Ontario Case Studies of LID Design & Construction for Retrofits and New Developments:

"Real world" experience and lessons learned

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Aquafor Beech Ltd

TRIECA _ March 26-27th, 2013

Overview

- New Development
- ROW- Upper Middle Road

- Retrofits
- Public Realm- Green Glades
- Public Realm- Beach Boulevard Park Retrofit
- ROW Retrofit – Lakeview

Upper Middle Road

Background

- Bioretention Unit
- New Development
- Oakville, Ontario
- Constructed in 2011
- Facility- 1,600m^2
- Accepts 4ha road drainage
- 25mm event

Rational

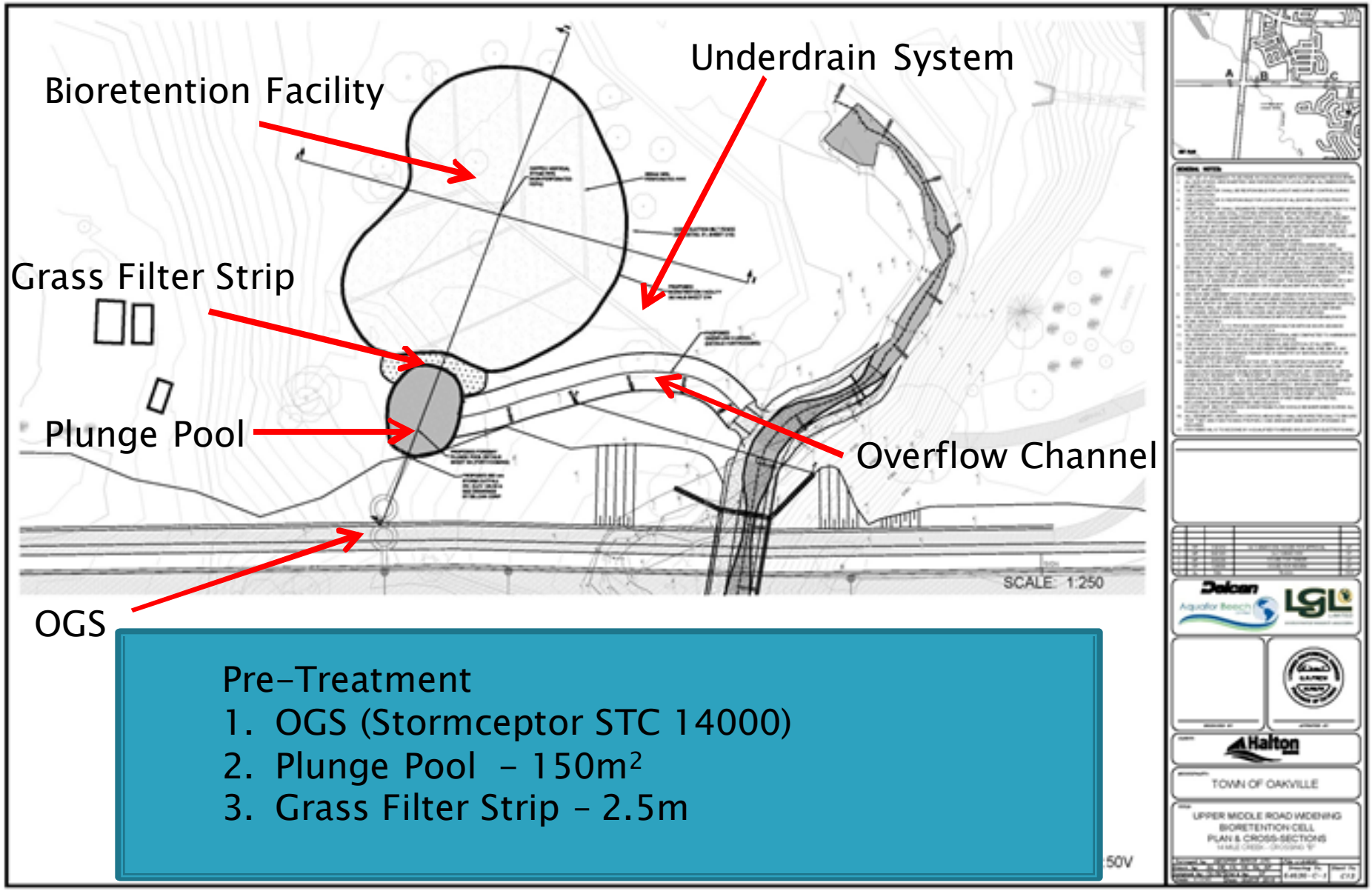
- Designed and constructed to address stormwater impacts to the habitat of Red-Side Dace, a fish species provincially designated as At Risk and protected under the Species at Risk Act (SARA).
- General reluctance to approve conventional SWM approaches: Wet ponds, wetlands and OGS for water quality
- Facility that can be characterized/become habitat are discouraged
- Thermal impacts are now a concern
- Disruption of baseflow, etc

Site Conditions

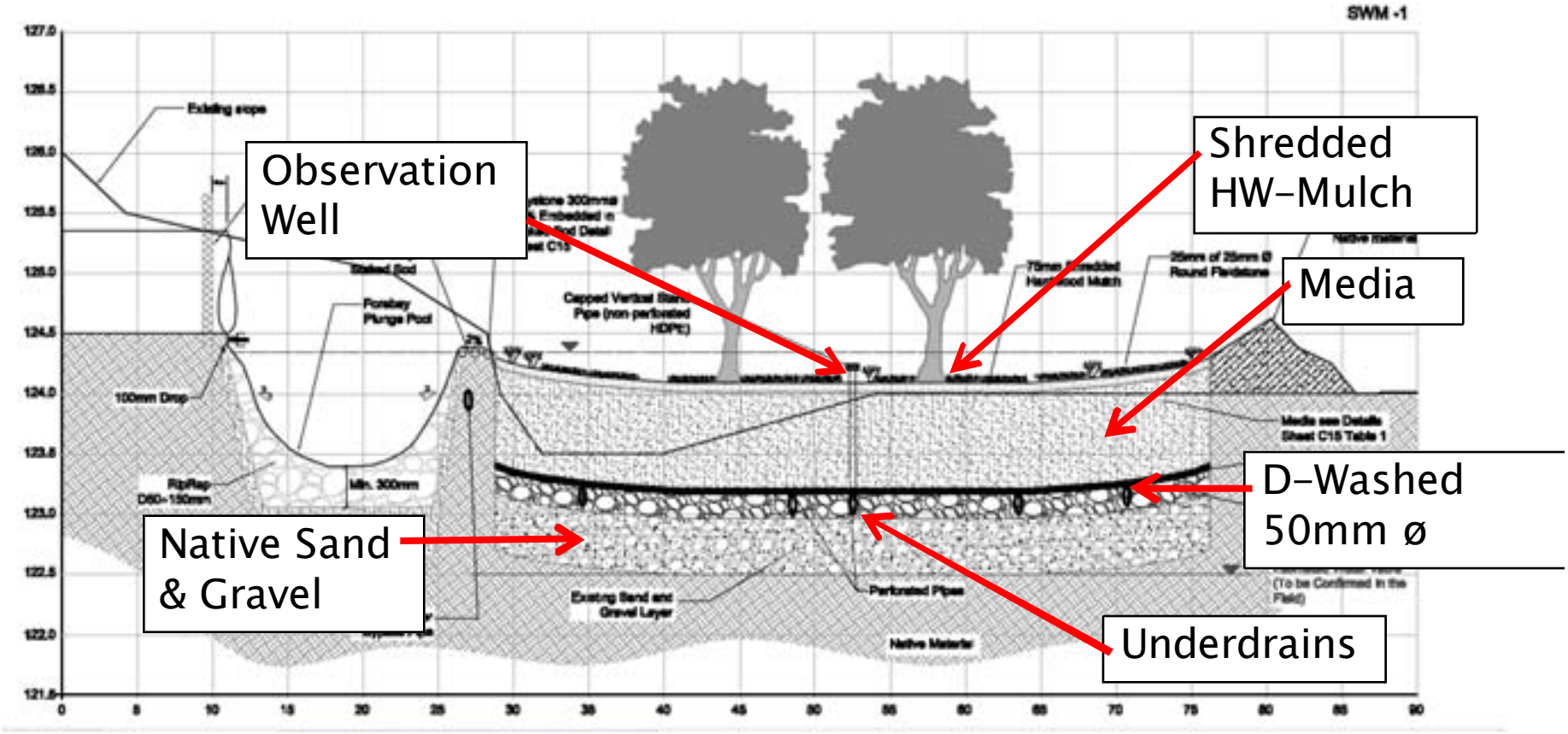
- Hydrogeological Study of Groundwater – Surface Water Interaction (Aquafor, 2009)
- Previous Geotechnical reports – 05 & 07

Soil Stratigraphy	>8m of unsorted Sand & Gravel, overlain and confined within the valley slopes by 5-10m of silty clay (Halton Till)
Hydraulic Conductivity	Silty Clay till –low conductivity (10^{-7} to 10^{-10} m/s) Sand & Gravel unit – high conductivity (10^{-5} to 10^{-6} m/s) • 2-3 orders of magnitude difference •Using a sensitivity analysis, 15 mm/hr was determined using hand-driven piezometers & sharp response to rainfall events and rapid drainage as baseflow
Seasonally High Groundwater Table Elevation	±122.5m
Groundwater Table Fluctuation	0.2-0.5m

