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Engineering Green Roofs for Stormwater Management

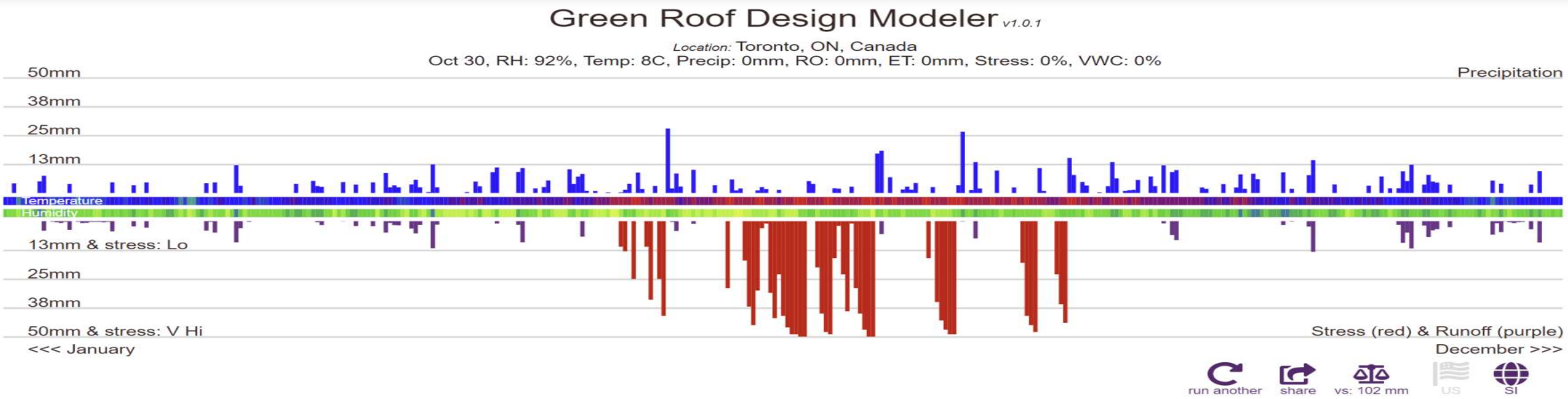
Karen Liu, PhD

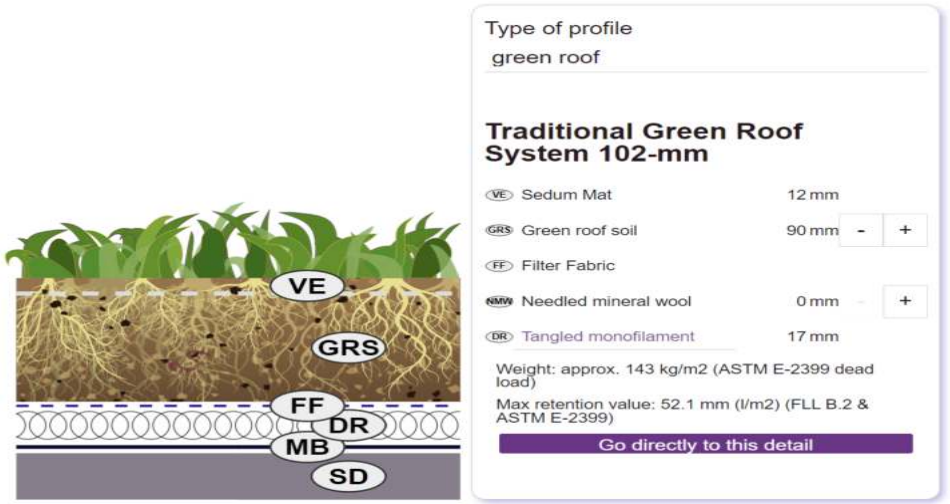
