A.0 SITE CONDITIONS

- For sites with subsoil permeability >15mm/hr

A.1 PRETREATMENT

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

A.2 GRAVEL STORAGE

- Depth - Min. 1800mm;
- Material - 50 mm dia. clear stone;
- Capacity - Volumetric computation based on depth;

A.3 OVERFLOW

- Manhole connected to conventional storm sewer;

A.4 INLET PIPE

- Material - Solid PVC pipe or approve equal;
- Size - Volume dependent - min. 200mm dia.;

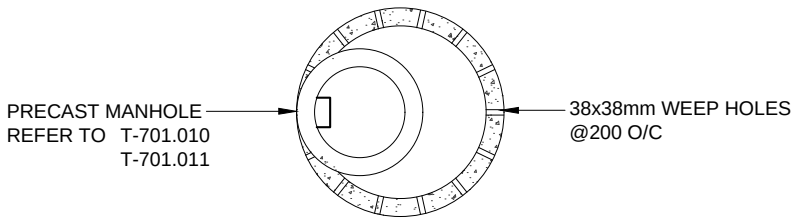
A.5 GEOTEXTILE

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

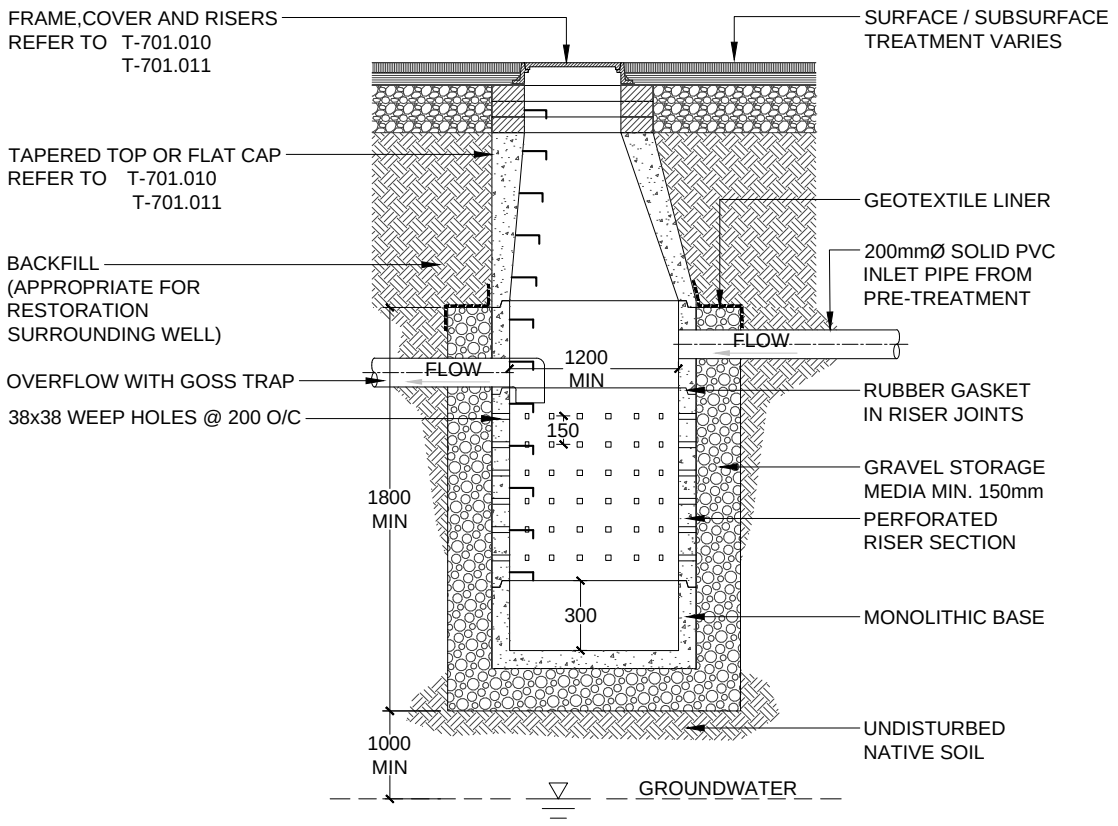
A.6 IDENTIFICATION MEDALLION

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

DRAINAGE WELL

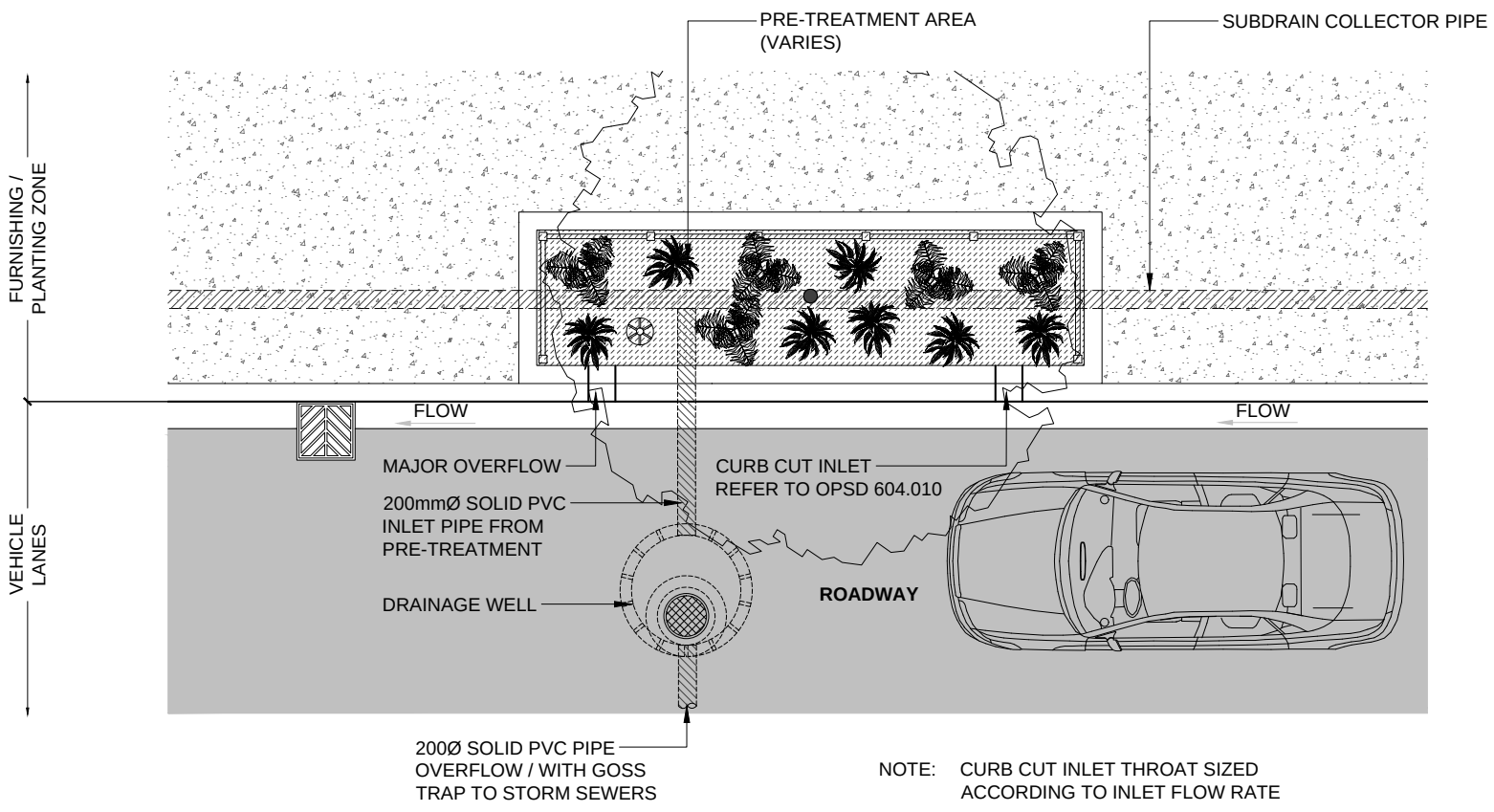


PLAN



SECTION

DRAINAGE WELL WITH PRE-TREATMENT



LAYOUT

All dimensions are in millimetres unless otherwise shown.

	CITY OF TORONTO GUIDELINE DRAWING	REV 0	APR 2017
TORONTO	DRAINAGE WELL SECTIONS AND LAYOUTS	WQ-10.1	
		NTS	1 OF 1

A.0 SITE CONDITIONS

- For sites with subsoil permeability >15mm/hr.

A.1 PRETREATMENT

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

A.2 GRAVEL STORAGE

- Material - 50 mm dia. washed clear stone;
- Slope - 0.5 - 1%;
- Depth
  - Below pipe - volume dependent
  - Above pipe - 75 -150mm

A.3 OVERFLOW

- Manhole connected to conventional storm sewer.

A.4 PIPE

- Material - Smooth walled PVC perforated pipe wrapped in filter fabric;
- Size - Volume dependent - min. 200mm dia.

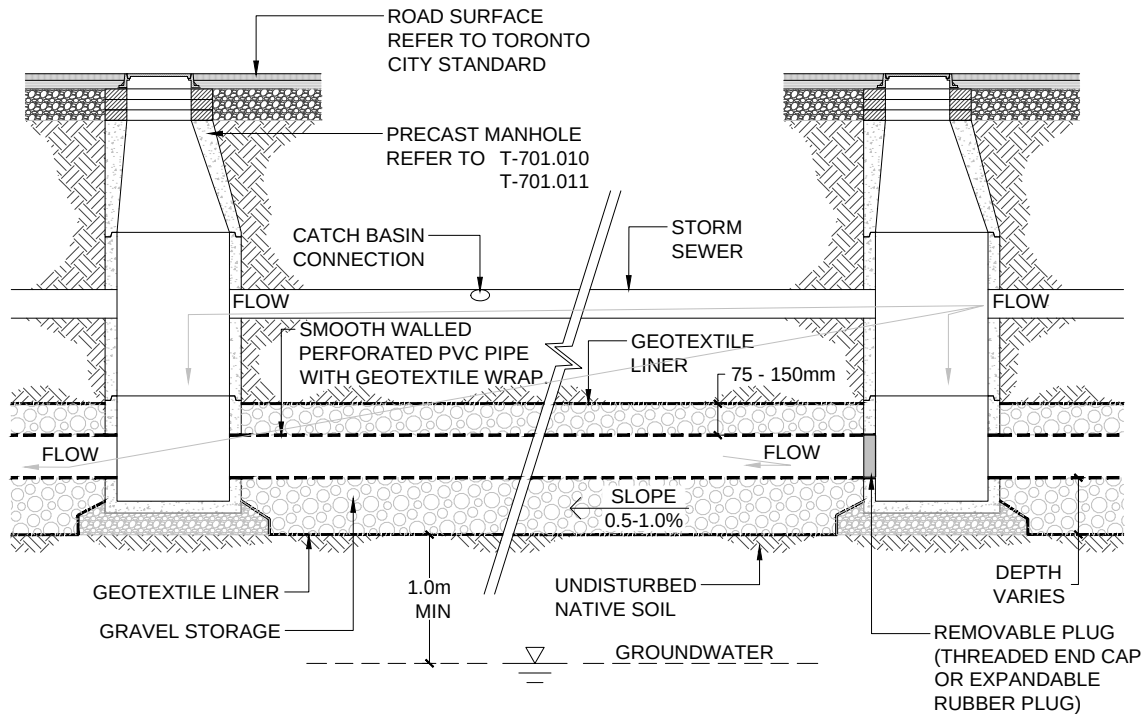
A.5 GEOTEXTILE

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

A.6 IDENTIFICATION MEDALLION

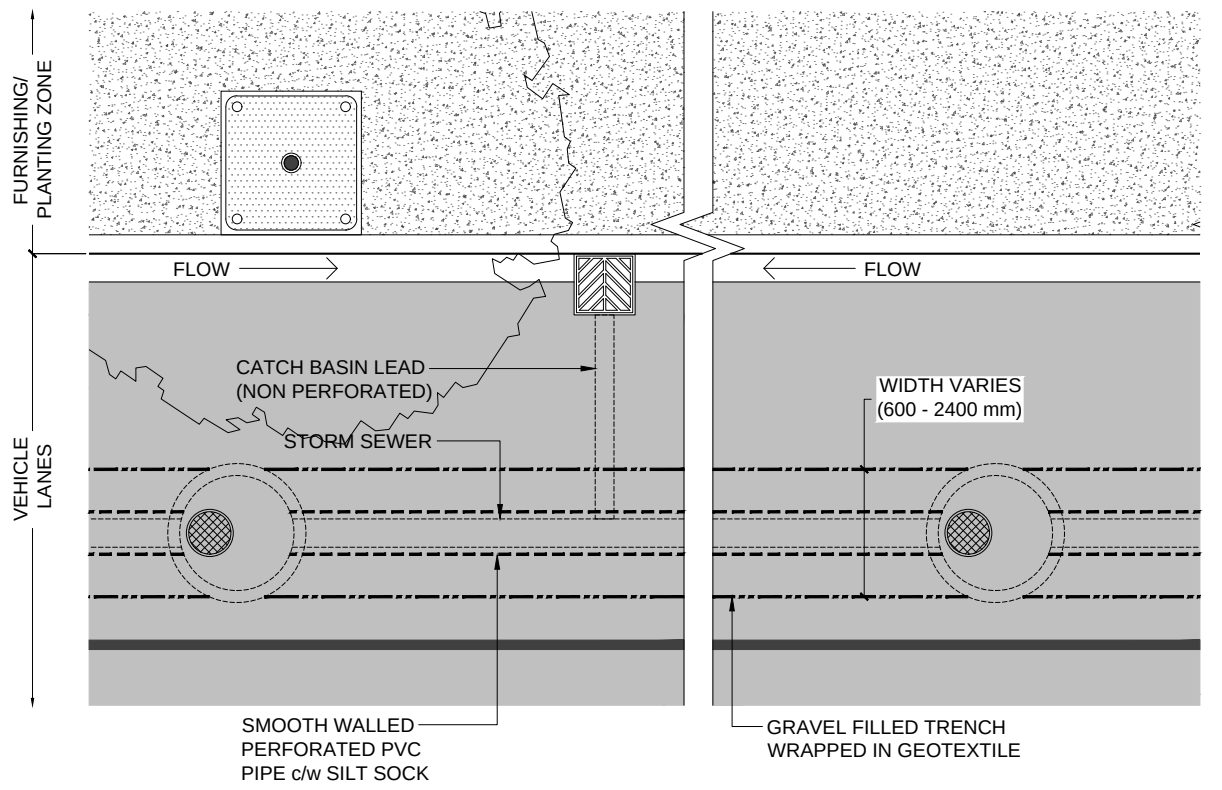
- To be installed on sidewalk or curb adjacent to installation. Refer to guideline drawing G-1.

PERFORATED PIPE



SECTION

PERFORATED PIPE UNDER VEHICLE LANES



LAYOUT

All dimensions are in millimetres unless otherwise shown.

	CITY OF TORONTO GUIDELINE DRAWING	REV 0	APR 2017
TORONTO	PERFORATED PIPE UNDER VEHICULAR TRAVEL LANES SECTION AND LAYOUT	WQ-11.1a	
		NTS	1 OF 2

A.0 SITE CONDITIONS

- For sites with subsoil permeability >15mm/hr

A.1 PRETREATMENT

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

A.2 GRAVEL STORAGE

- Material - 50 mm dia. clear stone;
- Slope - 0.5 - 1%
- Depth
  - Below pipe - volume dependent
  - Above pipe - 75 -150mm

A.3 OVERFLOW

- Manhole connected to conventional storm sewer

A.4 PIPE

- Material - Smooth walled PVC perforated pipe wrapped in filter fabric;
- Size - Volume dependent - min. 200mm dia.

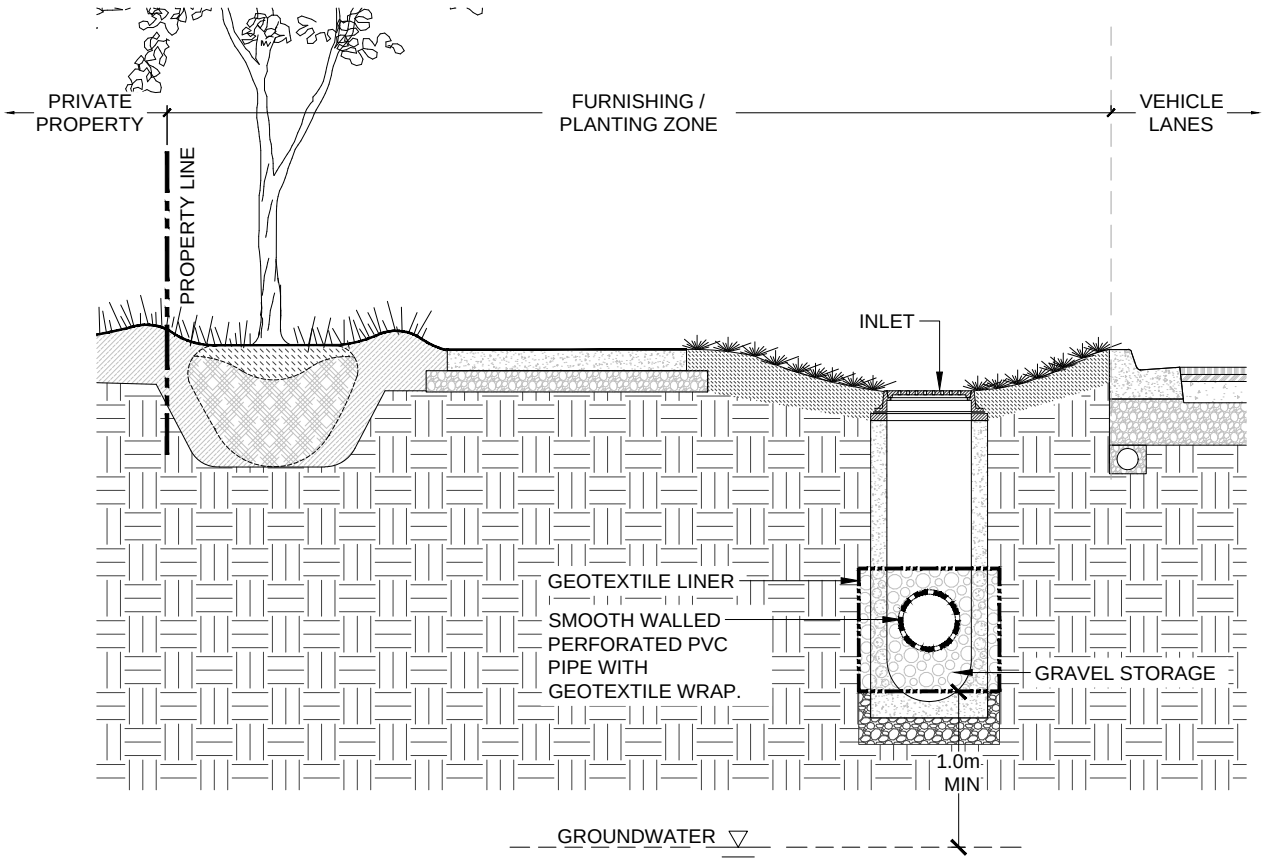
A.5 GEOTEXTILE

- Material - Woven monofilament or non-woven needle punched fabric;
- Refer to OPSS 1860 Material Specification for Geotextiles for Class II Geotextile Fabrics.