Bioretention Design

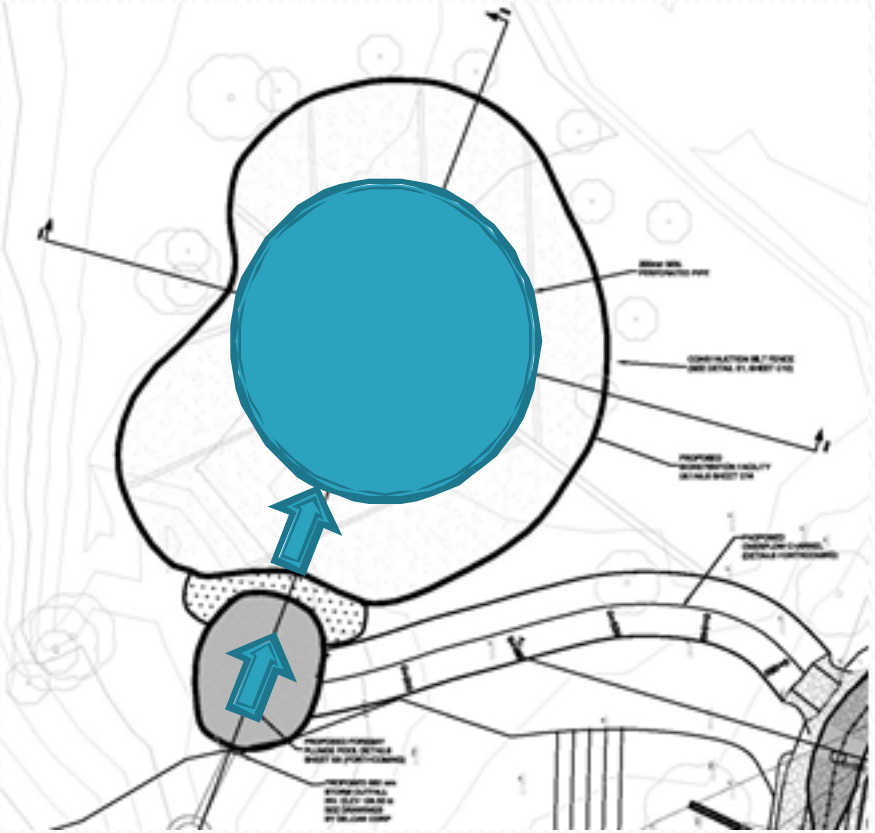


Bioretention Facility Design



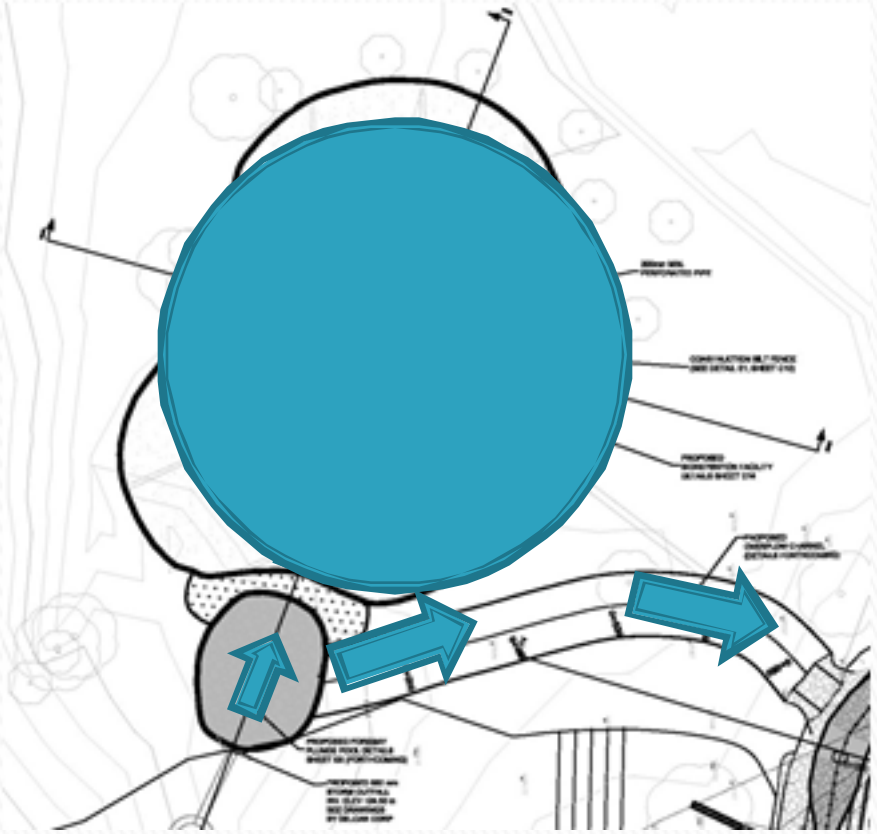
Conceptual Flow Path

- Can be characterized by the rain event type: **Small Event**
  - Frequent/ 'typical events' – representing the majority of the annual rainfall events, typically characterized by low intensity, long duration.



Conceptual Flow Path

- Can be characterized by the rain event type: **Large Events**
  - Infrequent/ Large Events – these types of events occur infrequently but are characterized by high intensity and short duration.



Media Development

Bioretention Media is the functional component of the system – critical to the long-term function of the system

TABLE 1: MEDIA FOR BIOSWALE FACILITY

MEDIA	SIZE	% BY WEIGHT
1 - SAND	2 to 0.05mm	85 - 88%
2 - FINES	< 0.050mm	8 - 12%
3 - LEAF COMPOST (Organic Matter)	-	3 - 5%

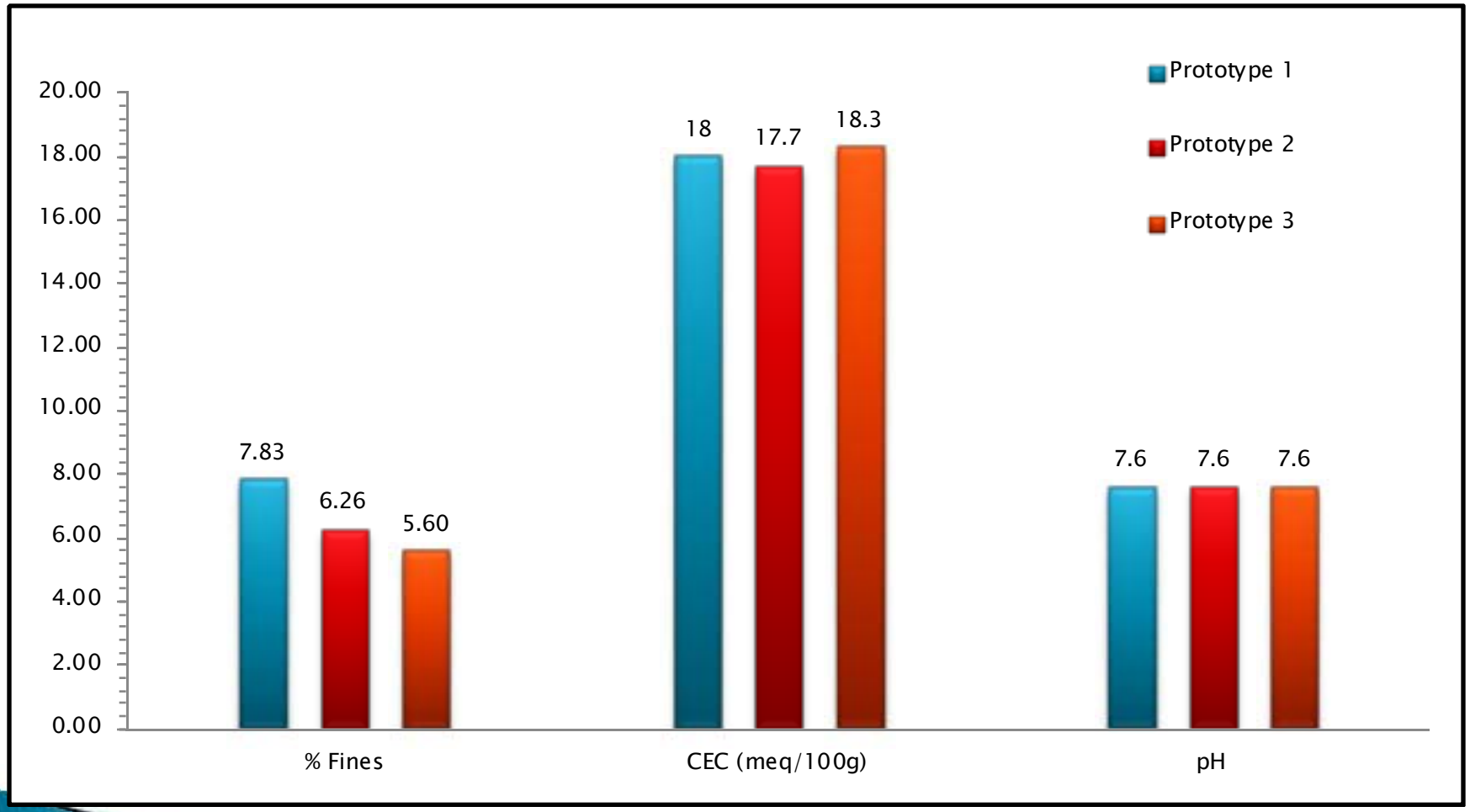
Notes:

- CEC greater than 10 mg/100g
- PH = 5.5 - 7.5
- K greater than 25mm/hr

Soil Texture Classification:

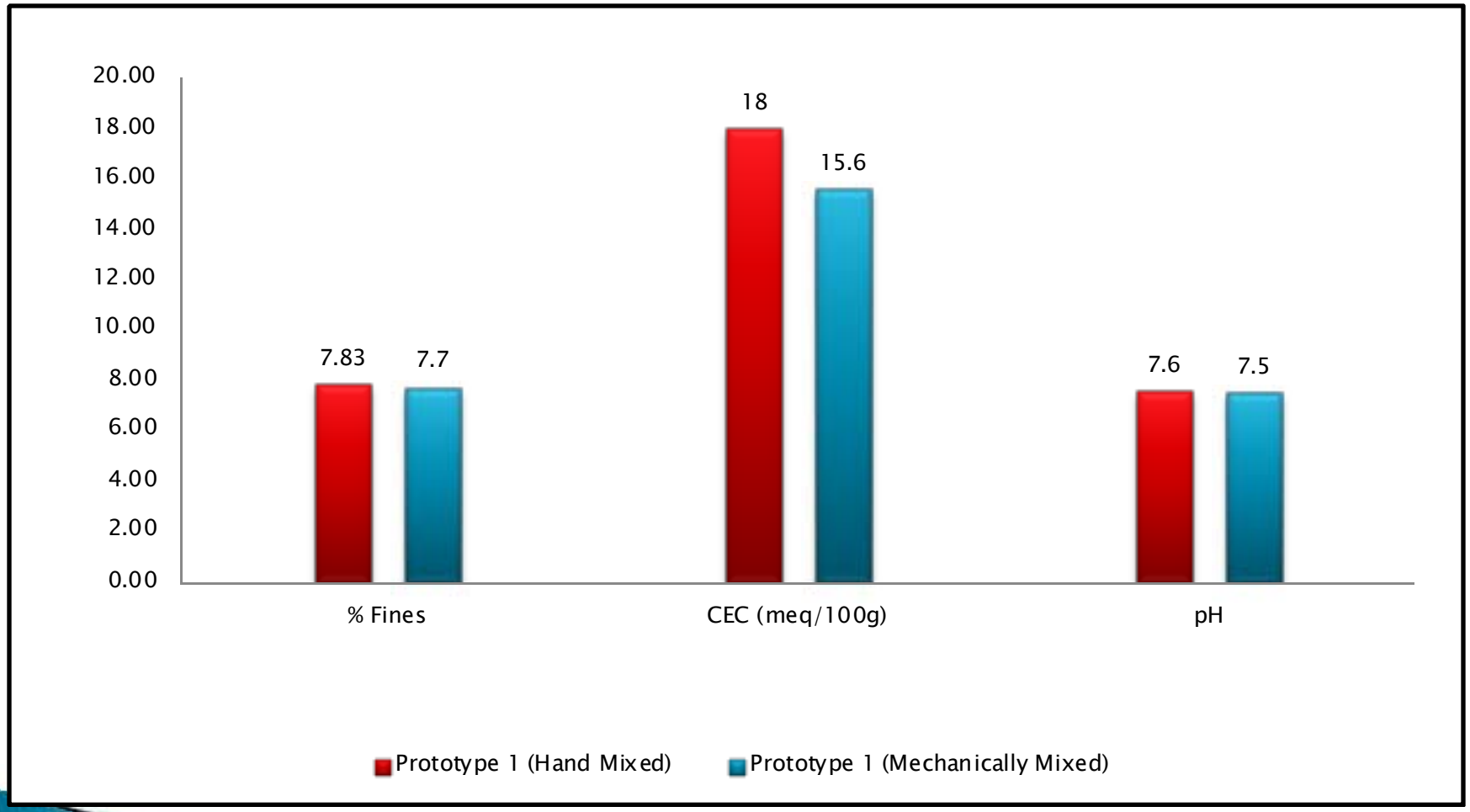
- No objects greater than 50mm
- Media obtained from vendor to be tested to confirm design specifications prior to installation. Field engineer to confirm conformance with specification prior to installation.

