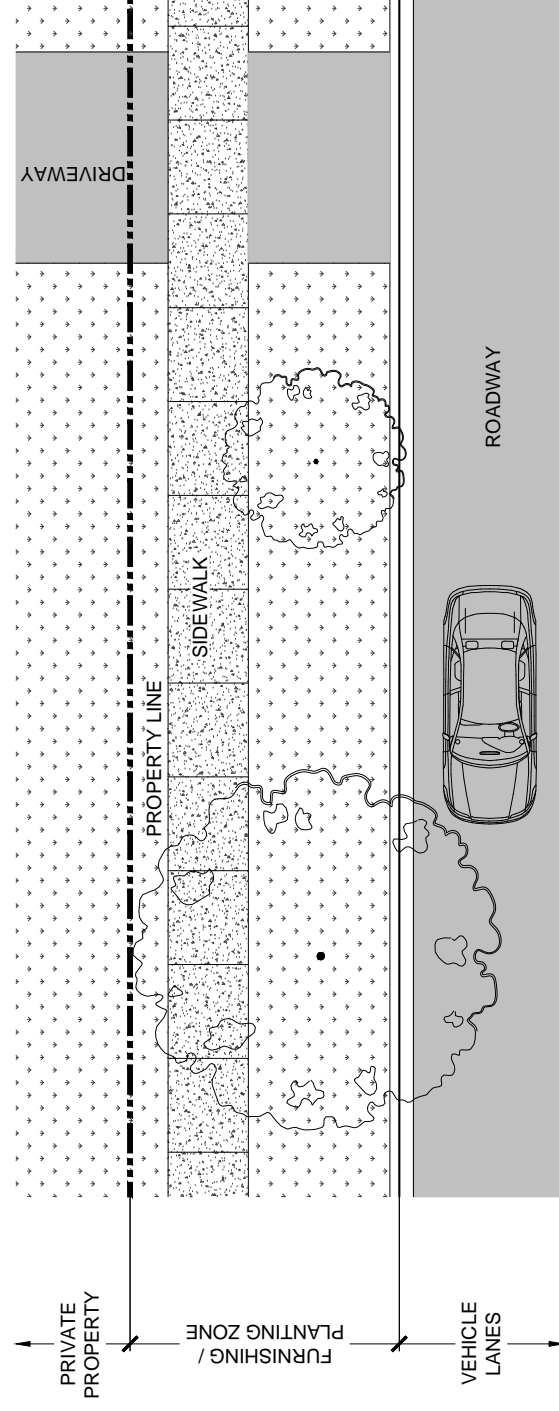
NTS

1 OF 2

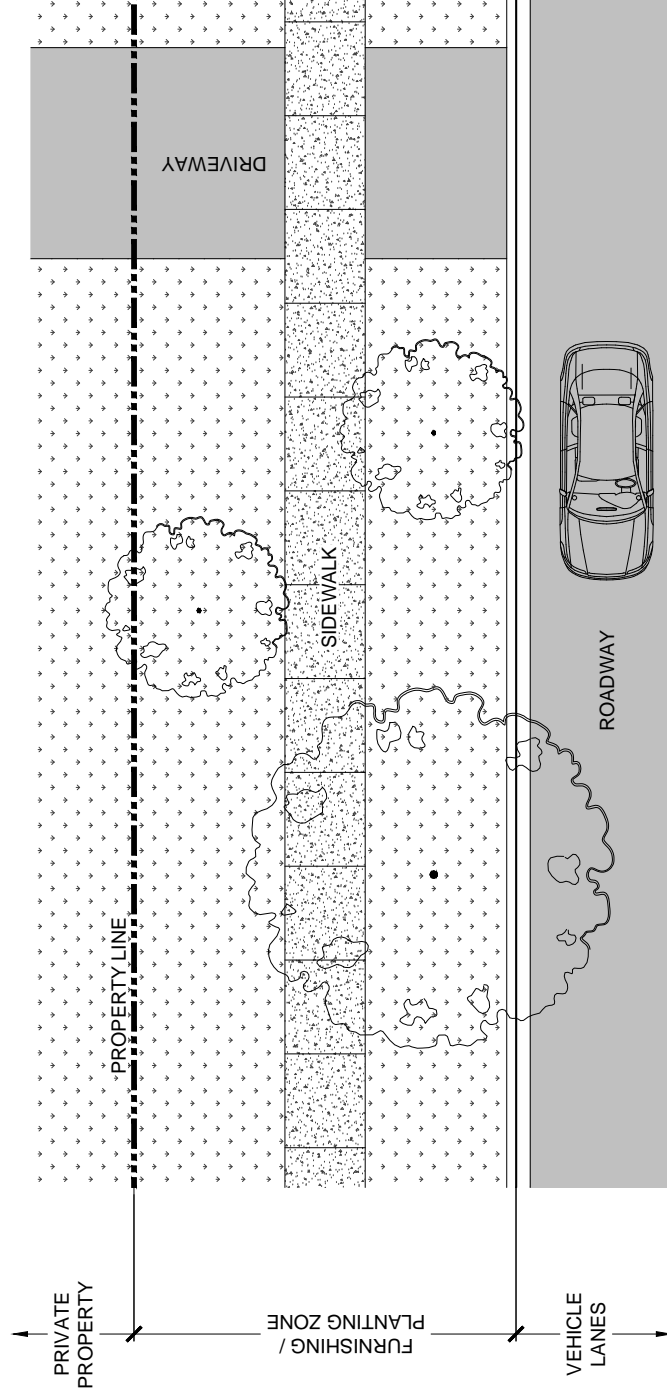
TREE PLANTING-BETWEEN SIDEWALK AND PROPERTY LINE



TREE PLANTING-BETWEEN CURB AND SIDEWALK



TREE PLANTING-DOUBLE ROW



NOTE: LAYOUTS ADAPTED "FROM TORONTO URBAN DESIGN STREETScape MANUAL" REFER TO TREES IN SOFT LANDSCAPE (sL) DRAWINGS T-sL1-1 TO T-sL1-4 FOR FURTHER DETAILS

All dimensions are in millimetres unless otherwise shown.



CITY OF TORONTO GUIDELINE DRAWING

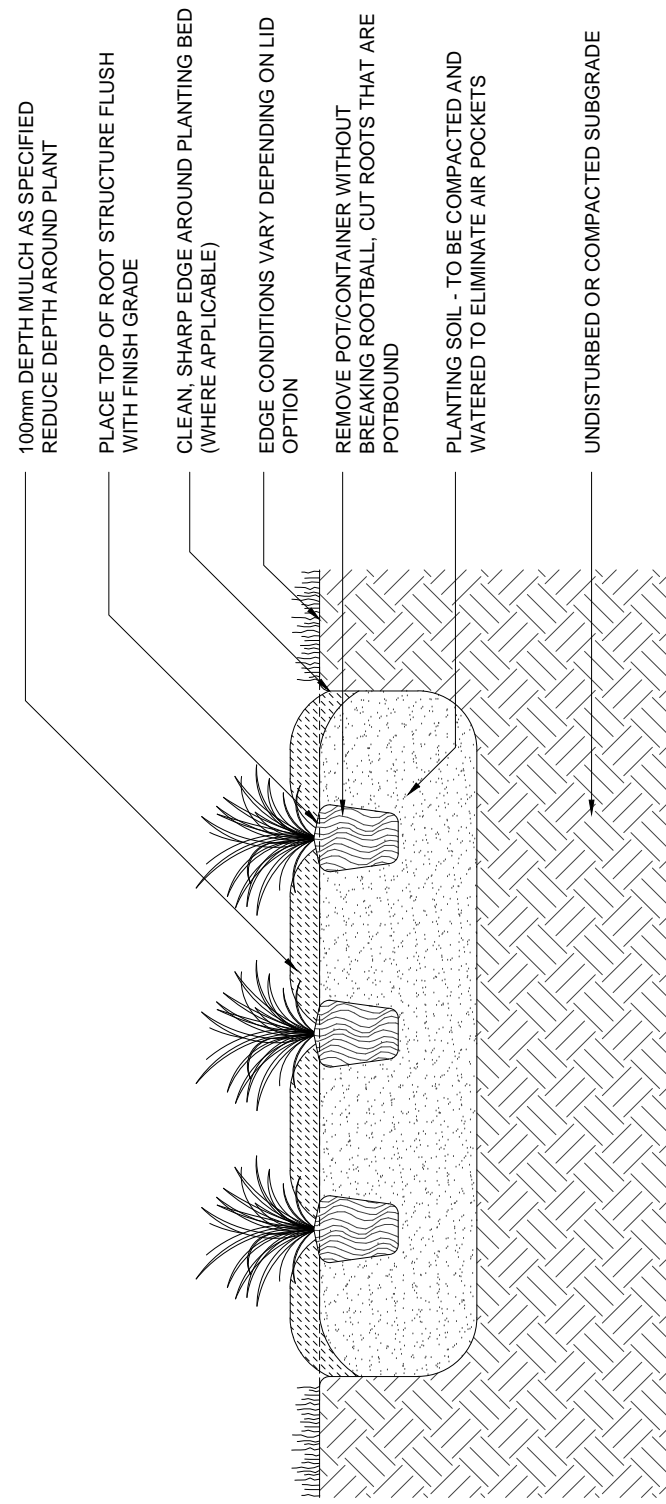
TREE PLANTING LAYOUTS

REV 0 APR 2017

E-1.2

NTS 2 OF 2

HERBACEOUS PLANTING



NOTES:

1. ALL DIMENSIONS SHOWN IN MILLIMETRES
2. THE ABOVE DETAIL DOES NOT REPRESENT ANY PARTICULAR SPECIES OR LOCATION
3. PLANTING CONTEXT AND MATERIALS VARY DEPENDING ON THE LID OPTION AND STREET TYPOLOGY
4. WATER THOROUGHLY AFTER INSTALLATION
5. REFER TO TS 5.30 FOR PLANTING SPECIFICATIONS
6. REFER TO TS 5.10 FOR GROWING MEDIA SPECIFICATIONS

All dimensions are in millimetres unless otherwise shown.