A.6 IDENTIFICATION MEDALLION

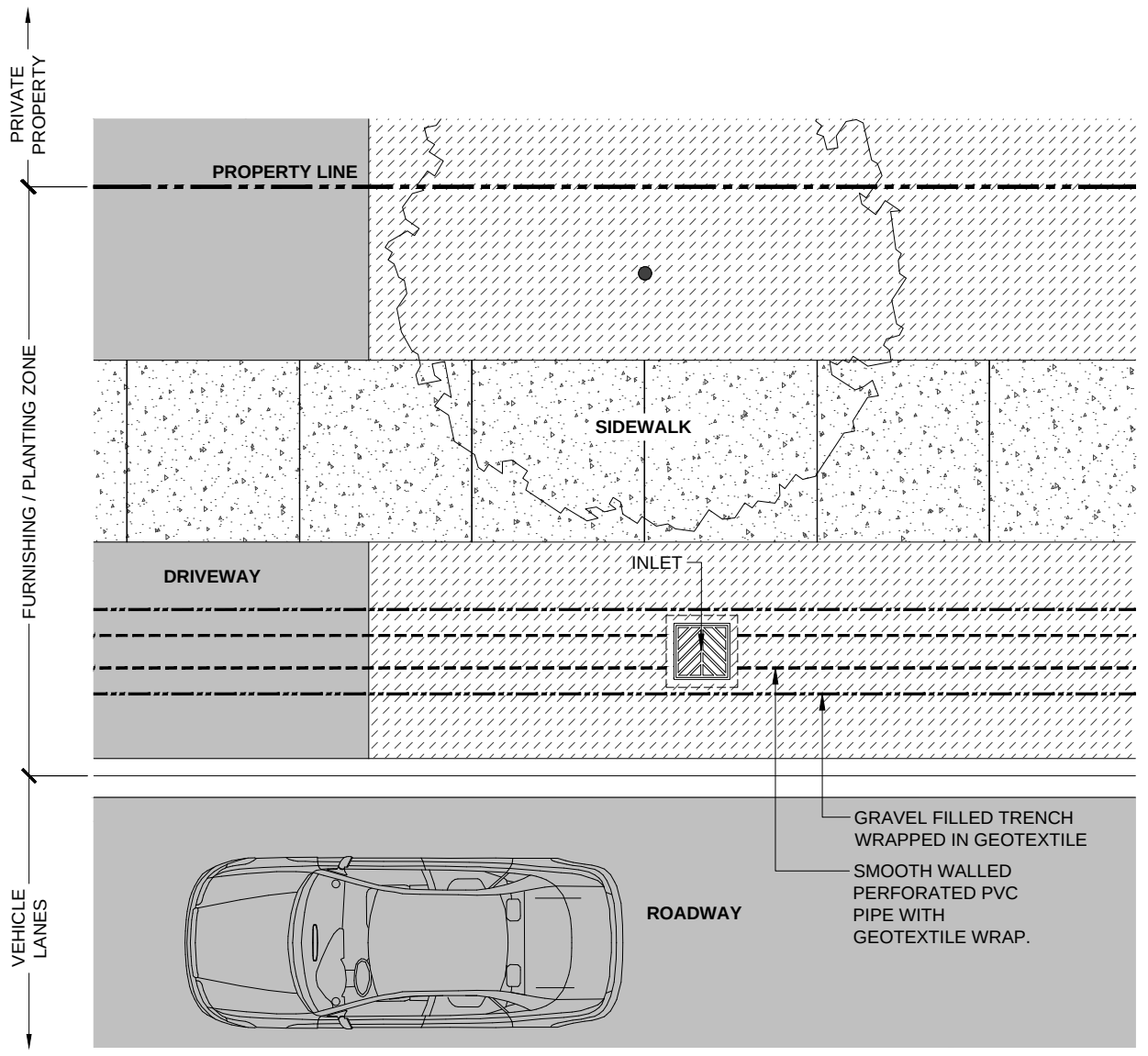
- To be installed on sidewalk or curb adjacent to installation. Refer to guideline drawing G-1.

PERFORATED PIPE



SECTION

PERFORATED PIPE UNDER FURNISHING / PLANTING ZONE



LAYOUT

All dimensions are in millimetres unless otherwise shown.

	CITY OF TORONTO GUIDELINE DRAWING	REV 0	APR 2017
TORONTO	PERFORATED PIPE UNDER BOULEVARD SECTION AND LAYOUT	WQ-11.1b	
		NTS	2 OF 2

A.0 GEOMETRY & LAYOUT

- Rectangular excavations
  - Depth - Min. 3000mm
  - Bottom width varies (600mm-2400 mm)
  - Bottom surface should be level

A.1 SAND LAYER

- Should contain minimal fines and organic matter
- Depth varies - 150-300mm

A.2 GRAVEL STORAGE

- Uniformly graded 50mm clear stone
- 30-40% void space
- Depth varies

A.3 SUBDRAINS

- Inlet pipe (if applicable)
  - Perforated PVC or equivalent (200mm ⌀) connected to non-perforated pipe from source
  - Installed below frost level
- Overflow pipe (if required)
  - Overflow not required if permeability of native soils is >15mm/hr
  - Overflow pipe at the top of gravel layer to be connected to the storm sewer. Pipes must be sized appropriately by engineer.
- Monitoring well / Cleanout
  - Capped non-perforated standpipe connected to the underdrain (if required) at the furthest downstream end.
- Refer to OPSS 405 - Construction Specification for Pipe Subdrains.

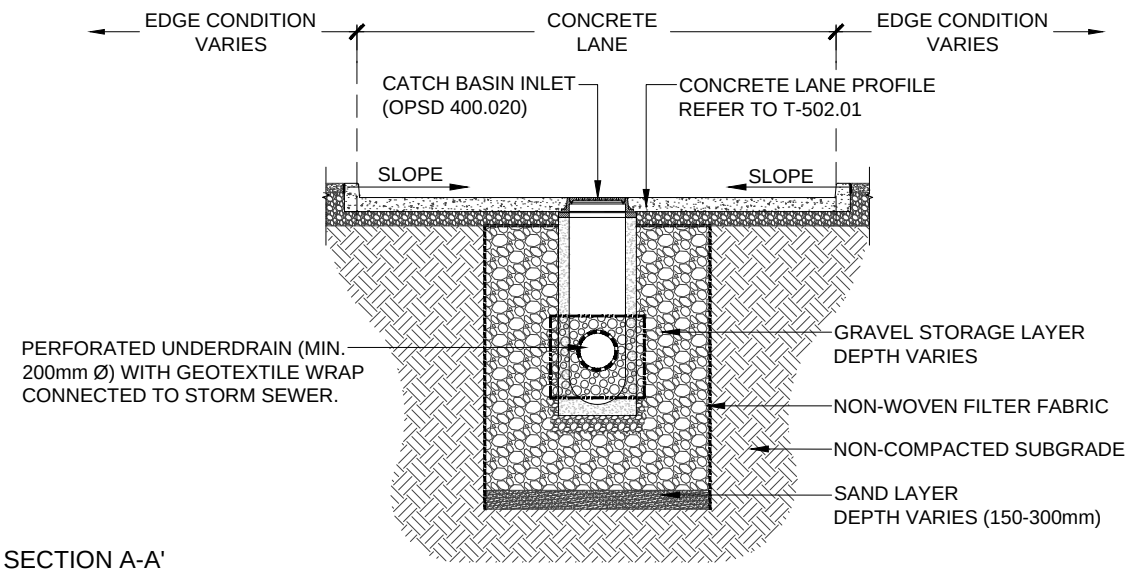
A.4 GEOTEXTILE

- Non-woven needle punched fabric or approved equal;
- Refer to OPSS 1860 - Material Specification for Geotextiles;
- Line sidewalls and overlap 300mm at top if required.

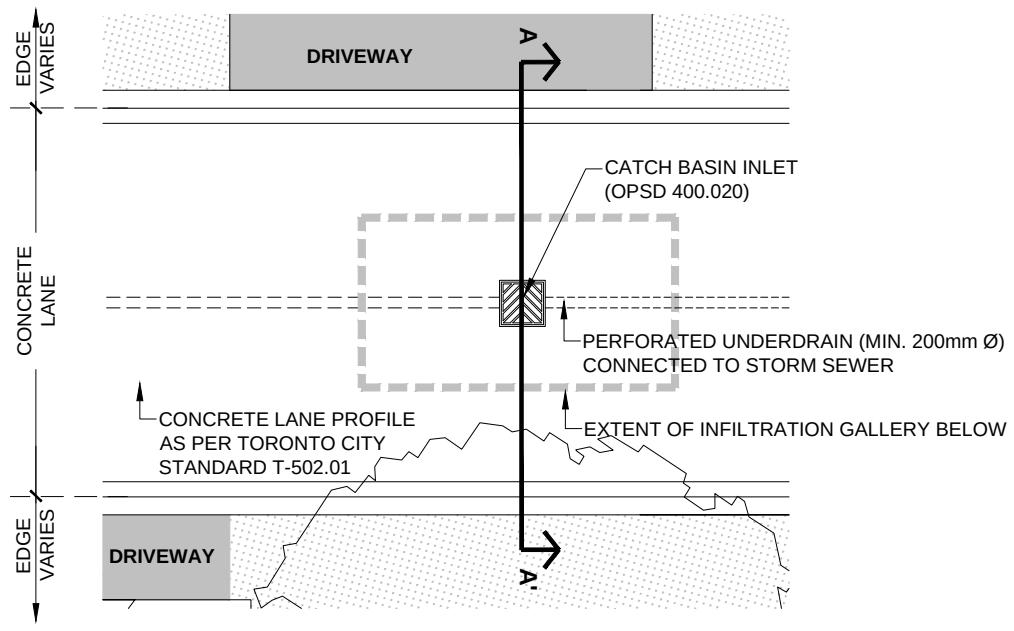
A.5 IDENTIFICATION MEDALLION

- To be installed on sidewalk or curb adjacent to installation. Refer to guideline drawing G-1.

SOAKAWAY UNDER CONCRETE LANE

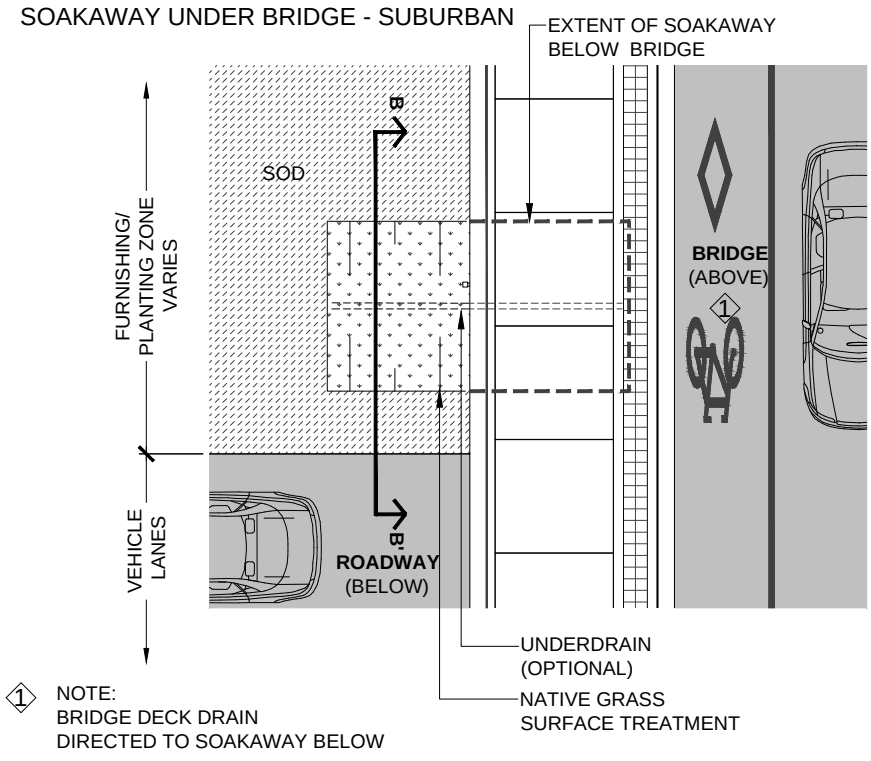


SECTION A-A'

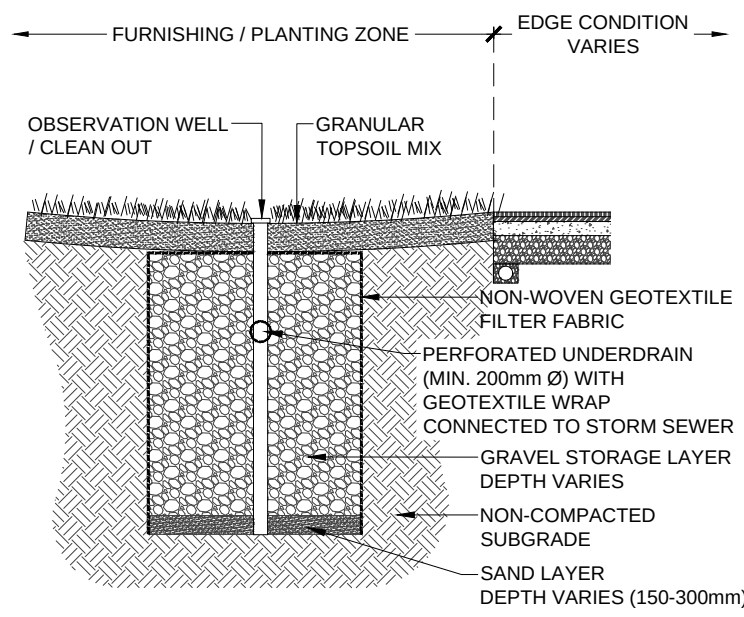


PLAN VIEW

SOAKAWAY UNDER BRIDGE - SUBURBAN



1 NOTE:
BRIDGE DECK DRAIN
DIRECTED TO SOAKAWAY BELOW



SECTION B-B'

All dimensions are in millimetres unless otherwise shown.

	CITY OF TORONTO GUIDELINE DRAWING	REV 0	APR 2017
TORONTO	SOAKAWAYS SECTIONS AND LAYOUTS	WQ-12.1	
		NTS	1 OF 1

A.0 GEOMETRY & LAYOUT

- Rectangular excavations
  - Length varies based on desired capacity
  - Bottom width varies (600mm-2400 mm)
  - Bottom surface should be level

A.1 SAND LAYER

- Should contain minimal fines and organic matter
- Depth varies - 150 - 300mm

A.2 GRAVEL STORAGE

- Uniformly graded 50mm clear stone
- 30-40% void space
- Depth varies

A.3 SUBDRAINS

- Inlet pipe (if applicable)
  - Perforated PVC or equivalent (200mm ⌀) connected to non-perforated pipe from source
  - Installed below frost level
- Overflow pipe (if required)
  - Overflow not required if permeability of native soils is >15mm/hr
  - Overflow pipe at the top of gravel layer to be connected to the storm sewer. Pipes must be sized appropriately by engineer.
- Monitoring well / Cleanout
  - Capped non-perforated standpipe connected to the underdrain (if required) at the furthest downstream end.
- Refer to OPSS 405 - Construction Specification for Pipe Subdrains.

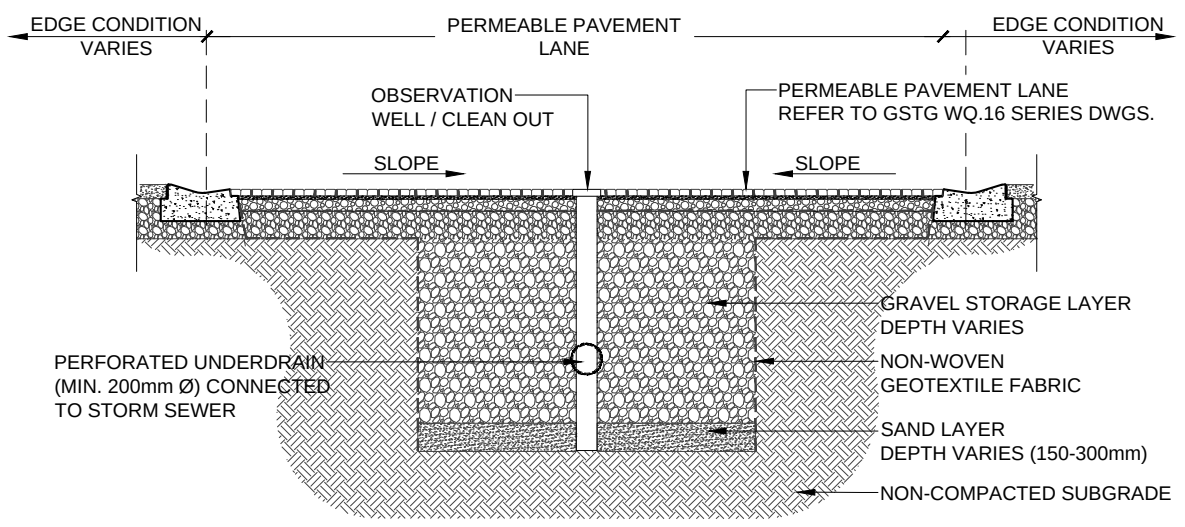
A.4 GEOTEXTILE

- Non-woven needle punched fabric or approved equal;
- Refer to OPSS 1860 - Material Specification for Geotextiles;
- Line sidewalls and overlap 300mm at top if required.

