

Size Matters

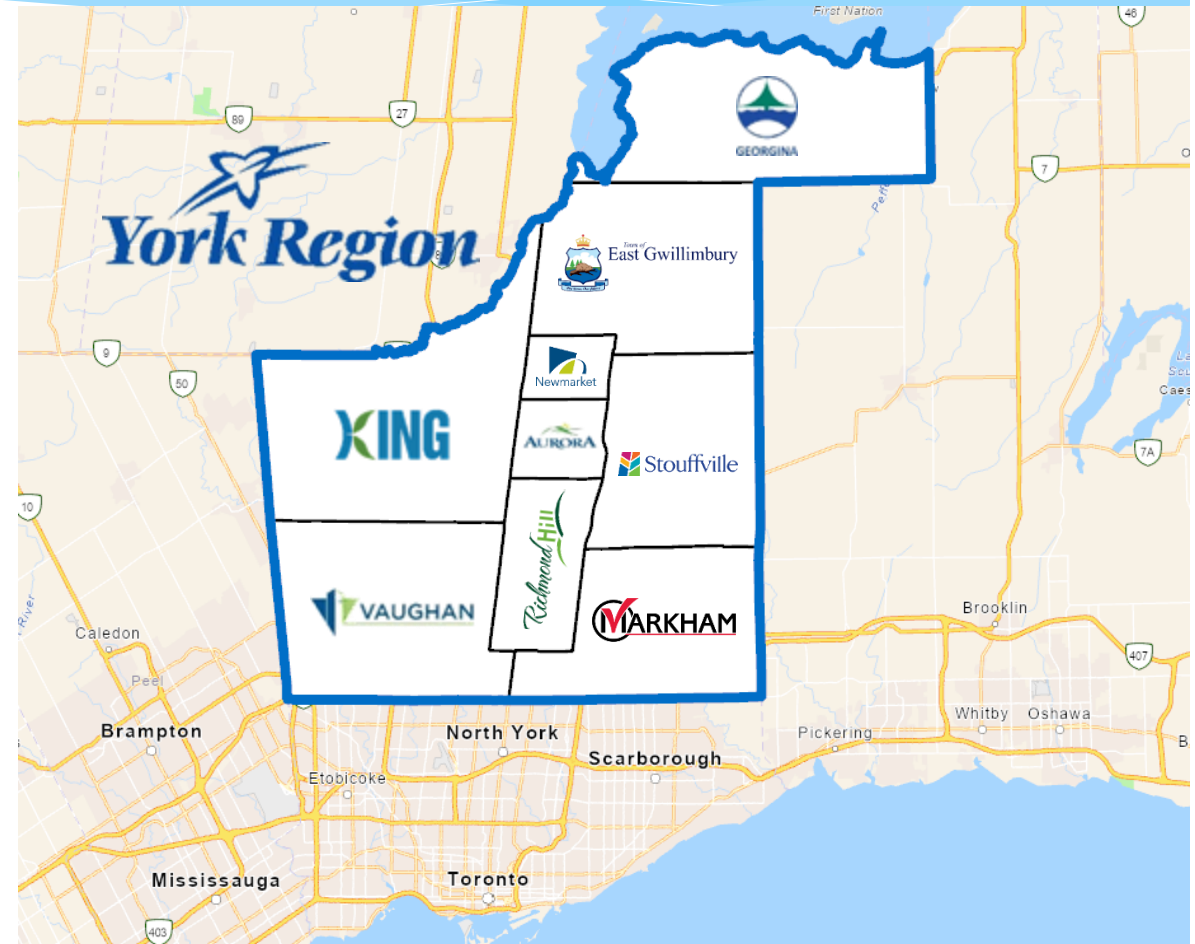
Scaling Design Criteria to Service Area Size

Kelvin Meng & Fabian Papa, FP&P HydraTek Inc.
Freddy Baron & Carolyn Truong, York Region

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Background

- * **York Region (York)** responsible for:
 - * Water treatment, pumping, storage, transmission
 - * Trunk wastewater collection & conveyance
- * **Local Municipalities (LMs)** responsible for:
 - * Local water distribution
 - * Local wastewater collection



Why this study?

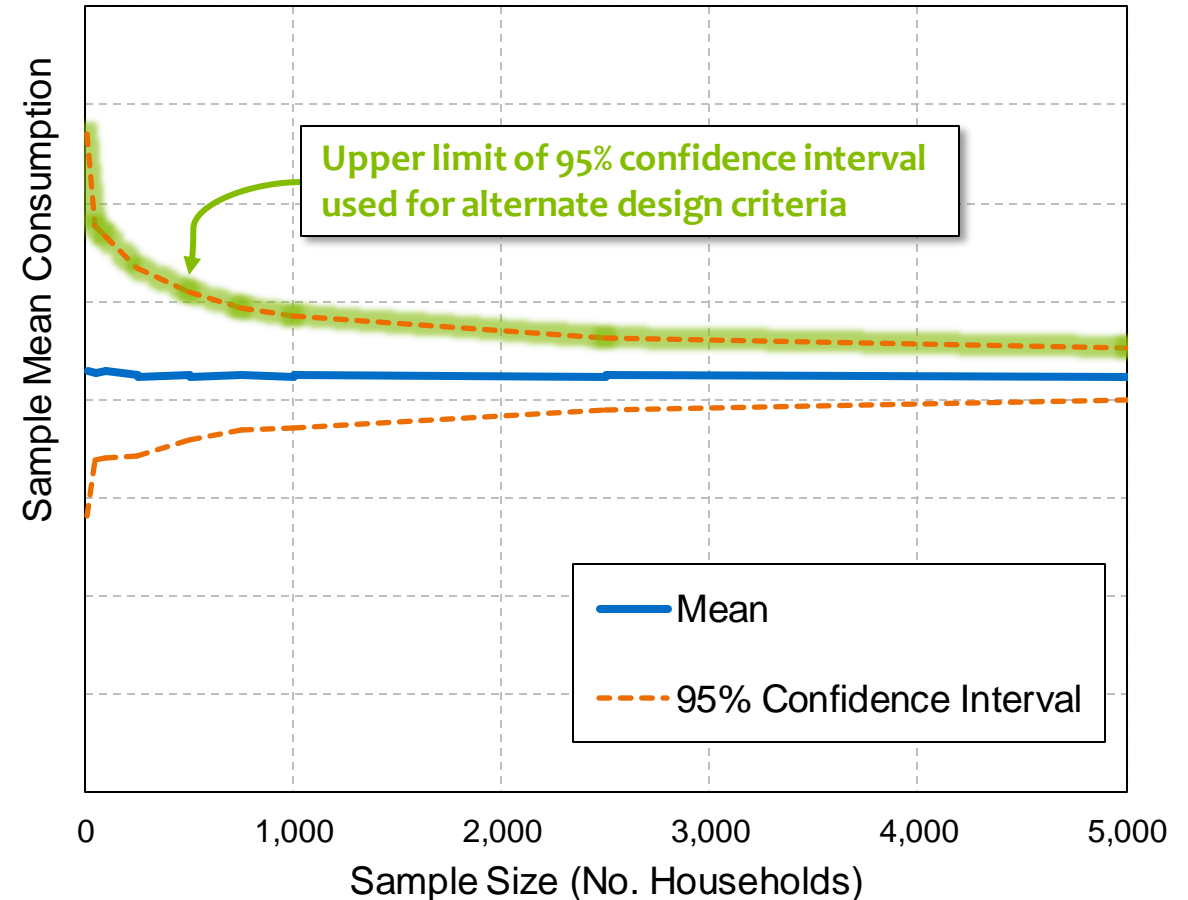
- * To analyze the wealth of available data and examine appropriateness of current design criteria
 - * That is, to **reconcile** York and LM criteria
 - * **WHY?** York and LM criteria differ due to differing perspectives
 - * Appropriateness of criteria driven by system **SCALE**
- * **Origin of study:**
 - * Design of wastewater drop structure at a jurisdictional interface
 - * Estimated hydraulic loading: $Q_{LM} > 2 \times Q_{York}$