Media Development



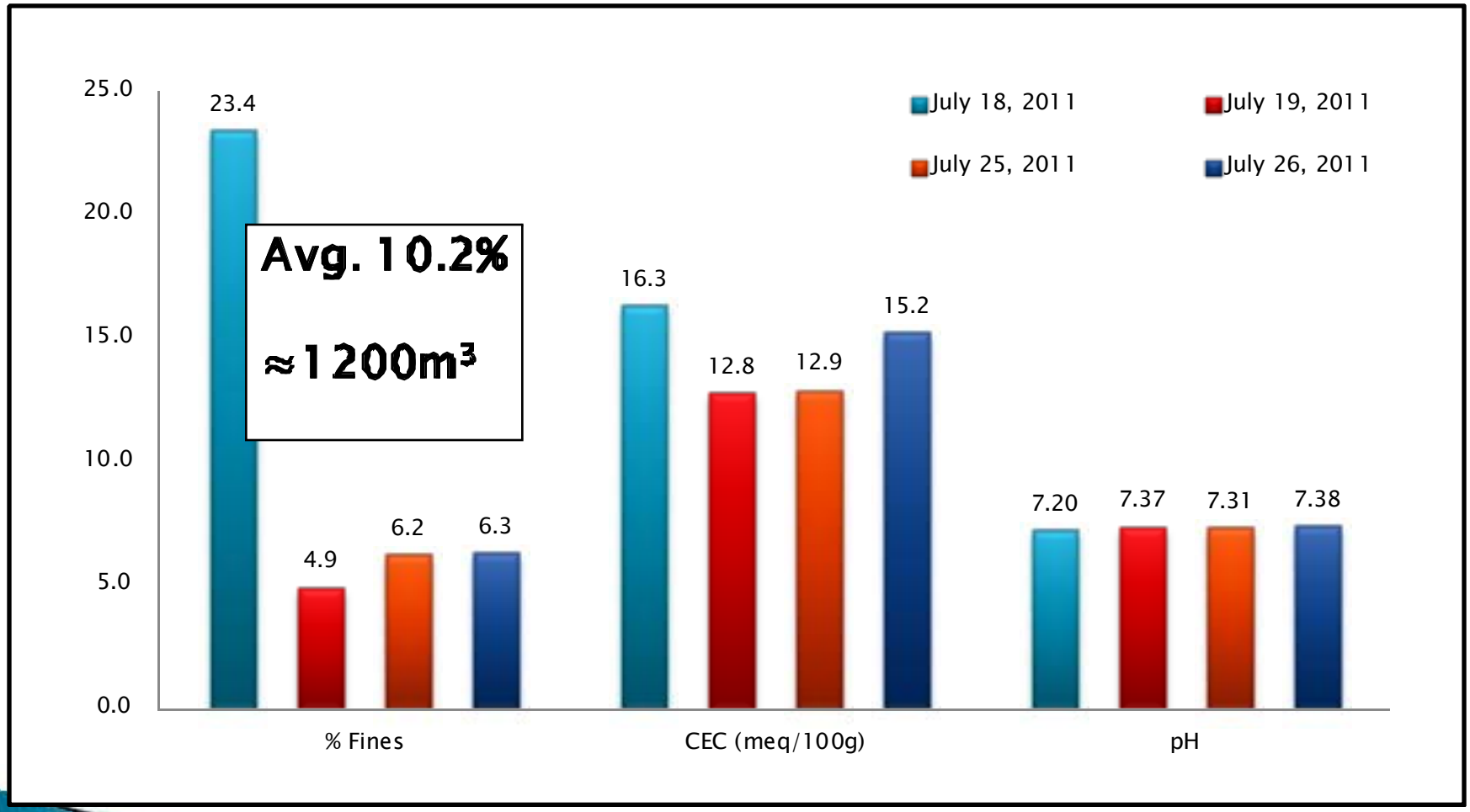
Hand Mixed Prototypes

Media Development



Mechanically Mixed Prototypes – Mass Production

Construction – QA/QC



For Construction – Large Site

Construction – QA/QC

Infiltration Testing During Construction: 50-75mm/hr

Construction

Construction

Construction

Construction

Bioretention Facility Design

Construction

Construction

Construction

Construction

Bioretention Facility Design

Bioretention Facility Design

Erosion & Sediment Control

Erosion & Sediment Control

Erosion & Sediment Control

Erosion & Sediment Control

Erosion & Sediment Control

April 2012

On-Line

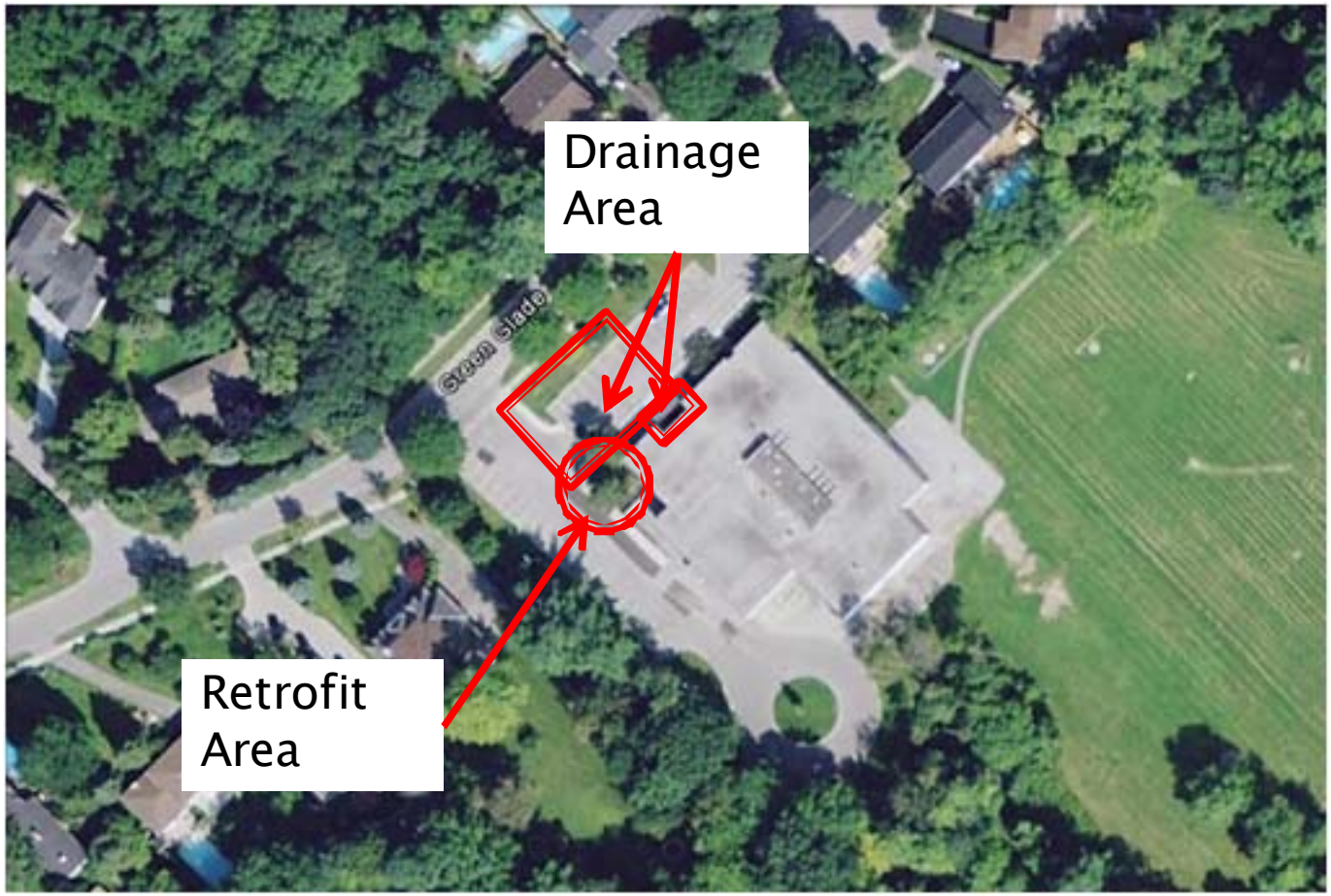
June 2012

Green Glades Public School

Background

- Bioretention Unit Retrofit
- Mississauga, ON
- Constructed in 2011
- Facility- 11m^2
- Accepts 0.03ha road & roof drainage
- 25mm event