A.5 IDENTIFICATION MEDALLION

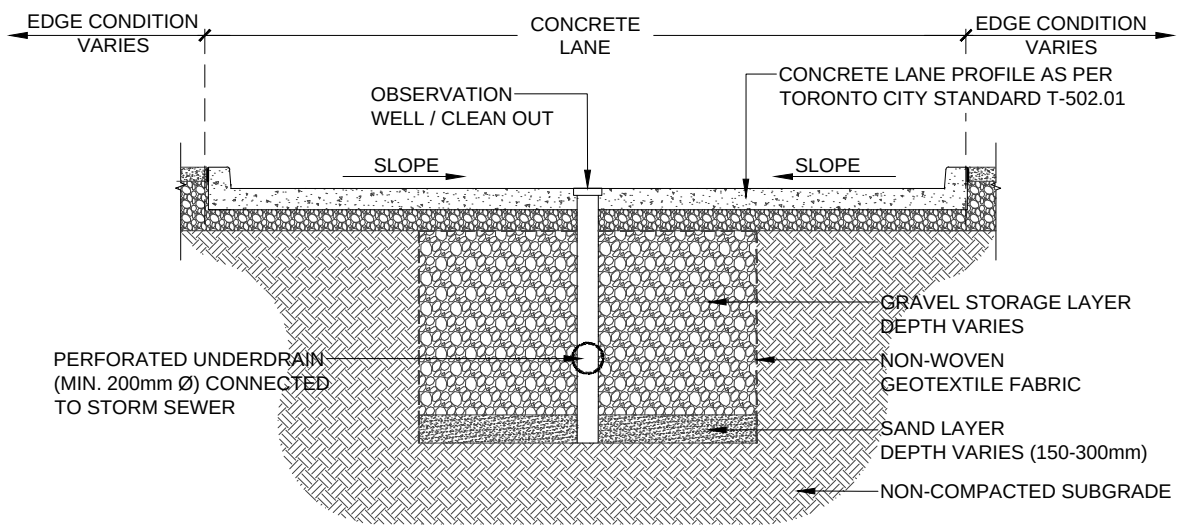
- To be installed on curb or paving adjacent to installation. Refer to guideline drawing G-1.

INFILTRATION TRENCH UNDER PERMEABLE PAVEMENT LANE

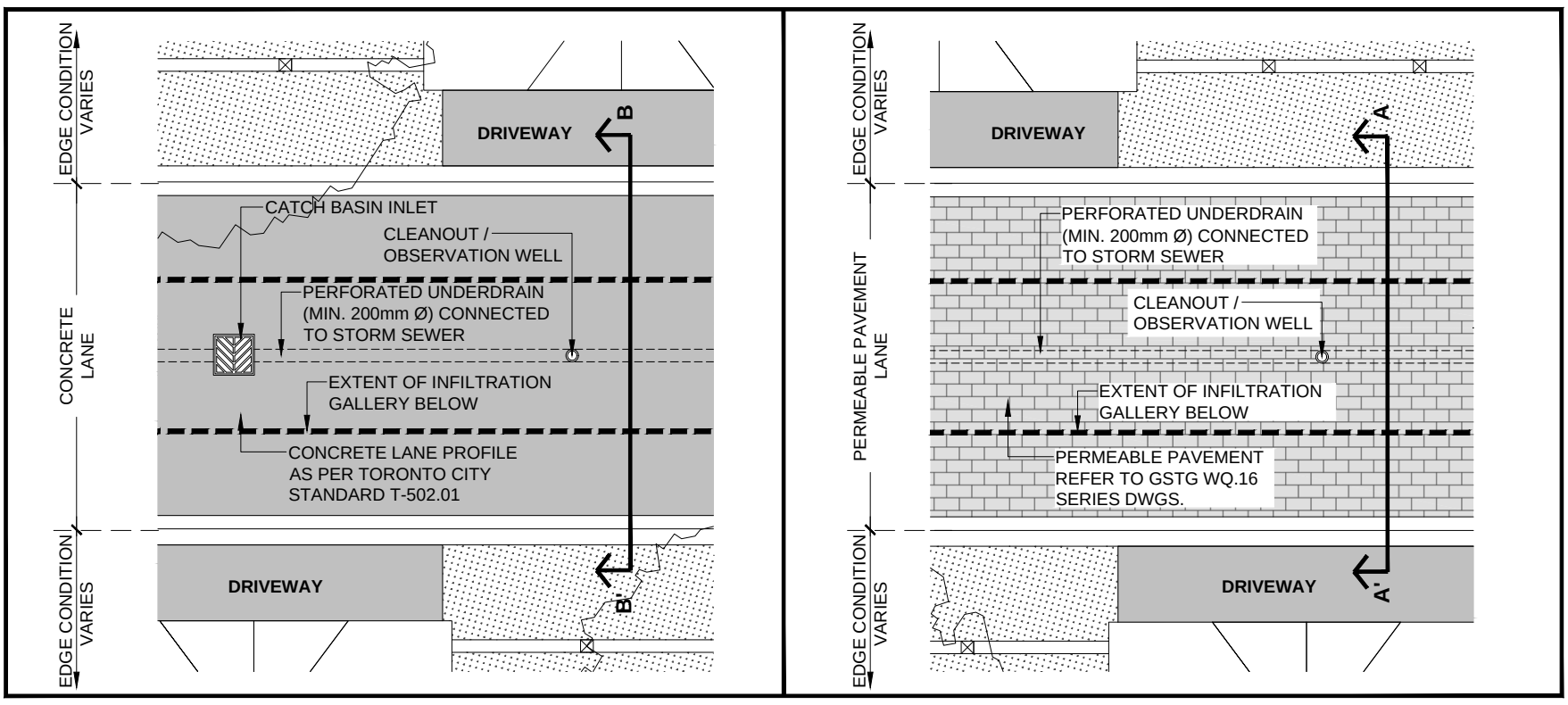


SECTION A-A'

INFILTRATION TRENCH UNDER CONCRETE LANE



SECTION B-B'



PLAN VIEW

All dimensions are in millimetres unless otherwise shown.

CITY OF TORONTO GUIDELINE DRAWING

INFILTRATION TRENCH UNDER LANE

SECTIONS AND LAYOUTS

REV 0	APR 2107
WQ-13.1a	
NTS	1 OF 3

A.0 GEOMETRY & LAYOUT

- Rectangular excavations
  - Length varies based on desired capacity
  - Bottom width varies (600mm-2400 mm)
  - Bottom surface should be level

A.1 SAND LAYER

- Should contain minimal fines and organic matter
- Depth varies - 150 - 300mm

A.2 GRAVEL STORAGE

- Uniformly graded 50mm clear stone
- 30-40% void space
- Depth varies

A.3 SUBDRAINS

- Inlet pipe (if applicable)
  - Perforated HDPE or equivalent (200mm ⌀) connected to non-perforated pipe from source
  - Installed below frost level
- Overflow pipe (if required)
  - Overflow not required if permeability of native soils is >15mm/hr
  - Overflow pipe at the top of gravel layer to be connected to the storm sewer. Pipes must be sized appropriately by engineer.
- Monitoring well / Cleanout
  - Capped non-perforated standpipe connected to the underdrain (if required) at the furthest downstream end.
- Refer to OPSS 405 - Construction Specification for Pipe Subdrains.

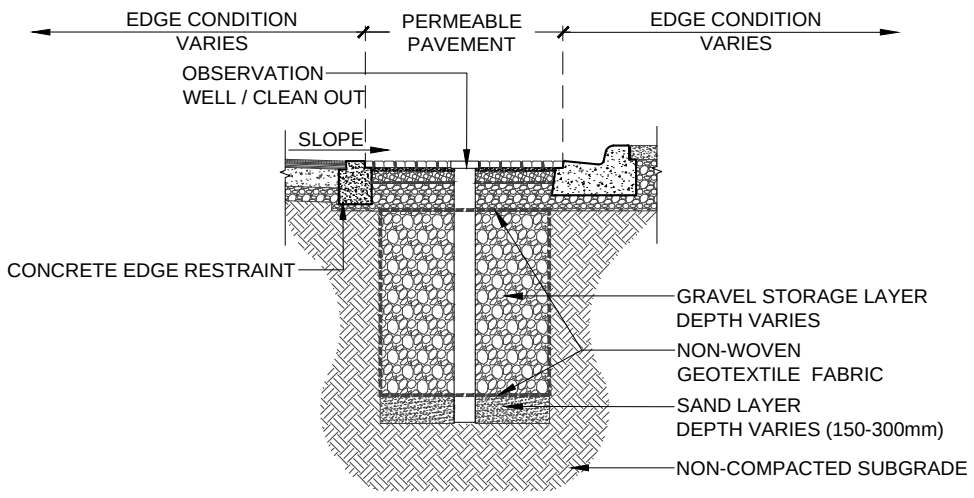
A.4 GEOTEXTILE

- Non-woven needle punched fabric or approved equal;
- Refer to OPSS 1860 - Material Specification for Geotextiles;
- Line sidewalls and over lap 300mm at top if required.

A.5 IDENTIFICATION MEDALLION

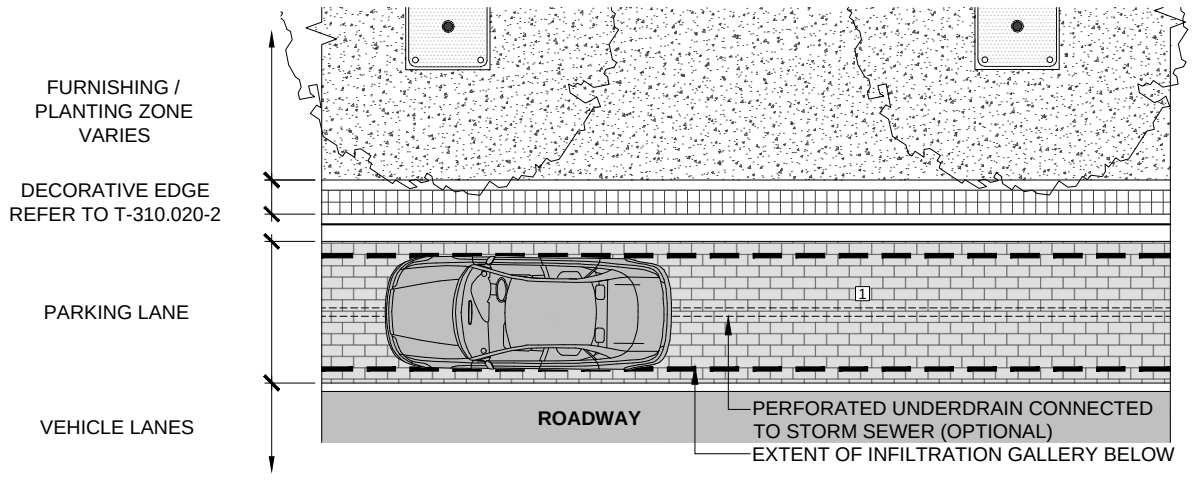
- To be installed on sidewalk or curb adjacent installation. Refer to guideline drawing G-1.

INFILTRATION TRENCH UNDER PERMEABLE PAVEMENT

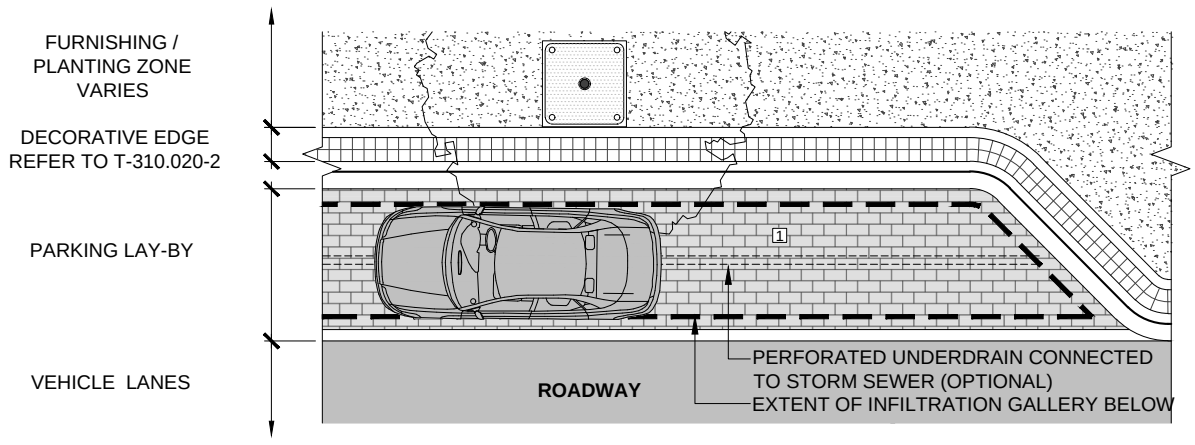


SECTION

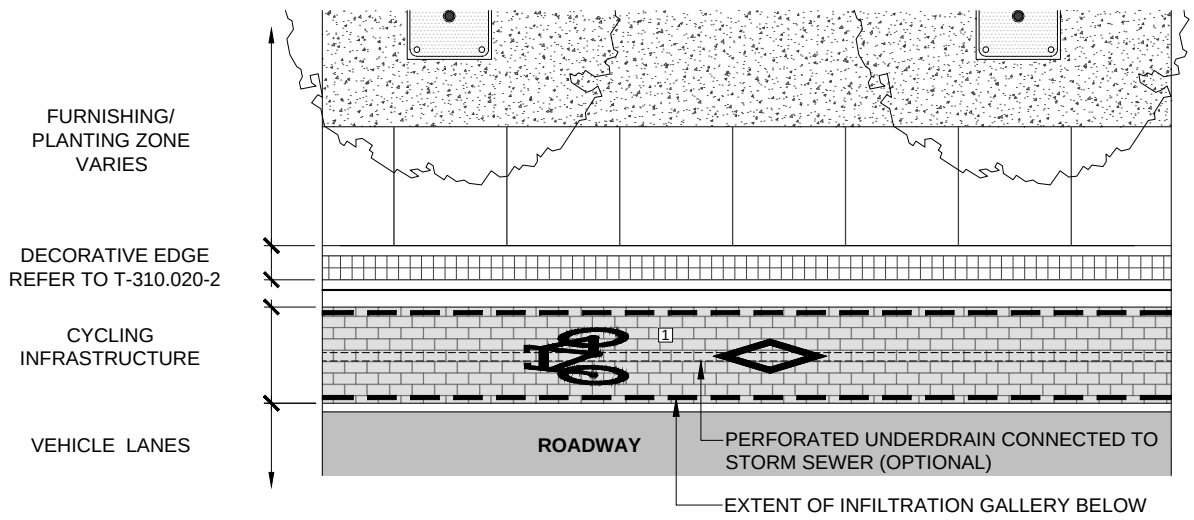
INFILTRATION TRENCH UNDER PERMEABLE PAVEMENT - ON STREET PARKING LANES



INFILTRATION TRENCH UNDER PERMEABLE PAVEMENT - PARKING LAY-BYS



INFILTRATION TRENCH UNDER PERMEABLE PAVEMENT - CYCLING INFRASTRUCTURE



NOTE

[1] FOR PERMEABLE PAVEMENT OPTIONS REFER TO GSTG WQ.16 SERIES DRAWINGS.

CROSS SLOPE VARIES CONTINGENT ON OVERALL ROAD CROSS-SECTION AND PROFILE. PREFERRED MAXIMUM CROSS SLOPE GRADIENT FOR PERMEABLE PAVING SURFACE NOT TO EXCEED 2%

All dimensions are in millimetres unless otherwise shown.

TORONTO	CITY OF TORONTO GUIDELINE DRAWING	REV 0 / APR 2017
	INFILTRATION TRENCH UNDER PERMEABLE PAVEMENT SECTION & LAYOUTS	WQ-13.1b NTS / 2 OF 3

A.0 GEOMETRY & LAYOUT

- Rectangular excavations
  - Length varies based on desired capacity
  - Bottom width varies (600mm-2400 mm)
  - Bottom surface should be 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 SAND LAYER

- Should contain minimal fines and organic matter
- Depth varies - 150 - 300mm

A.3 GRAVEL STORAGE

- Uniformly graded 50mm clear stone
- 30-40% void space
- Depth varies

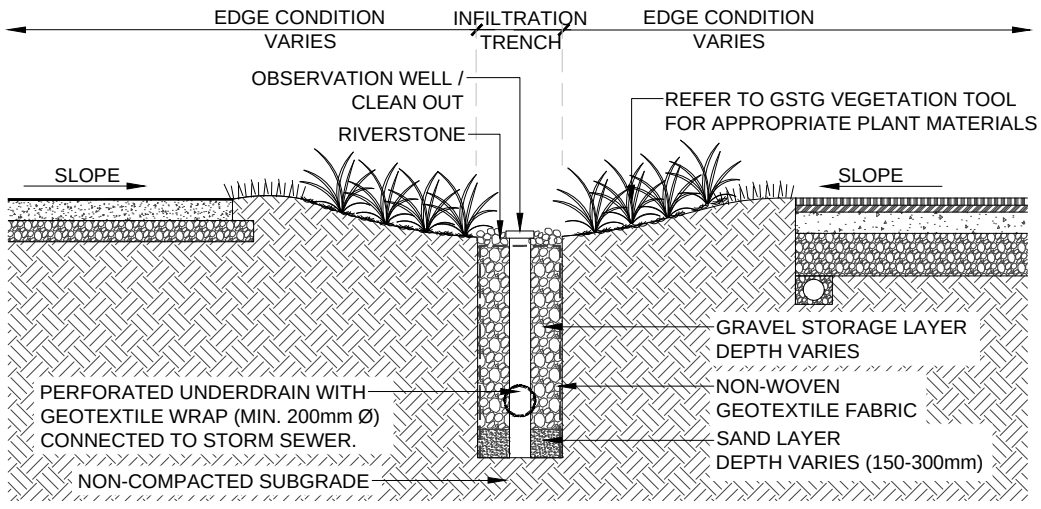
A.4 SUBDRAINS

- Inlet pipe (if applicable)
  - Perforated PVC or equivalent (200mm ϕ) connected to non-perforated pipe from source
  - Installed below frost level
- Overflow pipe (if required)
  - Overflow not required if permeability of native soils is >15mm/hr
  - Overflow pipe at the top of gravel layer to be connected to the storm sewer. Pipes must be sized appropriately by engineer.
- Monitoring well / Cleanout
  - Capped non-perforated standpipe connected to the underdrain (if required) at the furthest downstream end.
- Refer to OPSS 405 - Construction Specification for Pipe Subdrains.