Objectives of Study

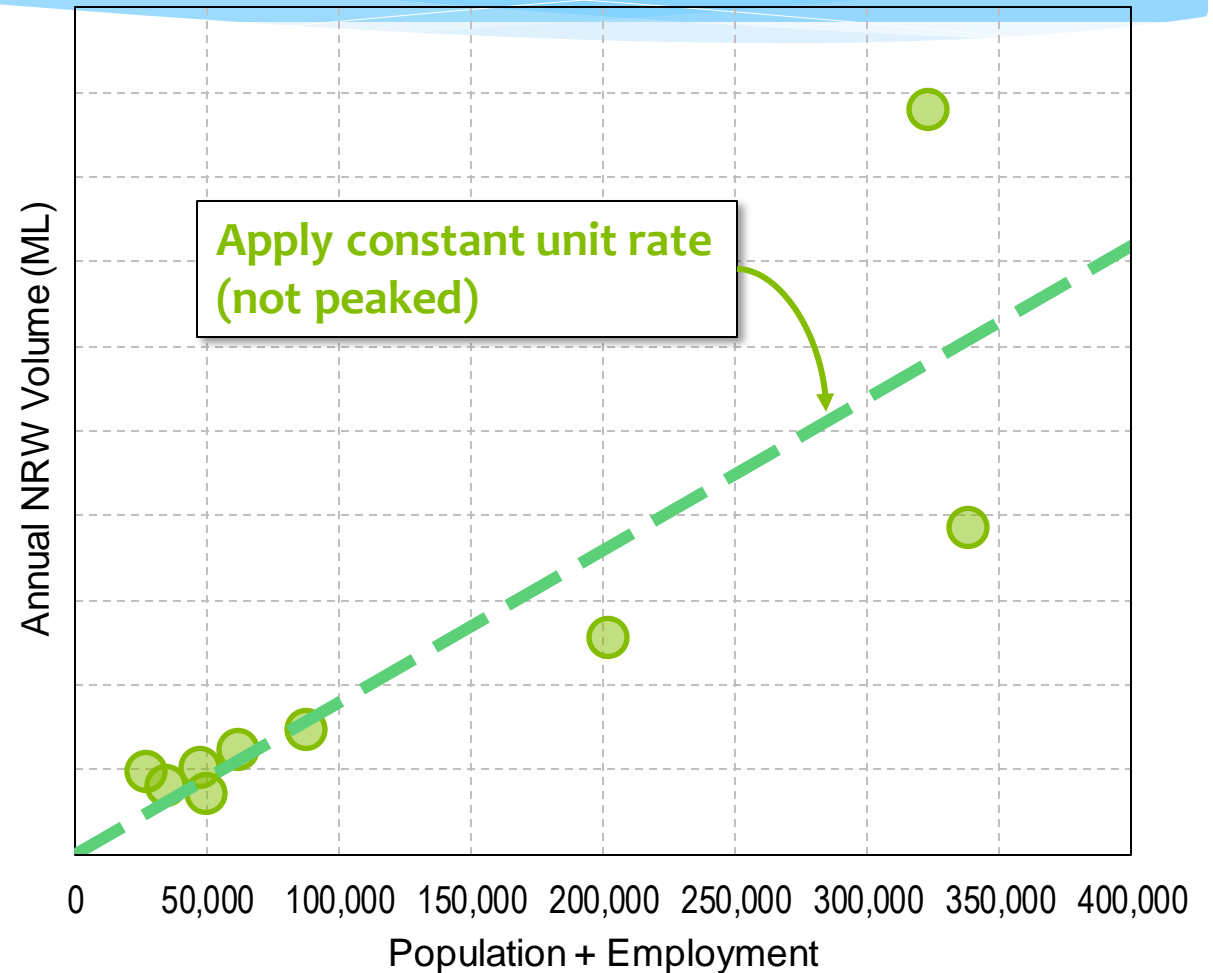
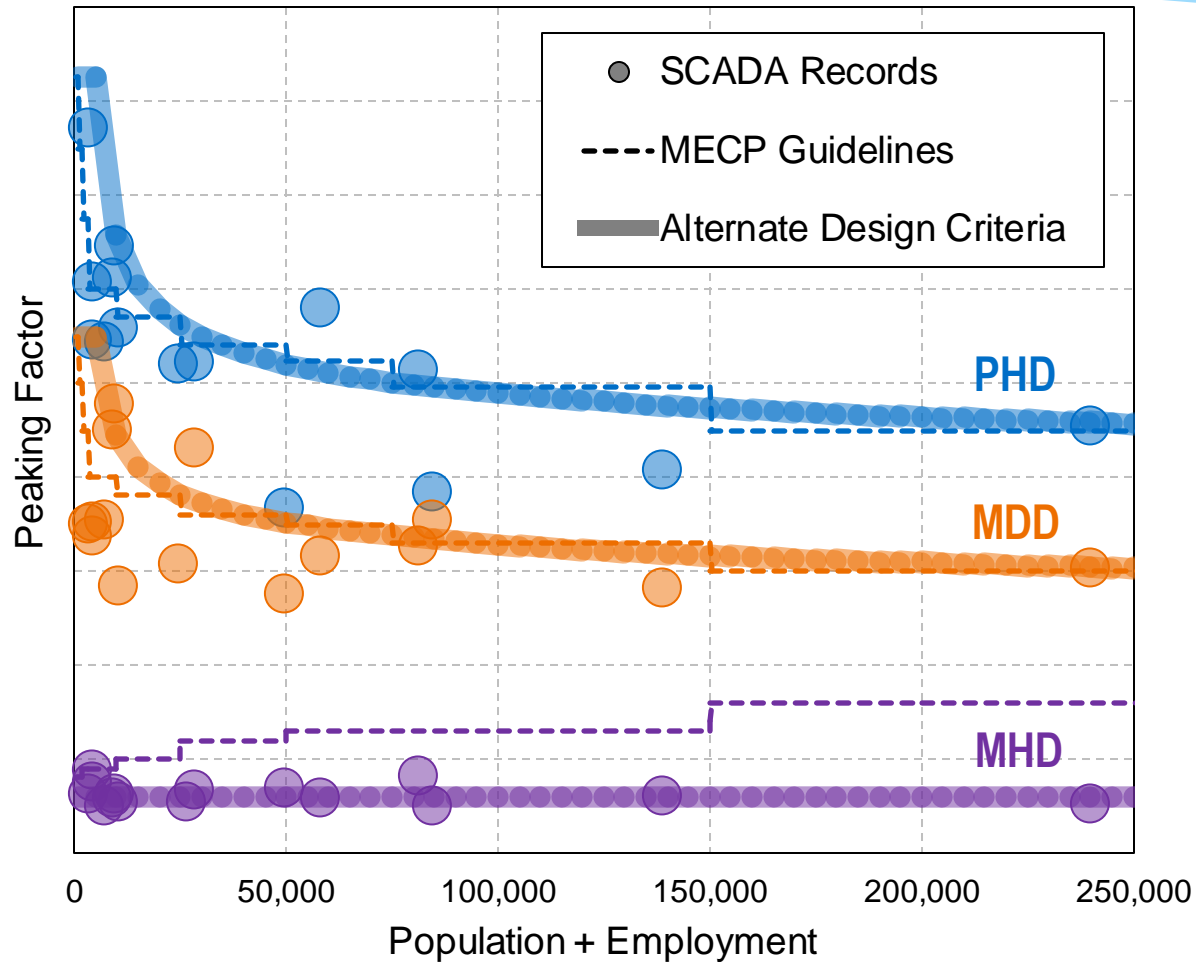
- * To offer **alternative criteria** that may be *considered* to:
 - * To **facilitate discussions between York and LMs** in relation to infrastructure planning and design, particularly at *jurisdictional interfaces*.
 - * To offer defensible criteria to support opportunities to **downscale, defer** and/or **potentially avoid** major infrastructure investments.
- * To provide a framework for conducting **probabilistic risk assessment**
- * Project is near completion; only conceptual results are presented