CITY OF TORONTO GUIDELINE DRAWING

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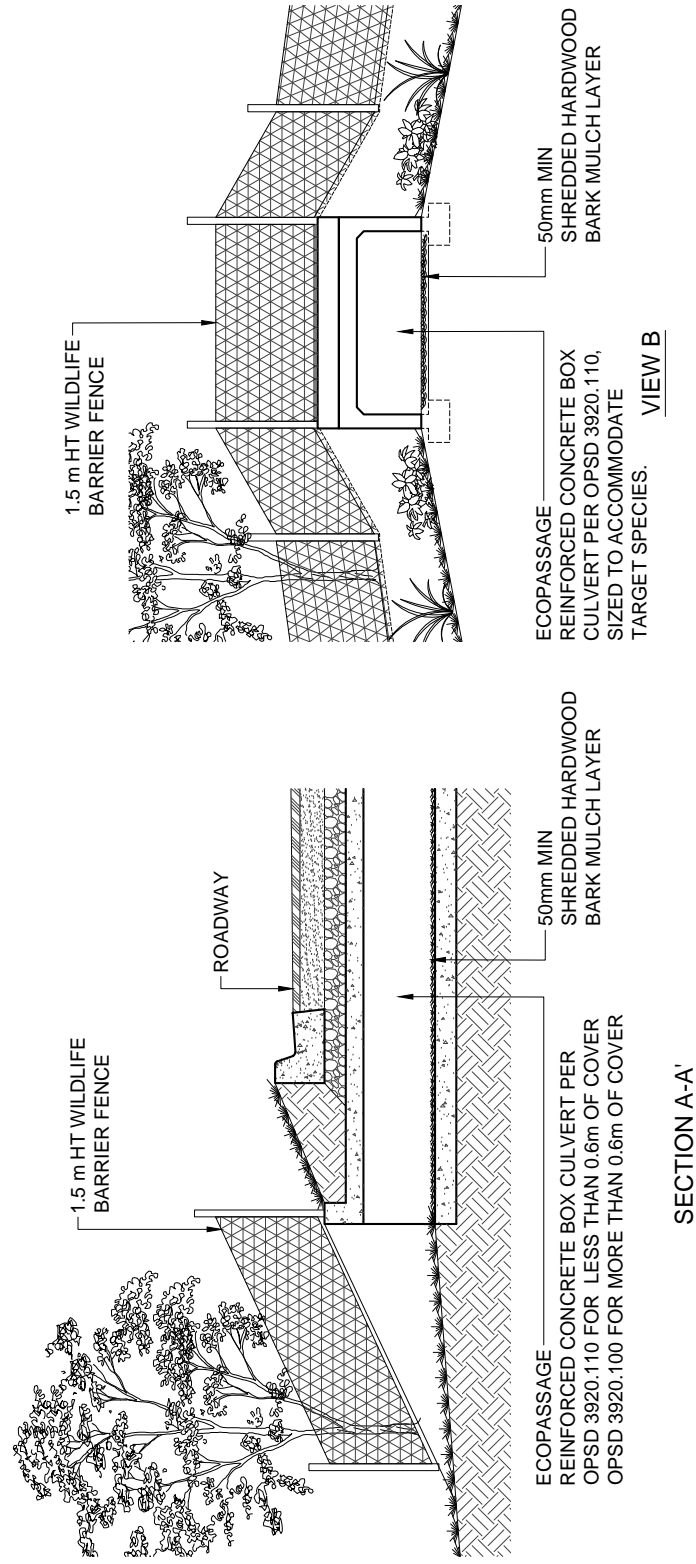


HERBACEOUS PLANTING
DETAIL

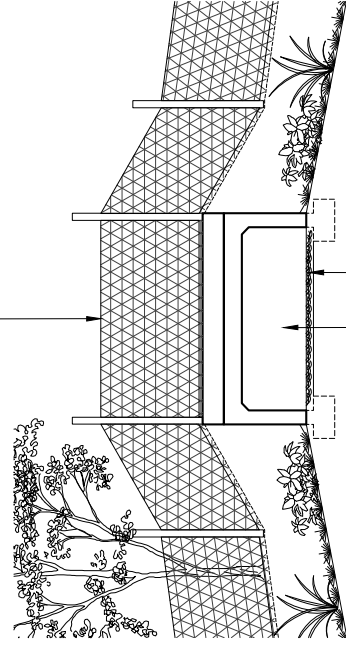
E-2

NTS 1 OF 1

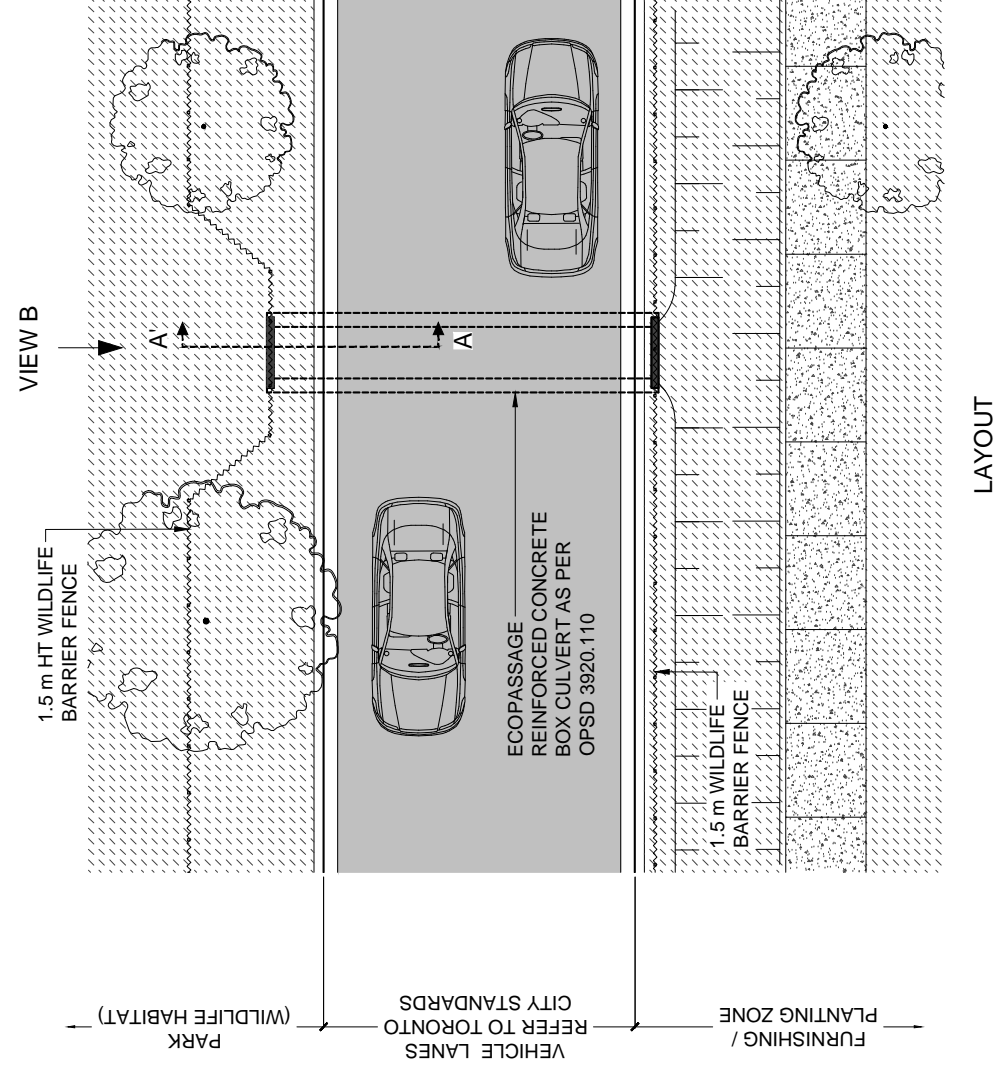
ECOPASSAGE UNDER TRAVEL LANES



1.5 m HT WILDLIFE BARRIER FENCE



ECOPASSAGE UNDER TRAVEL LANES



LAYOUT

All dimensions are in millimetres unless otherwise shown.