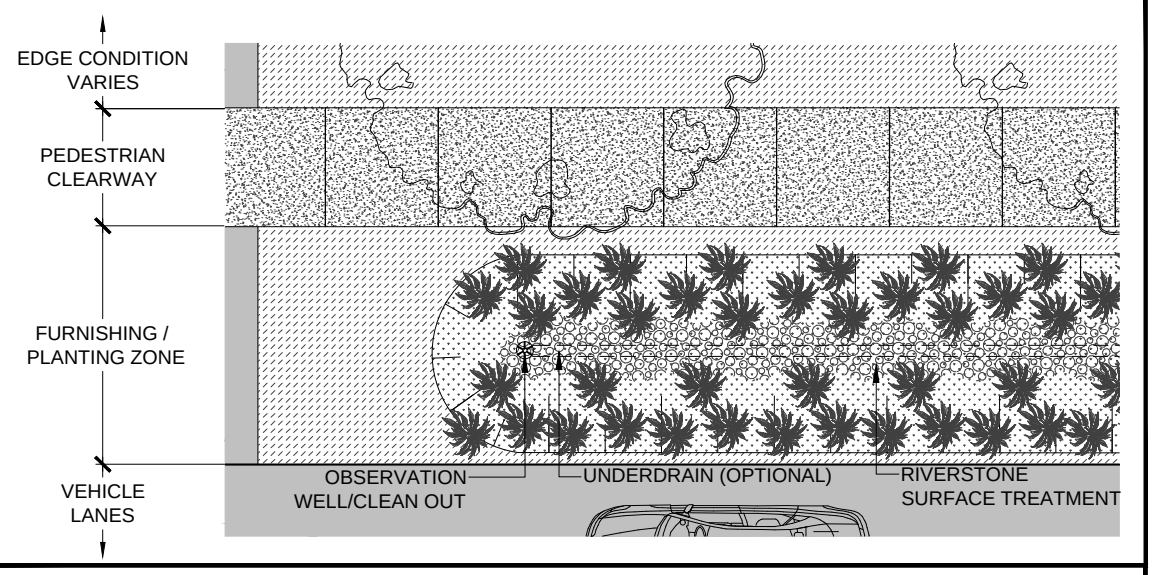
A.5 GEOTEXTILE

- Non-woven needle punched fabric or approved equal;
- Refer to OPSS 1860 - Material Specification for Geotextiles;
- Line sidewalls and overlap 300mm at top if required.

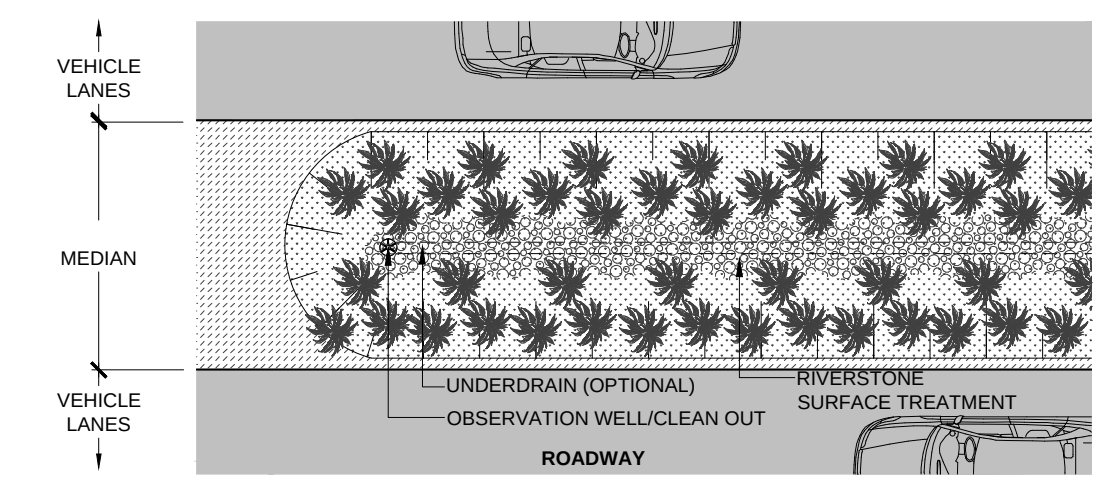
INFILTRATION TRENCH UNDER SOFT LANDSCAPE



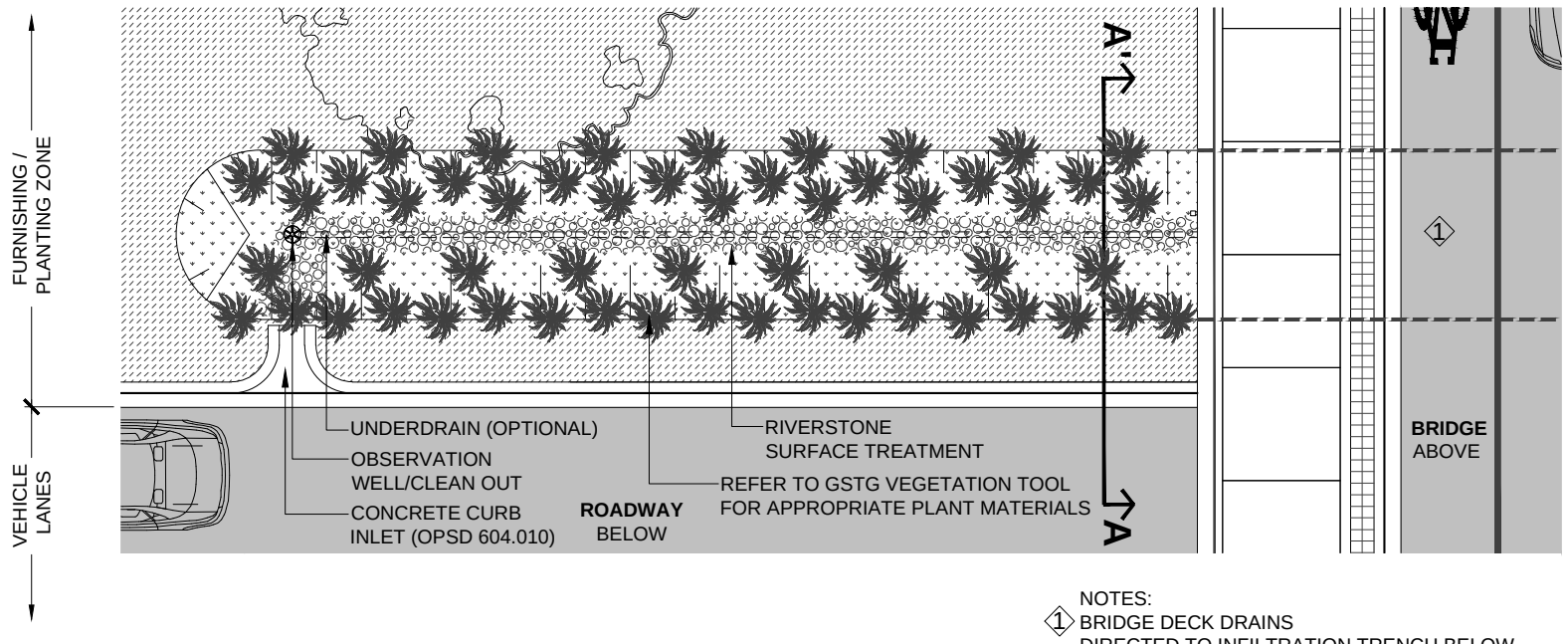
INFILTRATION TRENCH UNDER BOULEVARD - SUBURBAN



INFILTRATION TRENCH UNDER MEDIAN - SUBURBAN



INFILTRATION TRENCH UNDER BRIDGE - SUBURBAN



NOTES:
1. BRIDGE DECK DRAINS DIRECTED TO INFILTRATION TRENCH BELOW

All dimensions are in millimetres unless otherwise shown.

TORONTO	CITY OF TORONTO GUIDELINE DRAWING	REV 0	APR 2017
	INFILTRATION TRENCH UNDER SOFT LANDSCAPES SECTION & LAYOUTS	WQ-13.1c	
		NTS	3 OF 3

A.0 GEOMETRY & LAYOUT

- Rectangular excavations
  - Length varies based on desired capacity
  - Bottom width varies (600mm-2400 mm)
  - Bottom surface should be level

A.1 SAND LAYER

- Should contain minimal fines and organic matter
- Depth varies - 150 - 300mm

A.2 GRAVEL STORAGE

- Uniformly graded 50mm clear stone
- 30-40% void space
- Depth varies

A.3 SUBDRAINS

- Inlet pipe (if applicable)
  - Perforated PVC or equivalent (200mm ⌀) connected to non-perforated pipe from source
  - Installed below frost level
- Monitoring well / Cleanout
  - Capped non-perforated standpipe connected to the underdrain (if required) at the furthest downstream end.
- Refer to OPSS 405 - Construction Specification for Pipe Subdrains.

A.4 INFILTRATION CHAMBERS

- Refer to manufacturer's specifications

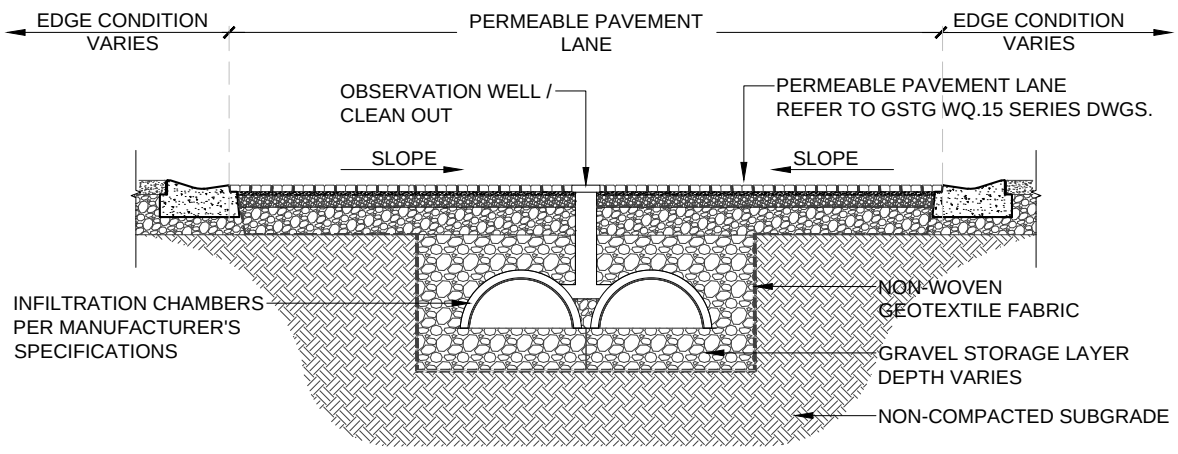
A.6 GEOTEXTILE

- Non-woven needle punched fabric or approved equal. Refer to OPSS 1860 - Material Specification for Geotextiles;
- Line sidewalls and overlap 300mm at top if required.

A.7 IDENTIFICATION MEDALLION

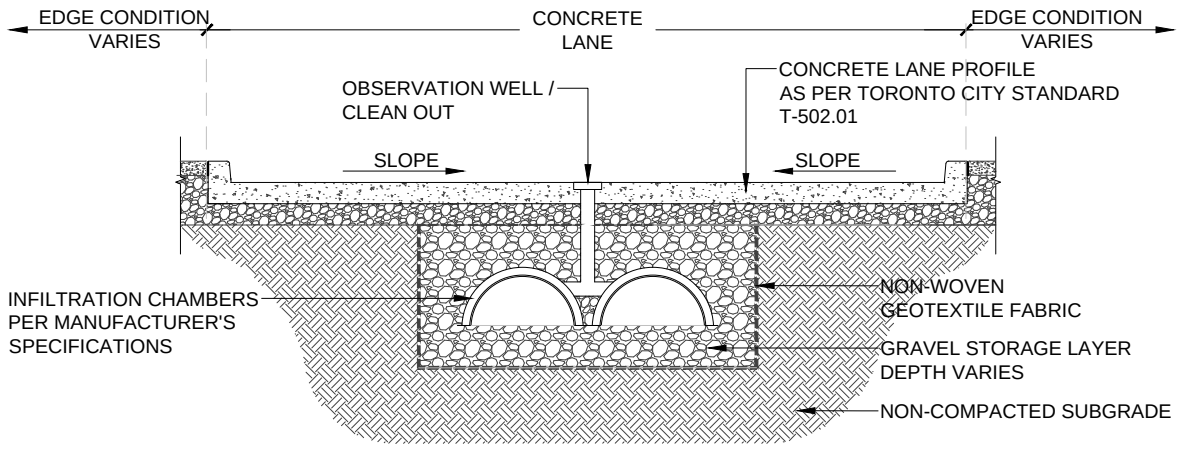
- To be installed on paving or curb adjacent installation. Refer to guideline drawing G-1.

INFILTRATION CHAMBER UNDER PERMEABLE PAVEMENT LANE

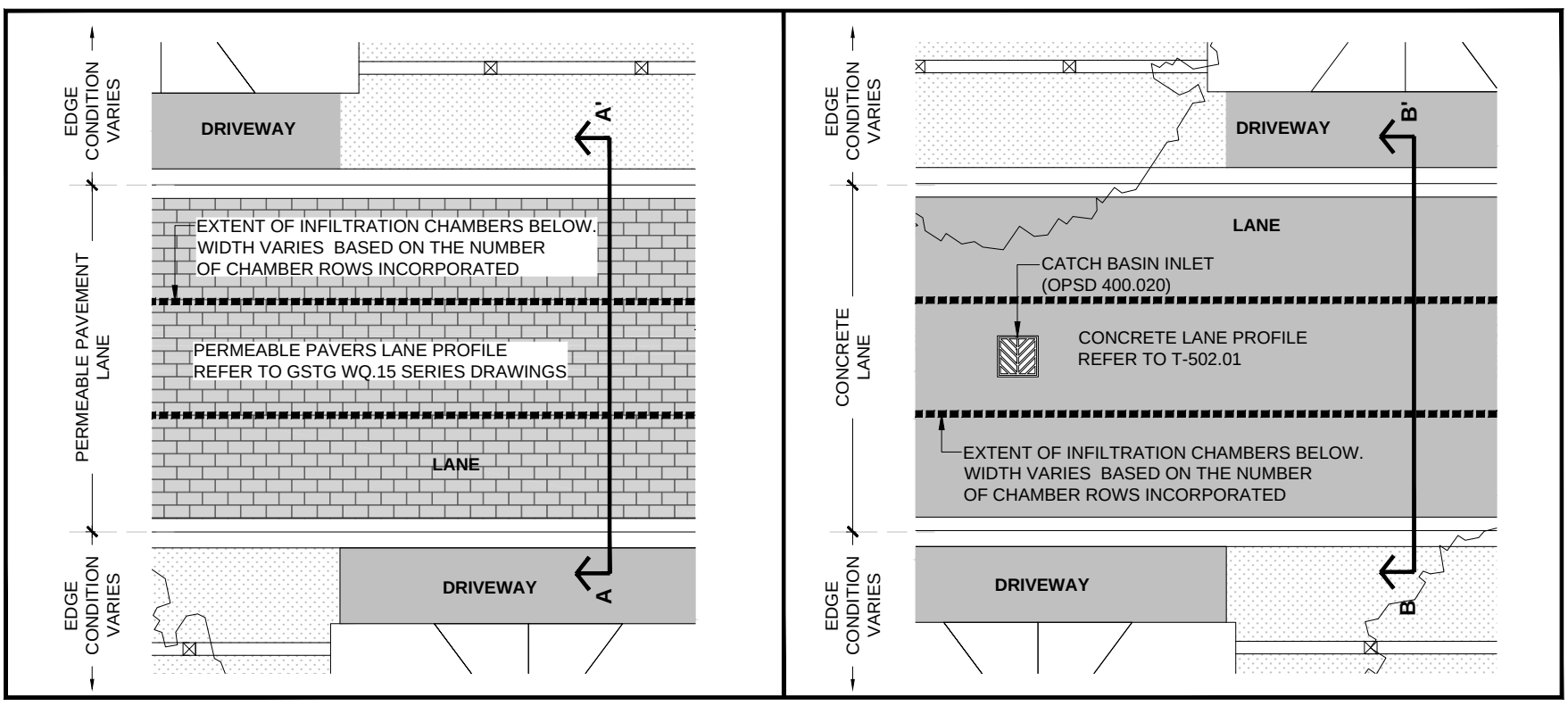


SECTION A-A'

INFILTRATION CHAMBER UNDER CONCRETE LANE



SECTION B-B'



PLAN VIEW

All dimensions are in millimetres unless otherwise shown.

TORONTO	CITY OF TORONTO GUIDELINE DRAWING	REV 0 / APR 2017
	INFILTRATION CHAMBER UNDER LANE SECTIONS AND LAYOUTS	WQ-14.1.a
		NTS / 1 OF 3

A.0 GEOMETRY & LAYOUT

- Rectangular excavations
  - Length varies based on desired capacity
  - Bottom width varies (600mm-2400 mm)
  - Bottom surface should be level

A.1 SAND LAYER

- Should contain minimal fines and organic matter
- Depth varies - 150 - 300mm

A.2 GRAVEL STORAGE

- Uniformly graded 50mm clear stone
- 30-40% void space
- Depth varies

A.3 SUBDRAINS

- Inlet pipe (if applicable)
  - Perforated PVC or equivalent (200mmØ) connected to non-perforated pipe from source;
  - Installed below frost level.
- Monitoring well / Cleanout
  - Capped non-perforated standpipe connected to the underdrain (if required) at the furthest downstream end.
- Refer to OPSS 405 - Construction Specification for Pipe Subdrains.

A.4 INFILTRATION CHAMBER

- Refer to manufacturer's specifications.

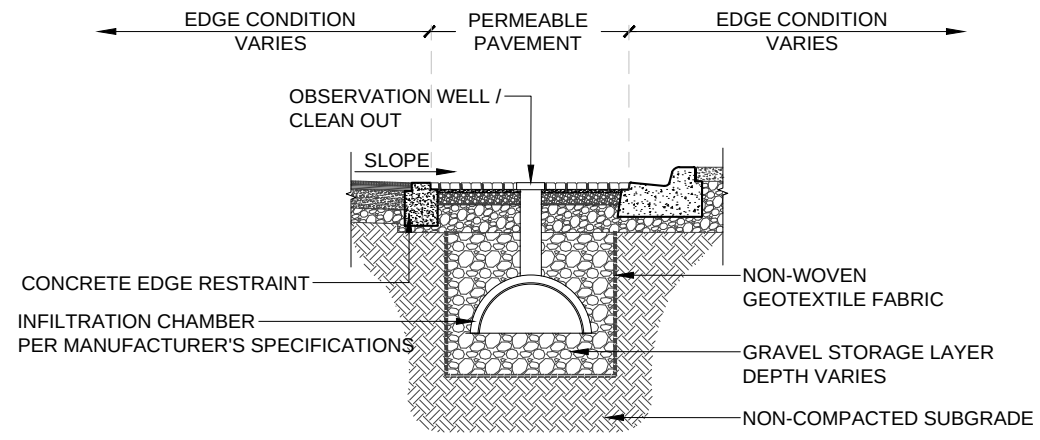
A.5 GEOTEXTILE

- Non-woven needle punched fabric or approved equal. Refer to OPSS 1860 - Material Specification for Geotextiles;
- Line sidewalls and over lap 300mm at top if required.