Water | Unit Consumption

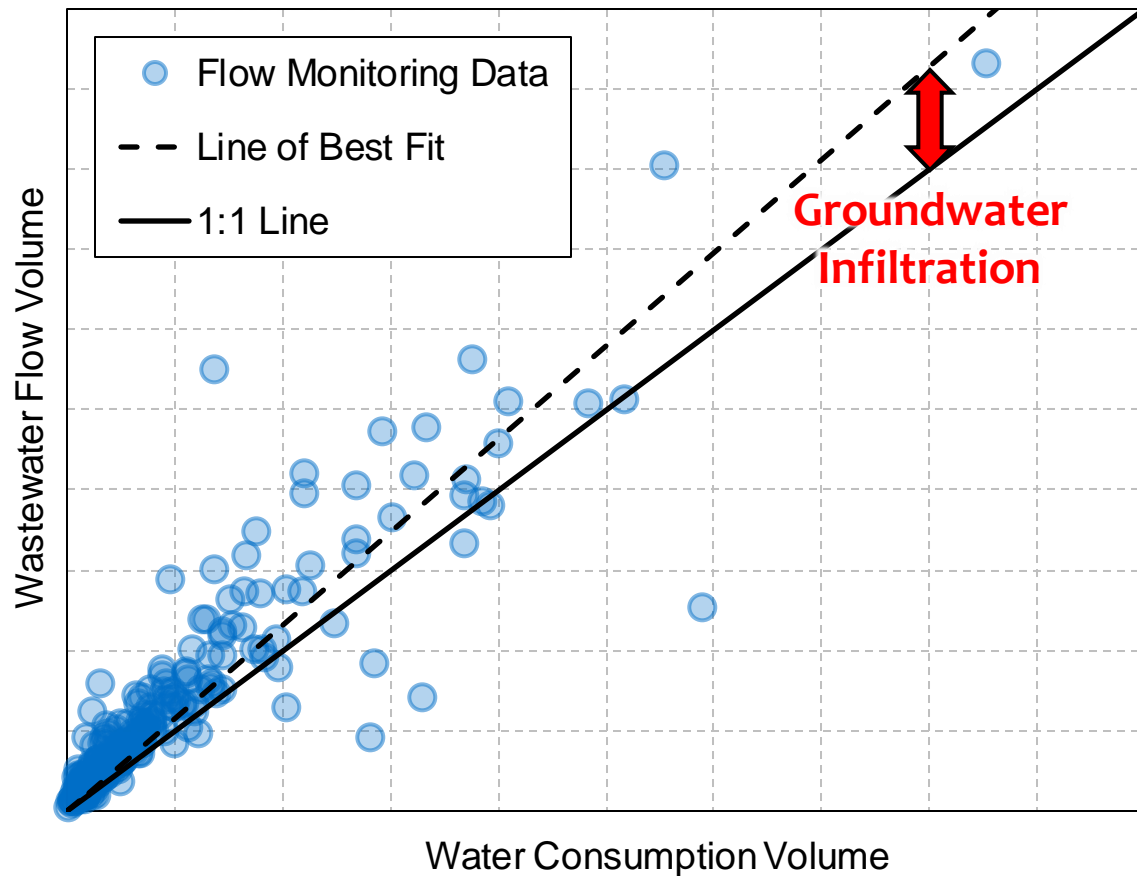
- * Bootstrapping analysis of consumption records across all of York Region
- * Variability reduces **rapidly** with population size
- * Fit **scaling function** to upper bound of 95% confidence interval