CITY OF TORONTO GUIDELINE DRAWING

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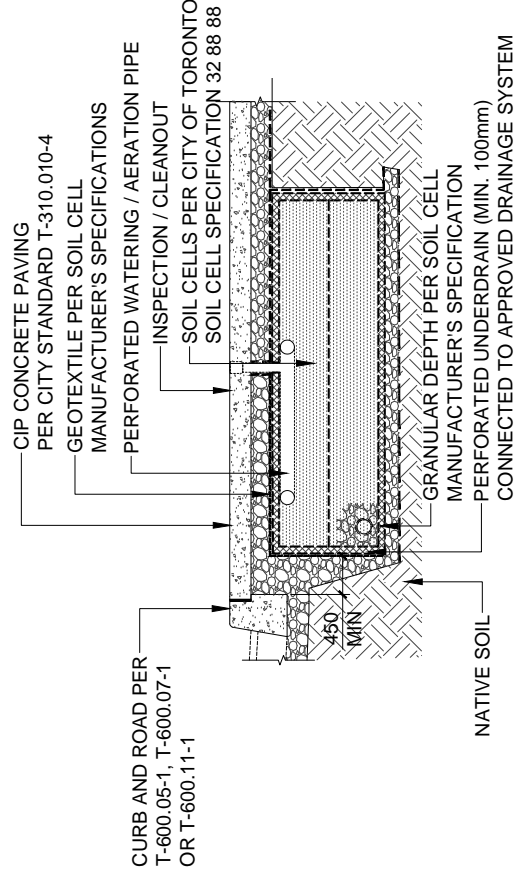


ECOPASSAGE LAYOUTS

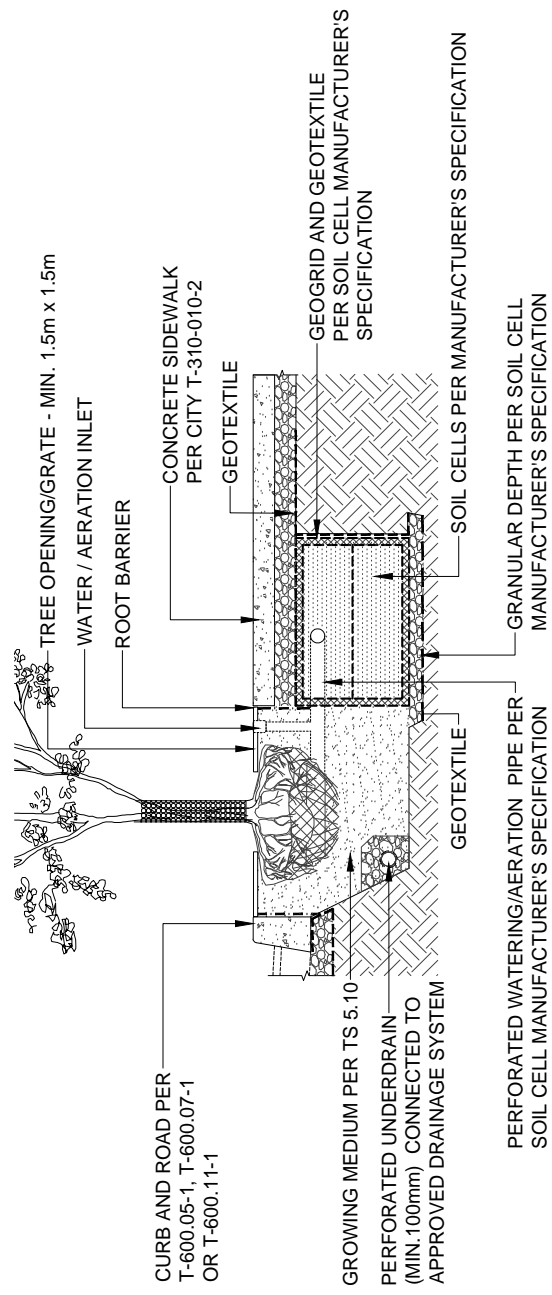
E-3

NTS 1 OF 1

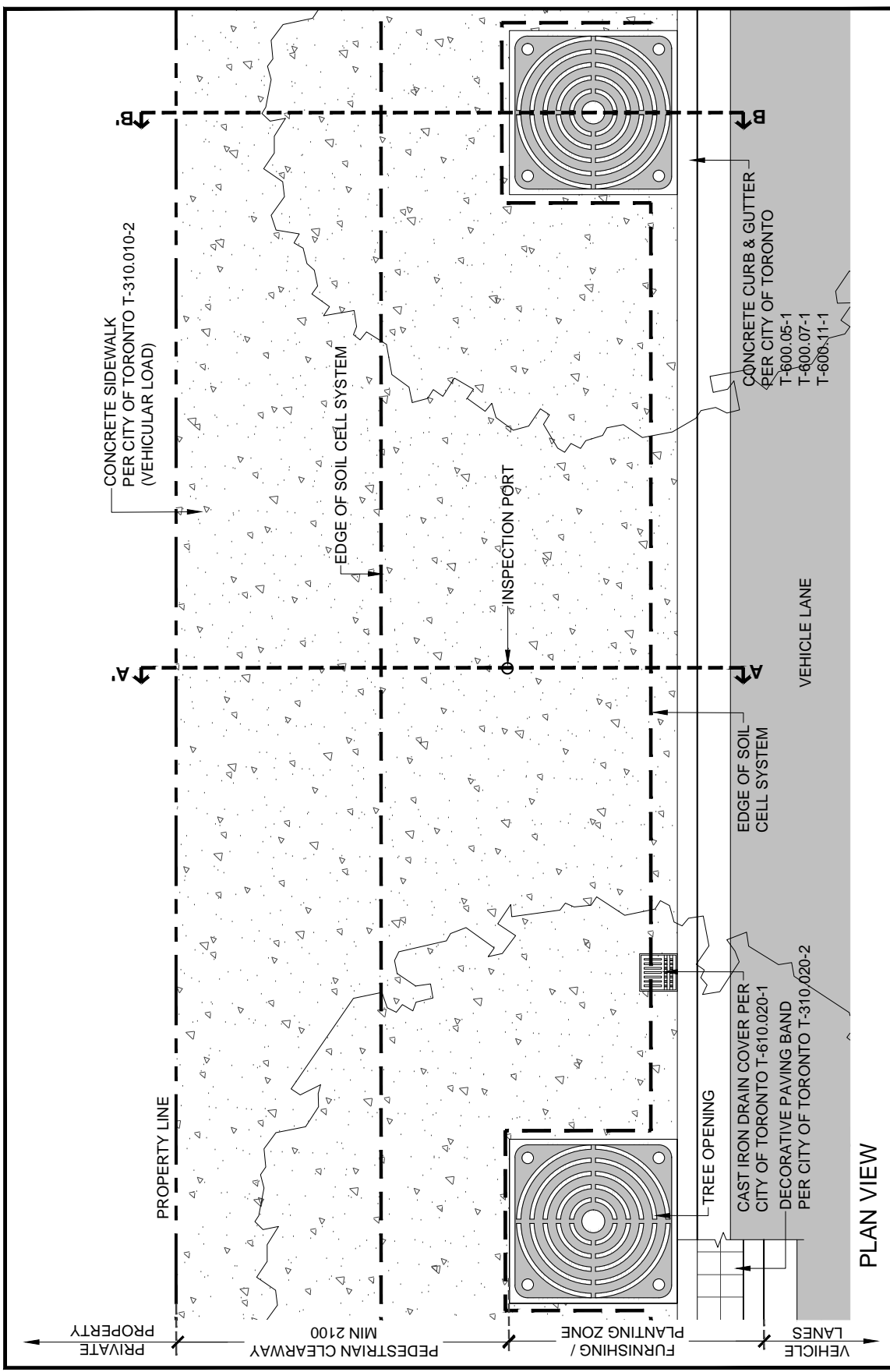
SOIL CELLS IN CONTINUOUS GROWING MEDIUM UNDER CIP CONCRETE- HEAVY DUTY / VEHICULAR LOAD



SECTION A - A'



SECTION B - B'



NOTE: DRAWINGS ADAPTED FROM "CITY OF TORONTO - TREE PLANTING SOLUTIONS IN HARD BOULEVARD SURFACES". REFER TO TREE PLANTING SOLUTIONS IN HARD BOULEVARD SURFACES FOR DETAILED SPECIFICATIONS

All dimensions are in millimetres unless otherwise shown.



