Green Technology Research and Pilot Initiatives in Southern Alberta: a City of Calgary Perspective Upcoming CSA Standards and Events

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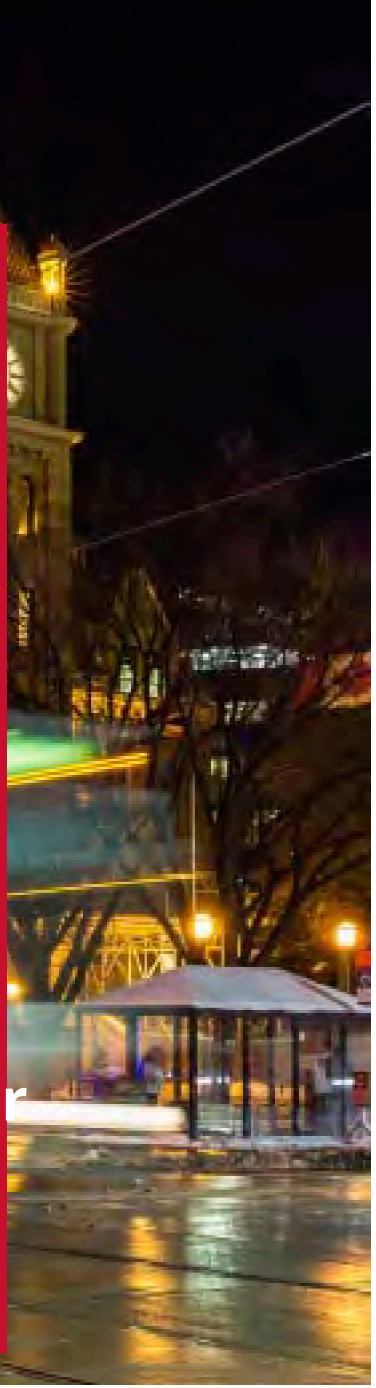
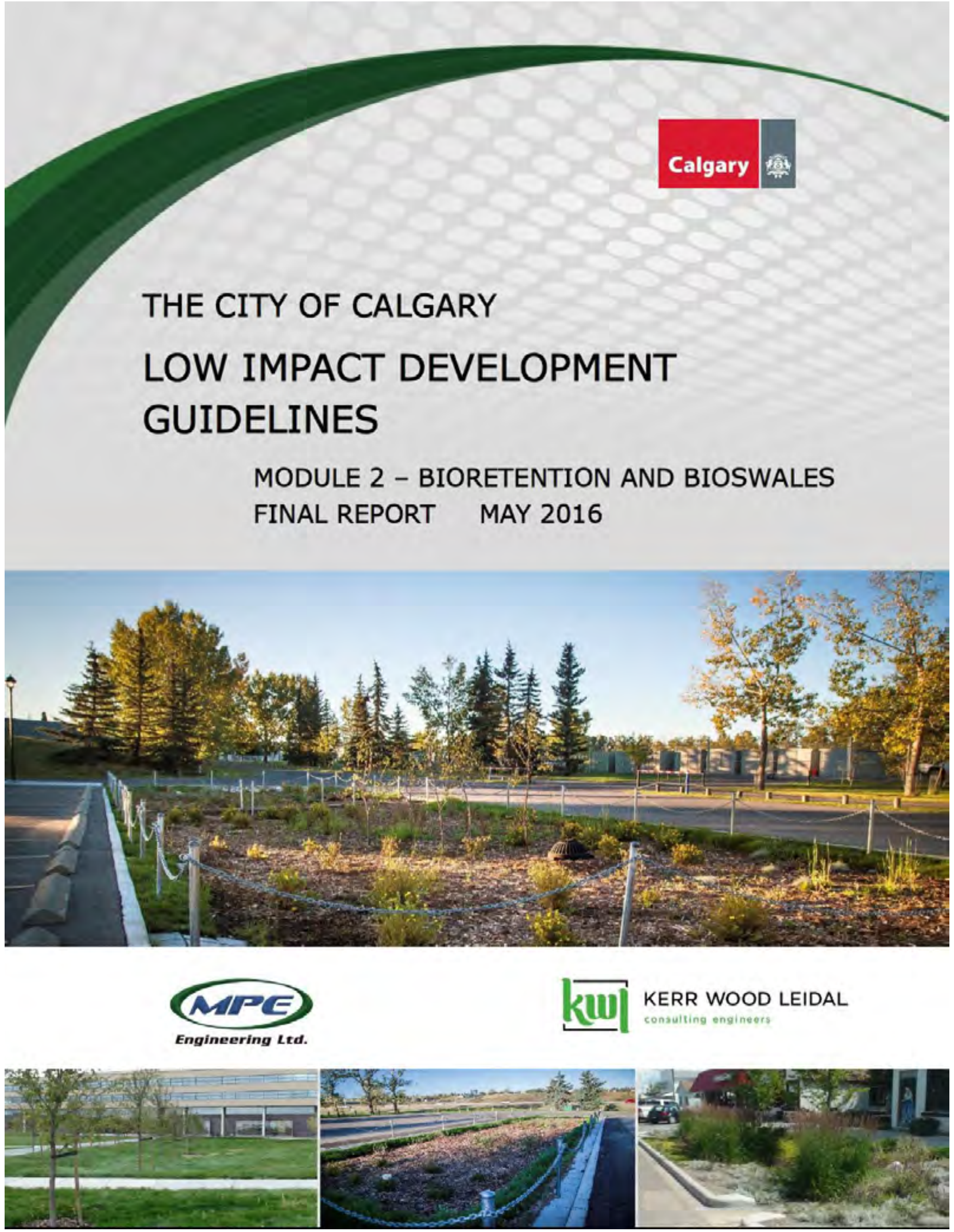