Water | Peaking Factors & NRW



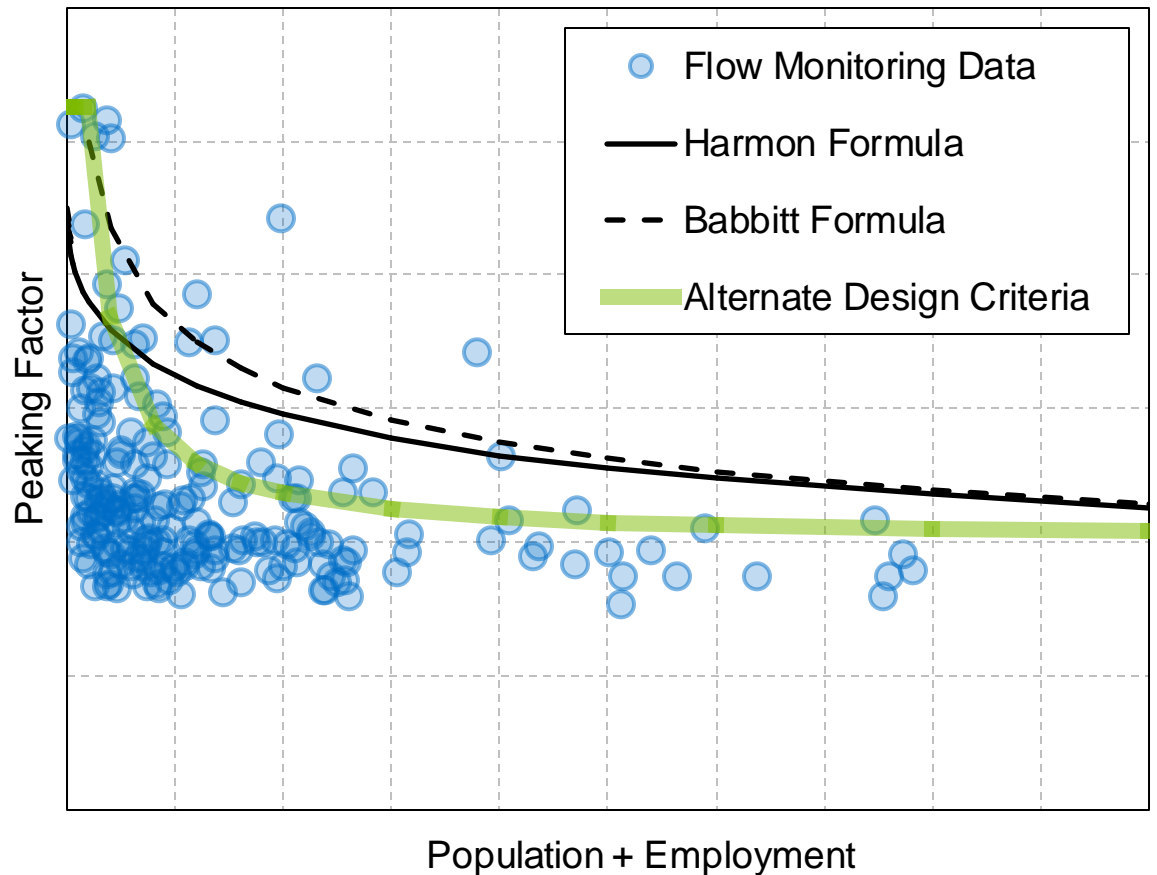
Wastewater | Base Infiltration



- * Utilize water consumption as a proxy for sewage generation
- * Flow monitoring data reviewed across >250 sewersheds
- * Wastewater flow measured higher than water consumption
- * Difference attributed to groundwater infiltration (baseflow)