CITY OF TORONTO GUIDELINE DRAWING

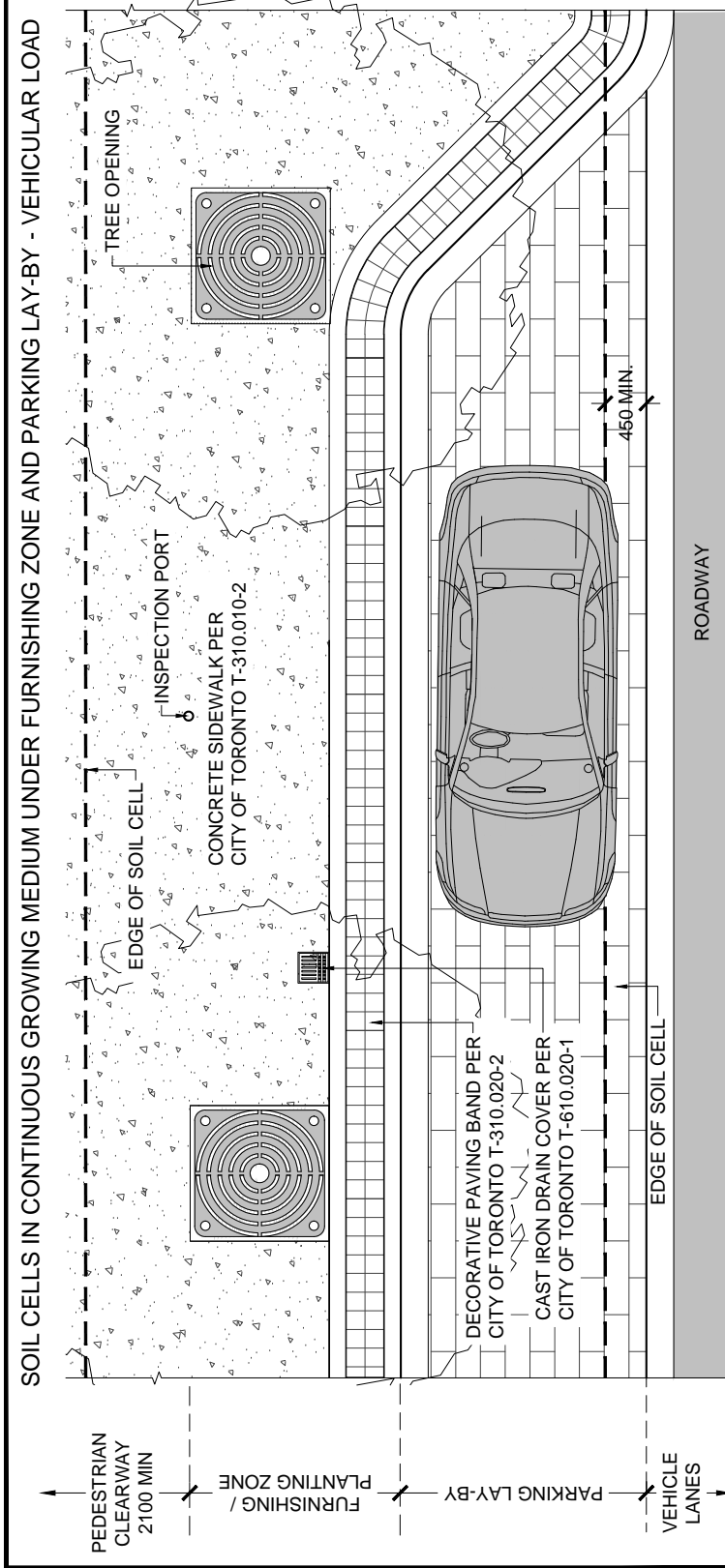
TREE IN SOIL CELLS (VEHICULAR LOAD)
SECTIONS & LAYOUT