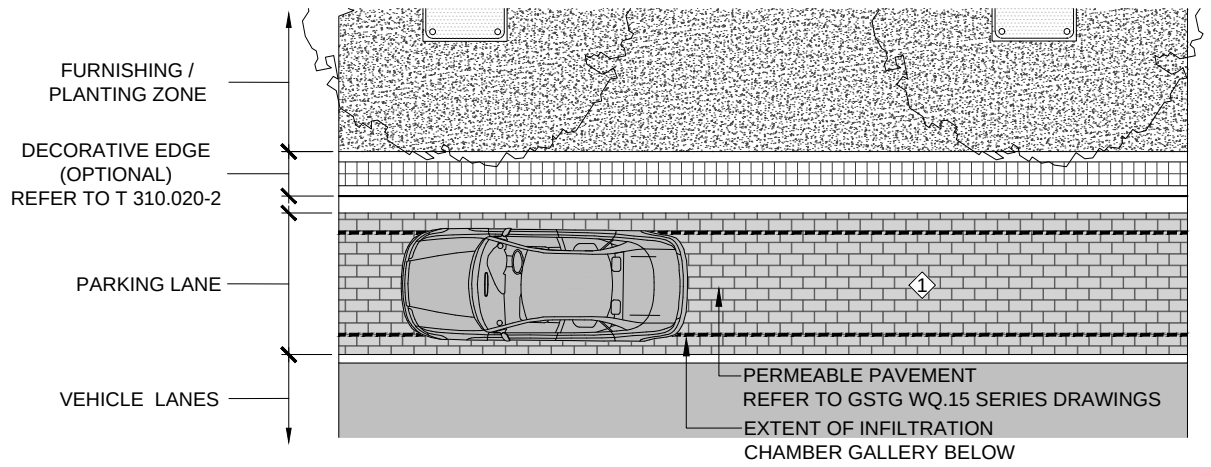
A. IDENTIFICATION MEDALLION

- To be installed on sidewalk or curb adjacent installation. Refer to guideline drawing G-1.

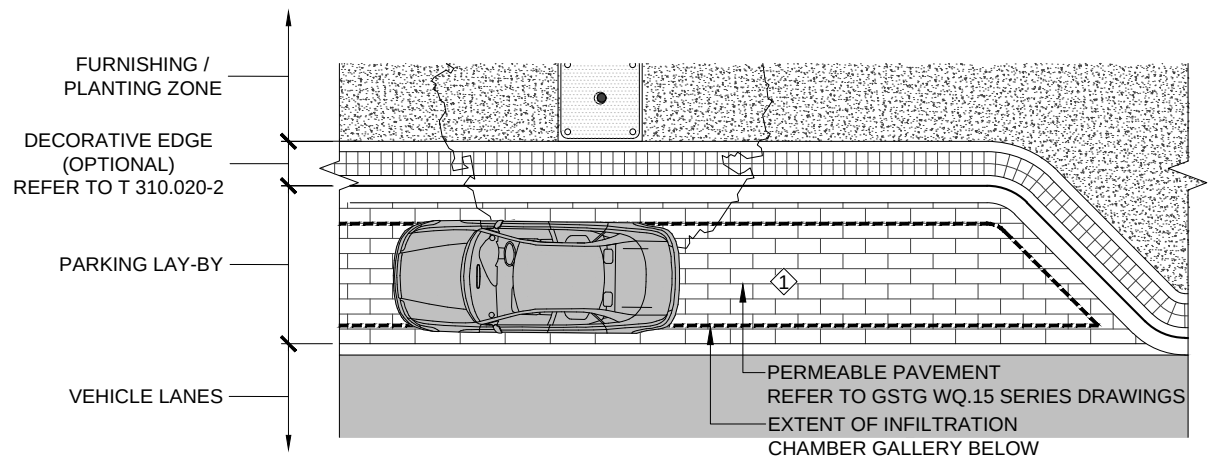
INFILTRATION CHAMBER UNDER PERMEABLE PAVEMENT



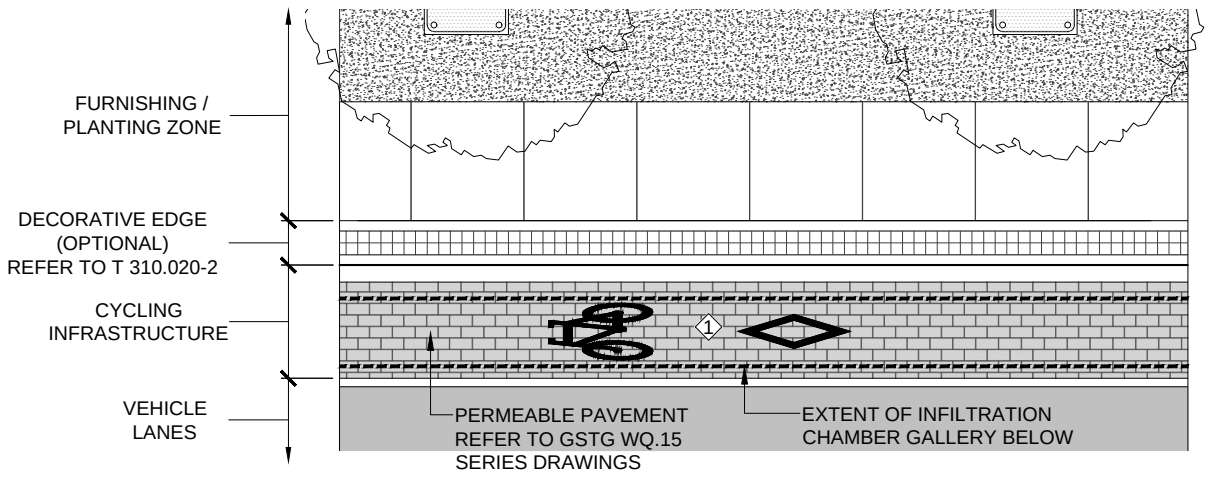
INFILTRATION CHAMBER UNDER PERMEABLE PAVEMENT - ON STREET PARKING LANES



INFILTRATION CHAMBER UNDER PERMEABLE PAVEMENT - PARKING LAY-BYS



INFILTRATION CHAMBER UNDER PERMEABLE PAVEMENT - CYCLING INFRASTRUCTURE



NOTE

1. FOR PERMEABLE PAVEMENT OPTIONS REFER TO GSTG WQ.16 SERIES DRAWINGS.

CROSS SLOPE VARIES CONTINGENT ON OVERALL ROAD CROSS-SECTION AND PROFILE. PREFERRED MAXIMUM CROSS SLOPE GRADIENT FOR PERMEABLE PAVING SURFACE NOT TO EXCEED 2%

All dimensions are in millimetres unless otherwise shown.

TORONTO	CITY OF TORONTO GUIDELINE DRAWING	REV 0	APR 2017
	INFILTRATION CHAMBER UNDER PERMEABLE PAVEMENT SECTION & LAYOUTS	WQ-14.1b	
		NTS	2 OF 3

A.0 GEOMETRY & LAYOUT

- Rectangular excavations
  - Length varies based on desired capacity
  - Bottom width varies (600mm-2400 mm)
  - Bottom surface should be 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 SAND LAYER

- Should contain minimal fines and organic matter
- Depth varies - 150-300mm

A.3 GRAVEL STORAGE

- Uniformly graded 50mm clear stone
- 30-40% void space
- Depth varies

A.4 SUBDRAINS

- Inlet pipe (if applicable)
  - Perforated PVC or equivalent (200mm ϕ) connected to non-perforated pipe from source
  - Installed below frost level
- Monitoring well / Cleanout
  - Capped non-perforated standpipe connected to the underdrain (if required) at the furthest downstream end.
- Refer to OPSS 405 - Construction Specification for Pipe Subdrains.

A.5 INFILTRATION CHAMBER

- Refer to manufacturer's specifications

A.6 GEOTEXTILE

- Non-woven needle punched fabric or approved equal. Refer to OPSS 1860 - Material Specification for Geotextiles;
- Line sidewalls and over lap 300mm at top if required.

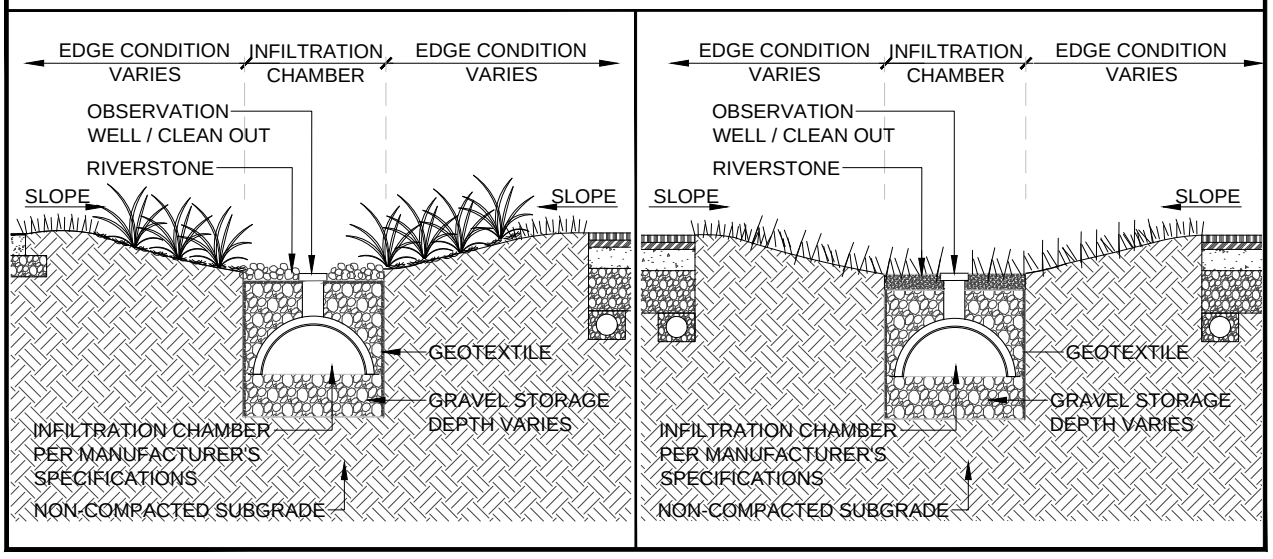
A.7 PLANTING

- Plant material should tolerant of salt and urban conditions. Refer to the GSTG Vegetation Selection Tool for an appropriate palette.

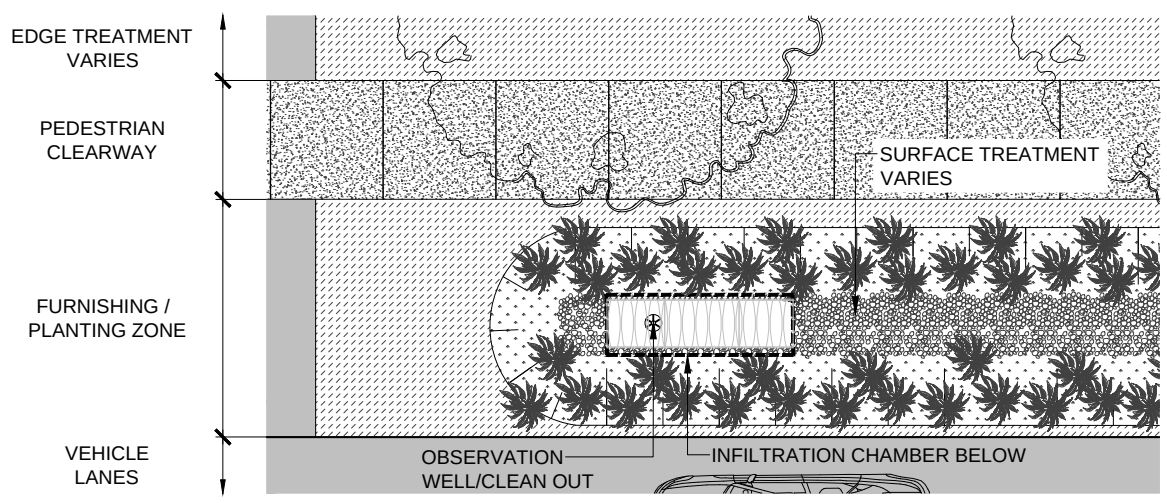
A.8 IDENTIFICATION MEDALLION

- To be installed on sidewalk or curb adjacent installation. Refer to guideline drawing G-1.

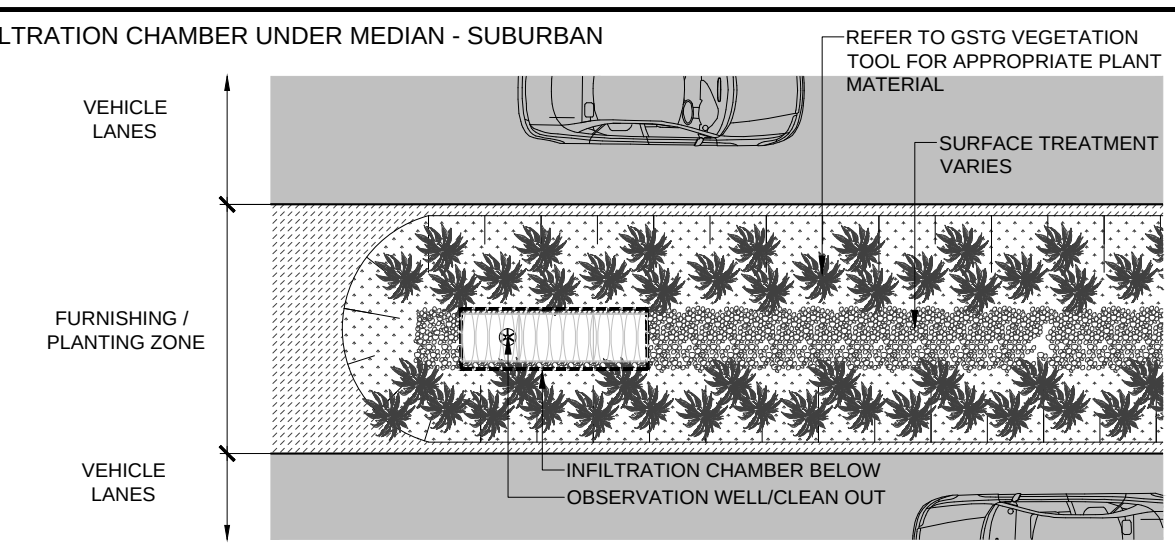
INFILTRATION CHAMBER UNDER SOFT LANDSCAPE



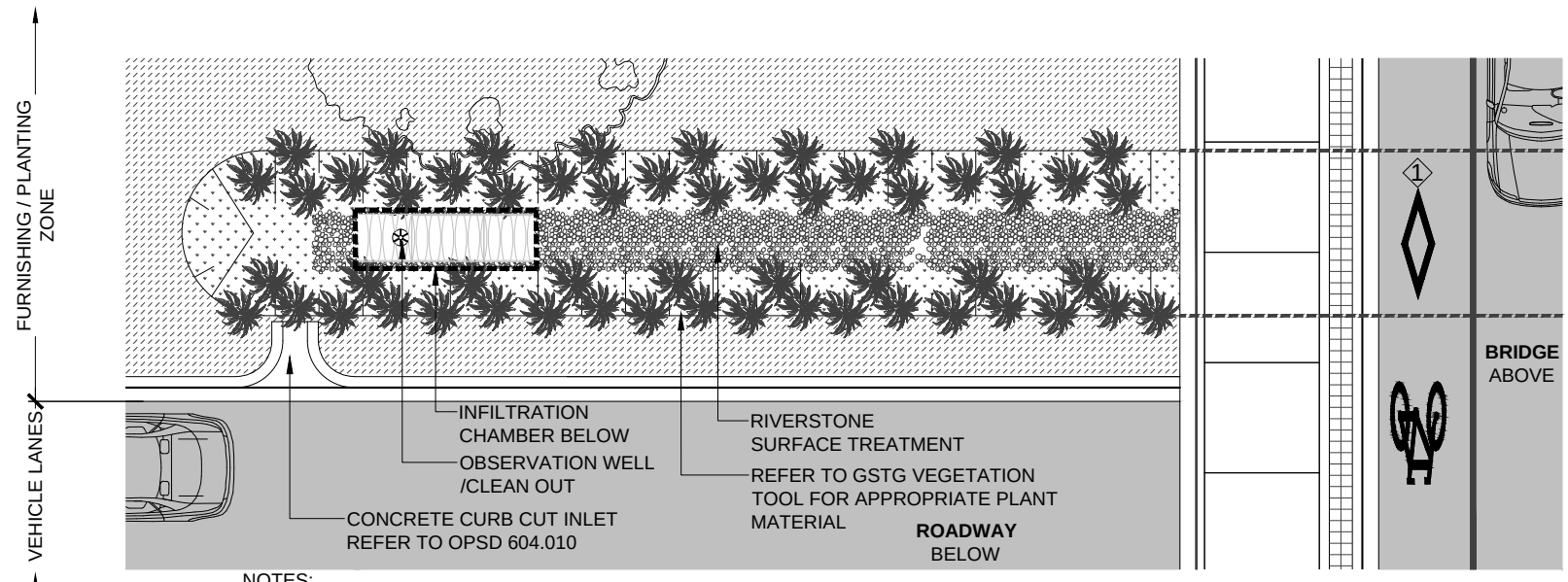
INFILTRATION CHAMBER UNDER BOULEVARD - SUBURBAN



INFILTRATION CHAMBER UNDER MEDIAN - SUBURBAN



INFILTRATION CHAMBER UNDER BRIDGE - SUBURBAN



NOTES:
1. BRIDGE DECK DRAINS DIRECTED TO INFILTRATION CHAMBER BELOW
- CURB CUT INLET THROAT SIZED BY ENGINEER ACCORDING TO INLET FLOW RATE

All dimensions are in millimetres unless otherwise shown.