Green Glades Public School



Rational

ve

walk

Site Conditions

- Guelph Permeameter – In-situ infiltration testing
- Sub-s

Soi	lt)
Hydra	ctivity hr
Groundw	r than

Design

Inlet Grate

Dry River Bed

Biore

Outle

Ex

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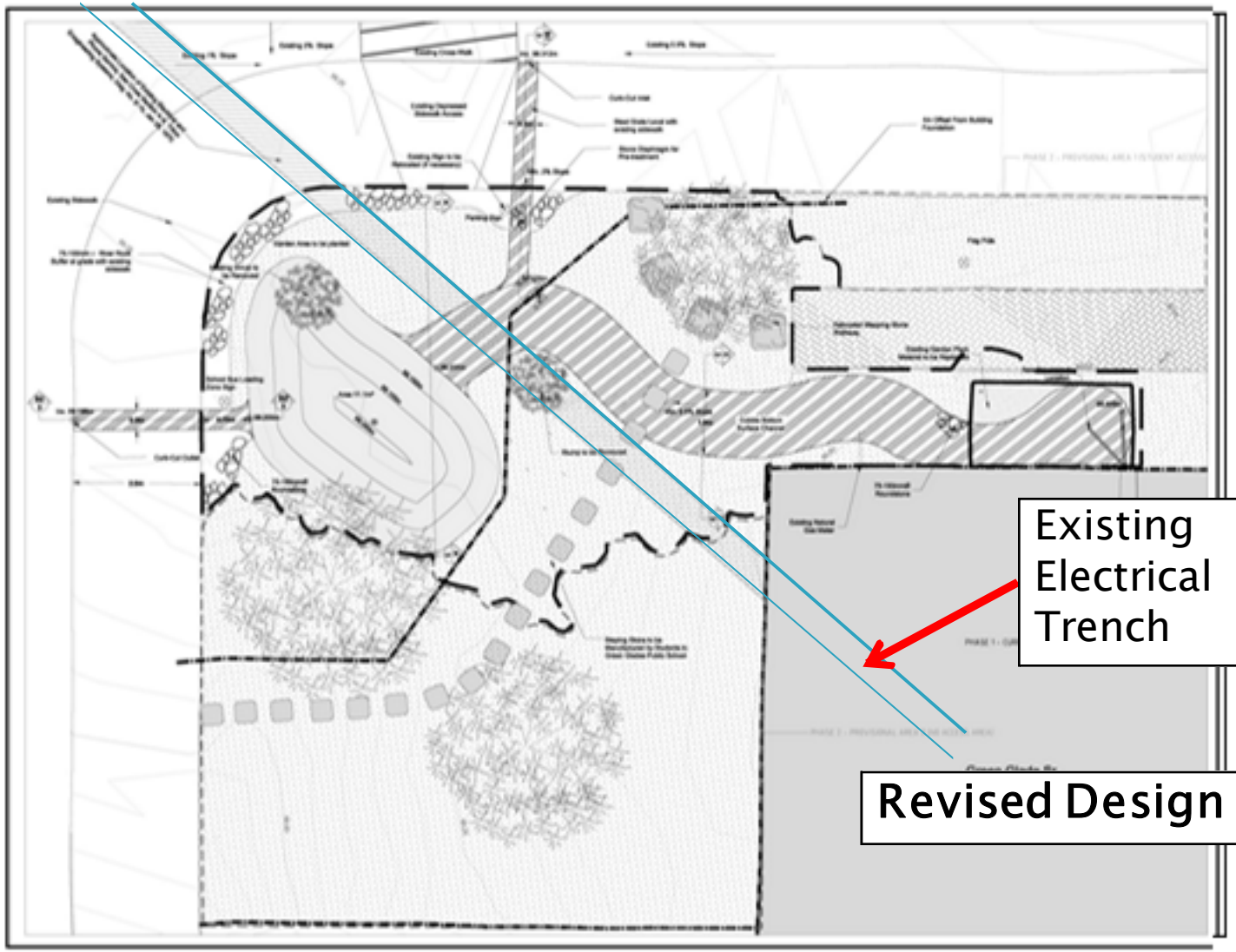
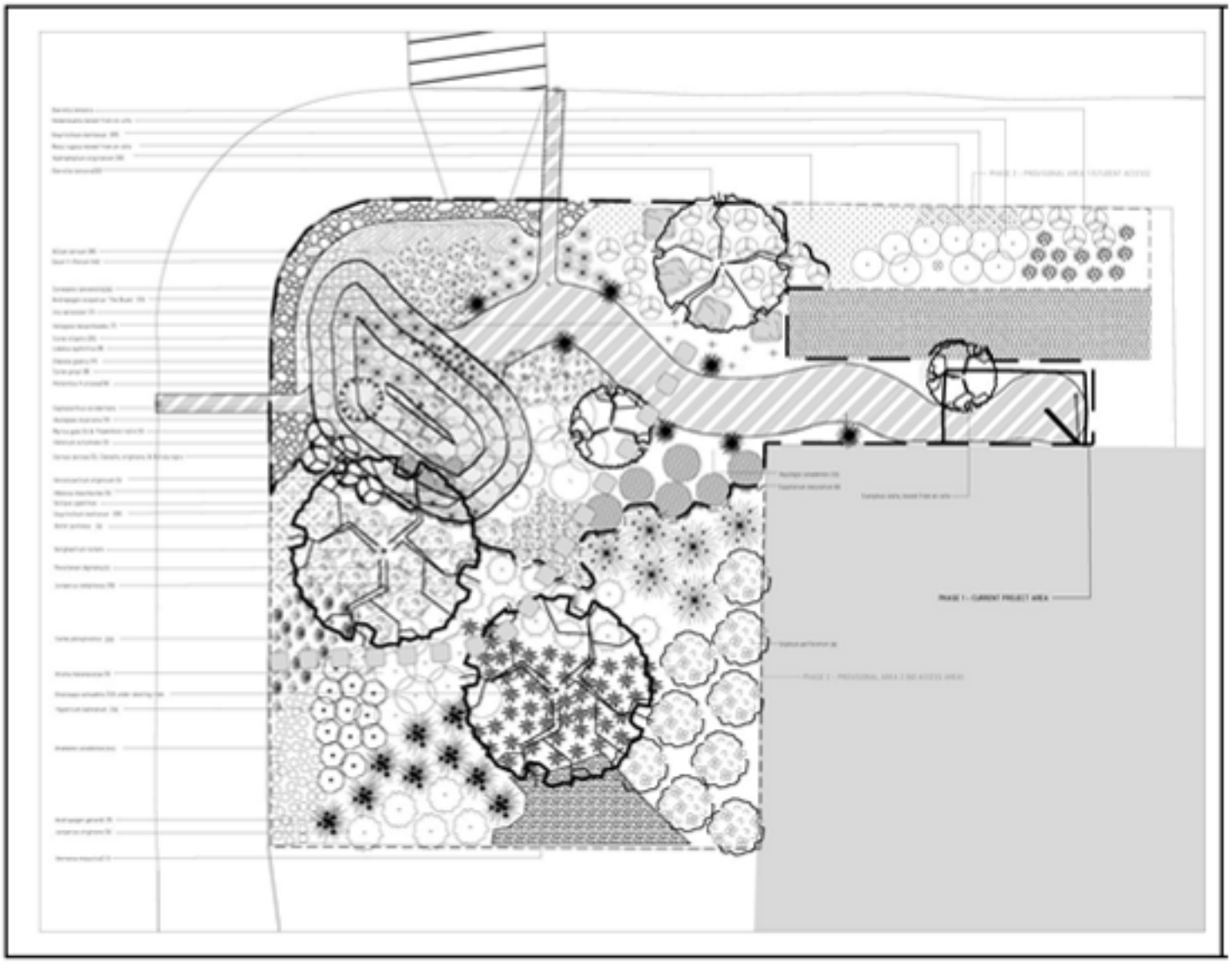
Importance of Locates



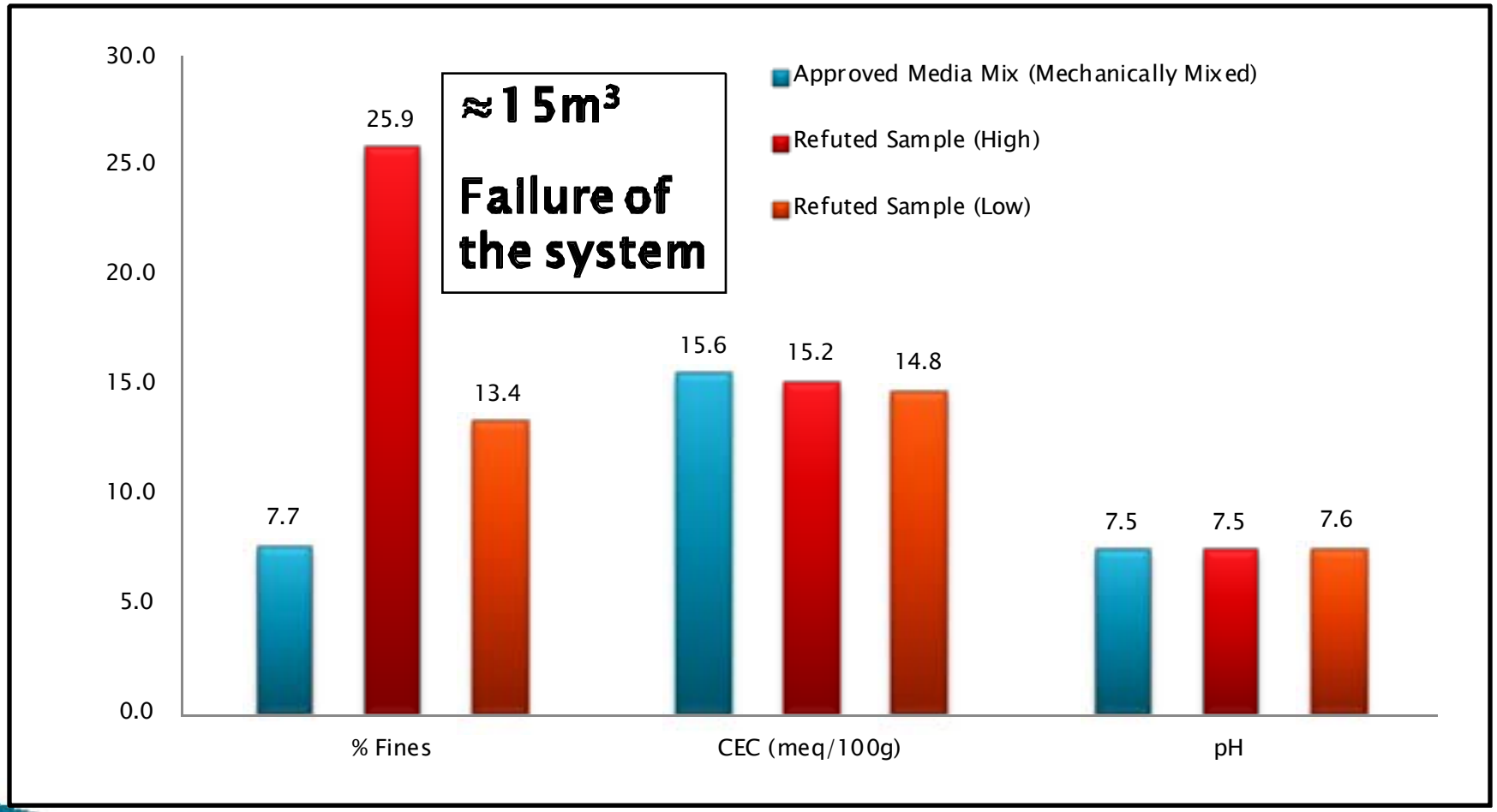
Design – Planting Plan



Design – Planting Plan

Construction- QA/QC

Construction- QA/QC



For Construction – Small Site

Construction- QA/QC

Construction- QA/QC

Green Glade, August 10, 2011 24 hours after a 23 mm event

Green Glades – Before

Before

Green Glades – After

After

Lakeview Bioswale Retrofit: A Community Streetscape Re-imagined

Aquafor Beech Limited

MISSISSAUGA
Leading today for tomorrow

CVC

SCHOLLEN & Company Inc.
220 Duncan Mill Road, Suite 109
Toronto, Ontario M3B 3J5
Tel: 416.441.3044
Fax: 416.441.6010
Email: design@schollenandcompany.com