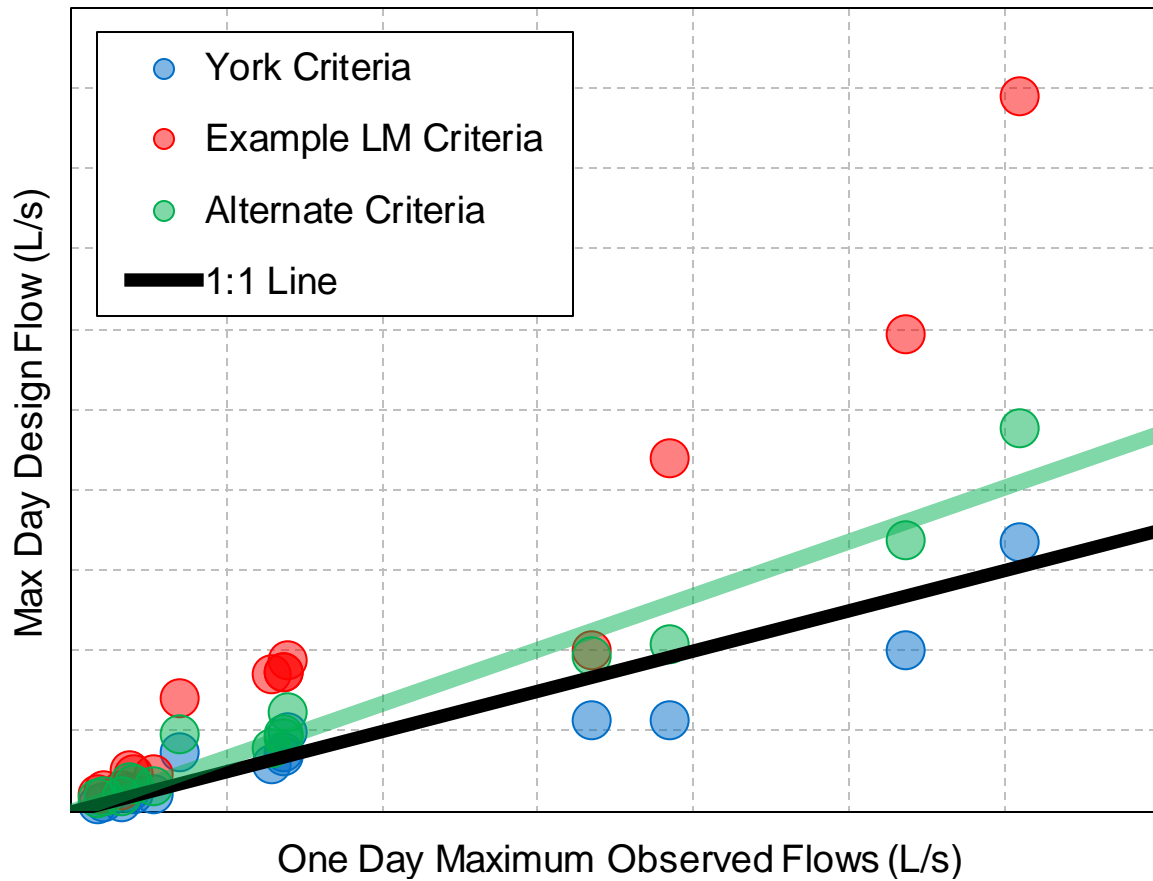
Wastewater | Peaking Factor

- * Computed as the ratio of highest hourly flow rate to the average
- * Traditional formulae conservative relative to observations
- * Introduce **custom curve** that better reflects data
 - * NOT applied to baseflow