- As part of series of LID Guidelines, Standards & Specifications documents, Module 2 pertaining to bioretention and bioswales was published in May 2016
- It can be found at http://www.calgary.ca/UEP/Water/Pages/Specifications/Submission-for-approval-/Development-Approvals-Submissions.aspx#lid
- Other modules cover:
  - Geotechnical and Hydrogeological Considerations
  - Green Roofs
  - Permeable Pavement



- This guidance document includes:
  - Step-by-step design guidance
  - Materials specifications
  - Construction considerations
  - Inspection considerations
  - Maintenance requirements
  - Performance monitoring considerations; and
  - A worked-out example

Contents

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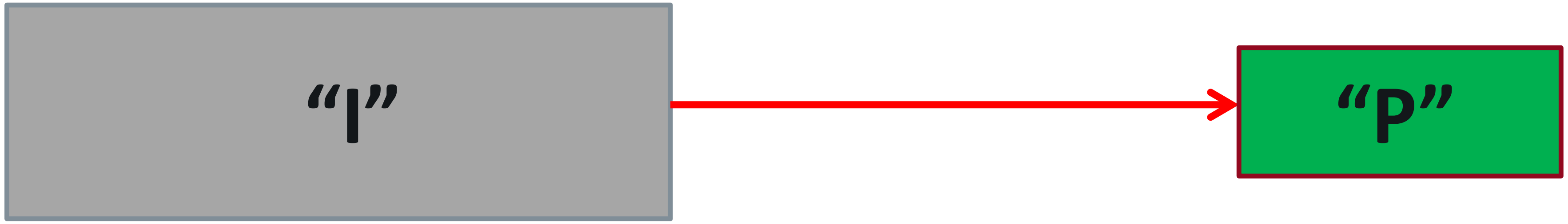
The long-term performance and maintenance needs of “filter” type systems such as bioretention are a function of the I/P Ratio



Footprint of Upstream Impervious Area (m^2)

Footprint of Bioretention Area (m^2)

The larger the I/P ratio, the greater the volumes of runoff and sediment loadings directed to the bioretention area

For instance: if I = 500 m^2 and P = 50 m^2, then I/P = 10

Graphic courtesy of the “Introduction to LID” course hosted by the ALIDP

ALIDP Alberta Low Impact Development Partnership

Table 2-1: Maximum Permissible I/P Ratios for Bioretention or Bioswale by Surface Type

Surface Type	Maximum I/P Ratio
General/Industrial Storage/Loading Areas	20:1
Arterials and Major Roads	20:1
Collector Roads	20:1
Parking >1 car/day/parking space	20:1
Residential Road	30:1
Parking <1 car/day/parking space	40:1
Low traffic areas, no parking (e.g. paved laneways)	50:1
Single Family Residential, Lot and Roof	50:1