REV 0 APR 2017

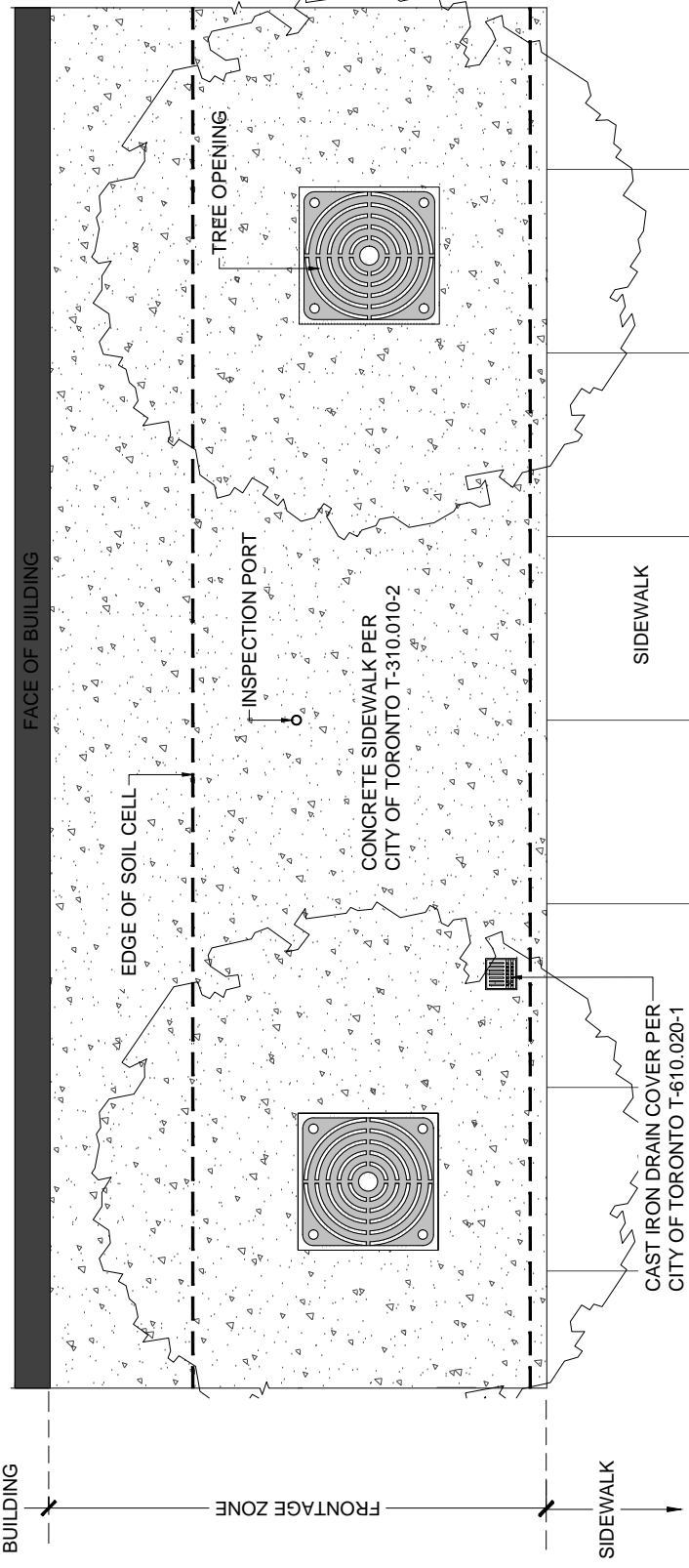
AQ.2a.1

NTS

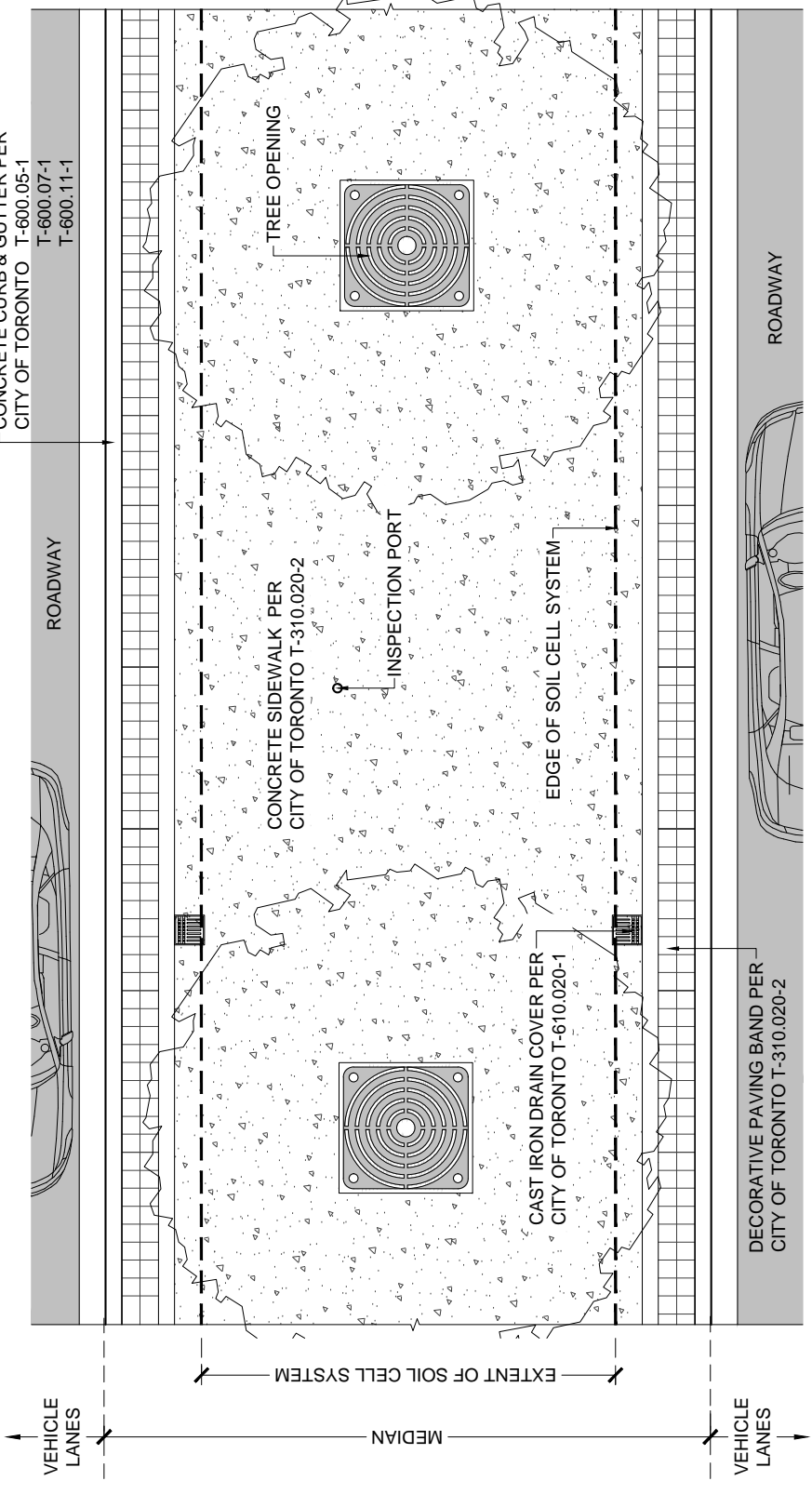
1 OF 2



SOIL CELLS IN CONTINUOUS GROWING MEDIUM IN FRONTAGE ZONE - VEHICULAR LOAD



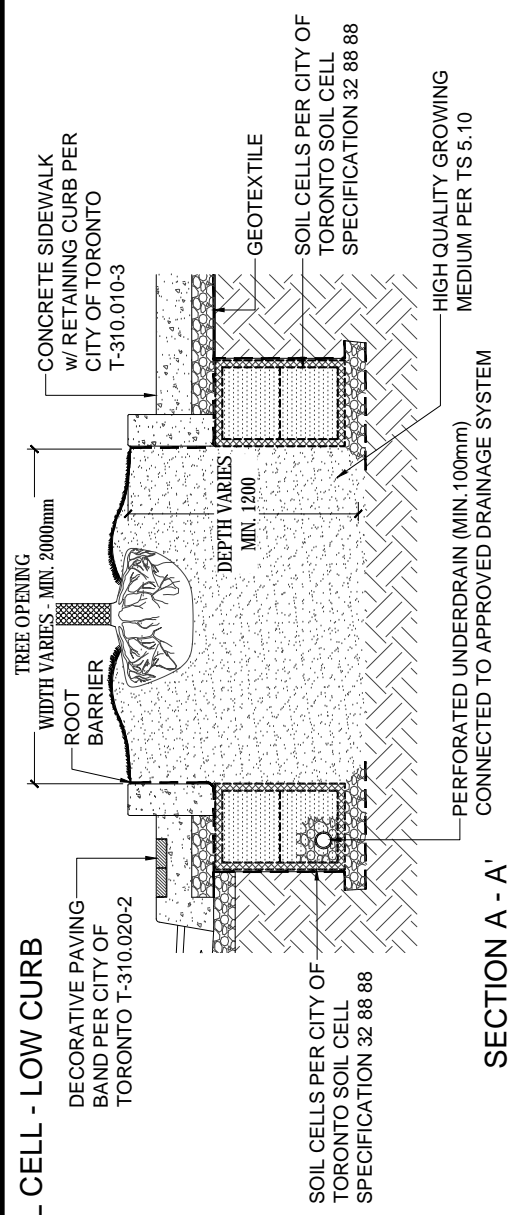
SOIL CELLS IN CONTINUOUS GROWING MEDIUM IN A MEDIAN - VEHICULAR LOAD



All dimensions are in millimetres unless otherwise shown.

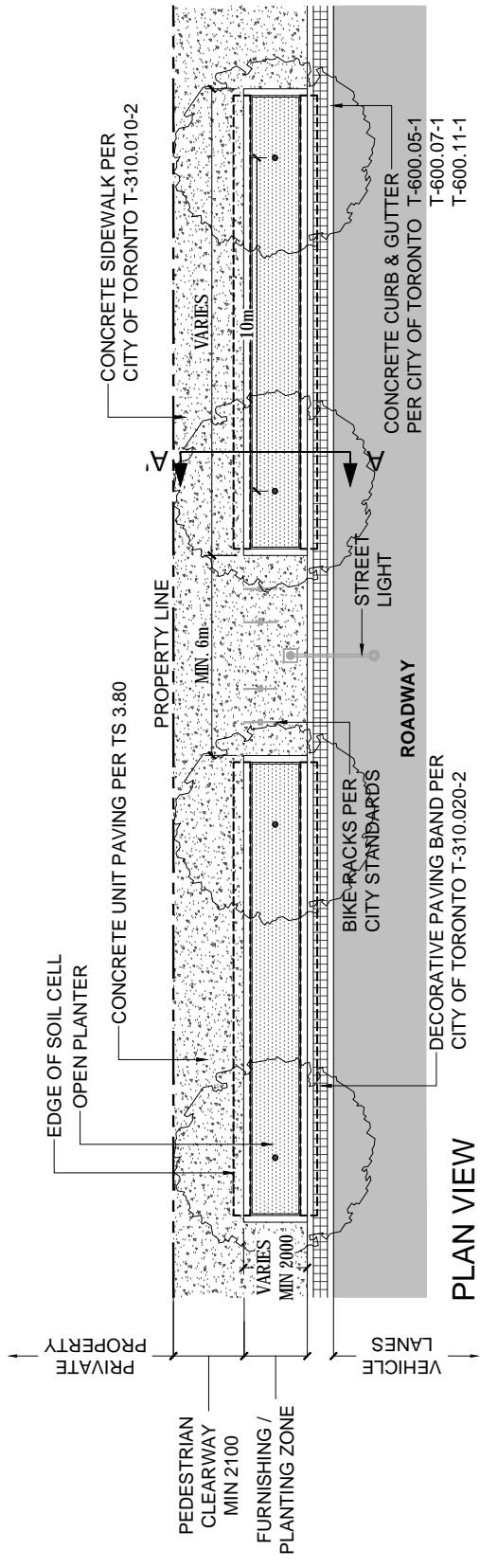
	CITY OF TORONTO GUIDELINE DRAWING		REV 0	APR 2017
	TREE IN SOIL CELLS (VEHICULAR LOAD) SECTIONS		AQ.2a.2	
			NTS	2 OF 2

OPEN TREE PLANTER WITH SOIL CELL - LOW CURB



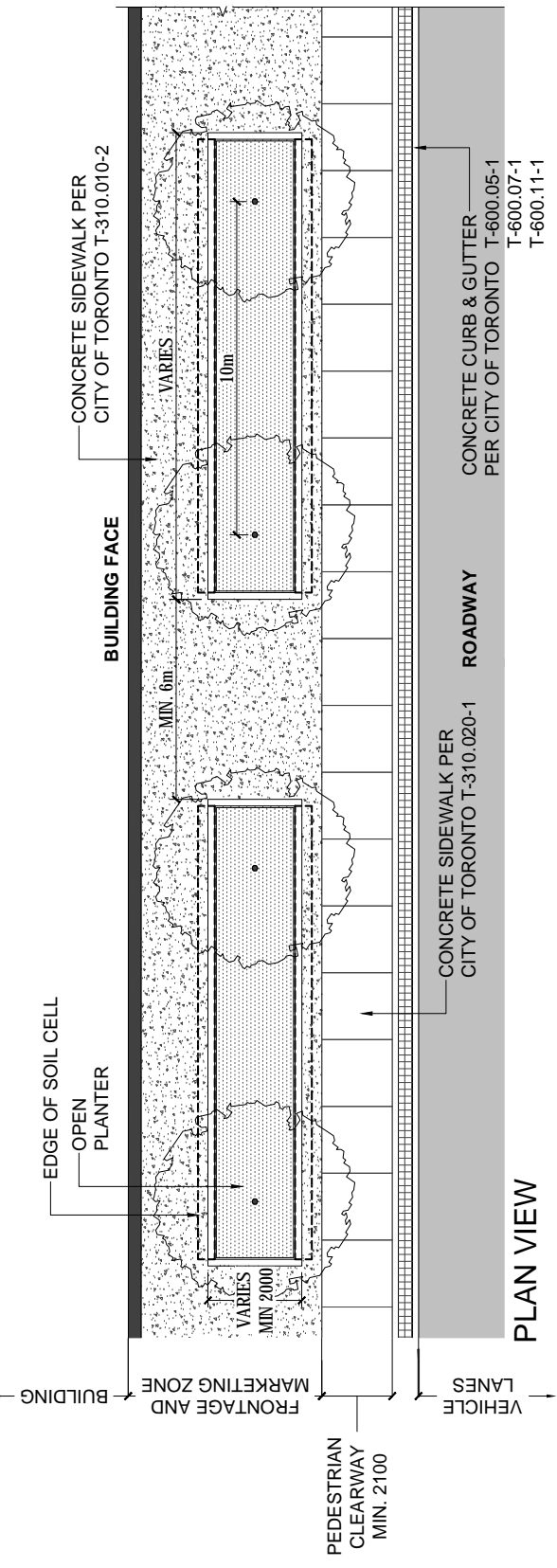
SECTION A - A'