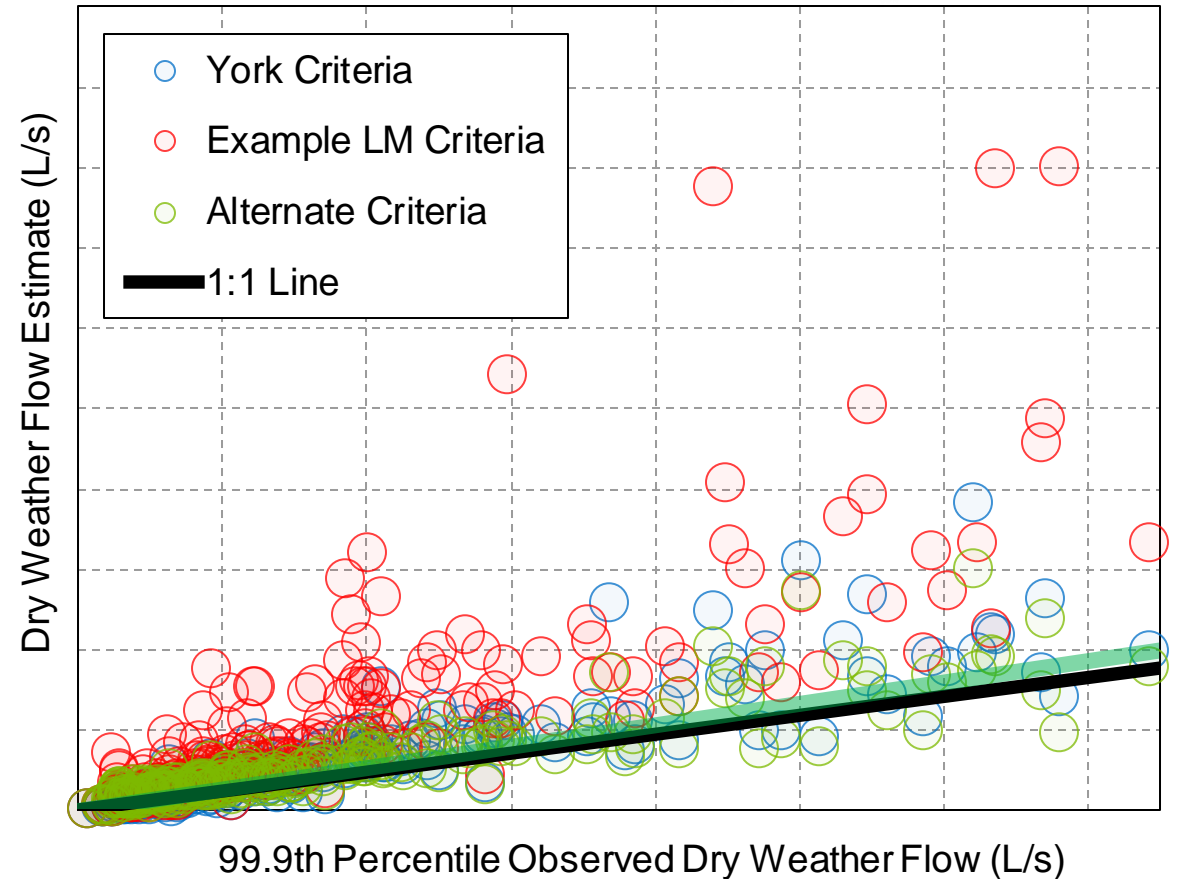


Back-Testing

Water



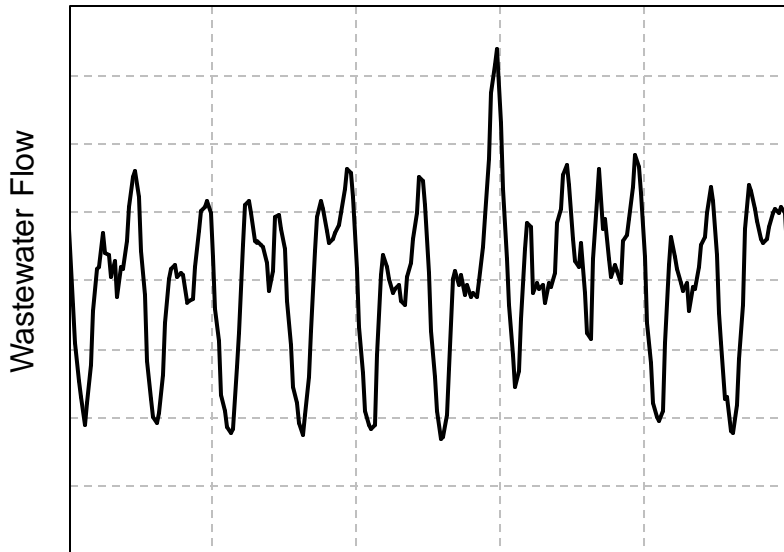
Wastewater (DWF)



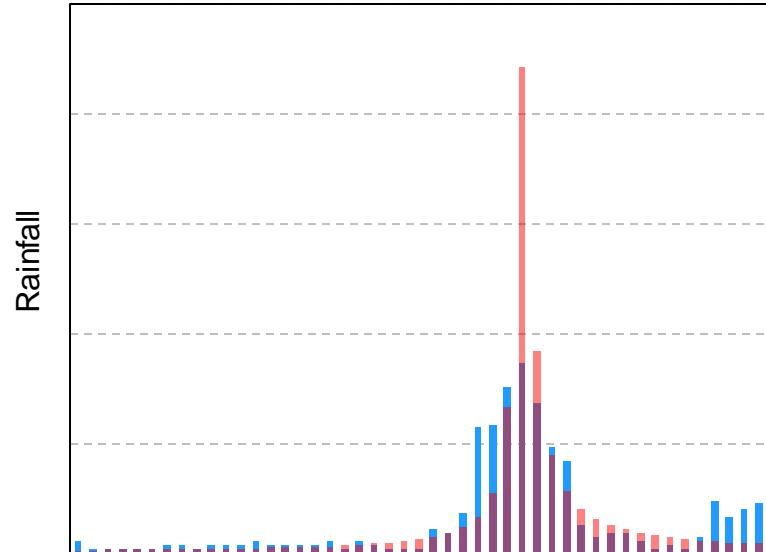
Rainfall-Derived Inflow & Infiltration

- * Numerous factors to consider; currently subject to further review
- * Direct measurement of RDII return frequencies being considered

Availability of data

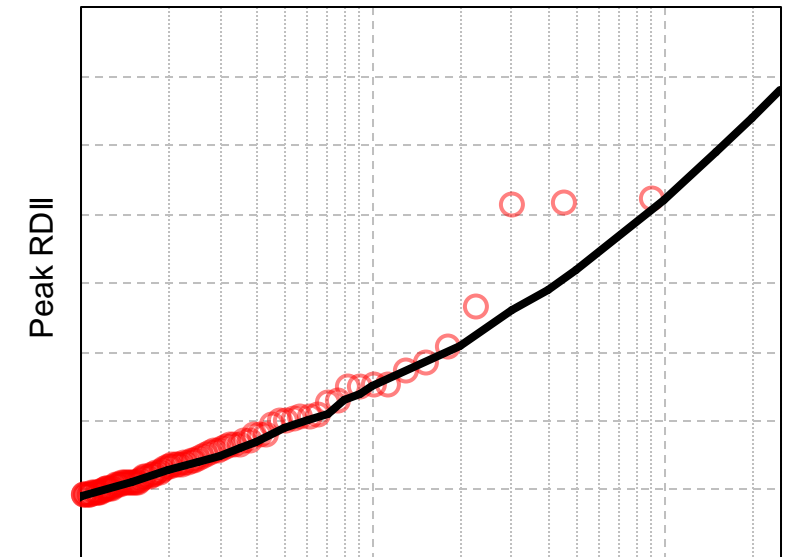


Design storm selection



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Correlation of RDII with storm event return frequency



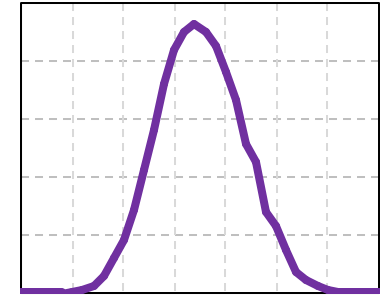
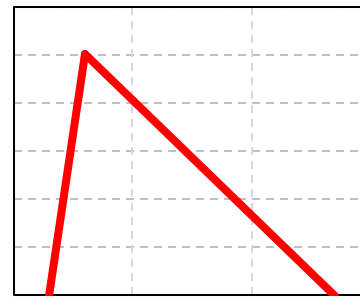
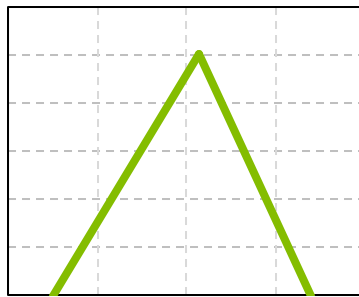
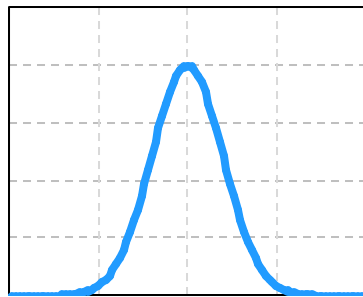
Return Period

Probabilistic Uncertainty Analysis

- * Traditional design flow estimation generates a singular value
- * Consider application of Monte Carlo Simulation (MCS) methodology