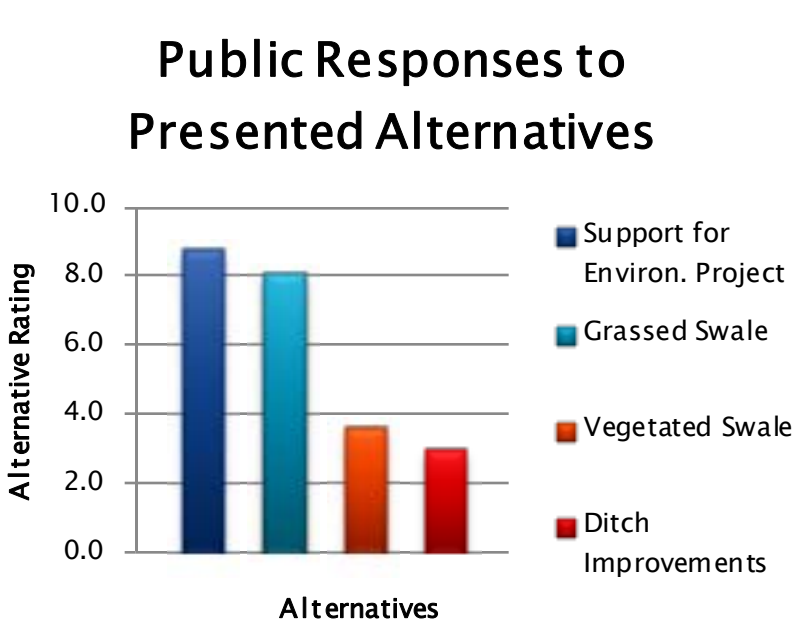
Background

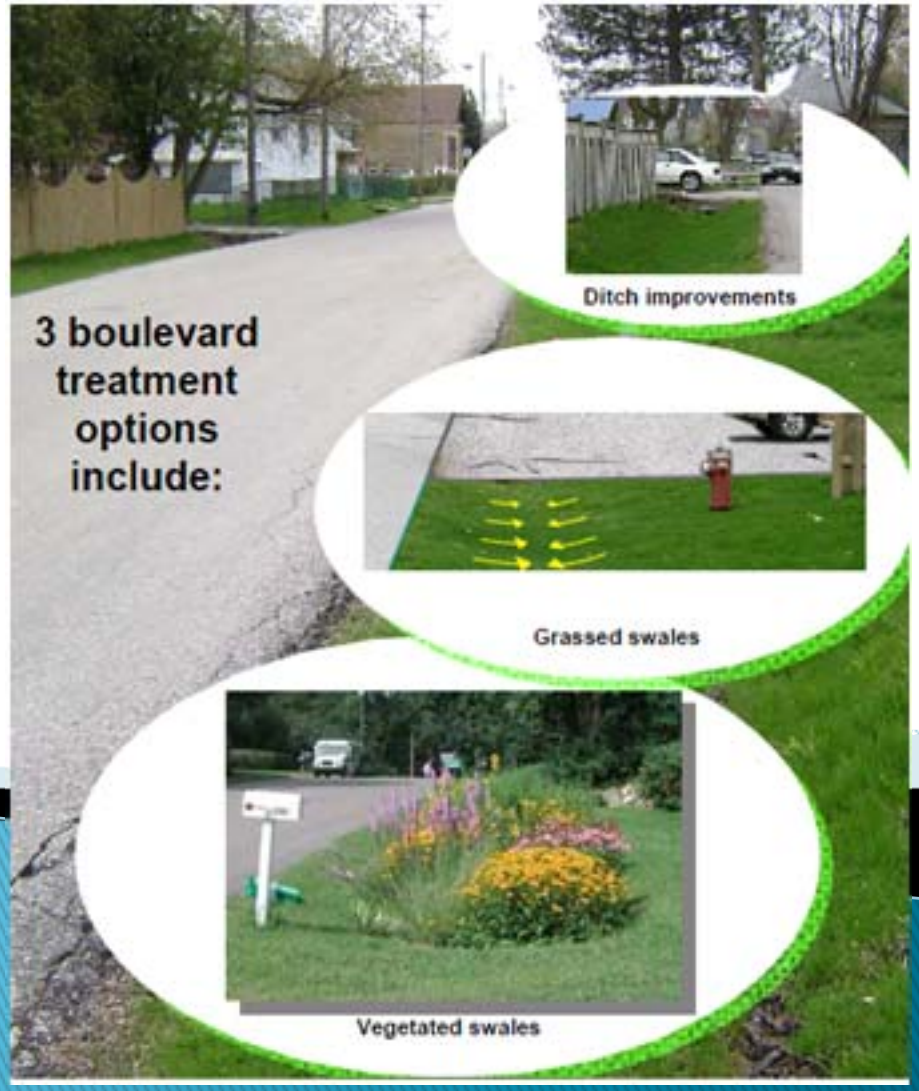
- ROW Retrofit within older residential area
  - Bioswales & Perforated Pipe System
  - Permeable pavement
  - Bioretention media for filtration and infiltration
- Mississauga, ON
- Construction – Spring 2012
- Accepts road & property drainage

Background


Ogden Ave
Edgelagh Ave
Gardner Ave
Alexandra Ave
Eastmount Ave
Lakeshore Rd E

Background


Public Responses to Presented Alternatives
10.0
8.0
6.0
4.0
2.0
0.0
Alternative Rating
Alternatives
Support for Environ. Project
Grassed Swale
Vegetated Swale
Ditch Improvements


3 boulevard treatment options include:
Ditch improvements
Grassed swales
Vegetated swales

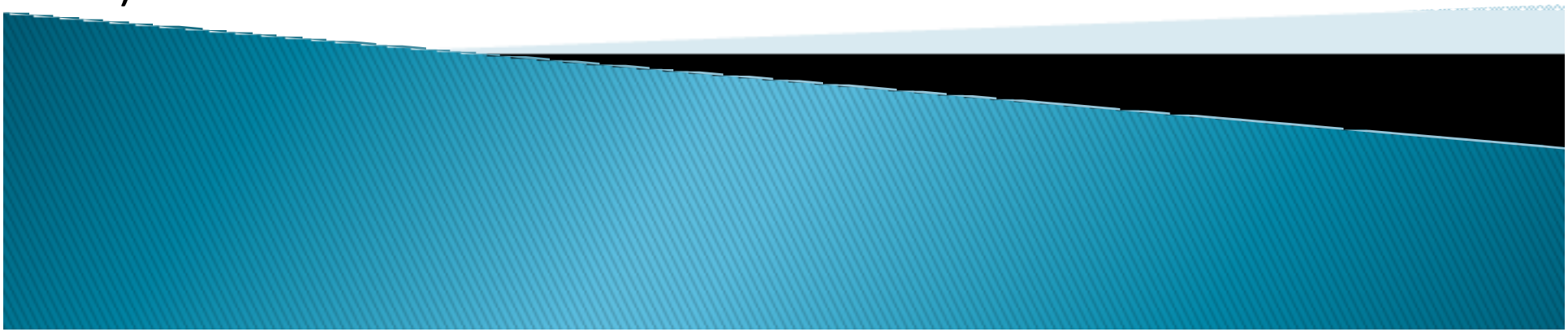
Background

(Most Important to least important)

1) Parking
2) Water Quality
3) Environmental Benefits
4) Prevent Flooding
5) Integration with the Environment
6) Improve Conveyance
7) Integration with Existing Infrastructure
8) Aesthetics

<u>Other results</u>

- No Sidewalks
- Cost not important
- Same Driveway width after construction
- 50% want perennial plants
- Willing to do maintenance



Encroachment Issues

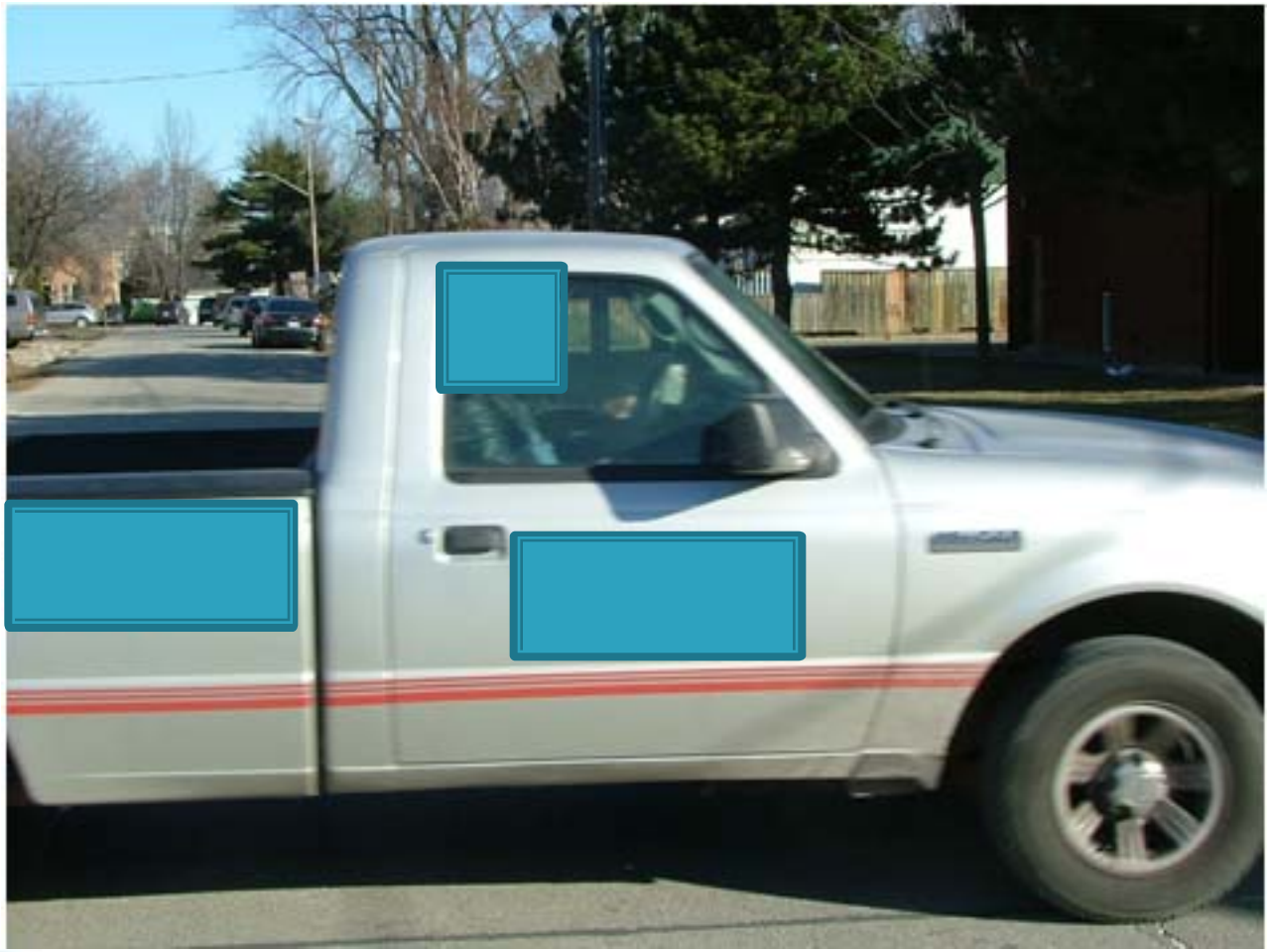
Encroachment Issues

Utilities

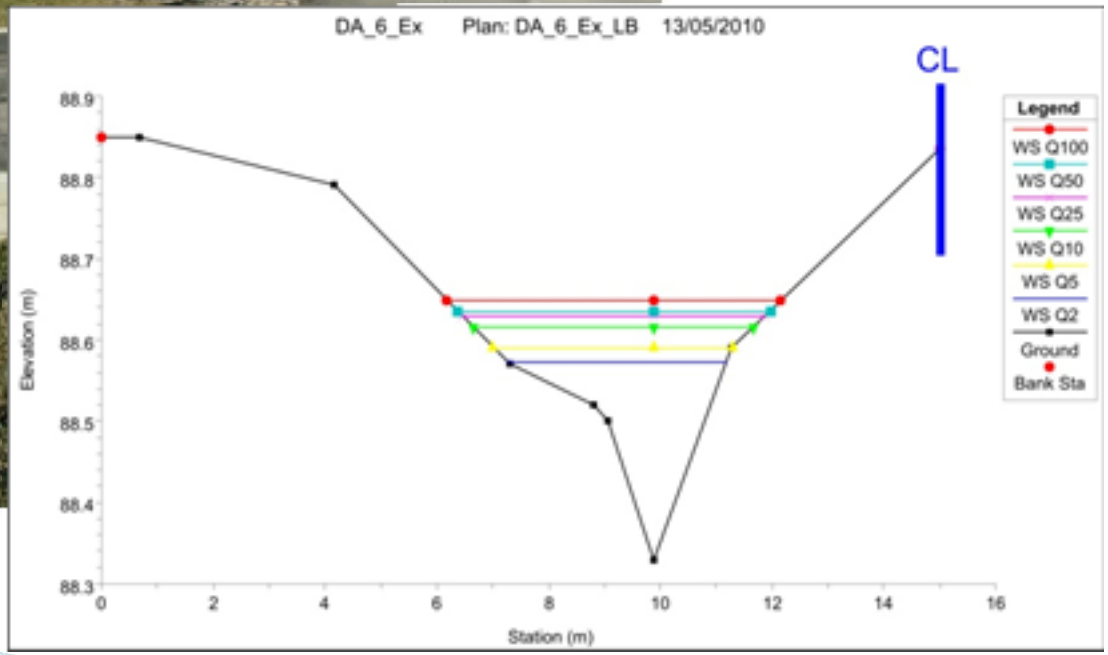

ENBRIDGE
WARNING
NATURAL GAS
PIPELINE
Call Before You Dig: 1-800-400-2255
Emergency Toll Free: 1-866-763-5427
Enbridge