OPEN TREE PLANTER LOW CURB - FURNISHING ZONE



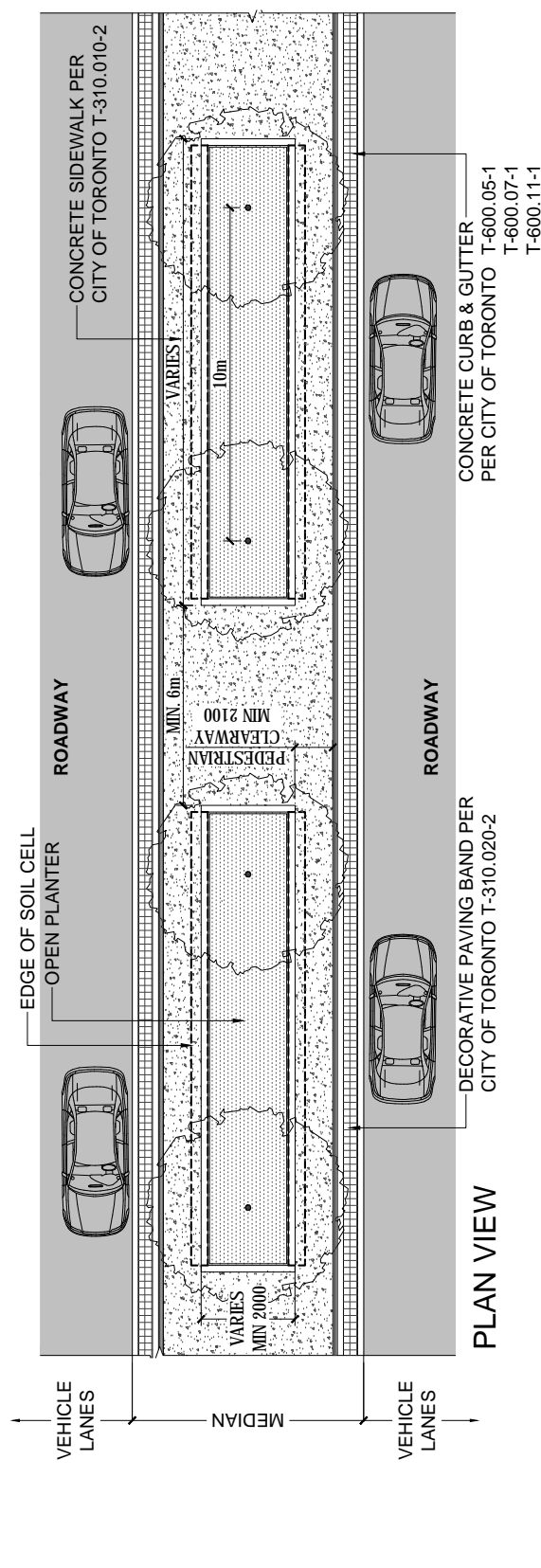
PLAN VIEW

OPEN TREE PLANTER LOW CURB - FRONTAGE ZONE



PLAN VIEW


OPEN TREE PLANTER LOW CURB - MEDIAN

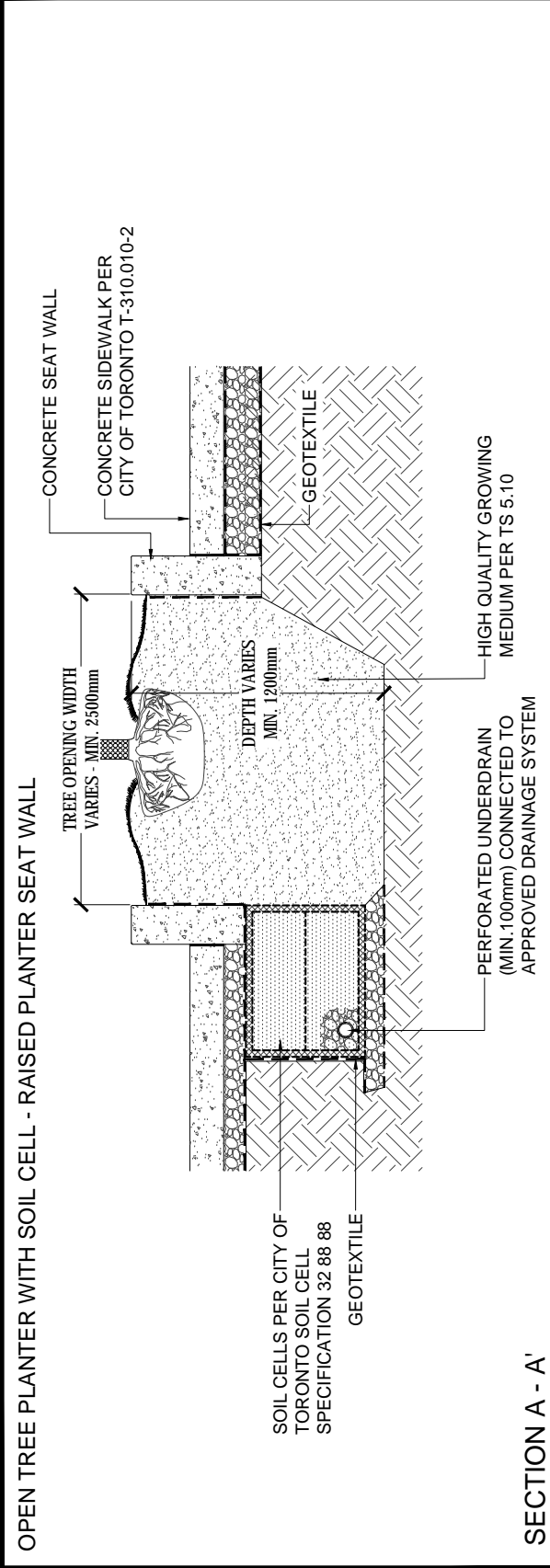


PLAN VIEW

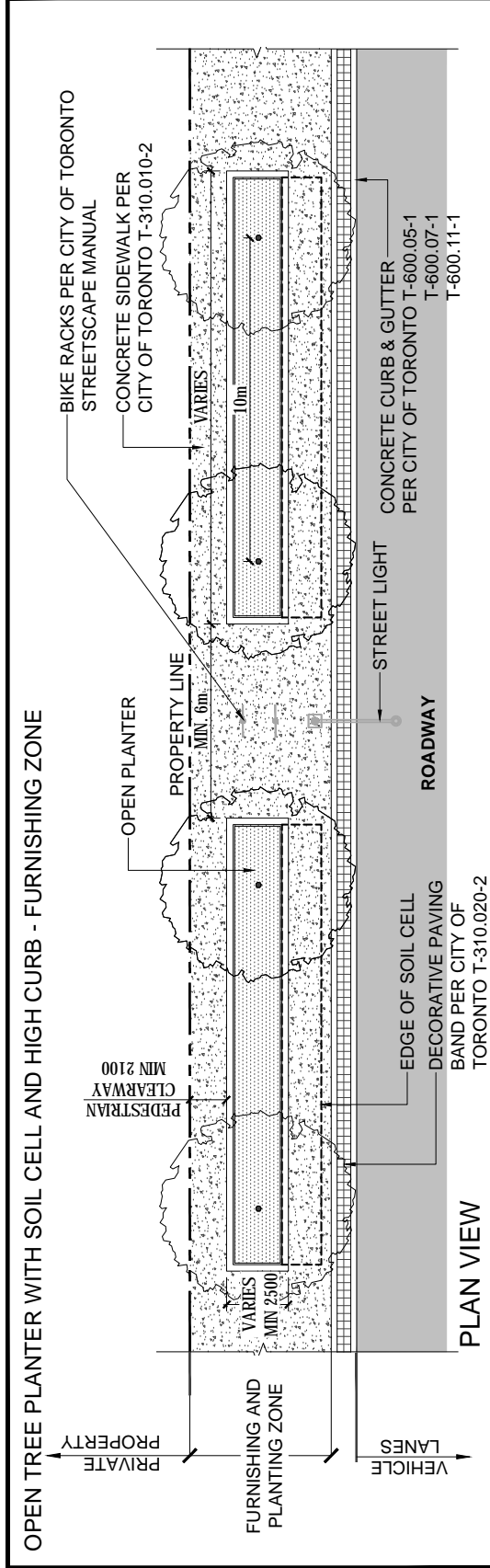
NOTE: DRAWINGS ADAPTED FROM "CITY OF TORONTO - TREE PLANTING SOLUTIONS IN HARD BOULEVARD SURFACES". REFER TO TREE PLANTING SOLUTIONS IN HARD BOULEVARD SURFACES FOR DETAILED SPECIFICATIONS