Green Roof Specialist

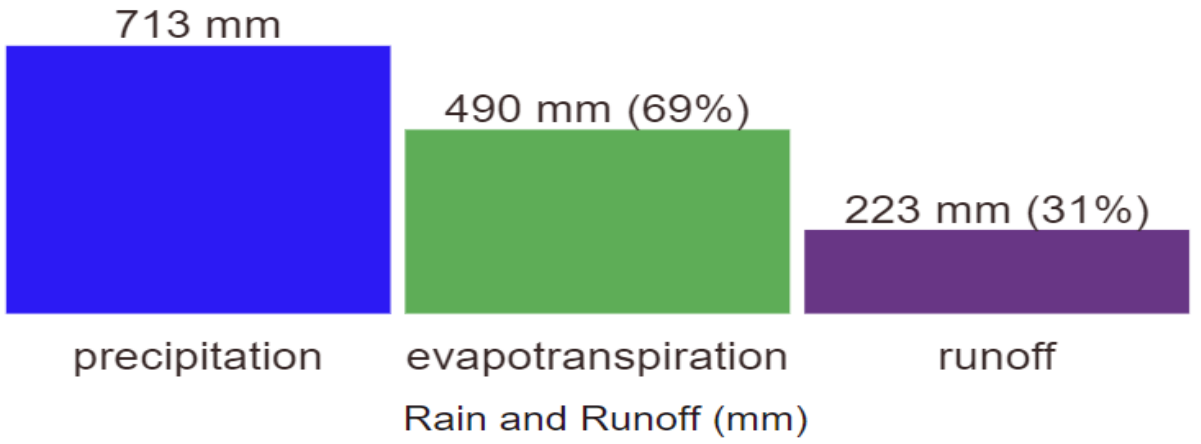
Next Level Stormwater Management

Two Old Mill, Toronto, ON

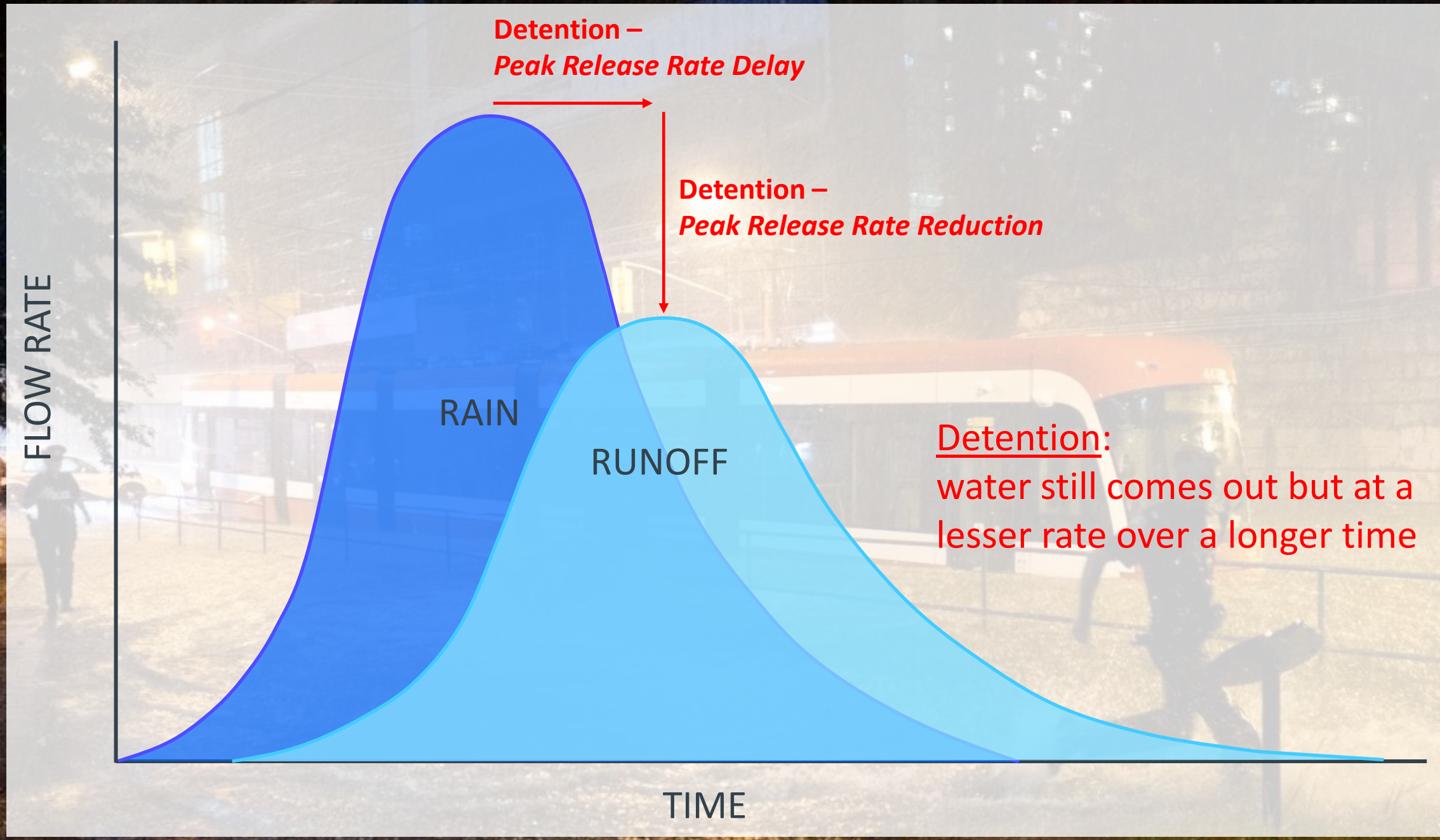
Retention of a Typical Green Roof in Toronto