Traffic Safety

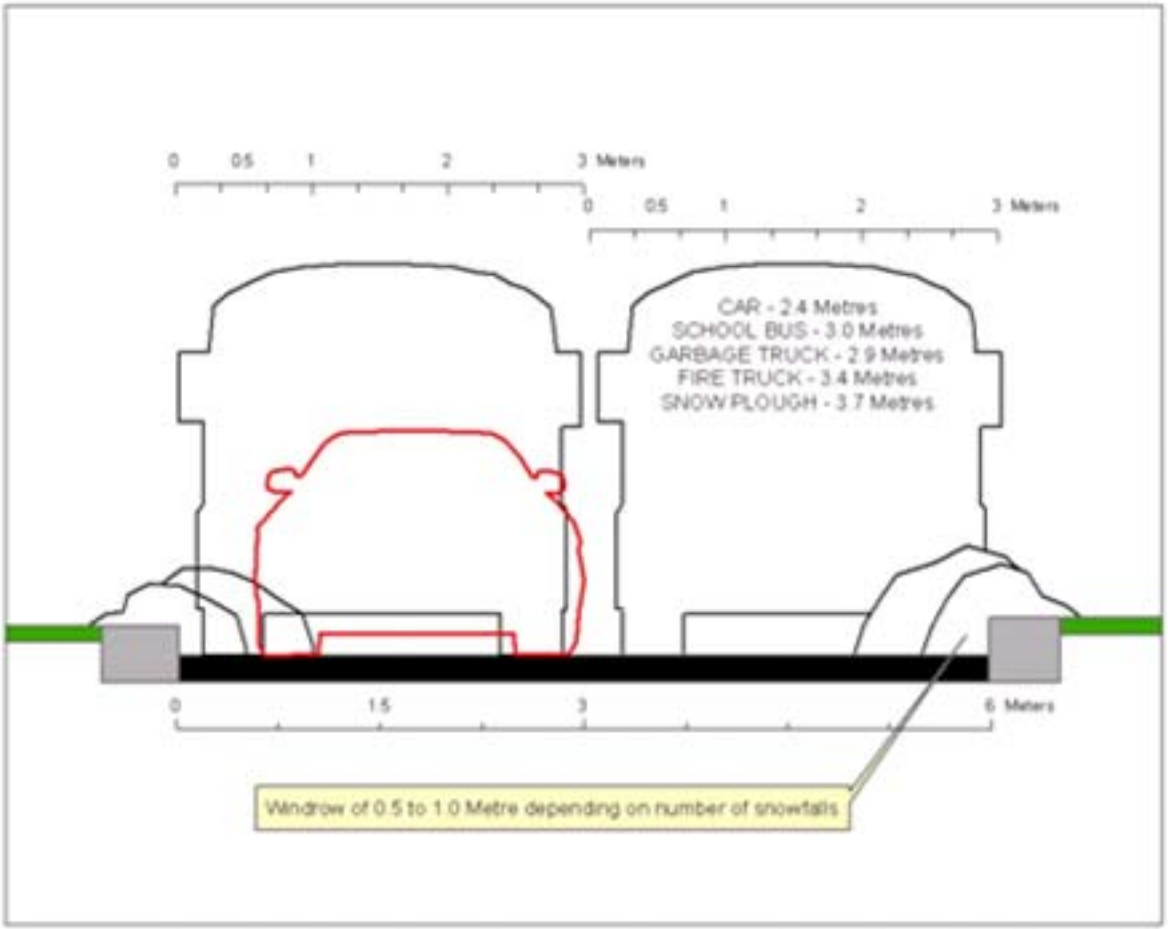
Traffic Safety



Flooding Issues



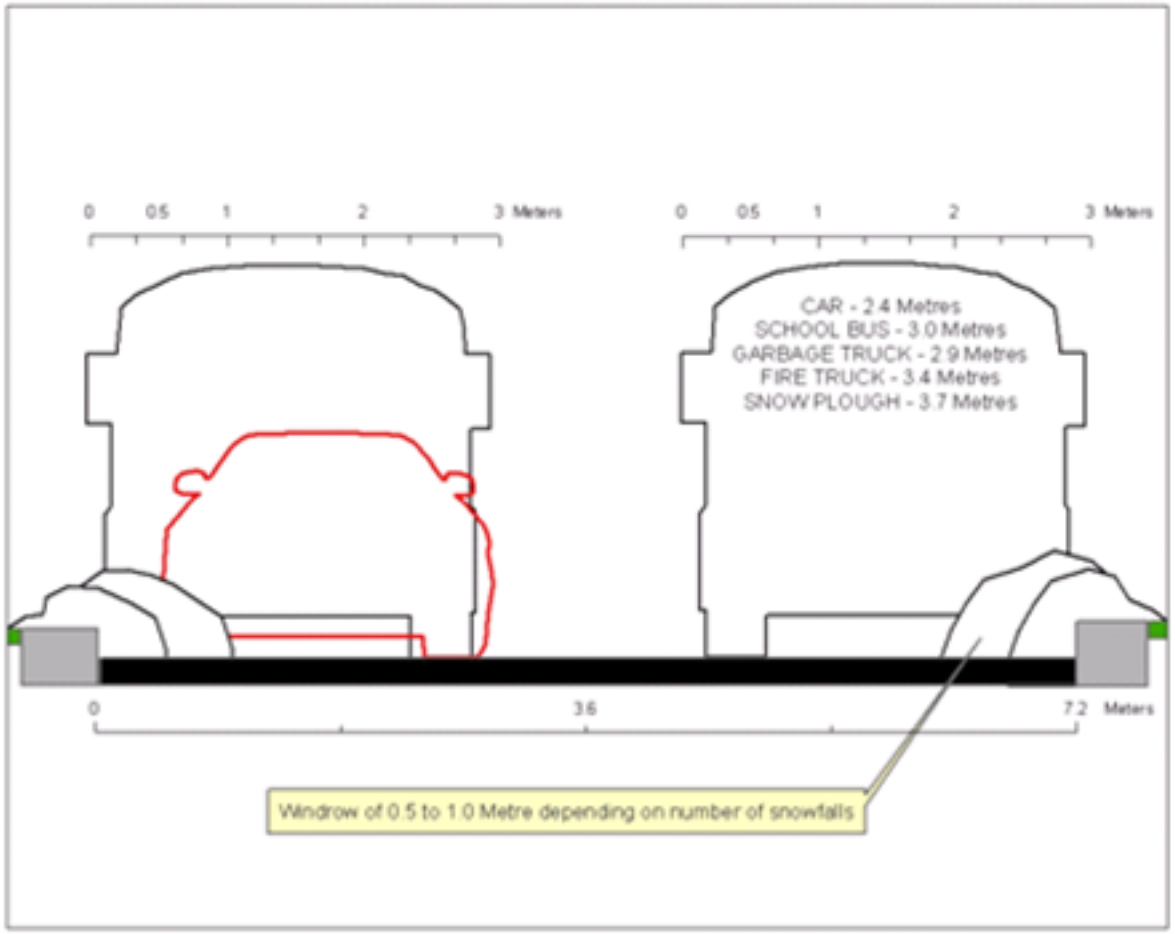
Road Widths
(Emergency Vehicle Access)



Effect of winter Operations on a 6.0m Road width

Road Widths

(Vehicle Access – Emergency & Snow Removal)



7.2m widths provides access but is less than current City Standard (8.0m)

Selected to reduce impervious cover and allow for additional area for bioswales

Parking

Geotech. and Infiltration Testing

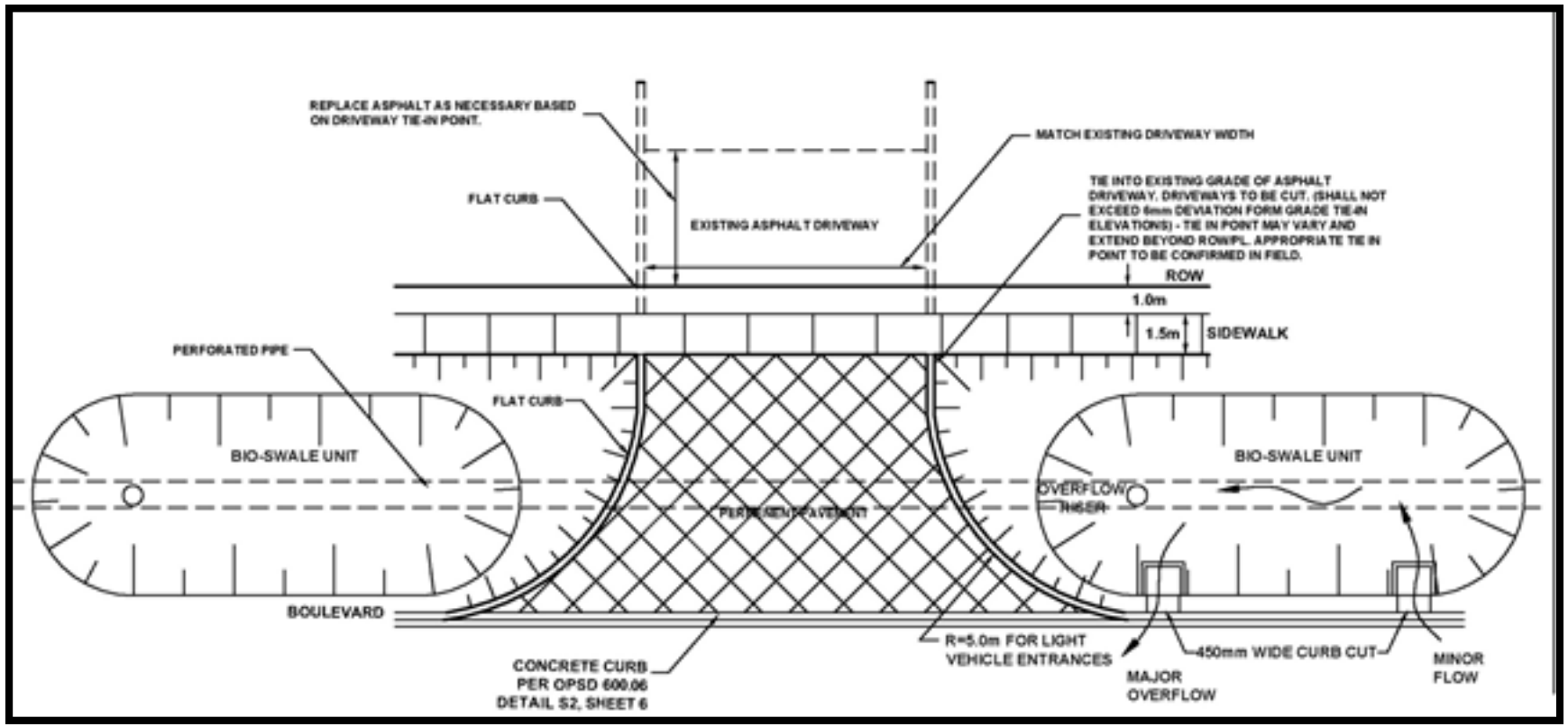
Geotech. and Infiltration Testing

- Geotechnical investigation undertaken within the existing ROW/ditches

Soil Stratigraphy	5-30cm of topsoil 0.2-1.5m of Clayey Silty Fill with some sand & gravel Clayey Silt Till deposits at depth
Hydraulic Conductivity	At 1.0-1.2m depth below surface- design infiltration rate was determined to be 5.45mm/hr (2.5 SF) – 5mm/hr used in the design
Groundwater Table Elevation	Observations included generally no GW (GW observed at surface in some locations - attributed to water perched in the ditches and fill stratum)