Various performance curves are provided as a function of the I/P Ratio

In this case, percentage of runoff treated

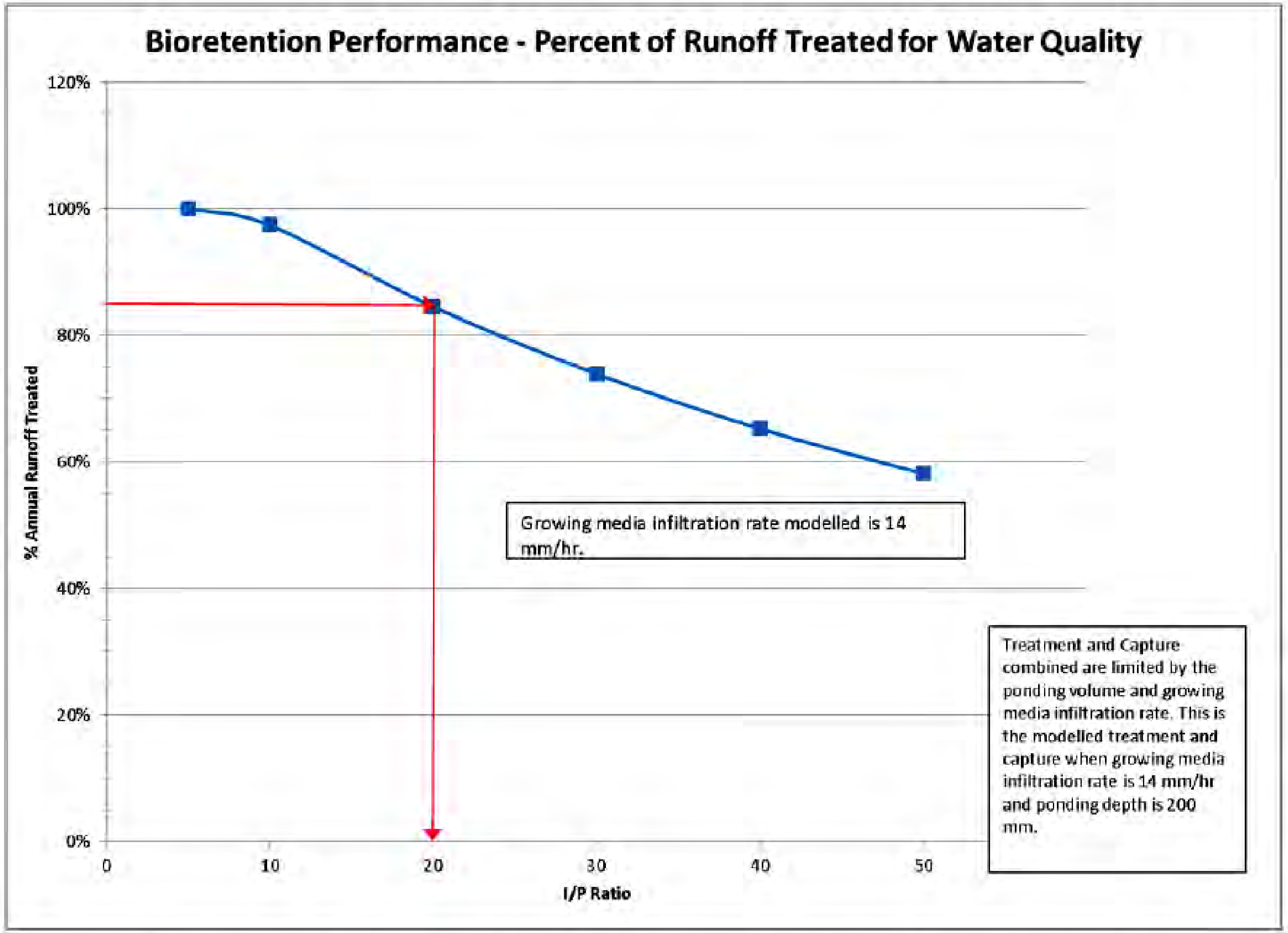


Figure 2-3: Bioretention Performance Showing Percentage of Annual Runoff Captured and Treated For Water Quality Design and Sizing Purposes