https://www.purple-roof.com/model

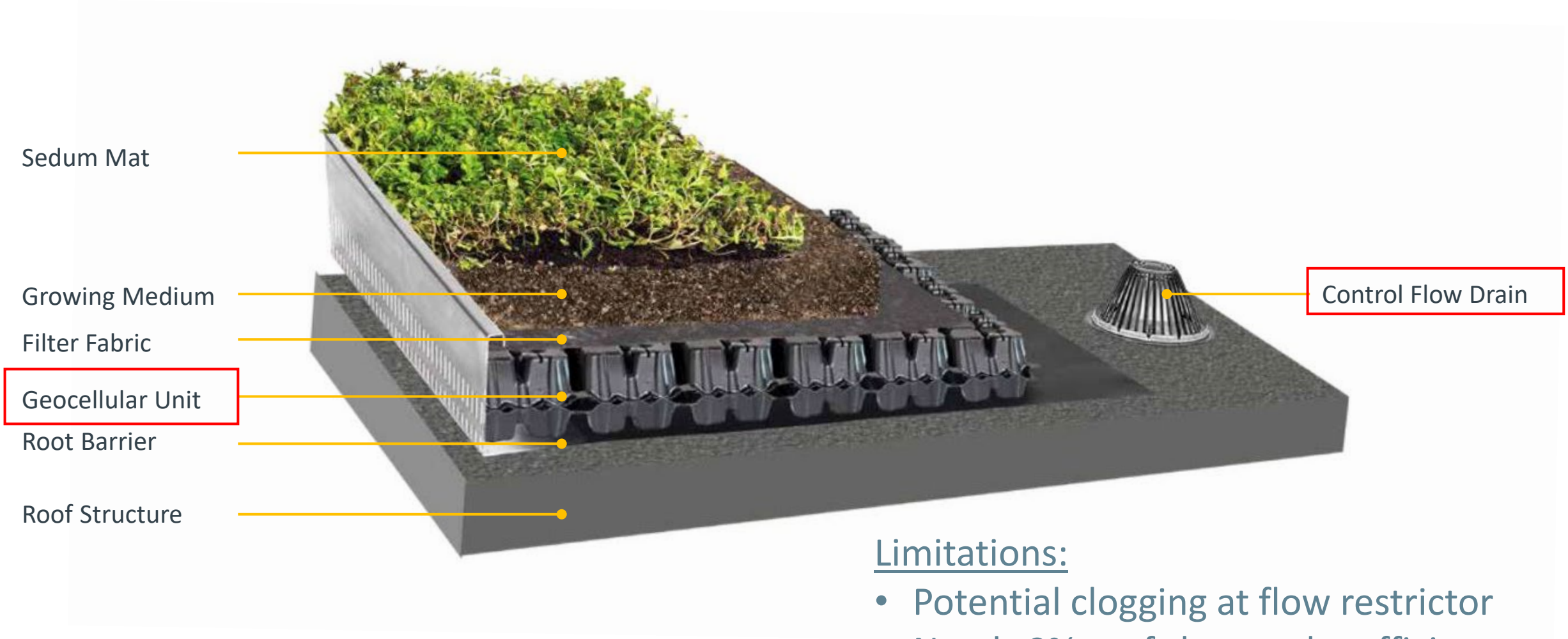


Detention:
water still comes out but at a lesser rate over a longer time

Why Detain Stormwater on the Roof?