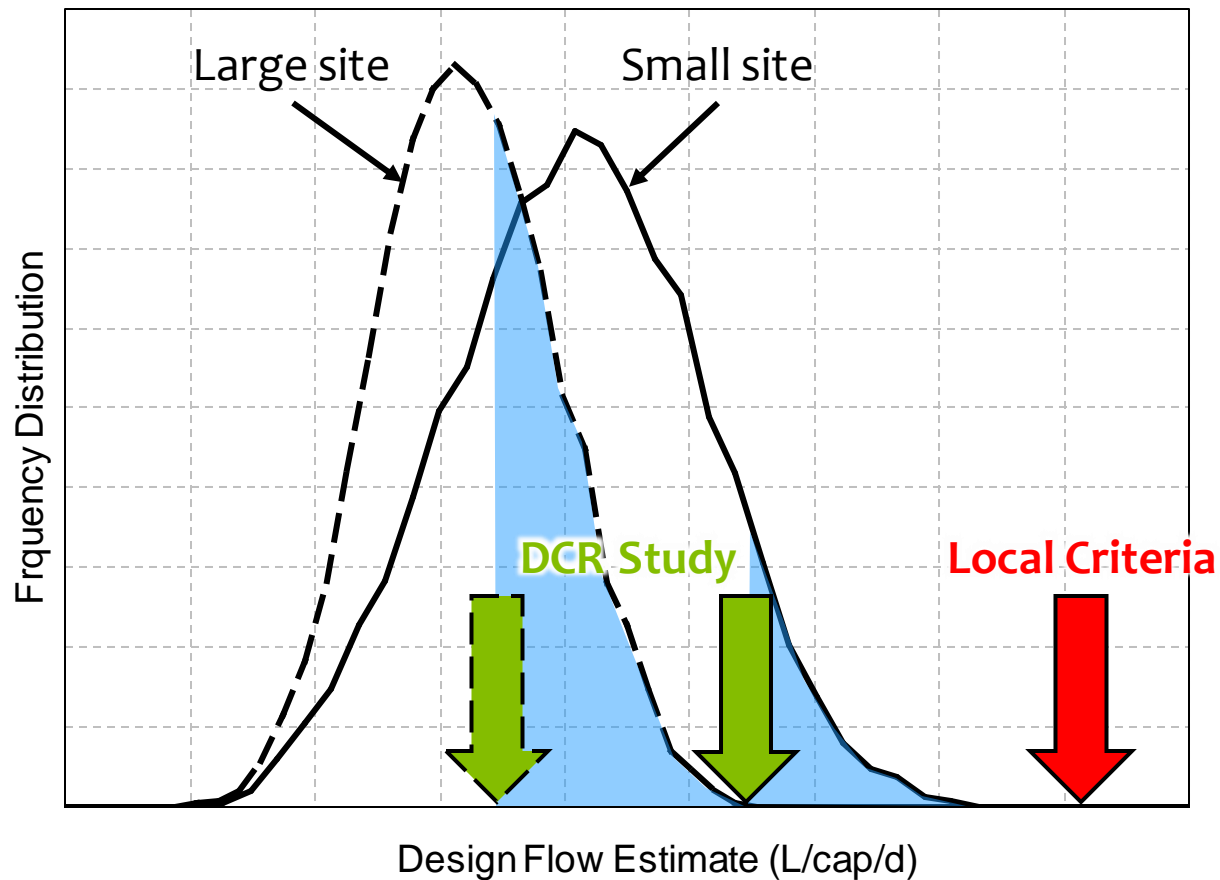
Population × **Unit Demand** × **Peaking Factor** + **Extraneous Flows** = **Design Flow Estimate**