and in this case, the resulting average annual runoff volume

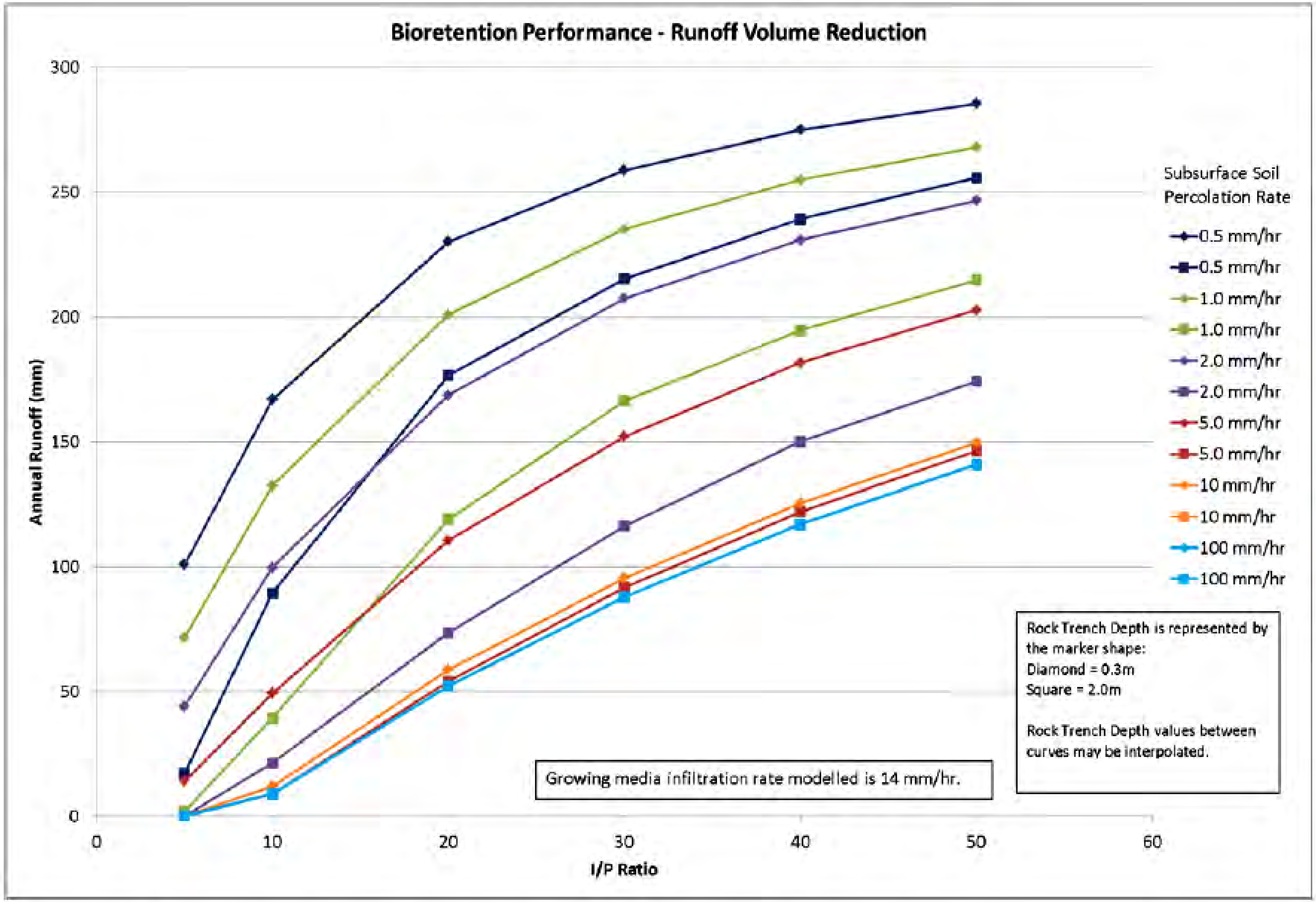


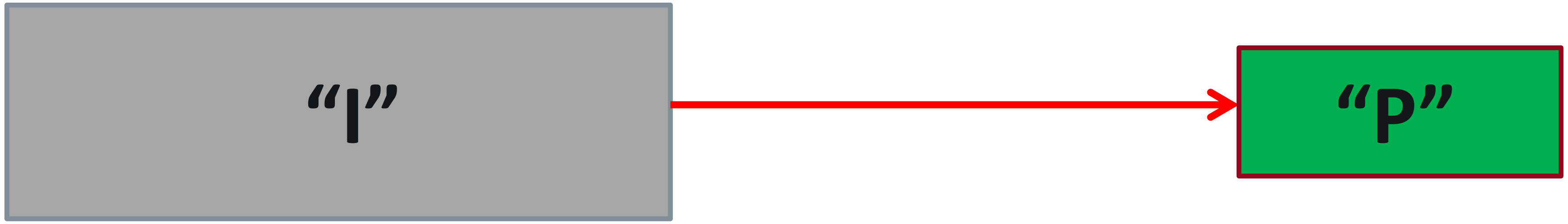
Figure 2-5: Performance of Bioretention for Runoff Volume Reduction

To put these values into perspective: in the Calgary area, the average annual runoff volume from hard areas is approximately 300 mm (out of approximately 400 mm of precipitation per year). Hence, the bioretention area will be subjected to