TORONTO	CITY OF TORONTO GUIDELINE DRAWING	REV 0	APR 2017
	INFILTRATION CHAMBER UNDER SOFT LANDSCAPES SECTION & LAYOUTS	WQ-14.1c	
		NTS	3 OF 3

A.0 PERVIOUS CONCRETE PAVING

A.0.1 Material: NO4-RG-S7 mix;

A.0.2 Thickness varies: 100mm-150mm;

A.0.3 28 day compressive strength = 15MPa;

A.0.4 Void ratio = 15% to 25%;

A.0.5 Permeability = 900 to 21,500 mm/hr;

Refer to OPSS 356 - Construction Specification for Previous Concrete Pavement for Low Volume Traffic Applications

A.1 STONE RESERVOIR

A.1.1 ALL AGGREGATES:
- Max. wash loss - 0.5%
- Min. durability index - 35
- Max. abrasion - 10% for 100 and
  - 50% for 500 revolutions

A.1.2 BEDDING:
- 5 mm diameter stone or as per the Design Engineer.
- Depth varies:
  - 75mm heavy duty;
  - 40mm light duty;

* Max allowable depth of the filter bed determined by the following:

$$dmax = i \times ts / Vr$$

Where:
- dmax = Maximum stone bed depth (m);
- i = Infiltration rate for native soils (m/hr);
- Vr = Void ratio for stone bed (typically 0.3-0.4);
- ts = Time to drain stone bed (typically 24 hours; 72 hours max) (hr).

A.1.3 GRANULAR BASE
- Material:
  - 0-5% smaller than 2.36mm
  - 0-10% smaller than 4.75mm
  - 25-60% smaller than 12.5mm
  - 95-100% smaller than 25.0mm
  - 100% smaller than 37.5mm

* Stone storage bed design calculated based on the following:

$$dp = [Qc * R + P - i * T] / Vr$$

Where:
- **dp** = Stone bed depth (m)
- **Qc** = Depth of contributing runoff area (not including permeable surface (m)
- **R** = Contributing drainage area (Ac) / Permeable paving area (Ap)
- **P** = Rainfall depth (m)
- **i** = Infiltration rate for native soils (m/day)
- **T** = Time to fill stone bed (typically 2 hr)
- **Vr** = Void ratio for stone bed (0.3-0.4)

* Note - Ac - should not contain pervious areas.

A.1.4 GRANULAR SUB-BASE:
- Material: 50mm dia. clear crushed gravel;
- Refer to Material Specification for Aggregates (TS 1010).

A.2 GEOTEXTILE
- Material: Woven monofilament or non-woven needle punched fabrics;
- Refer to OPSS 1860 Material Specification for Geotextiles.

A.3 UNDERDRAIN (Optional)
- Required where native soil infiltration rates are <15mm/hr;
- 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.

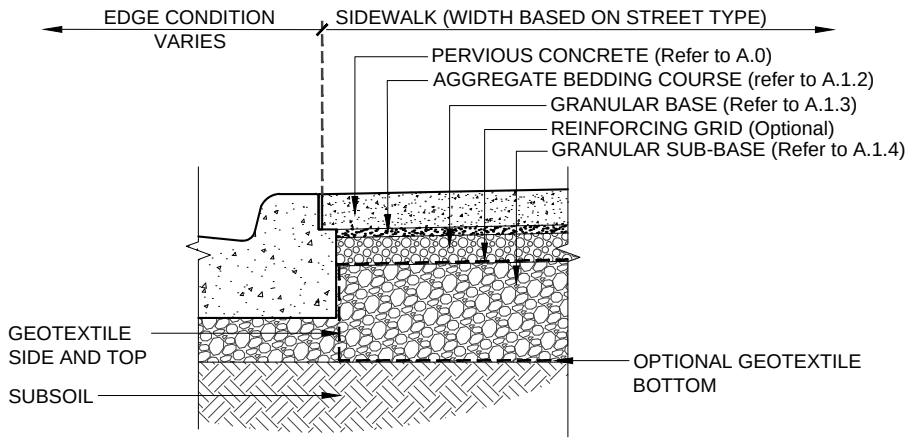
A.4 TESTING

Refer to:
- ASTM 1688 - Standard testing method for density and void content;
- ASTM 1701 - Standard testing method for infiltration rate of in-place pervious concrete;
- ASTM 1754 - Standard testing method for density & void content of hardened pervious concrete.

A.5 IDENTIFICATION MEDALLION
- To be installed on curb. Refer to guideline drawing G-1.

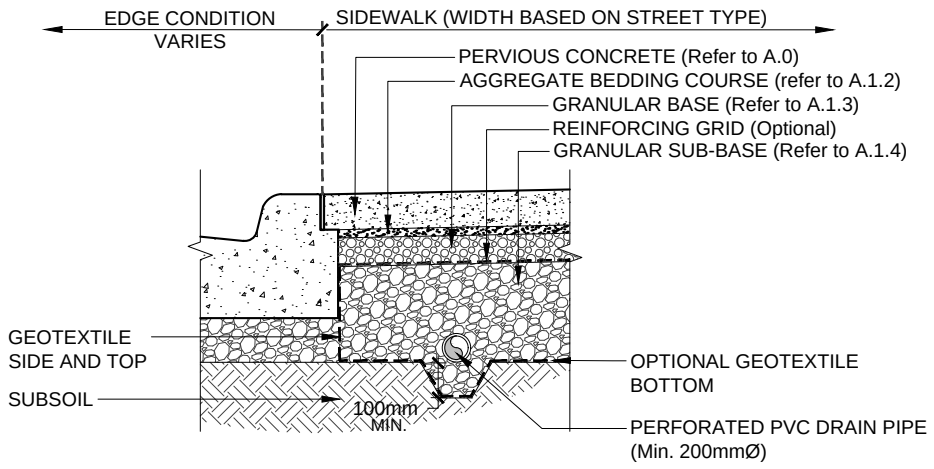
PERVIOUS CONCRETE WITHOUT UNDERDRAIN

For sites with subsoil permeability >15mm/hr



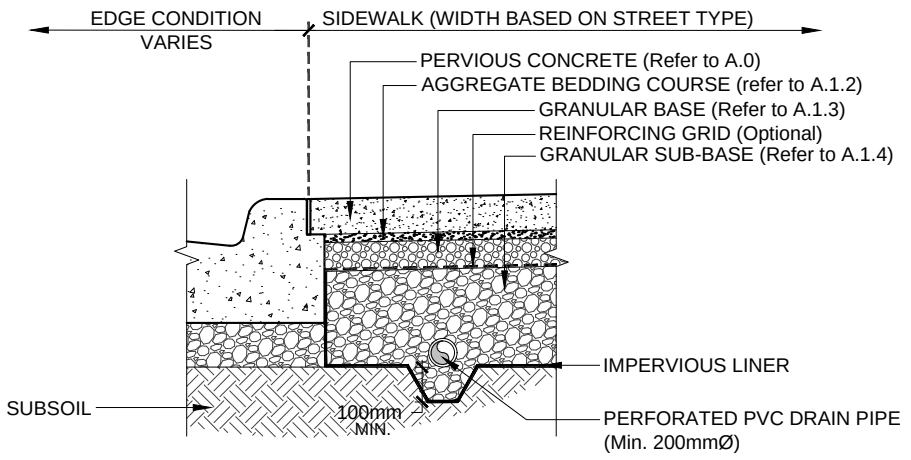
PERVIOUS CONCRETE WITH UNDERDRAIN

For sites with subsoil permeability >1 and <15mm/hr.



PERVIOUS CONCRETE WITH UNDERDRAIN & IMPERVIOUS LINER

For sites with contaminated soils



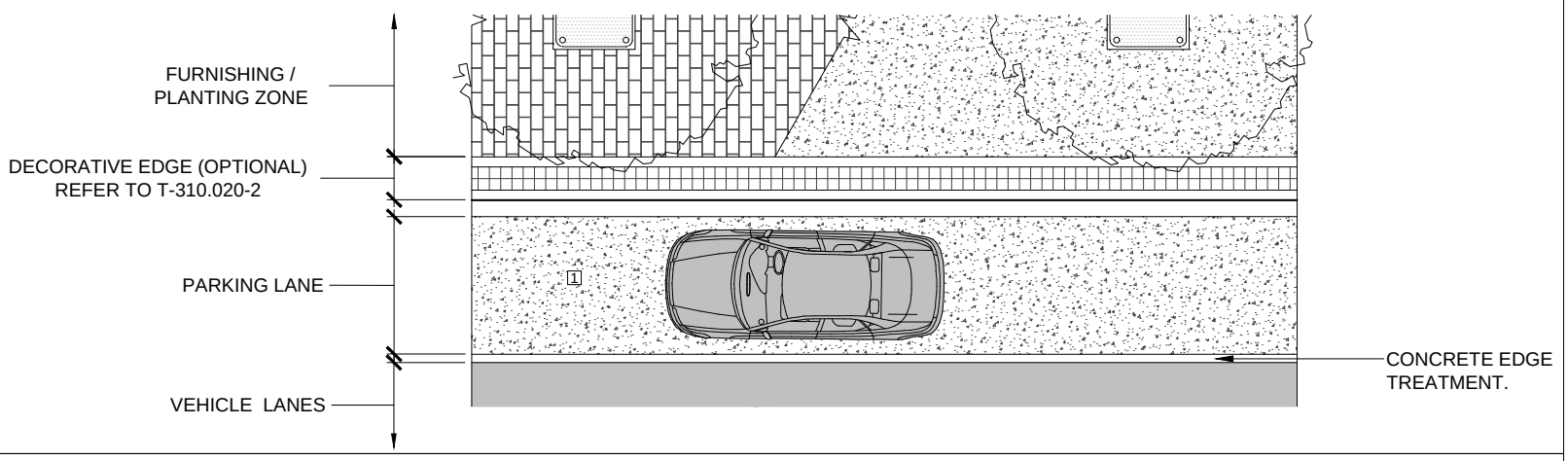
NOTES:

- DESIGN DETAILS TO BE ADAPTED FOR THE SPECIFIC LOCATION AND INSTALLATION.
- ANY PRE-EXISTING IMPERVIOUS BASE COURSE MATERIAL MUST BE REMOVED PRIOR TO PERMEABLE PAVER INSTALLATION.

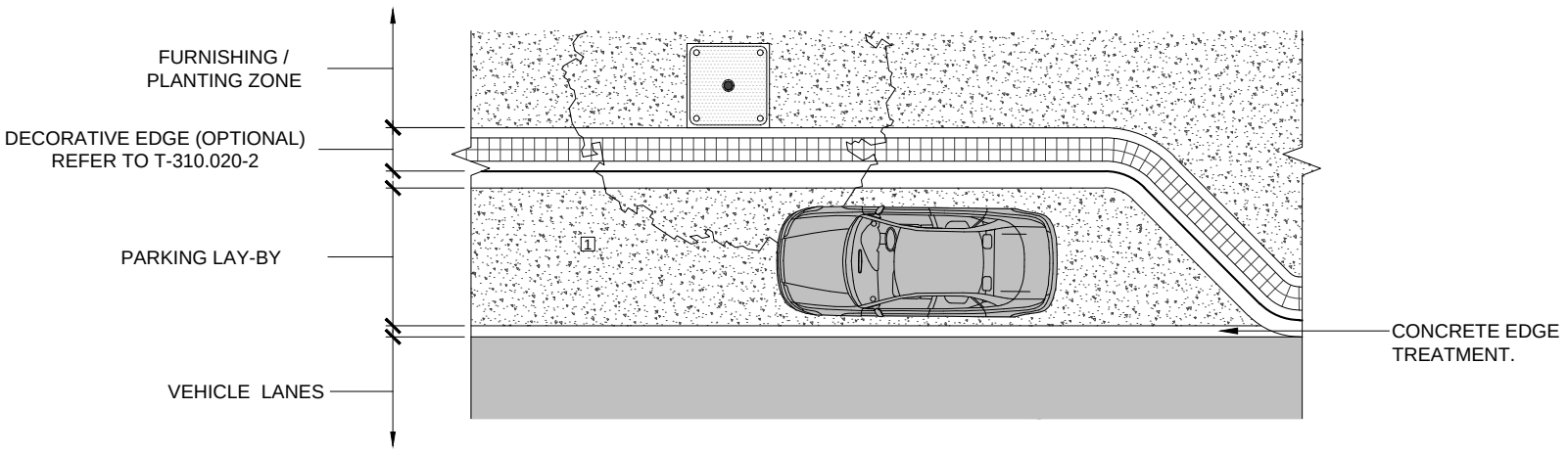
All dimensions are in millimetres unless otherwise shown.

	CITY OF TORONTO GUIDELINE DRAWING	REV 0	APR 2017
TORONTO	PERMEABLE PAVEMENT - PERVIOUS CONCRETE SECTIONS	WQ-15.i.a	
		NTS	1 OF 2

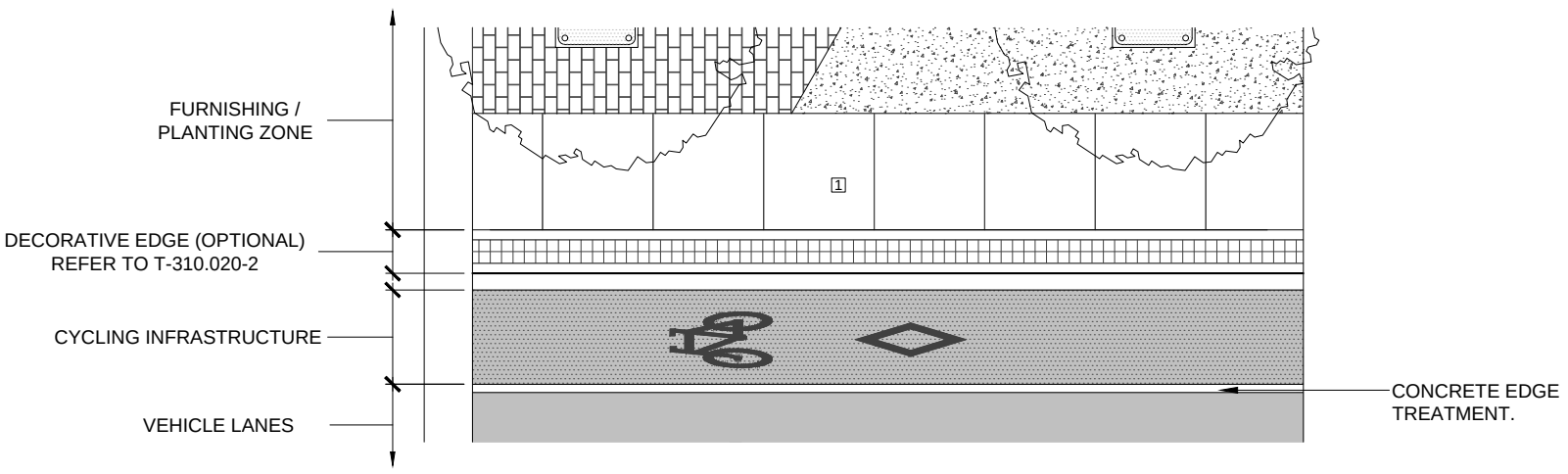
PERVIOUS CONCRETE - ON-STREET PARKING LANES



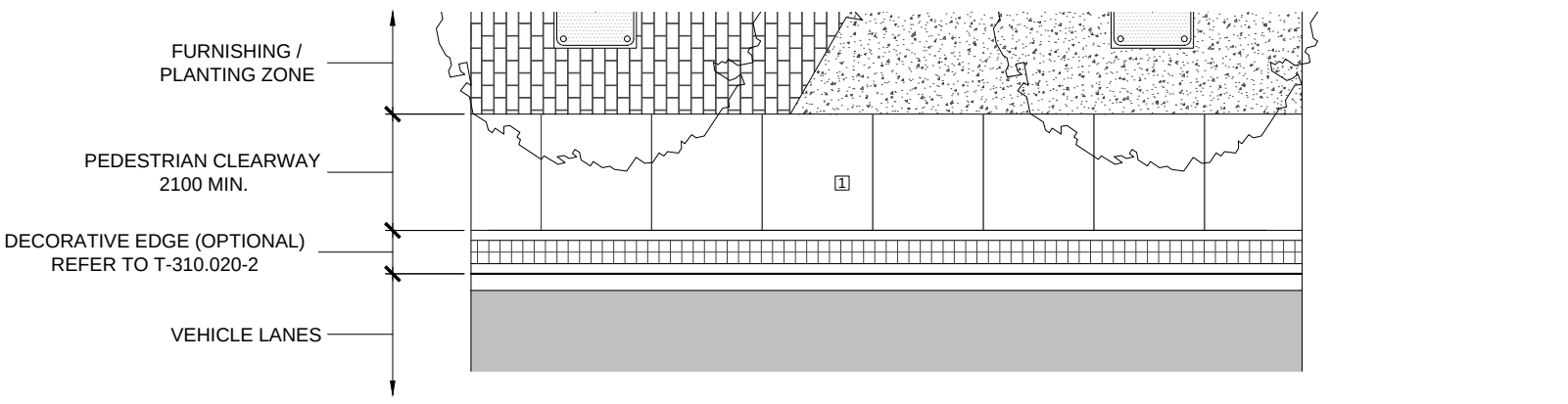
PERVIOUS CONCRETE - PARKING LAY-BYS



PERVIOUS CONCRETE - CYCLING INFRASTRUCTURE



PERVIOUS CONCRETE - SIDEWALKS



NOTE

1 CROSS SLOPE VARIES CONTINGENT ON OVERALL ROAD CROSS-SECTION AND PROFILE. PREFERRED MAXIMUM CROSS SLOPE GRADIENT FOR PERVIOUS CONCRETE SURFACE NOT TO EXCEED 2%

All dimensions are in millimetres unless otherwise shown.

TORONTO	CITY OF TORONTO GUIDELINE DRAWING	REV 0	APR 2017
	PERMEABLE PAVEMENT - PERVIOUS CONCRETE LAYOUTS	WQ-15.i.b	
		NTS	2 OF 2

A.0 POROUS ASPHALT PAVING

A.0.1 Thickness varies from 50-100mm depending on expected load.

A.0.2 Open-graded asphalt mix - 16% min. void space.

A.0.3 Add polymer to strengthen for heavy loads.