1. Extra parking space / EV charging station
2. More condo units / tenant space
3. Reduce need for surface & subsurface storage (e.g. permeable pavers)
4. More usable garden space
5. Site constraints
   - Underground utilities
   - Rock base layer
   - High ground water table
   - Sloped property

Blue-Green Roof: Ponding



Limitations:

- Potential clogging at flow restrictor
- Needs 0% roof slope to be efficient

Blue-Green Roof: Friction-Detention

Retention

Detention

Sedum Mat

Growing Medium

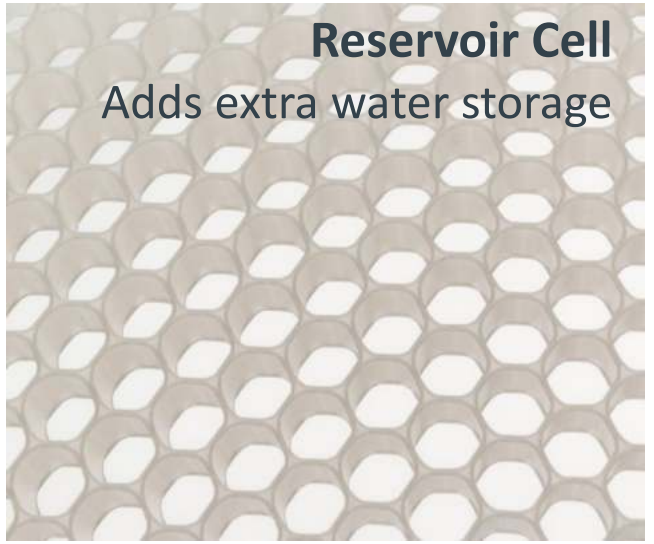
Retention Layer

Reservoir Cell

Detention Mat

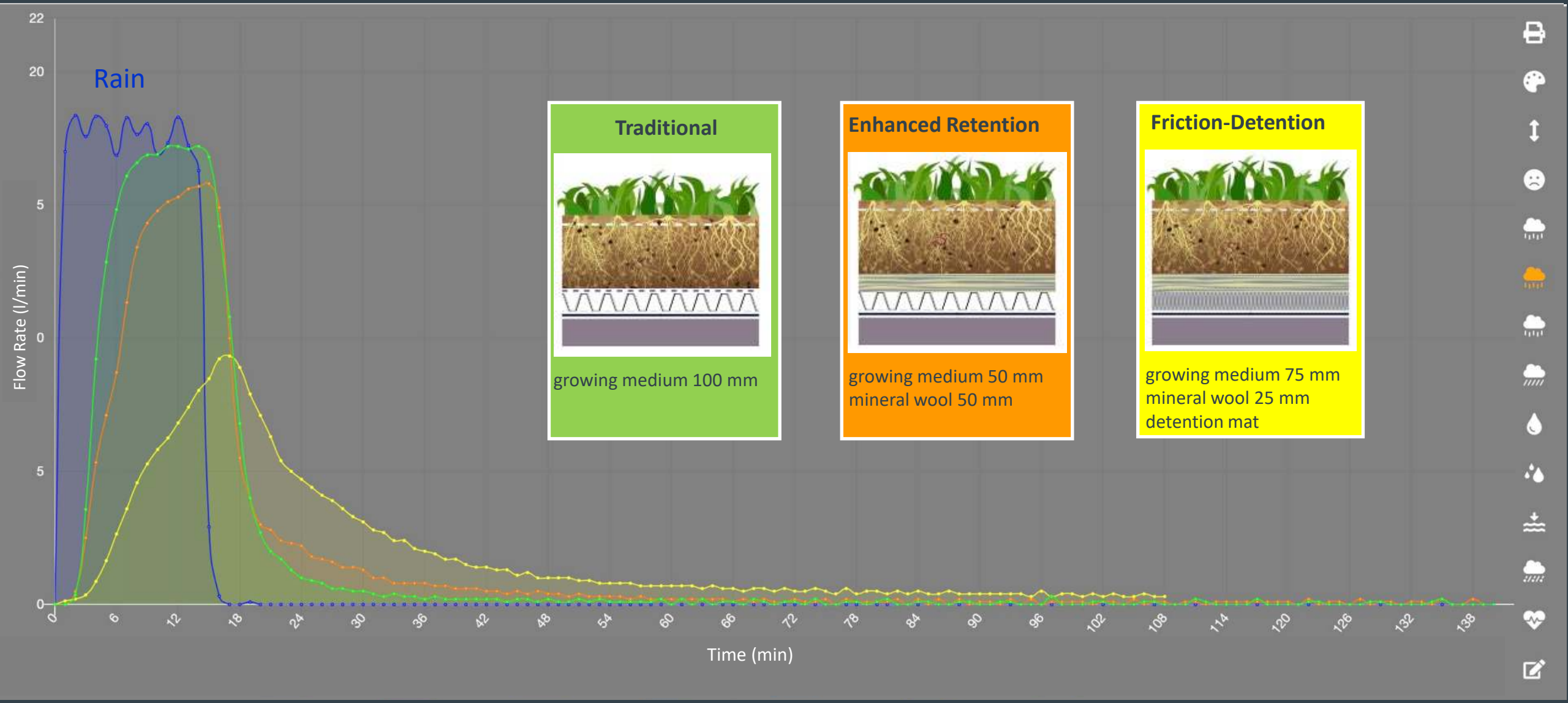
Edge Restraint

Root Barrier

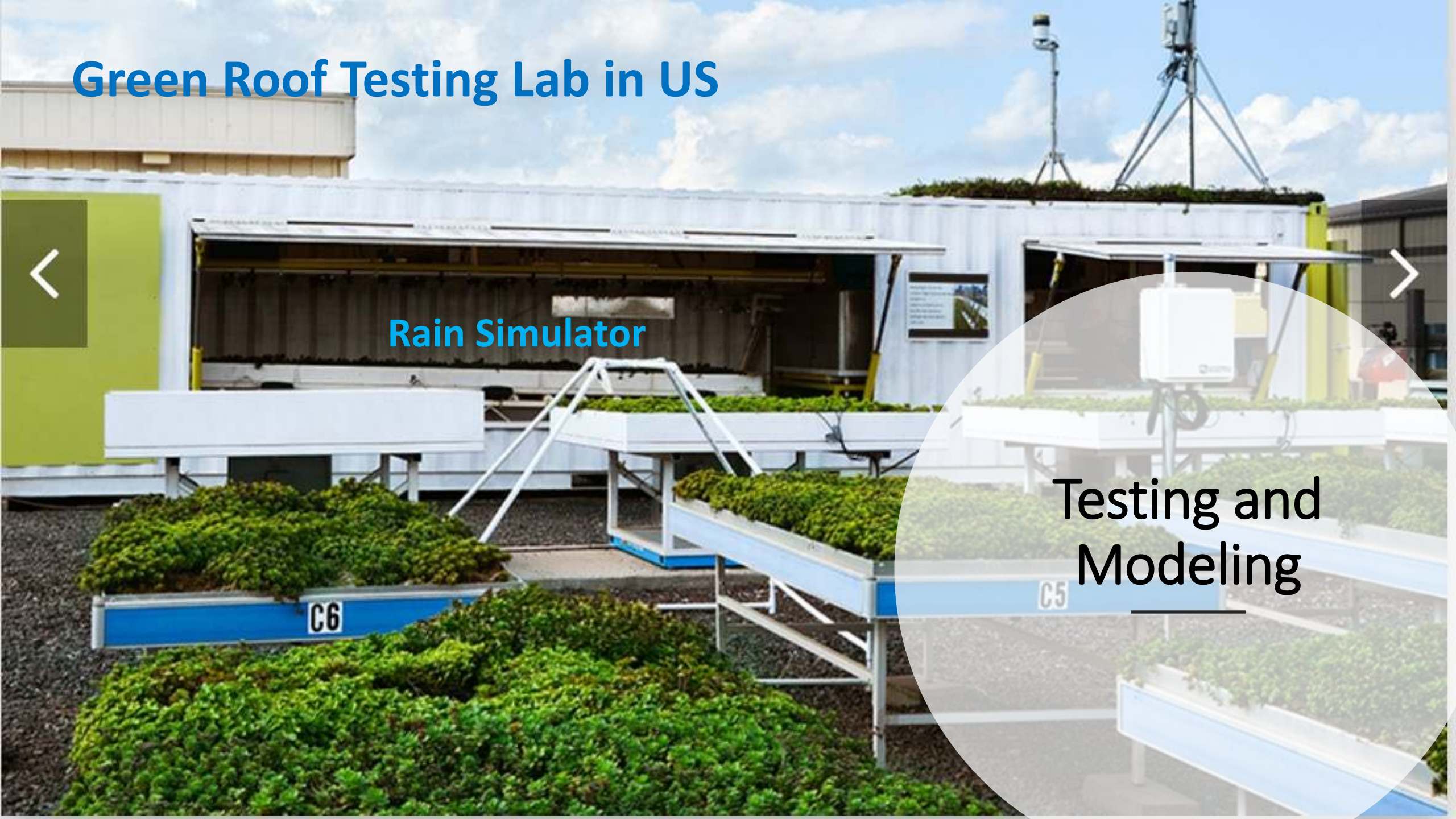


Note: Best suited for extensive green roof on low slope roofs

Runoff Hydrographs of Different Profiles



Green Roof Testing Lab in US



Rain Simulator

Specimen

Total 2200 tests (6 hours long)