$10 \times 300 + 400 = 3{,}400$ mm for I/P = 10

$30 \times 300 + 400 = 9{,}400$ mm for I/P = 30

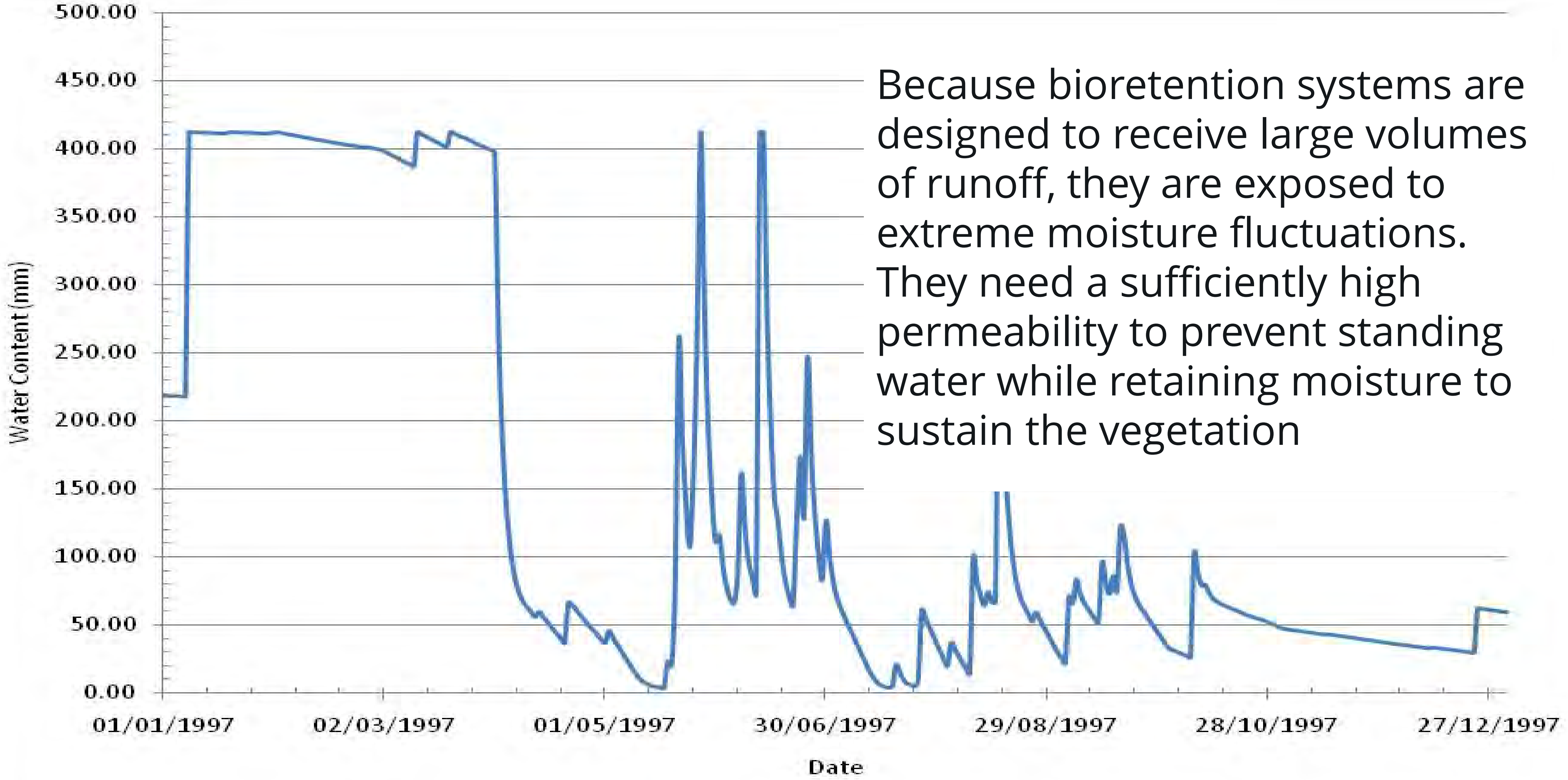
$50 \times 300 + 400 = 15{,}400$ mm for I/P = 50



Footprint of Upstream Impervious Area (m^2)

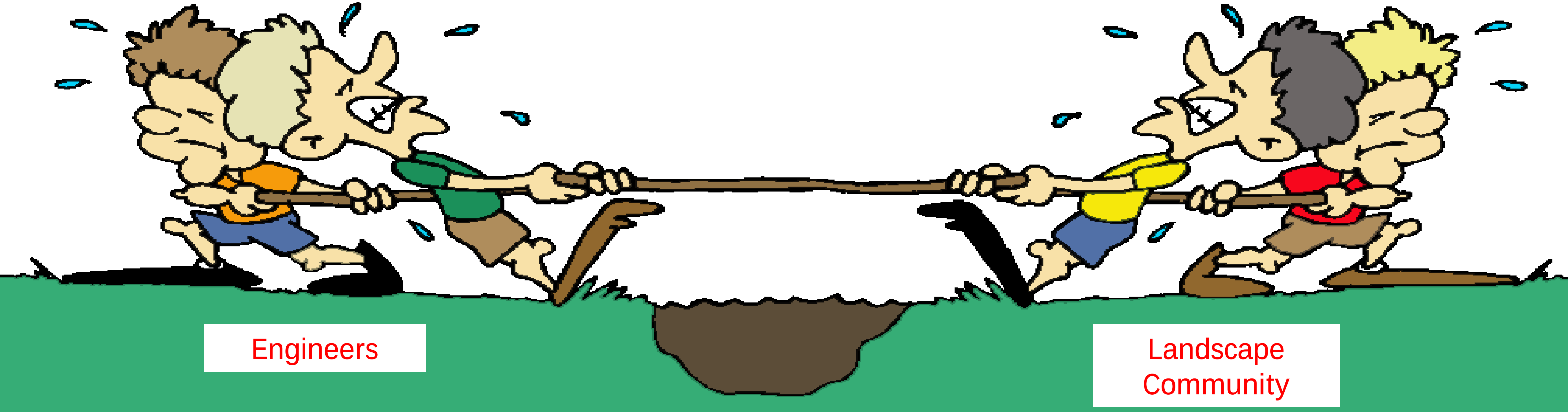
Footprint of Bioretention Area (m^2)