Designs Details

Designs Details



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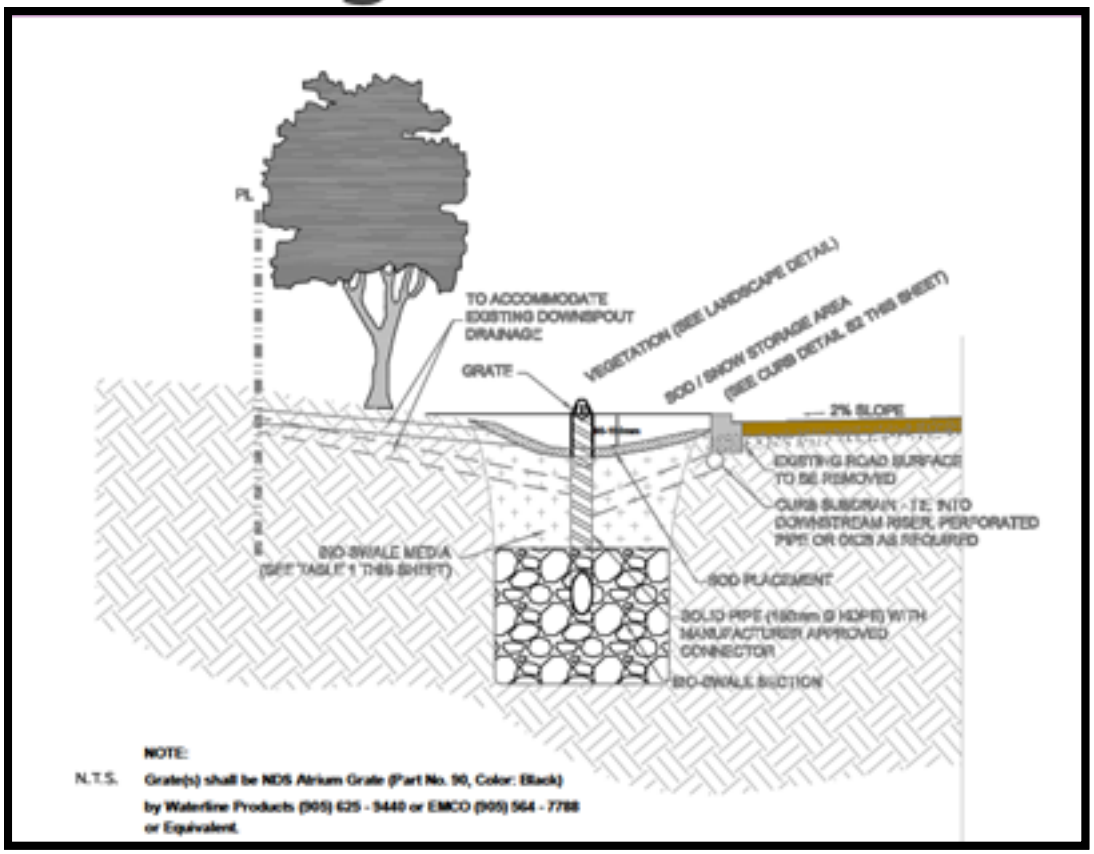
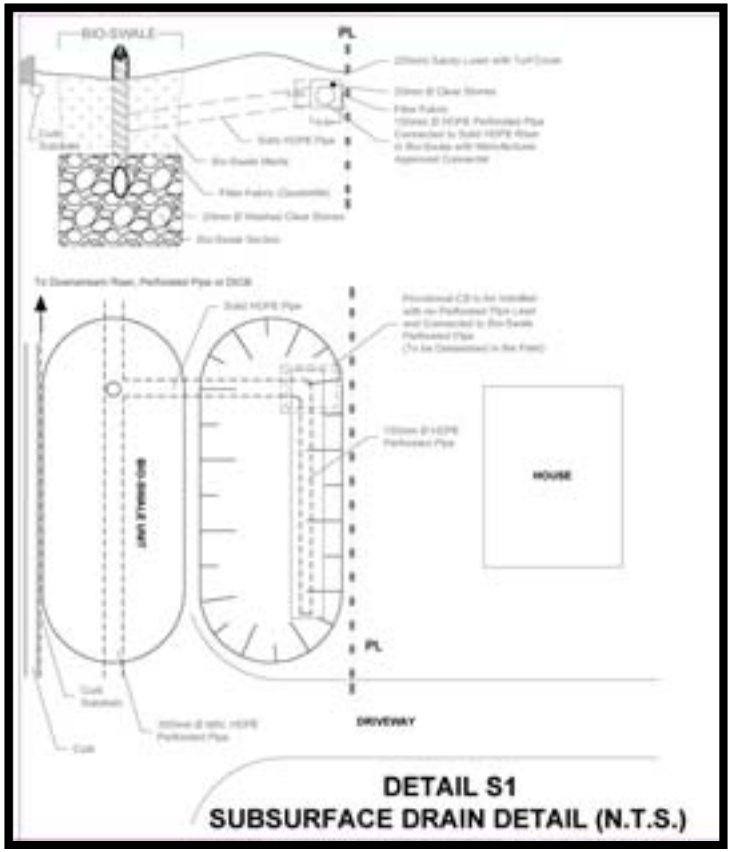
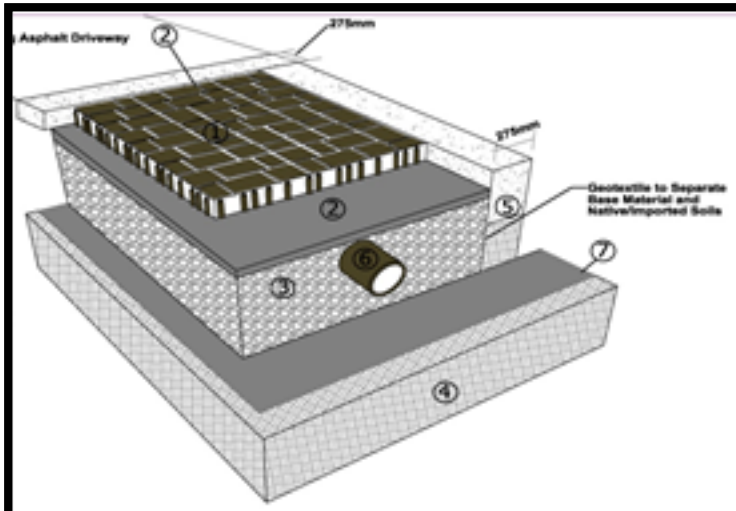
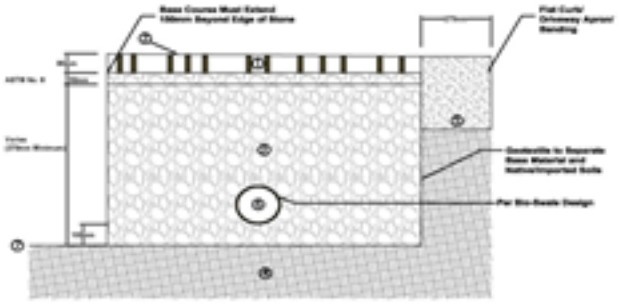




DETAIL S1
SUBSURFACE DRAIN DETAIL (N.T.S.)

Designs Details





② DRIVEWAY DETAIL NTS

DETAIL PD1
PERMEABLE INTERLOCKING DRIVEWAY DETAIL
N.T.S.

Construction

Water Service Line Punctured

Bell Line Damaged (Bell Service Onsite)

Construction

- To avoid an existing gas line, a section of perforated underdrain was notched to allow the gas line to transect the pipe

Construction

Construction

Materials not identified in the geotechnical reports!

Following Specs

Grading Issues

Changes after Design

- Re-grading of properties;
- Infil-development (3 homes);
- Abandoned and/or unmarked utilities;
- Sump-pump and property drainage connections;
- No trees;

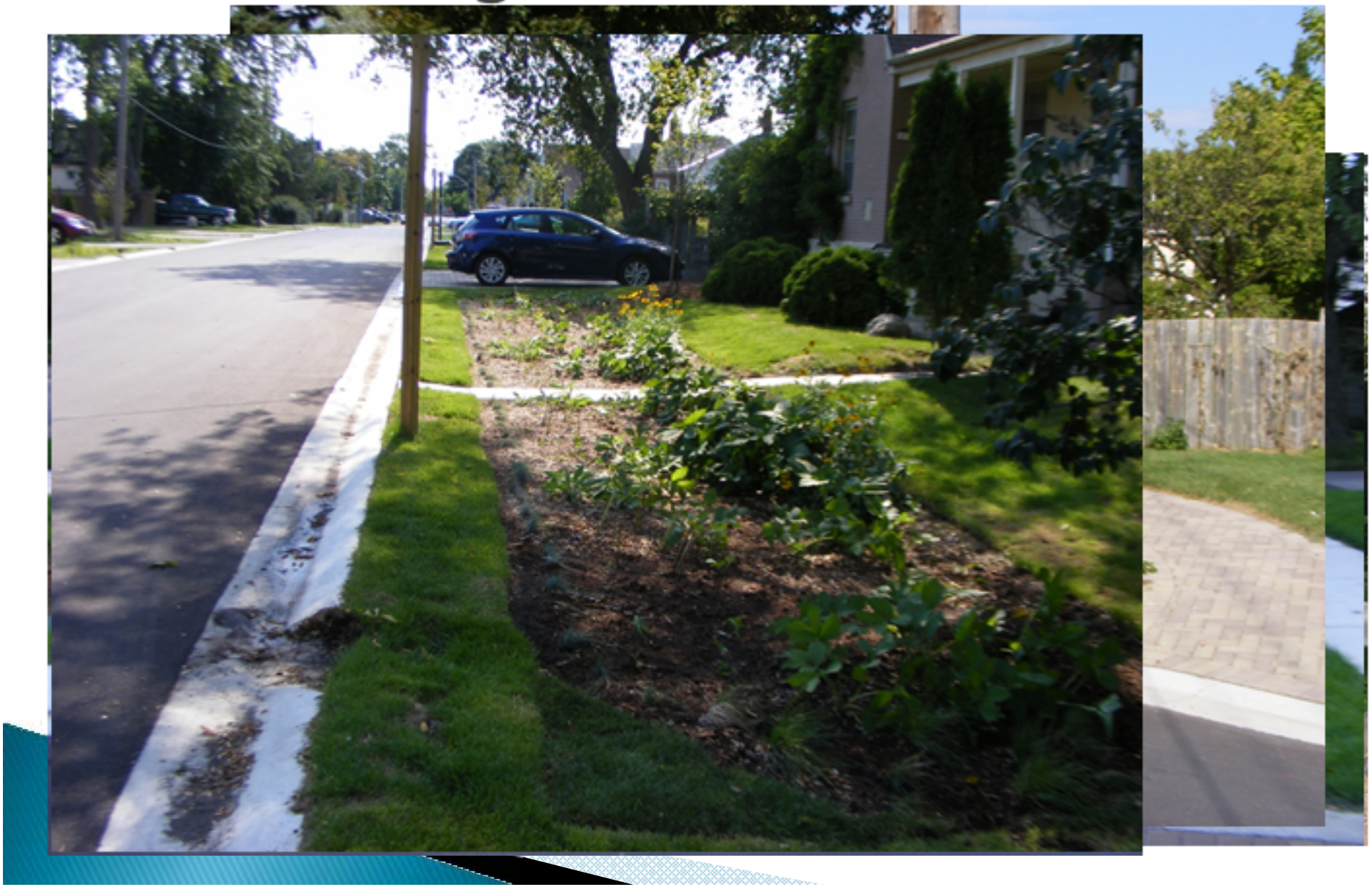
ESC

Sacrificial Geotextile

ESC

Inlet ESC Controls

Final Design



Beach Boulevard

Background

- Soakaway Pit
- Park Redevelopment of vacant land
- Hamilton, ON
- Constructed 2011
- Accepts parking lot drainage for up to 100 year storm (full infiltration)
- Combined and separated storm sewers – City desire to minimize flows resulting from infill developments