A.1 STONE RESERVOIR

A.1.1 ALL AGGREGATES:
- Max. wash loss - 0.5%
- Min. durability index - 35
- Max. abrasion - 10% for 100 and
  - 50% for 500 revolutions

A.1.2 BEDDING:
- 5 mm diameter stone or as per the Design Engineer.
- Depth varies:
  - 75mm heavy duty;
  - 40mm light duty;

* Max allowable depth of the filter bed determined by the following:

$$dmax = i \times ts / Vr$$

Where:
- dmax = Maximum stone bed depth (m)
- i = Infiltration rate for native soils (m/hr)
- Vr = Void ratio for stone bed (typically 0.3-0.4)
- ts = Time to drain stone bed (typically 24 hours; 72 hours max) (hr)

A.1.3 GRANULAR BASE
- Material:
  - 0-5% smaller than 2.36mm
  - 0-10% smaller than 4.75mm
  - 25-60% smaller than 12.5mm
  - 95-100% smaller than 25.0mm
  - 100% smaller than 37.5mm

* Stone storage bed design calculated based on the following:

$$dp = [Qc * R + P - i * T] / Vr$$

Where:
- **dp** = Stone bed depth (m)
- **Qc** = Depth of contributing runoff area (not including permeable surface (m)
- **R** = Contributing drainage area (Ac) / Permeable paving area (Ap)
- **P** = Rainfall depth (m)
- **i** = Infiltration rate for native soils (m/day)
- **T** = Time to fill stone bed (typically 2 hr)
- **Vr** = Void ratio for stone bed (0.3-0.4)

* Note - Ac - should not contain pervious areas.

A.1.4 GRANULAR SUB-BASE:
- Material: 50mm dia. clear crushed gravel
- Refer to Material Specification for Aggregates (TS 1010)

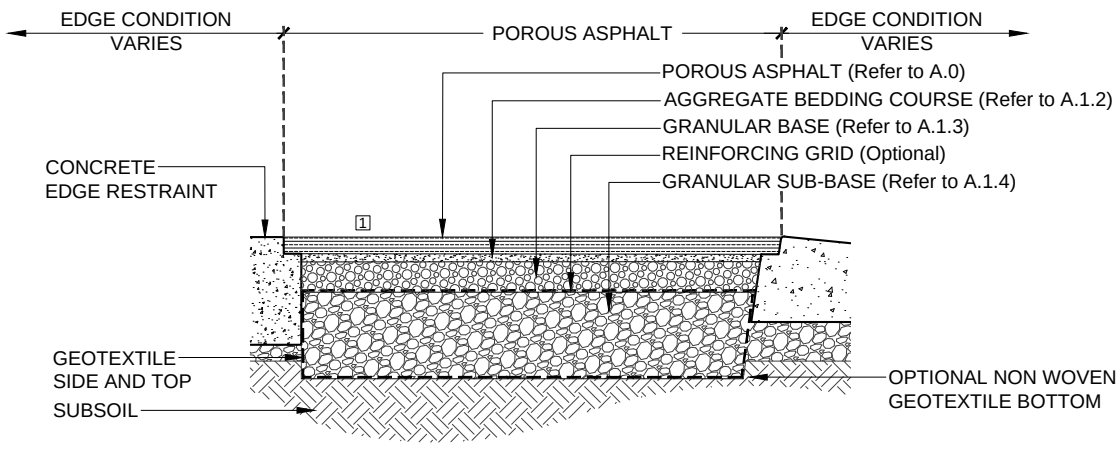
A.2 GEOTEXTILE
- Material: Woven monofilament or non-woven needle punched fabrics;
- Refer to OPSS 1860 Material Specification for Geotextiles.

A.3 UNDERDRAIN (Optional)
- Required where native soil infiltration rates are <15mm/hr;
- Min. 200mm dia. PVC 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.4 IDENTIFICATION MEDALLION
- To be installed on curb. Refer to guideline drawing G-1.

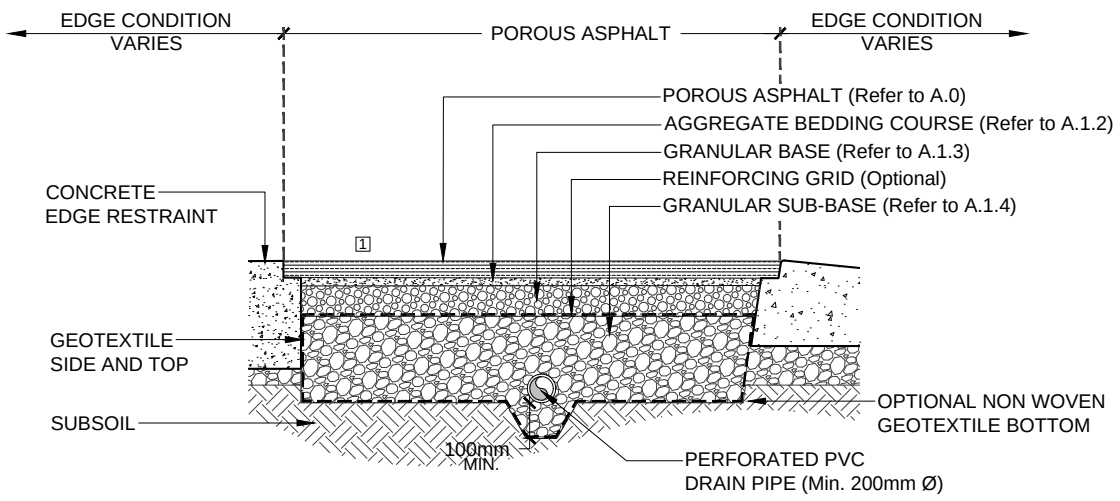
POROUS ASPHALT WITHOUT UNDERDRAIN

For sites with subsoil permeability >15mm/hr



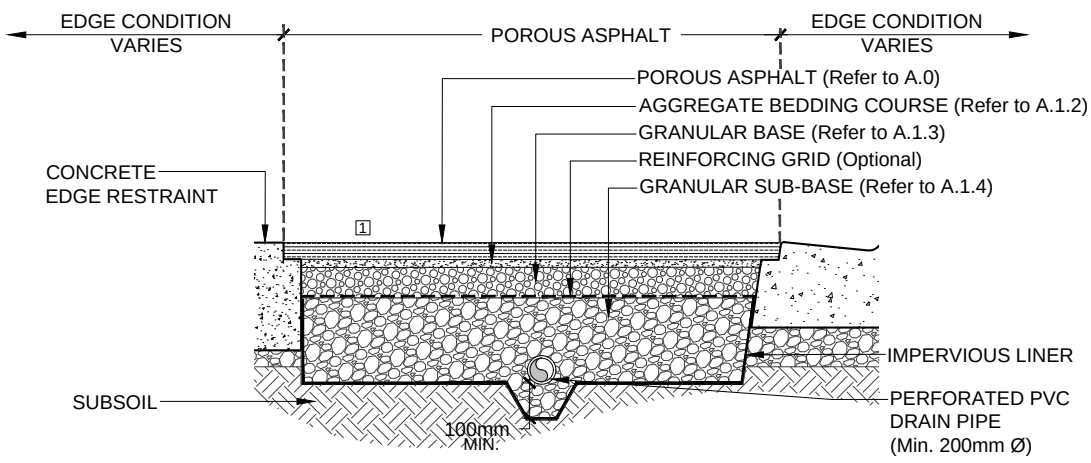
POROUS ASPHALT WITH UNDERDRAIN

For sites with subsoil permeability >1 and <15mm/hr.



POROUS ASPHALT WITH UNDERDRAIN & IMPERVIOUS LINER

For sites with contaminated soils



NOTE

1 CROSS SLOPE VARIES CONTINGENT ON OVERALL ROAD CROSS-SECTION AND PROFILE. PREFERRED MAXIMUM CROSS SLOPE GRADIENT FOR POROUS ASPHALT SURFACE NOT TO EXCEED 2%

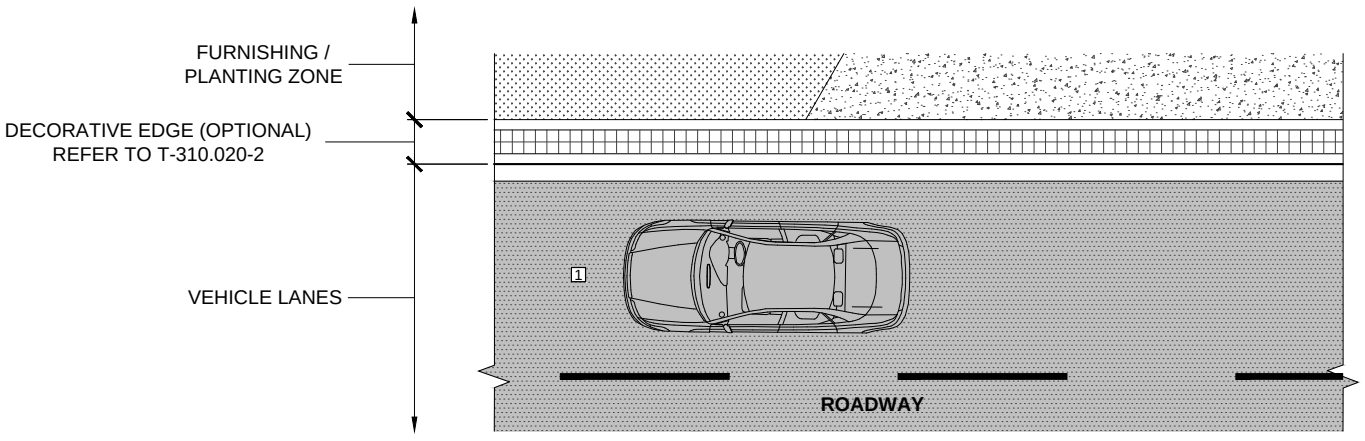
NOTES:

- DESIGN DETAILS TO BE ADAPTED FOR THE SPECIFIC LOCATION AND INSTALLATION.
- ANY PRE-EXISTING IMPERVIOUS BASE COURSE MATERIAL MUST BE REMOVED PRIOR TO PERMEABLE PAVER INSTALLATION.

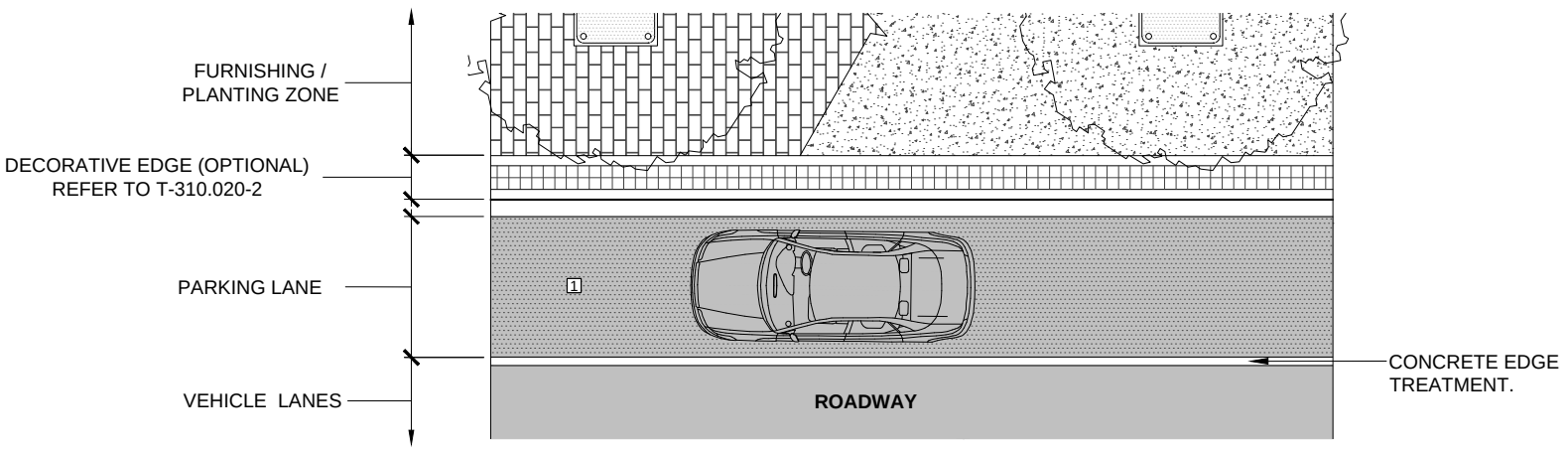
All dimensions are in millimetres unless otherwise shown.

	CITY OF TORONTO GUIDELINE DRAWING	REV 0	APR 2017
TORONTO	PERMEABLE PAVEMENT - POROUS ASPHALT SECTIONS	WQ-15.ii.a	
		NTS	1 OF 2

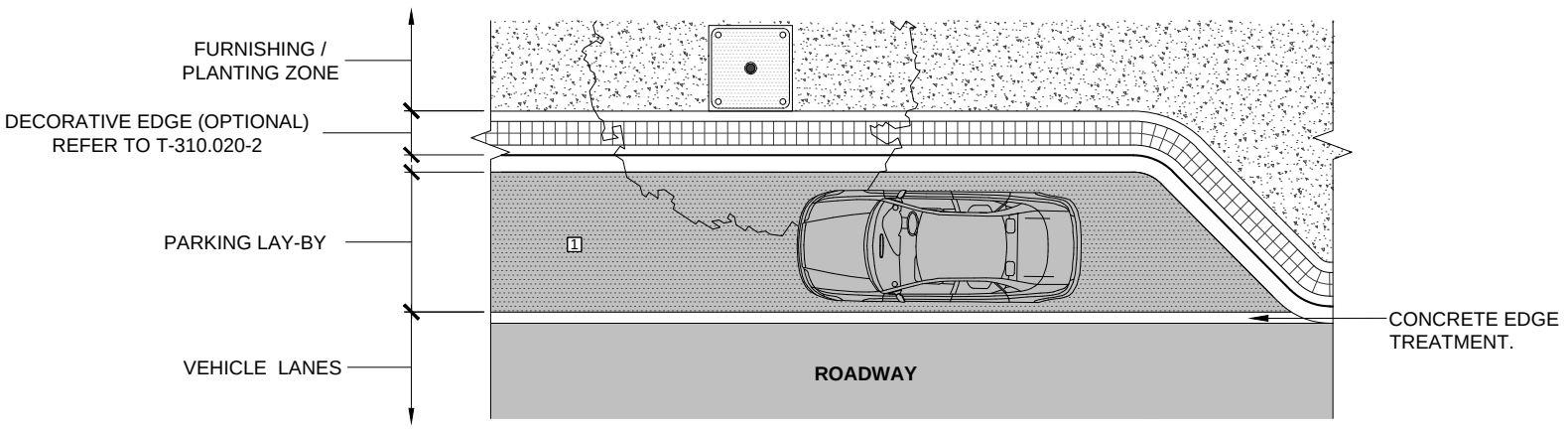
POROUS ASPHALT - VEHICLE LANES



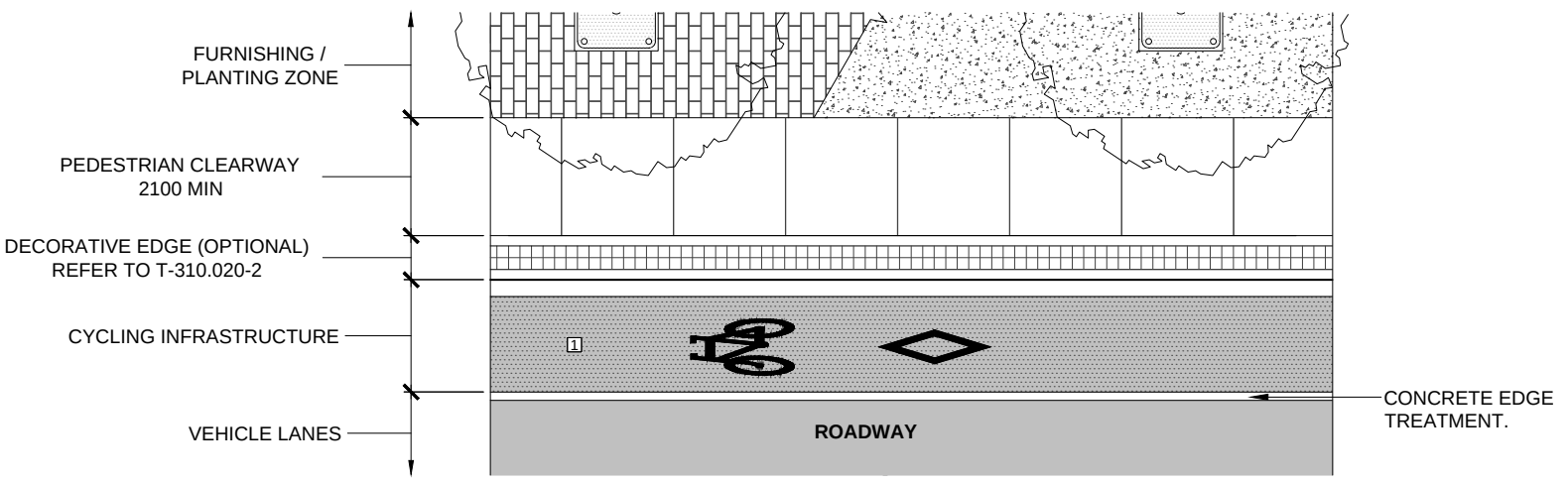
POROUS ASPHALT - ON-STREET PARKING LANES



POROUS ASPHALT - PARKING LAY-BYS



POROUS ASPHALT - CYCLING INFRASTRUCTURE



NOTE
CROSS SLOPE VARIES CONTINGENT ON OVERALL ROAD CROSS-SECTION AND PROFILE. PREFERRED MAXIMUM CROSS SLOPE GRADIENT FOR POROUS ASPHALT SURFACE NOT TO EXCEED 2%

All dimensions are in millimetres unless otherwise shown.

TORONTO	CITY OF TORONTO GUIDELINE DRAWING	REV 0	APR 2017
	PERMEABLE PAVEMENT - POROUS ASPHALT LAYOUTS	WQ-15.ii.b	
		NTS	2 OF 2

A.0 INTERLOCKING PRECAST CONCRETE PAVERS (IPCP)

Refer to OPSS PROV 355 - Construction Specification for Installation of Interlocking Concrete Pavers and CAN-3-A231.2, Standard Specification for Precast Concrete Pavers;

A.0.1 Paver thickness:
- Heavy duty - 100mm;
- Light duty - 80mm;

A.0.2 Pigment: Refer to ASTM C 979;

A.0.3 Maximum breakage = 5%;

A.0.4 Joints:
Width: 6mm - 10mm;
Joint fill material - 5 mm dia. crushed aggregate.