- Model each project with custom variables:
  - Design storm
  - Allowable Outflow Rate
  - Green roof assembly
  - Roof dimensions
  - Slope
  - # of drains

Friction-Detention Green Roof Design: Modeling Input

Project Information back to my list of projects

Project Name

Design Storm

shape	volume	units	duration hours
AES	80	mm	6

Maximum Allowable Outflow Rate

rate	unit	per area (0.18 ha)
50	l/s	ha

Optional Targets

Storage, Drain-Down, Delay		
Detention	100	m3
Retention	80	m3
Drain-down after rain ends	24	hours
Drain-down after peak rain	0	hours
Runoff delay (centroid)	0	minutes
Runoff delay (peak)	0	minutes

Friction-Detention Green Roof Design: Modeling Input

Type of profile

green roof

Friction-Detention 100+50+25

Sedum Blanket	12	mm		
Growing Media	90	mm	-	+
Needled Mineral Wool	50	mm	-	+
Reservoir Cell	25	mm	-	+
Detention Mat	5	mm		
XPS Extruded Polystyrene Insulation (XPS)	0	mm	-	+
RB NL120 Protective Fleece				
MB Waterproofing Membrane				

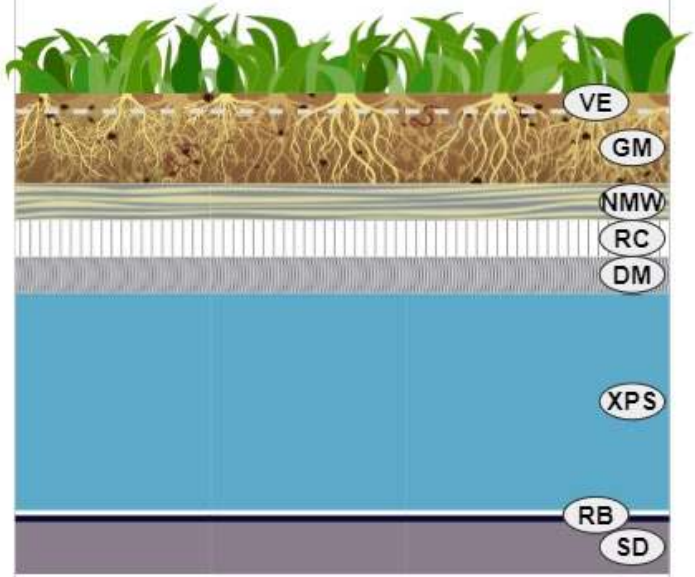
Areas +

1824 m2	Roof	Friction-Detention 100+50+25

general / size / notes

profile

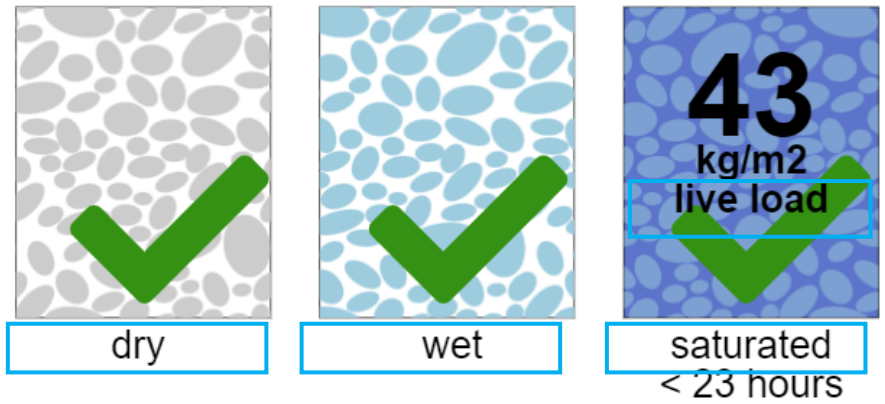
system	100+50+25



Friction-Detention Green Roof Design: Modeling Results

Note: Retention value is likely (modeled) retention, which is lower than the ASTM E-2399 / FLL B.2 maximum storage volume.