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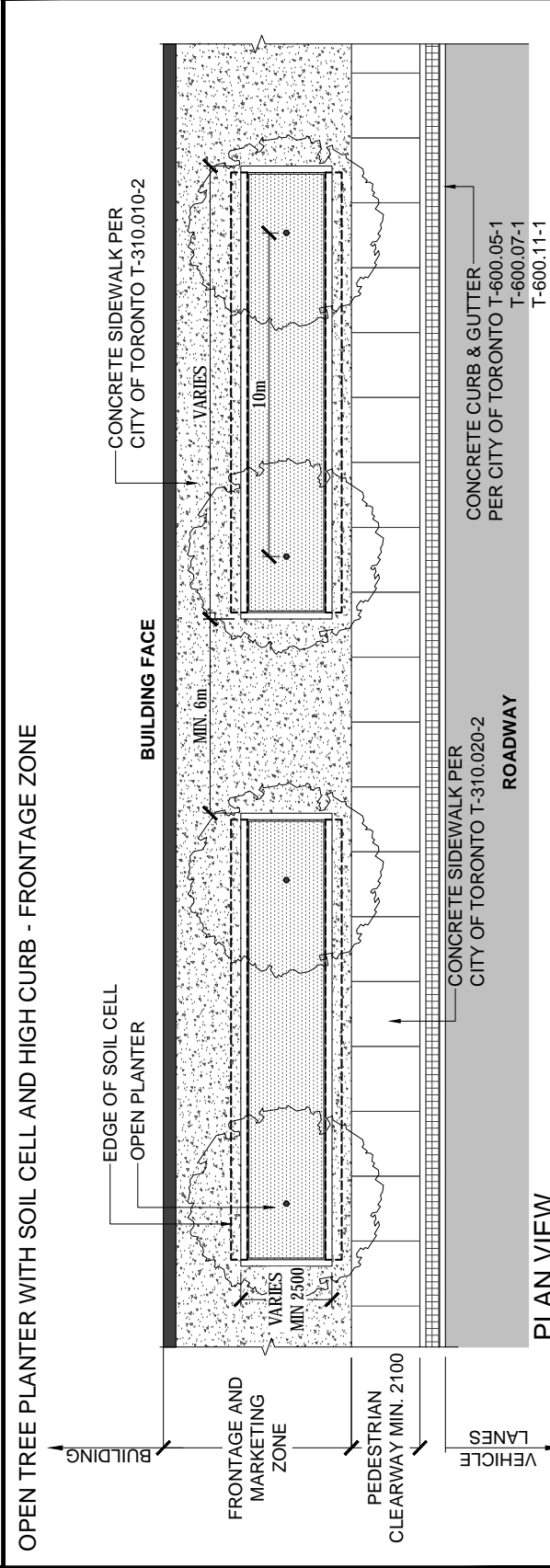
	CITY OF TORONTO GUIDELINE DRAWING		REV 0	APR 2017
	OPEN TREE PLANTER WITH SOIL CELLS - LOW CURB SECTIONS AND LAYOUTS		AQ.2b.1	1 OF 2



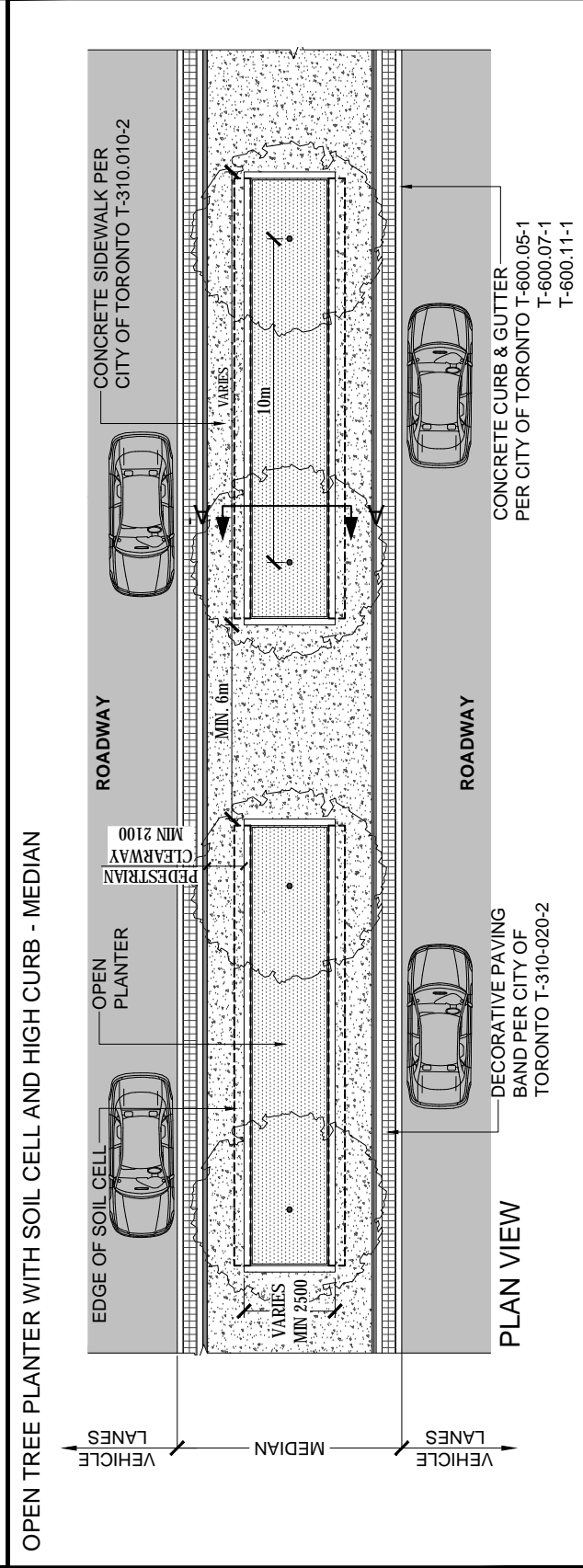
SECTION A - A'



PLAN VIEW



PLAN VIEW



PLAN VIEW

NOTE: DRAWINGS ADAPTED FROM "CITY OF TORONTO - TREE PLANTING SOLUTIONS IN HARD BOULEVARD SURFACES". REFER TO TREE PLANTING SOLUTIONS IN HARD BOULEVARD SURFACES FOR DETAILED SPECIFICATIONS

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CITY OF TORONTO GUIDELINE DRAWING

REV 0 APR 2017



OPEN TREE PLANTER WITH SOIL CELLS - RAISED PLANTER WALL
SECTIONS AND LAYOUTS

AQ.2b.2

NTS 2 OF 2

A.0 GEOMETRY & LAYOUT

- Minimum footprint based on size of drainage area. Impervious contributing area to treatment facility area should be 5:1 to 15:1.
- Ensure that the surface of the bioretention facility is level.

A.1 PRETREATMENT

- Pre-treatment area varies based on site context. Options include enhanced grass swales, bioswales and mechanical pre-treatment devices.

A.2 FILTER MEDIA

- Pre-mixed from an approved vendor;
- Filter media composition (by weight):
 - Sand - 75 to 85%
 - Fines - 2 to 5%
 - Organic Matter - 8 to 10%
 - P-Index value 12 to 30 ppm
 - Soluble Salts <2.0mmhos/cm
 - Cationic exchange capacity >5 meq/100 g
 - pH - 5.5 to 7.5
 - Infiltration rate > 120 mm/hr, max. 300mm/hr
- Materials testing by an independent testing lab is required to confirm filter media composition. Sample to be collected at supply site by a Geotechnical engineer using standard protocols. If issues arise with the performance of an installation, then samples should be collected from the constructed facility for further testing;
- Depth varies - Minimum recommended depth 1.0 - 1.25m for enhanced pollutant removal;
- Bioretention with trees - minimum depth 1.0m. Total volume 30m³/tree or 20m³/tree for trees sharing soil.
- Capacity - Volumetric computation should be based on surface area and depth.
- Refer to TS 5.10 - Construction Specification for Growing Media

A.3 GRAVEL STORAGE

- Depth - Min. 300 mm;
- Material - 50 mm dia. washed clear stone;
- Capacity - Volumetric computation based on depth;
- Choker Layer: 100 mm pea gravel layer between filter media and gravel storage layers.

A.4 MULCH

- Depth - 75 mm;
- Material - Shredded hardwood bark mulch.

A.5 OVERFLOW

- Sized to convey larger storm events;
- PVC Overflow Pipe invert should be set at a maximum of 250mm above the filter bed surface;
- Cap - metal beehive cap or approved equal.