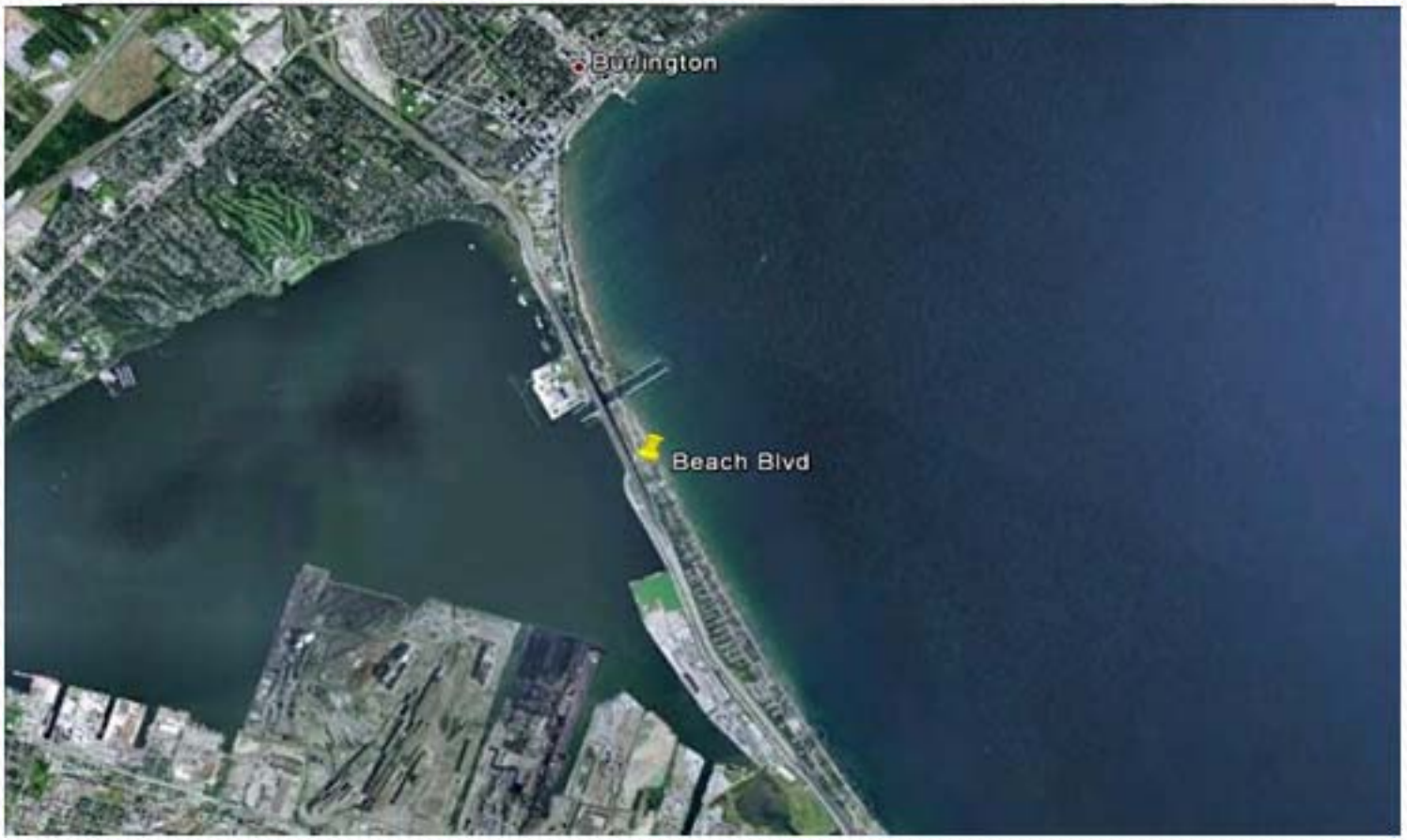
Site Conditions

Groundwater – Seasonally High

Sands and Gravel

Site Conditions

Groundwater – Seasonally High = Major Design Concern due to site location



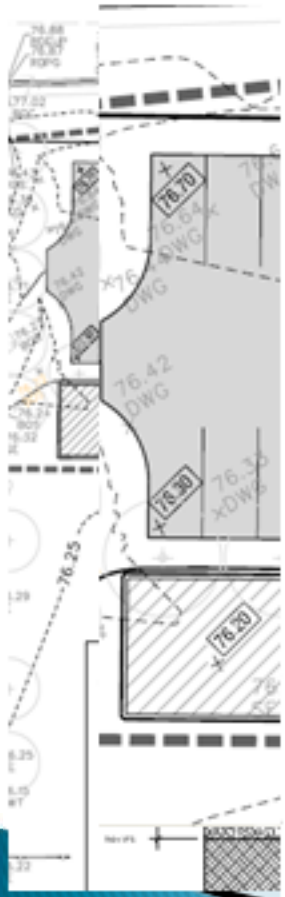
Infiltration Results

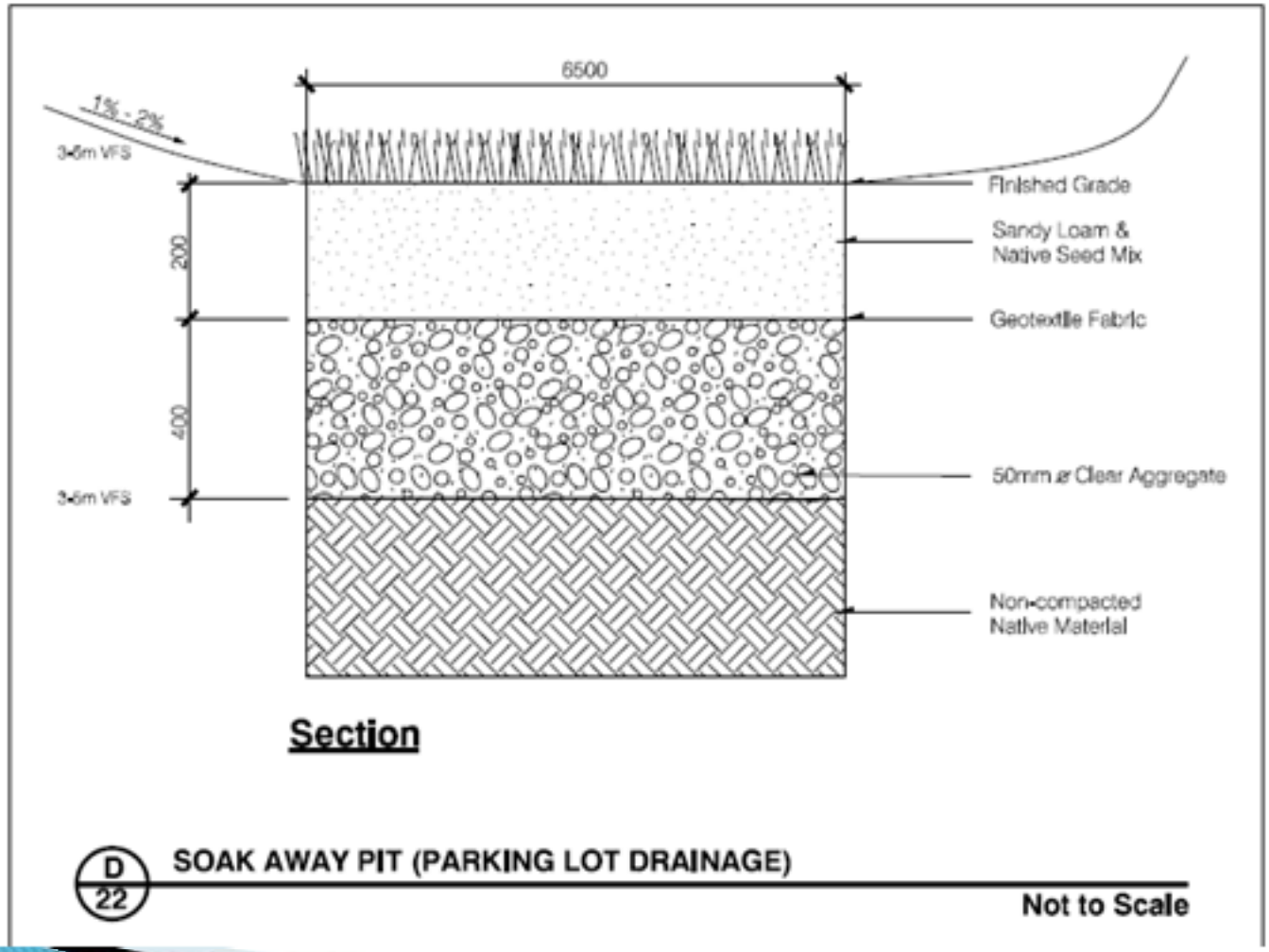
Table 1 – In-Situ Guelph Permeameter Testing Summary

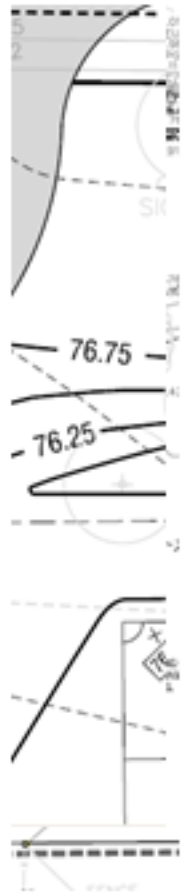
	Design Infiltration Rate (mm/hr)	Factor of Safety (SF)	Calculated Design Infiltration Rate (mm/hr)	Testing Depth below surface (m)	Approximate Ground Elevation (m)	Infiltration testing invert (m)
Location 1	160	2.5	64	1.0	76.2	75.2
Location 2	179	2.5	72	0.75	76.15	75.4
Location 3	133	2.5	53	0.70	76.25	75.55
		Average	**62.9**			

SF – corresponds to non-stratified soils condition i.e. based on completed geotechnical investigation, less permeable soil horizons within 1.5m below the proposed bottom elevation of the BMP do not exist.

Design




6500
1% - 2%
3-6m VFS
200
400
3-6m VFS
Finished Grade
Sandy Loam &
Native Seed Mix
Geotextile Fabric
50mm ø Clear Aggregate
Non-compacted
Native Material
Section
D
22
SOAK AWAY PIT (PARKING LOT DRAINAGE)
Not to Scale


76.75
76.25

Beach Boulevard – As Built

Thank-You

QUESTIONS ?

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