A.1 STONE RESERVOIR

A.1.1 ALL AGGREGATES:
- Max. wash loss - 0.5%
- Min. durability index - 35
- Max. abrasion - 10% for 100 and
  - 50% for 500 revolutions

A.1.2 BEDDING:
- 5 mm diameter stone or as per the Design Engineer.
- Depth varies:
  - 75mm heavy duty;
  - 40mm light duty;

* Max allowable depth of the filter bed determined by the following:

$$dmax = i \times ts / Vr$$

Where:
- dmax = Maximum stone bed depth (m)
- i = Infiltration rate for native soils (m/hr)
- Vr = Void ratio for stone bed (typically 0.3-0.4)
- ts = Time to drain stone bed (typically 24 hours; 72 hours max) (hr)

A.1.3 GRANULAR BASE
- Material:
  - 0-5% smaller than 2.36mm
  - 0-10% smaller than 4.75mm
  - 25-60% smaller than 12.5mm
  - 95-100% smaller than 25.0mm
  - 100% smaller than 37.5mm

* Stone storage bed design calculated based on the following:

$$dp = [Qc * R + P - i * T] / Vr$$

Where:
- **dp** = Stone bed depth (m)
- **Qc** = Depth of contributing runoff area (not including permeable surface (m)
- **R** = Contributing drainage area (Ac) / Permeable paving area (Ap)
- **P** = Rainfall depth (m)
- **i** = Infiltration rate for native soils (m/day)
- **T** = Time to fill stone bed (typically 2 hr)
- **Vr** = Void ratio for stone bed (0.3-0.4)

* Note - Ac - should not contain pervious areas.

A.1.4 GRANULAR SUB-BASE:
- Material: 50mm dia. crushed gravel;
- Refer to Material Specification for Aggregates (TS 1010).

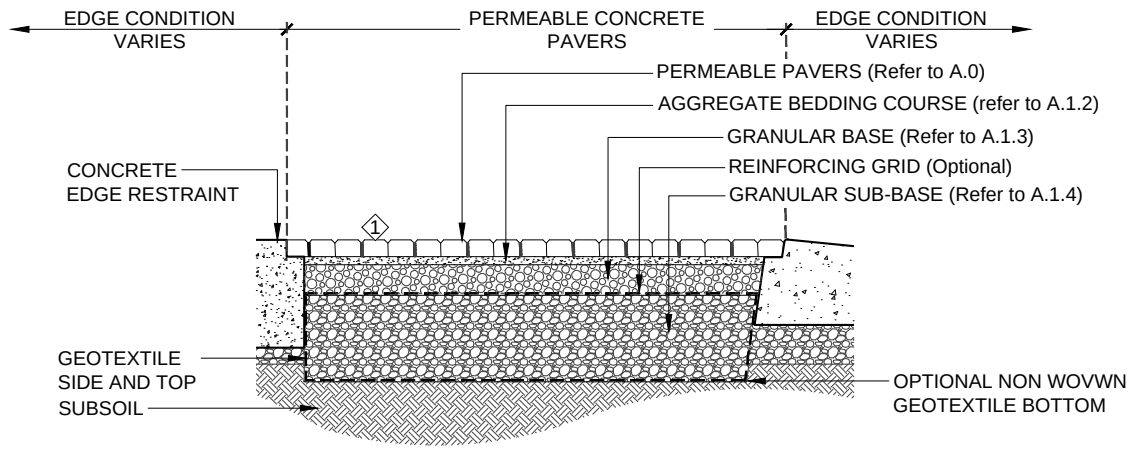
A.2 GEOTEXTILE
- Material: Woven monofilament or non-woven needle punched fabrics;
- Refer to OPSS 1860 Material Specification for Geotextiles.

A.3 UNDERDRAIN (Optional)
- Required where native soil infiltration rates are <15mm/hr;
- 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.4 IDENTIFICATION MEDALLION
- To be installed on curb. Refer to guideline drawing G-1.

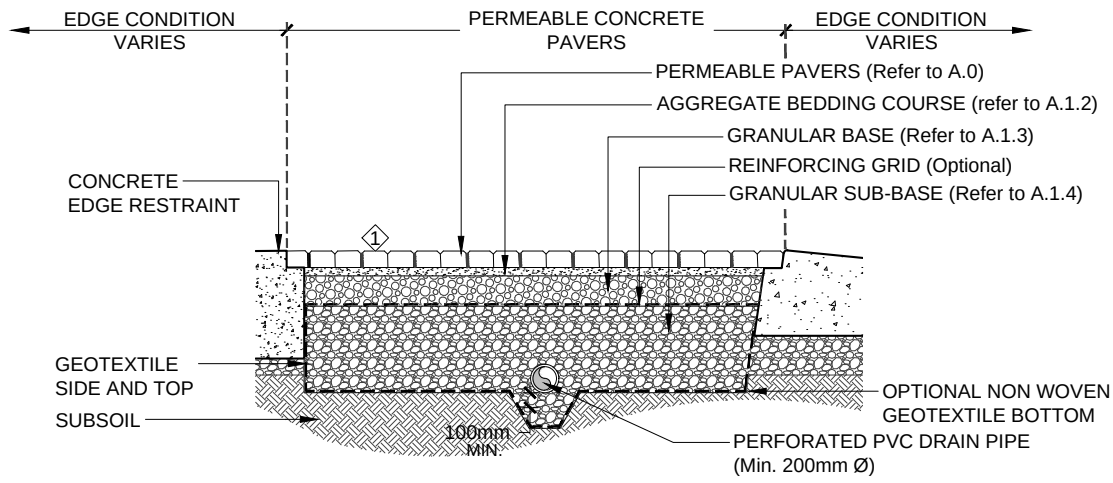
INTERLOCKING PRECAST CONCRETE PAVERS WITHOUT UNDERDRAIN

For sites with subsoil permeability >15mm/hr



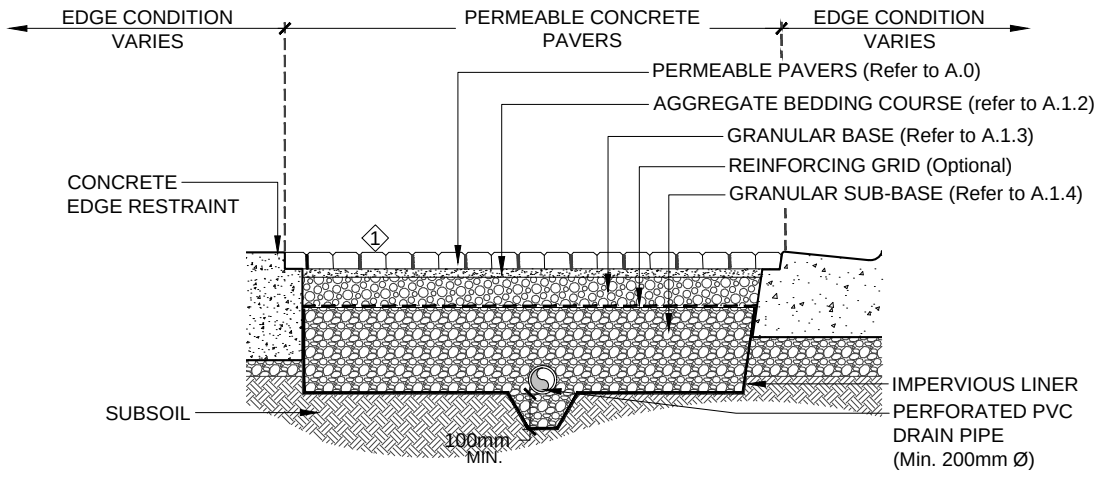
INTERLOCKING PRECAST CONCRETE PAVERS WITH UNDERDRAIN

For sites with subsoil permeability >1 and <15mm/hr.



INTERLOCKING PRECAST CONCRETE PAVERS WITH UNDERDRAIN & IMPERVIOUS LINER

For sites with contaminated soils



NOTE

1 CROSS SLOPE VARIES CONTINGENT ON OVERALL ROAD CROSS-SECTION AND PROFILE. PREFERRED MAXIMUM CROSS SLOPE GRADIENT FOR PERMEABLE PAVING SURFACE NOT TO EXCEED 2%

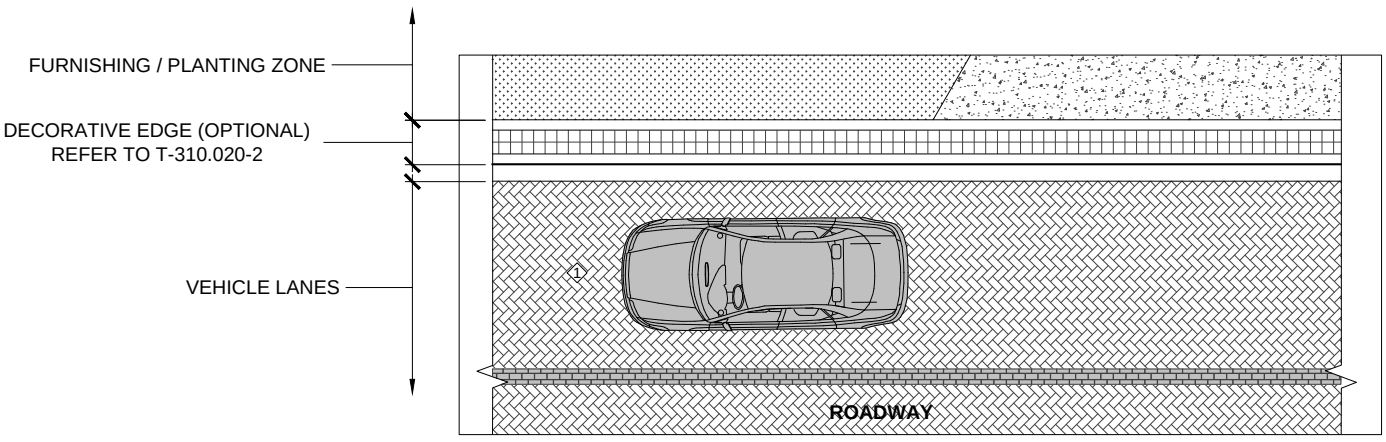
NOTES:

- DESIGN DETAILS TO BE ADAPTED FOR THE SPECIFIC LOCATION AND INSTALLATION.
- ANY PRE-EXISTING IMPERVIOUS BASE COURSE MATERIAL MUST BE REMOVED PRIOR TO PERMEABLE PAVER INSTALLATION.

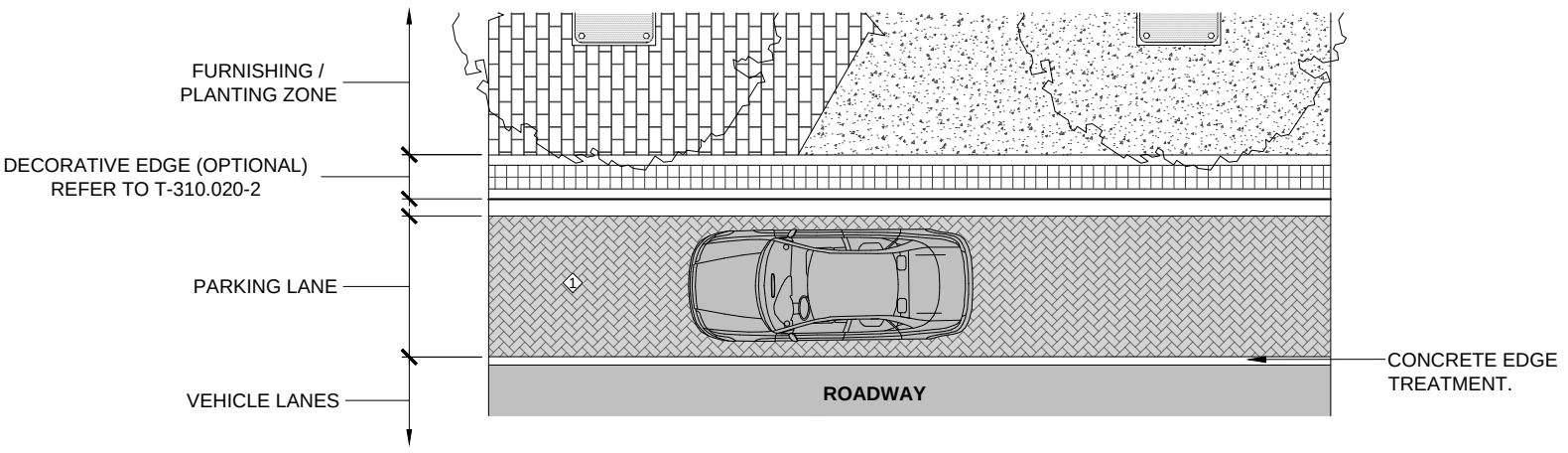
All dimensions are in millimetres unless otherwise shown.

	CITY OF TORONTO GUIDELINE DRAWING	REV 0	APR 2017
TORONTO	PERMEABLE PAVEMENT - INTERLOCKING PRECAST CONCRETE PAVERS (IPCP) SECTIONS	WQ-15.iii.a	
		NTS	1 OF 2

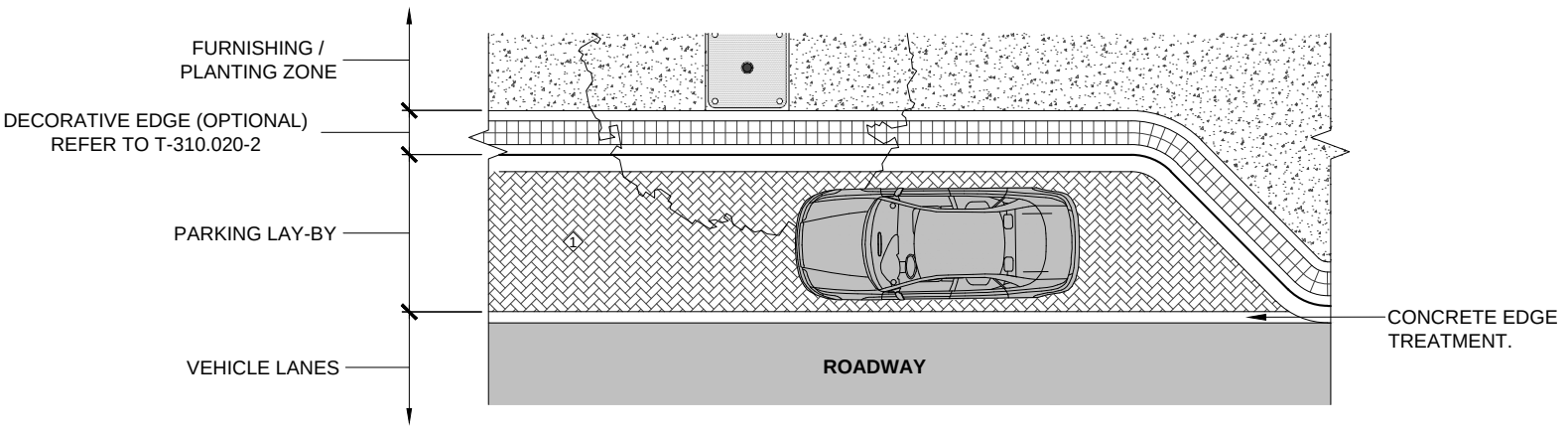
INTERLOCKING PRECAST CONCRETE PAVERS (IPCP) - VEHICLE LANES



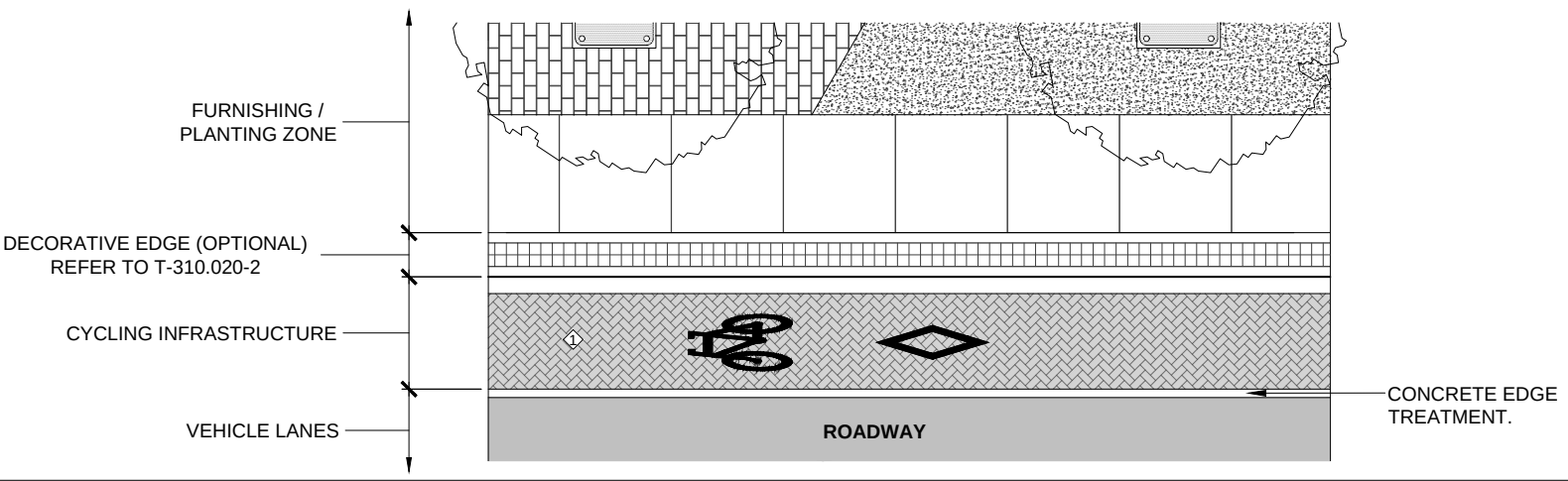
INTERLOCKING PRECAST CONCRETE PAVERS (IPCP) - ON-STREET PARKING LANES



INTERLOCKING PRECAST CONCRETE PAVERS (IPCP) - PARKING LAY-BYS



INTERLOCKING PRECAST CONCRETE PAVERS (IPCP) - CYCLING INFRASTRUCTURE



NOTE
1. CROSS SLOPE VARIES CONTINGENT ON OVERALL ROAD CROSS SECTION AND PROFILE. PREFERRED MAXIMUM CROSS SLOPE GRADIENT FOR PERMEABLE PAVING SURFACE NOT TO EXCEED 2%

All dimensions are in millimetres unless otherwise shown.

TORONTO	CITY OF TORONTO GUIDELINE DRAWING	REV 0	APR 2017
	PERMEABLE PAVEMENT - INTERLOCKING PRECAST CONCRETE PAVERS (IPCP) LAYOUTS	WQ-15.iii.b	
		NTS	2 OF 2