A.6 MONITORING WELL

- Vertical PVC perforated stand pipe (100-150mm dia.) with lockable cap;
- Extend to the bottom of the bioretention facility.

A.7 UNDERDRAIN (OPTIONAL)

- Required where native soil infiltration rates are <15mm/hr or adjacent to structures;
- Min. 200mm dia. perforated pipe installed 100mm above the bottom of the gravel storage layer;
- Capped at upstream end and connected to storm sewer;
- Connected to monitoring well for clean out;
- Refer to OPSS 405 - Construction Specification for Subdrain Pipe.

A.8 GEOTEXTILE

- Material - Woven monofilament or non-woven needle punched fabrics;
- Refer to OPSS 1860 Material Specification for Geotextiles.

A.9 PLANTING

- Plant material selection and arrangement considerations:
- Plant material selection and arrangement should consider the site context;
- Native plant material should be selected wherever possible;
- Plant materials should be selected for their tolerance of salt and urban conditions. Shade should also be considered for herbaceous material planted under trees or in other ultra-urban shaded areas;
- Planting design should provide variety in seasonal colour and winter interest;
- Plant material should be arranged in groupings by relative height texture and aesthetic attributes;
- Refer to the GSTG Vegetation Selection Tool for an appropriate palette;
- Refer to Construction Specification for Planting (TS 5.30).

A.10 IDENTIFICATION MEDALLION

- To be installed on planter wall. Refer to guideline drawing G-1.

All dimensions are in millimetres unless otherwise shown.



CITY OF TORONTO GUIDELINE DRAWING

BIORETENTION PLANTERS SECTIONS

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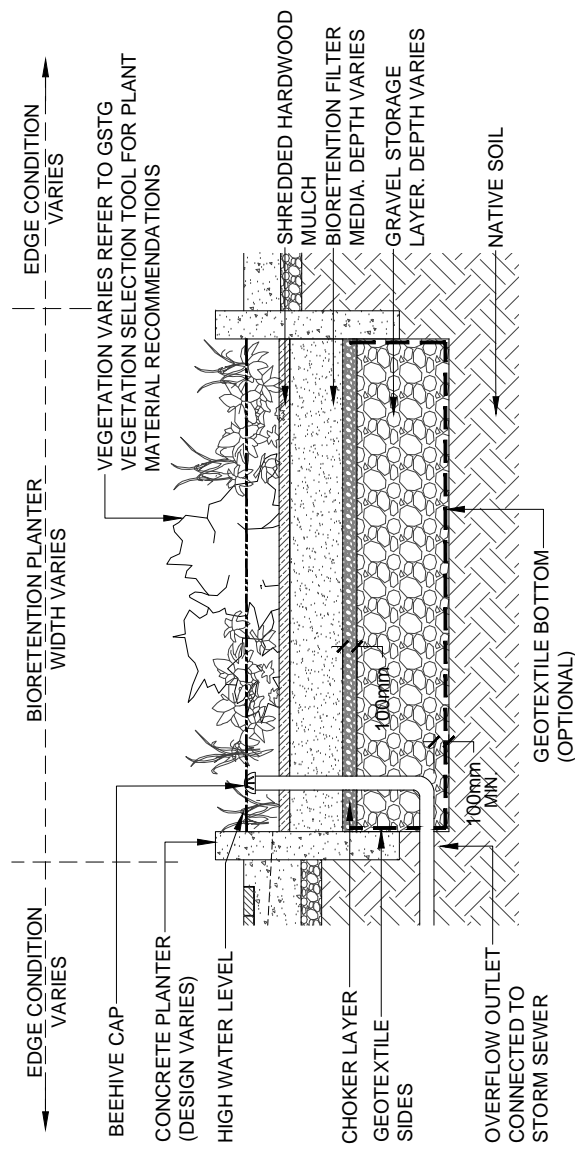
WQ-1.1a

NTS 1 OF 2

BIORETENTION PLANTER WITHOUT UNDERDRAIN

For sites with subsoil permeability >15mm/hr, water table depth > 1.0m

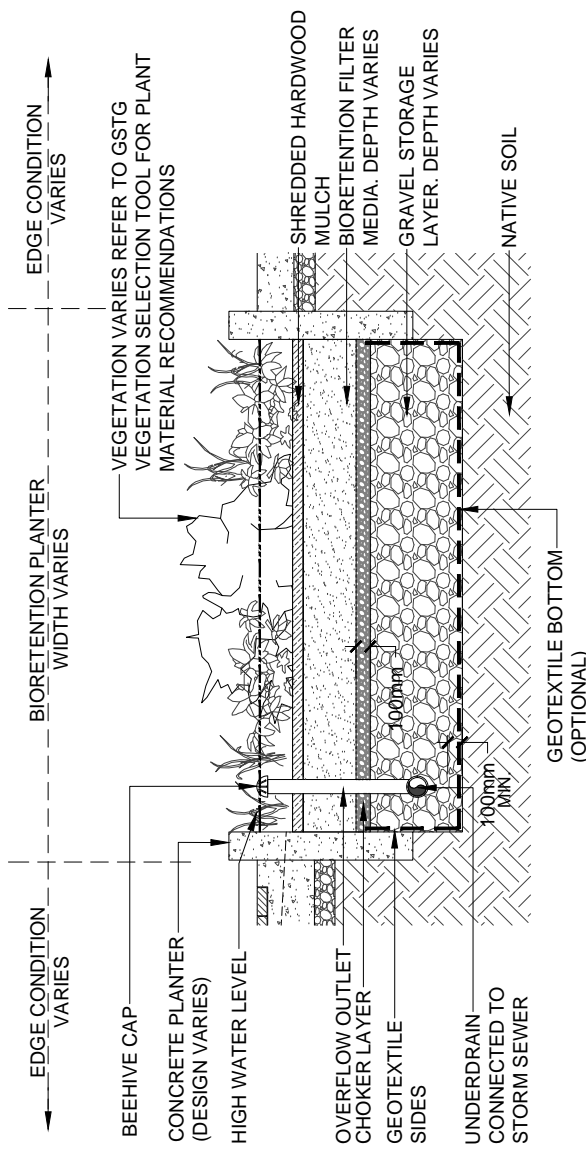
NOTE: 4.0m MIN SETBACK FROM BUILDING FACE



BIORETENTION PLANTER WITH UNDERDRAIN

For sites with subsoil permeability <15mm/hr, water table depth > 1.0m

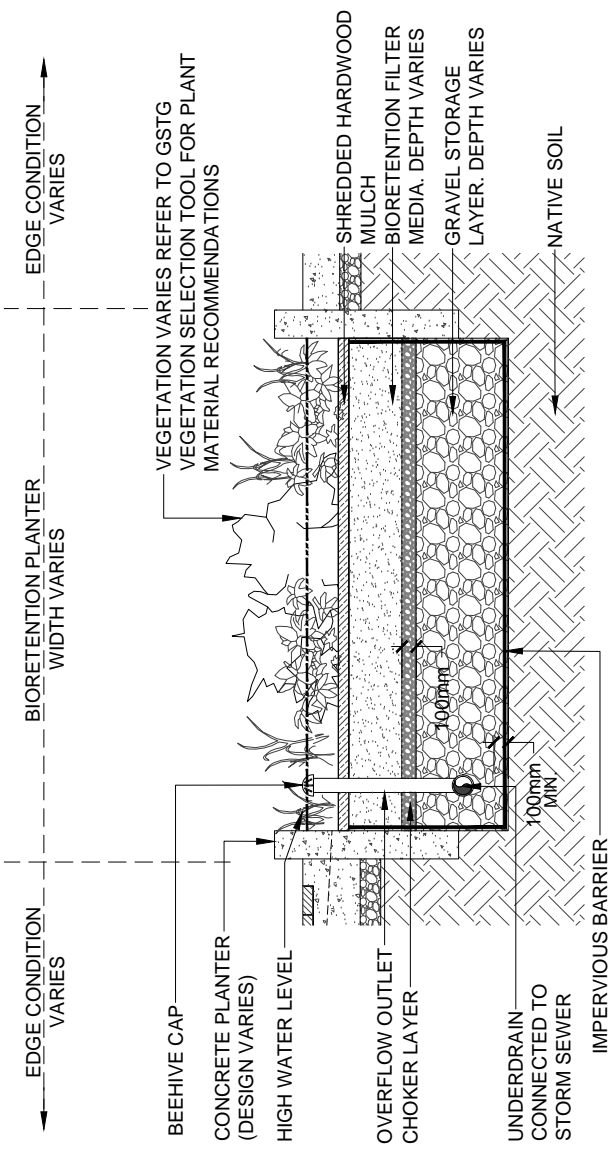
NOTE: 4.0m MIN SETBACK FROM BUILDING FACE



BIORETENTION PLANTER WITH UNDERDRAIN AND IMPERVIOUS LINER

For sites with contaminated subsoil or high water table within 1.0m

NOTE: NO MINIMUM SETBACK FROM BUILDING FACE REQUIRED



NOTE: SCARIFY BASE OF EXCAVATION