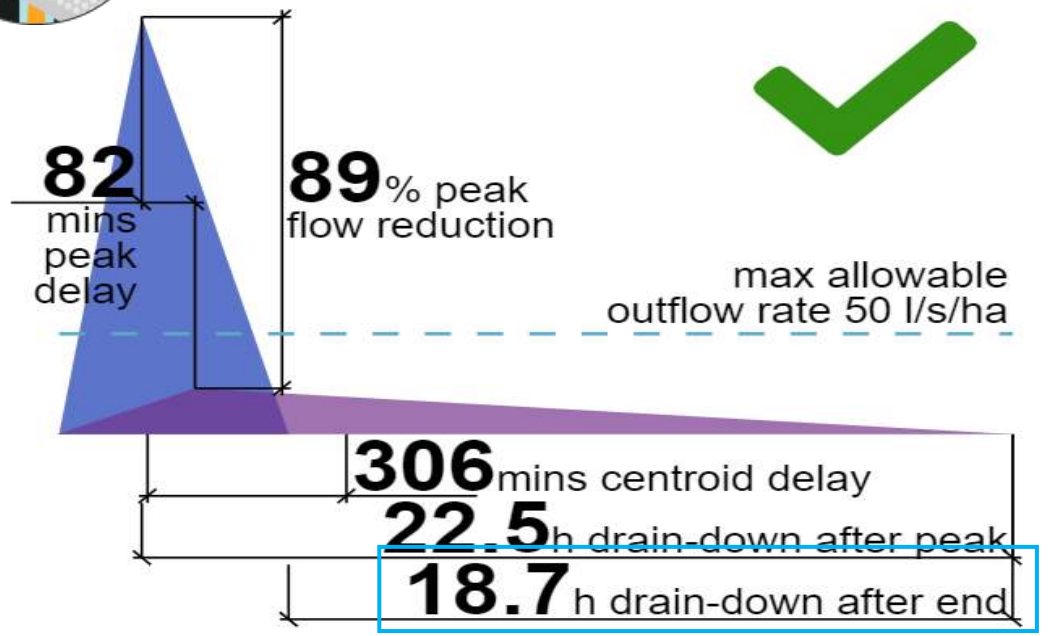
8. Overall Project Storage Summary (Modeled Values)



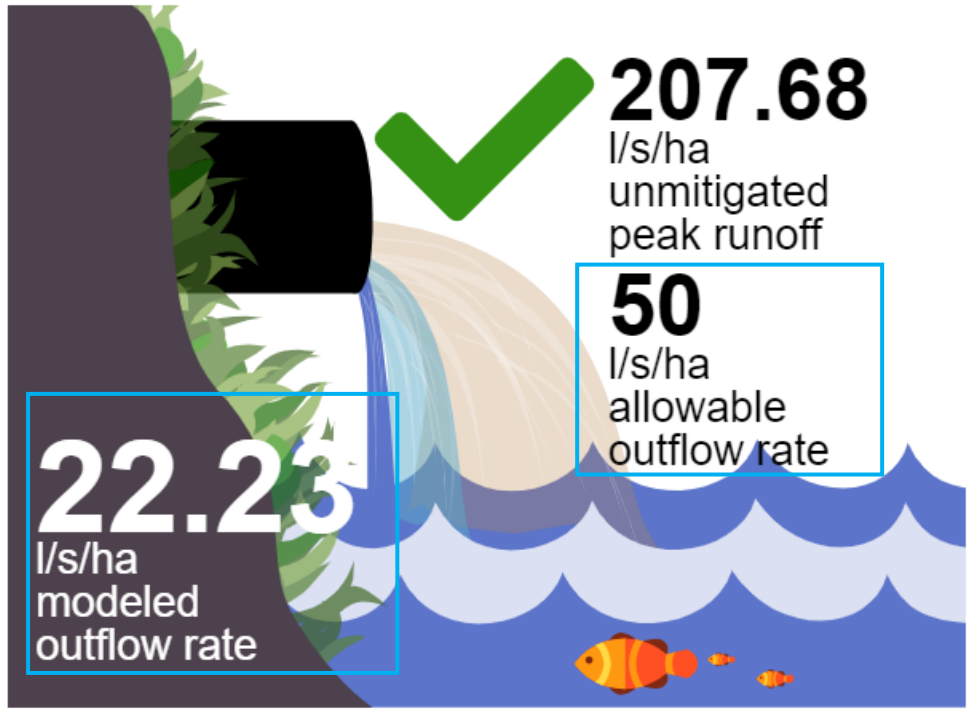
Note: Dead load corresponds with the maximum retention value per ASTM E-2399 / FLL B.2, which is used to estimate worst case scenario for structural conditions.