Sample Moisture Levels in a Bioretention area



Because bioretention systems are designed to receive large volumes of runoff, they are exposed to extreme moisture fluctuations. They need a sufficiently high permeability to prevent standing water while retaining moisture to sustain the vegetation

As a result, the selection of “proper” media feels like this



Engineers want high permeability so the media drain properly so that (a) the capacity is restored for the next event, and (b) we won’t have problems with mosquitoes

The landscape community wants moisture retention to make the vegetation survive/thrive. Plus, BTW, clays provide better water quality performance

Graphic courtesy of the “LID – Level 2” course hosted by the ALIDP

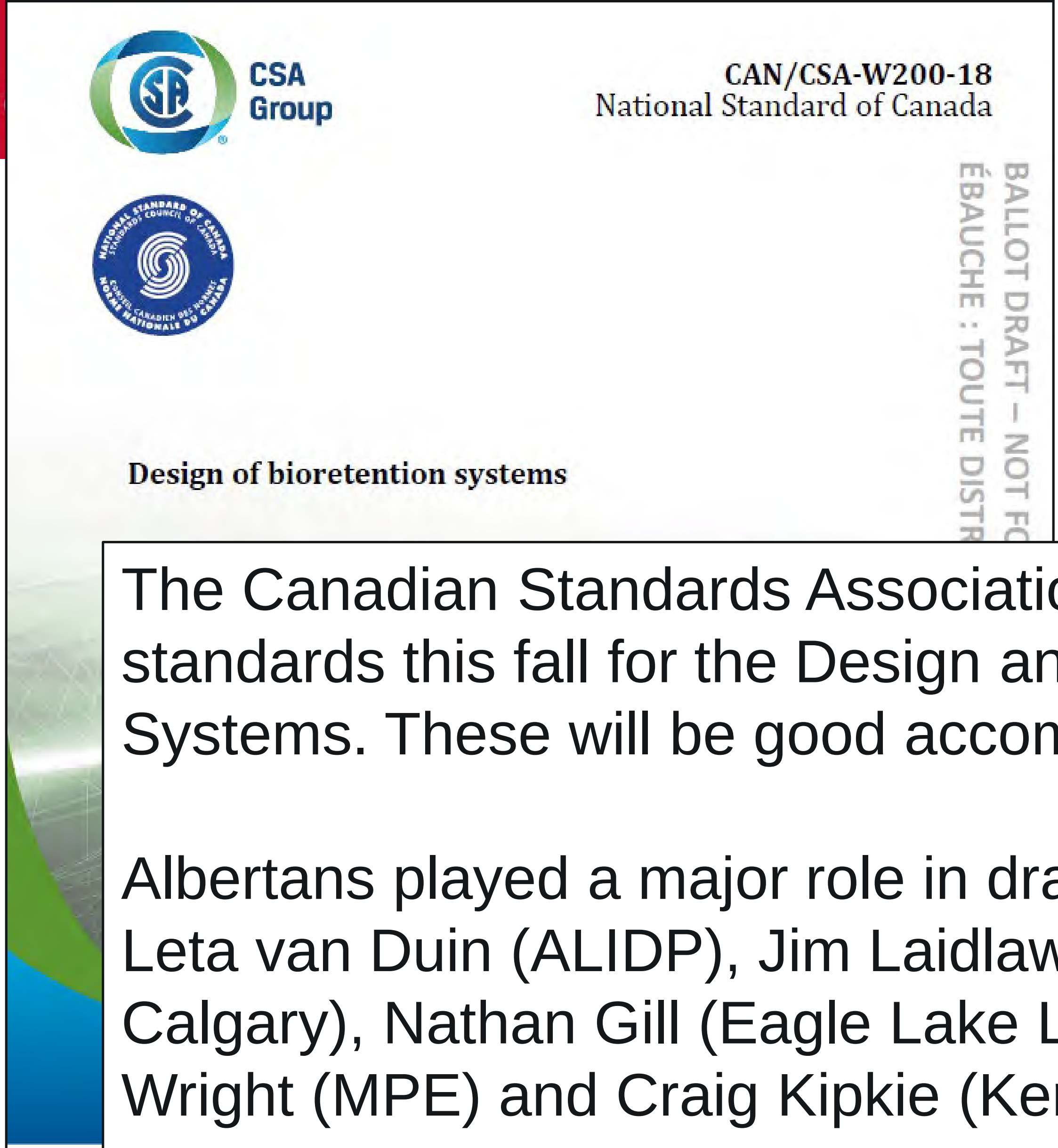
Table 3-3: Properties of Growing Media for Bioretention Areas and Bioswales