↑
Site-specific



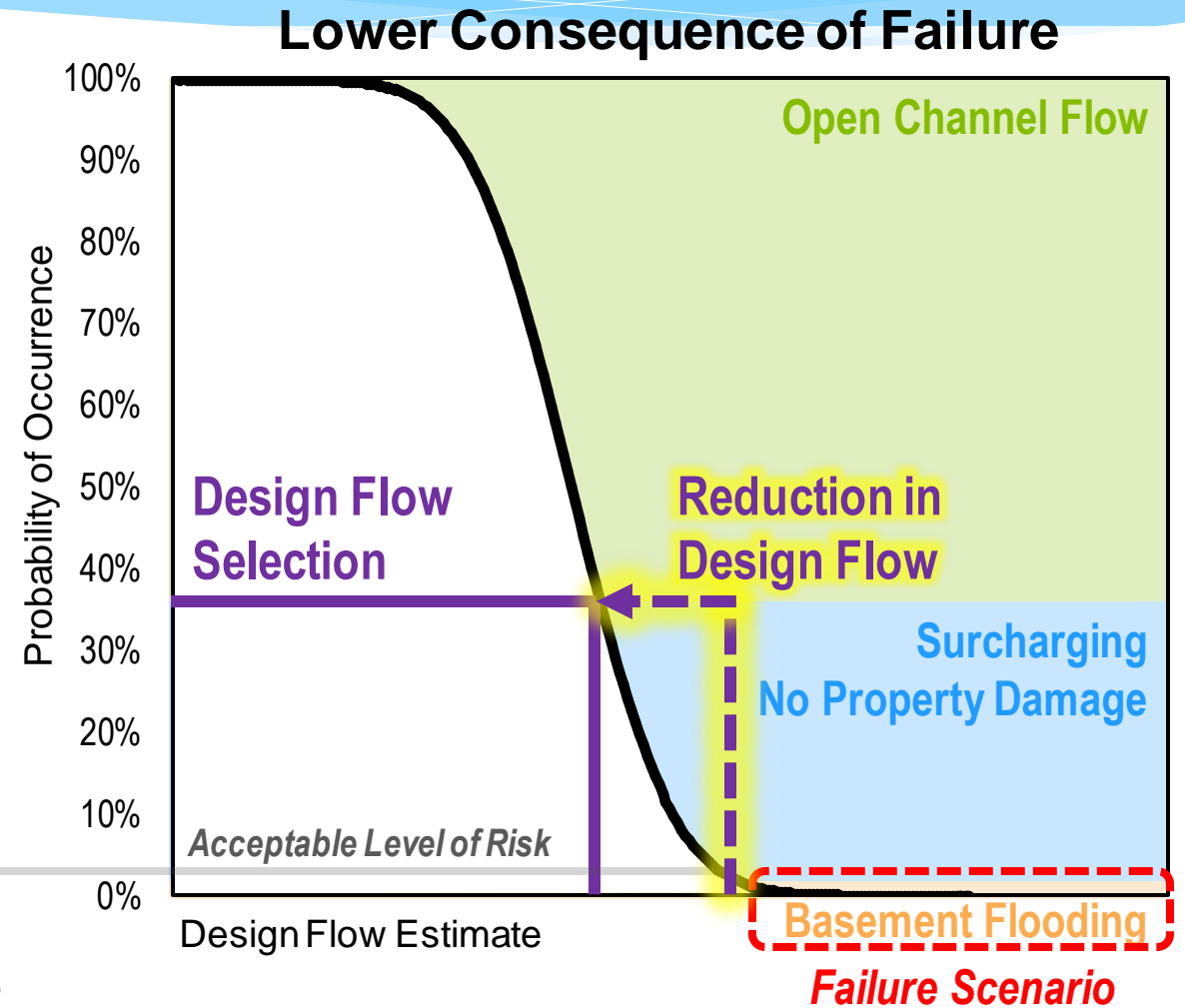
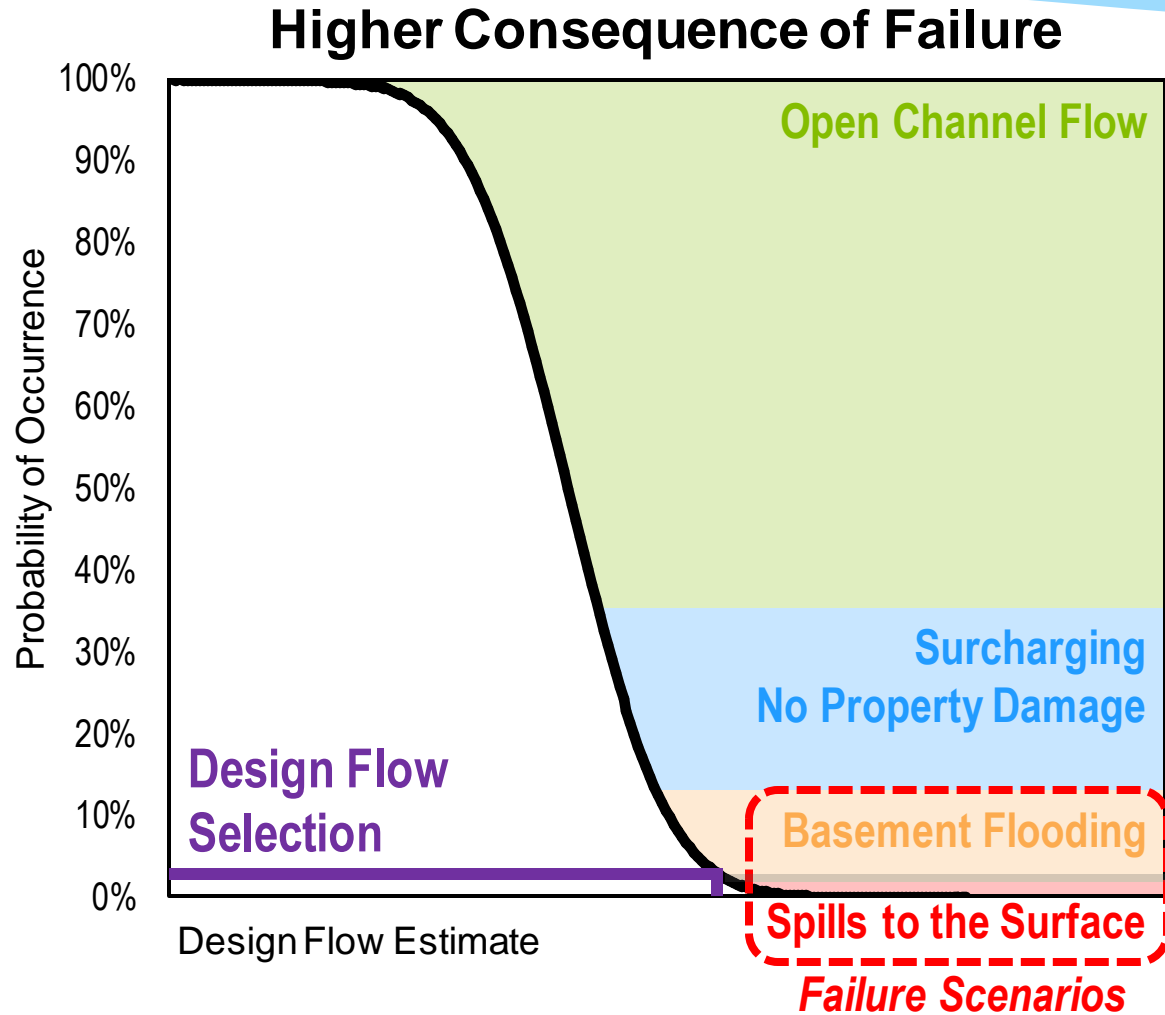
- * Produces design flow estimate as an output probability distribution

Monte Carlo Simulation Example



- * Example with two fictitious sites
 - * Small/Medium: 10,000 persons
 - * Large: 100,000 persons
- * Local municipality's criteria shows possible over-estimation at both scales
- * Consider consequences of failure at flow rates beyond criteria

Combining with Consequences of Failure



Why is this important?

- * **To reconcile level of service issues at jurisdictional interfaces**
- * **To facilitate future discussions and infrastructure decision-making between York Region, Local Municipalities and Land Developers**
- * **To rationally size new infrastructure for anticipated growth**
- * **To rationally time upgrades for existing (aging) infrastructure**
 - * That is, exploitation of existing capacities (“infra-stretch”)
- * **To facilitate risk-based probabilistic assessments of select key infrastructure elements wherever warranted**

Questions?

- * **Kelvin Meng**, FP&P HydraTek Inc.
k.meng@hydratek.com | +1 416 238 7681 ext. 460
- * **Fabian Papa**, FP&P HydraTek Inc.
f.papa@hydratek.com | +1 416 238 7681 ext. 410
- * **Freddy Baron**, York Region
freddy.baron@york.ca | +1 877 464 9675 ext. 75098
- * **Carolyn Truong**, York Region
carolyn.truong@york.ca | 289 716 4321