3. Banquet & Restaurant Weight Summary

Friction-Detention Green Roof Design: Modeling Results

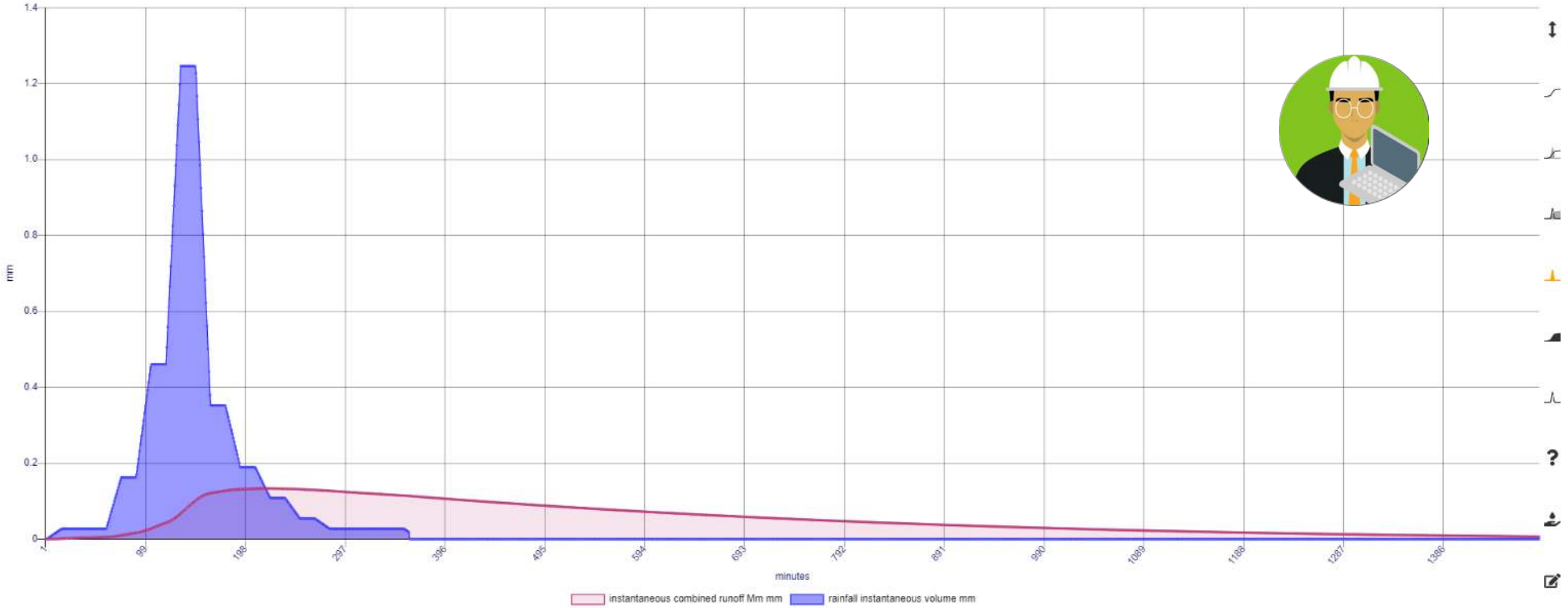


5. Overall Project Diagrammatic Hydrograph
Design Storm: AES distribution, 80 mm total volume, 6 hours total duration



6. Overall Project Diagrammatic Flow Rate Compliance
Design Storm: AES distribution, 80 mm total volume, 6 hours total duration

Friction-Detention Green Roof Design: Modeling Results



Start of Range 0 End of Range 1482 Increment Size 100

4. Overall Project Detailed Hydrograph

Design Storm: AES distribution, 80 mm total volume, 6 hours total duration

Key Takeaways

- Green roof is effective in retaining rainwater in Toronto and meeting water balance target.
- Blue-green roofs can reduce or eliminate surface and subsurface storage and create financial savings.
- Ponding blue-green roof is best suited on dead flat plaza decks under intensive system.
- Friction-detention blue-green roof works best under extensive system on low slope roofs.

Avani, Toronto ON

THANK YOU!

Karen Liu, Green Roof Specialist karen@nlsm.ca 604-396-5772

Next Level™
STORMWATER MANAGEMENT

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Sherway Gardens, Toronto ON

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