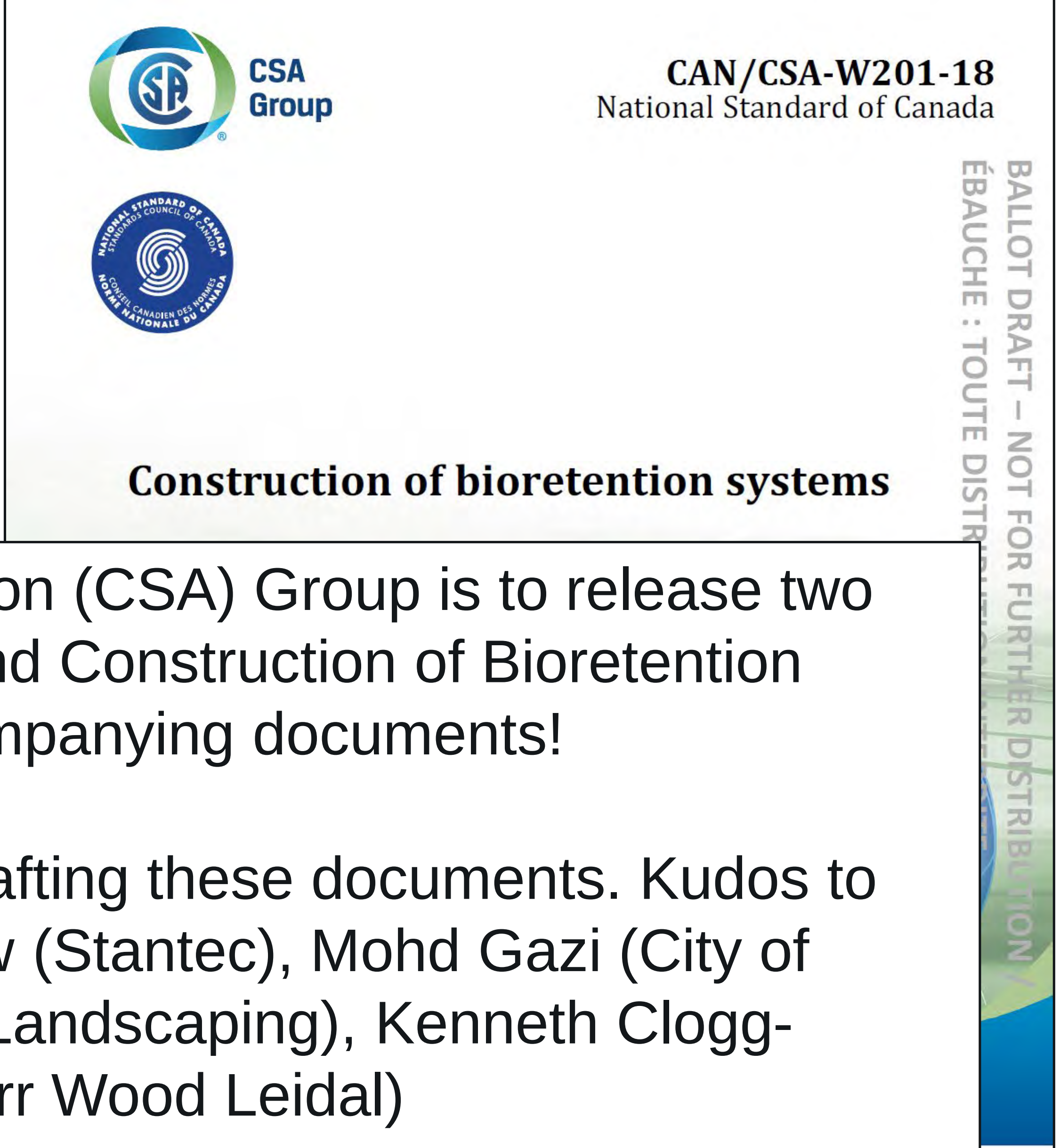
Property	Requirement: High Infiltration Media	Requirement: Moderate Infiltration Media	Notes
Minimum Saturated Hydraulic Conductivity	70 mm/hr	40 mm/hr	Hydraulic Conductivity must be above minimum shown on average per batch of media mixed.
Coarse Gravel: Larger than 19 mm Smaller than 40 mm	0-1%	0-1%	Gravel component is a maximum limit with a tolerance of 1% above values shown.
All Gravel: Larger than 2 mm Smaller than 40 mm	0-5%	0-5%	
Note: Percent Gravel is calculated as Percent of Dry Weight of Total Growing Media. All other Requirements are Calculated as Percent of Dry Weight of Growing Media Excluding Gravel.			
Sand: Larger than 0.05 mm Smaller than 2 mm	75-80%	40-80%	Particle ranges for clay, silt and sand have a tolerance of 2% outside of requirements shown.
Silt: Larger than 0.002 mm Smaller than 0.05 mm	10-15%	10-25%	
Clay: Smaller than .002 mm	3-10%	0-20%	
Clay and Silt Combined	Maximum 15%	Maximum 35%	
Organic Content	5-10% Tolerance for Organic content is +/- 1%	15-20% Tolerance for Organic content is +/- 1%	The organic content is recommended to be composted vegetable matter. Biosolids products may not be used as they may contain high metals contents and hydrophilic compounds that impede drainage.
Acidity (pH)(in water)[3]	5.5-7.3 Tolerance for Acidity is +/- 0.2 pH	5.5-7.5 Tolerance for Acidity is +/- 0.2 pH	The acidity of Calgary soils is known to generally be lower (i.e., higher pH value) than neutral. The pH values recommended for the growing media are independent of the native soil conditions because the growing media is
			expected to be an imported landscape soil prepared specifically for bioretention. The pH value of the growing media should be adjusted to within the specified range to promote the health and growth of vegetation in bioretention areas and bioswales. The pH range shown is a range designed for optimum plant growth; a higher pH value may be permitted, but will be expected to have less than optimum plant productivity.
Salinity (EC - ds/m)	0-3	0-2	The saturation extract conductivity shall not exceed 3.0 milliohms/cm at 25 degrees Celsius
Boron (ppm)	Maximum 1.0	Maximum 1.0	There is no tolerance above the maximum value.
Nitrogen (% by weight)	0.2% to 0.6%	0.2% to 0.6%	A minimum of 50% of nitrogen shall be in slow release form. Tolerance for N is +/- 0.05% outside of the range.
SAR (sodium adsorption ratio)	Target 0-4, Maximum 8	Target 0-4, Maximum 8	As calculated by analysis of the saturation extract. There is no tolerance above the maximum value.
Available Phosphorus (ppm)	Target 20 to 25	Target 20 to 25	If the tested Phosphorus level exceeds 30 ppm then the growing media must be amended with 5% iron filings by volume.
Available Potassium (ppm)	50 to 1000	50 to 1000	There is no tolerance outside of the range.
Carbon to Nitrogen Ratio	Maximum 40:1	Maximum 40:1	There is no tolerance above the maximum value.
Max Compaction	Normal Compaction	Normal Compaction	Normal compaction assumes 85% Proctor density; Tested density must be within 3% of target compaction.

Two options are provided for the bioretention media, a balance between permeability and sustainability

However, we still have some fundamental questions that we would like to see answered:

1) Confirmation of performance data with respect to TSS and nutrient removal efficiency for the bioretention growing media recommended in LID Module 2;
2) Confirmation of the plant palettes recommended in LID Module 2, reflecting the different growing media compositions;
3) Verification of the tools and parameters used to predict bioretention media performance with confidence, reflecting key factors such as soil media, vegetation and climatological conditions, and the required service level;
4) Would there be any potential impacts on groundwater from infiltrating runoff; and
5) Do you have recommendations to improve the contents of this module?





The Canadian Standards Association (CSA) Group is to release two standards this fall for the Design and Construction of Bioretention Systems. These will be good accompanying documents!

Albertans played a major role in drafting these documents. Kudos to Leta van Duin (ALIDP), Jim Laidlaw (Stantec), Mohd Gazi (City of Calgary), Nathan Gill (Eagle Lake Landscaping), Kenneth Clogg-Wright (MPE) and Craig Kipkie (Kerr Wood Leidal)

Experiences from both the Module and the Okotoks Research Site are reflected in these CSA standards!

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Other national documents in the works / recently released include:

I. Flood Resiliency for New Communities – Standard – CSA Group

II. Flood Resiliency for Existing Communities – Best Practices – Intact Insurance Centre for Climate Adaptation, University of Waterloo

III. IDF Curves – Standard update – CSA Group

IV. Combating Canada's Rising Flood Costs: Natural Infrastructure is an underutilized option – Insurance Bureau of Canada (September 2018)

V. Best Practices and Resources on Climate Resilient Natural Infrastructure – Canadian Council of Ministers of the Environment (June 2018)

Consider coming out the inaugural Canadian Stormwater Institute conference, hosted by the Western Canadian Water Environment Association, Calgary, November 26-27th, 2018
See http://csic.wcwea.org/ for more information

In conjunction with this conference, the ALIDP will be hosting a workshop "Ready, Aim, Fire: Strategies to Target and Achieve Resilience"

There are numerous drivers for implementing stormwater runoff volume targets, loading objectives, and other measures to achieve resilient outcomes. But when do you implement what and to what level of stringency? What are various jurisdictions across North America doing and why? What tools are being used and where should we go from here? Join us for an afternoon of presentations from jurisdictions across North America and opportunities to discuss the need for and merit of different approaches. Drivers to be considered include level of service, protection against overland flooding and surcharge conditions, fisheries and habitat protection, small stream and wetland protection, source water and groundwater protection, and prevention of harmful algae blooms.

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Questions?

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