



BURNSIDE

Barefoot Box Culvert™ 10 Years of Learning

Chris Pfohl, C.E.T., EP, CAN-CISEC
Sr. Aquatic Ecologist
RJ Burnside & Associates Ltd.

2026 Natural Channels Conference
Session K, The Good, the Bad and the Ugly
June 8, 2026



Presentation Outline

1. Introduction
2. Background on Barefoot Box Culvert
3. Suitable Conditions to Support Use
4. Design and Innovation
5. The Good, Bad and Ugly
6. Monitoring and Results
7. Video
8. Q & A Session



Chris Pfohl, C.E.T., EP, CAN-CISEC

Sr. Aquatic Ecologist

- Burnside Aquatic Group Team Lead – Project Manager
- 30yrs Aquatic related experience in Canada and Internationally
- Fish Habitat Protection and Enhancement, Permitting and Approvals, In-water Works, Natural Channel Design and Construction, Transportation, Development, Water Resources
- The Inventor of the Barefoot Box Culvert™
- Recipient of the “Outstanding Technical Achievement” Award by OACETT – 2021 for the Barefoot Box Culvert™ and Design



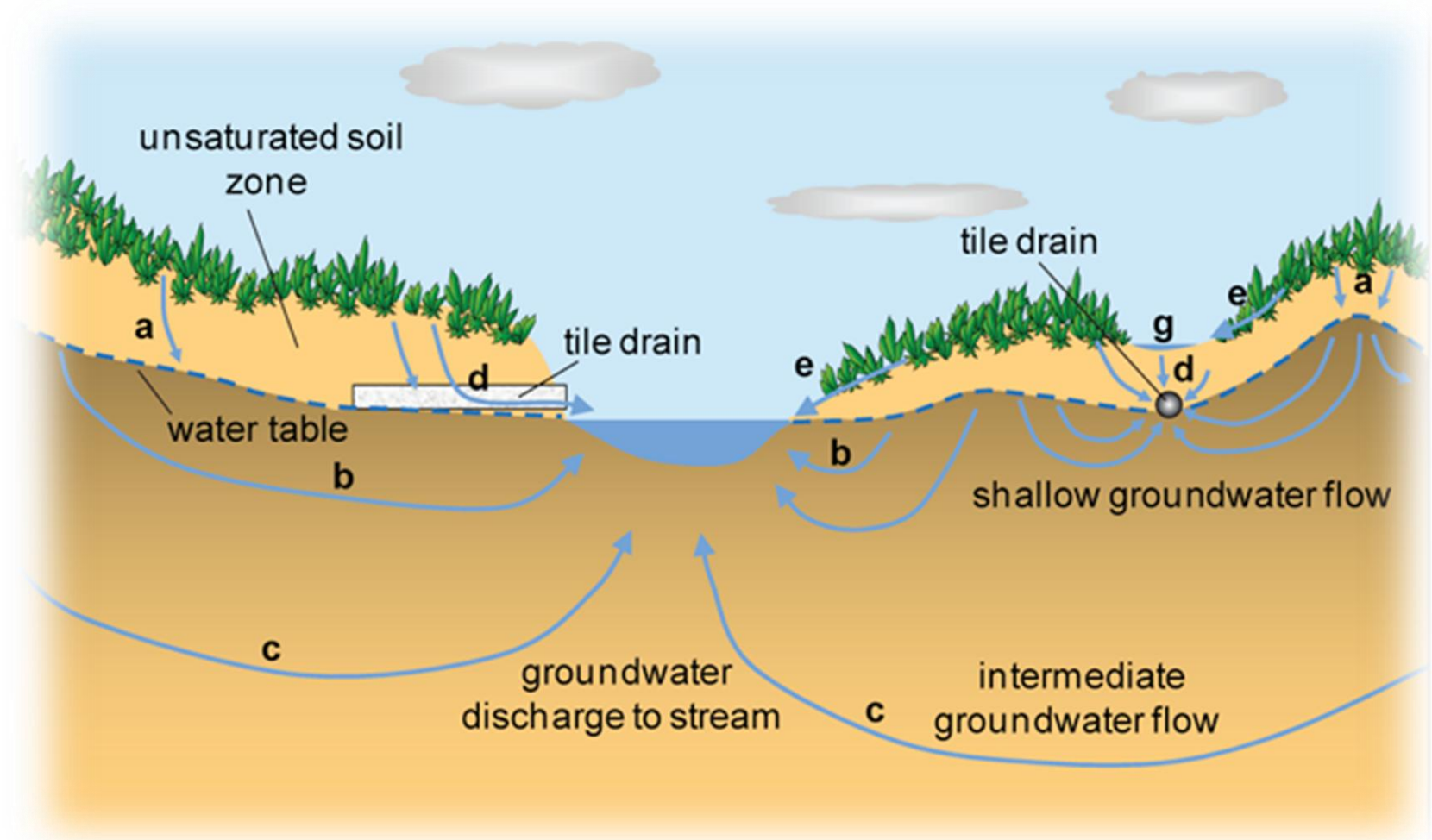
Background / Design

- Issues related to crossing design preference by RAs regarding replacement of three sided structures (cast in place footings) for Box Culverts
- Conformance with Hydraulic models (culvert sizing)
- Preference to replicate form and function of the open footing (channel meandering, substrate, groundwater input)

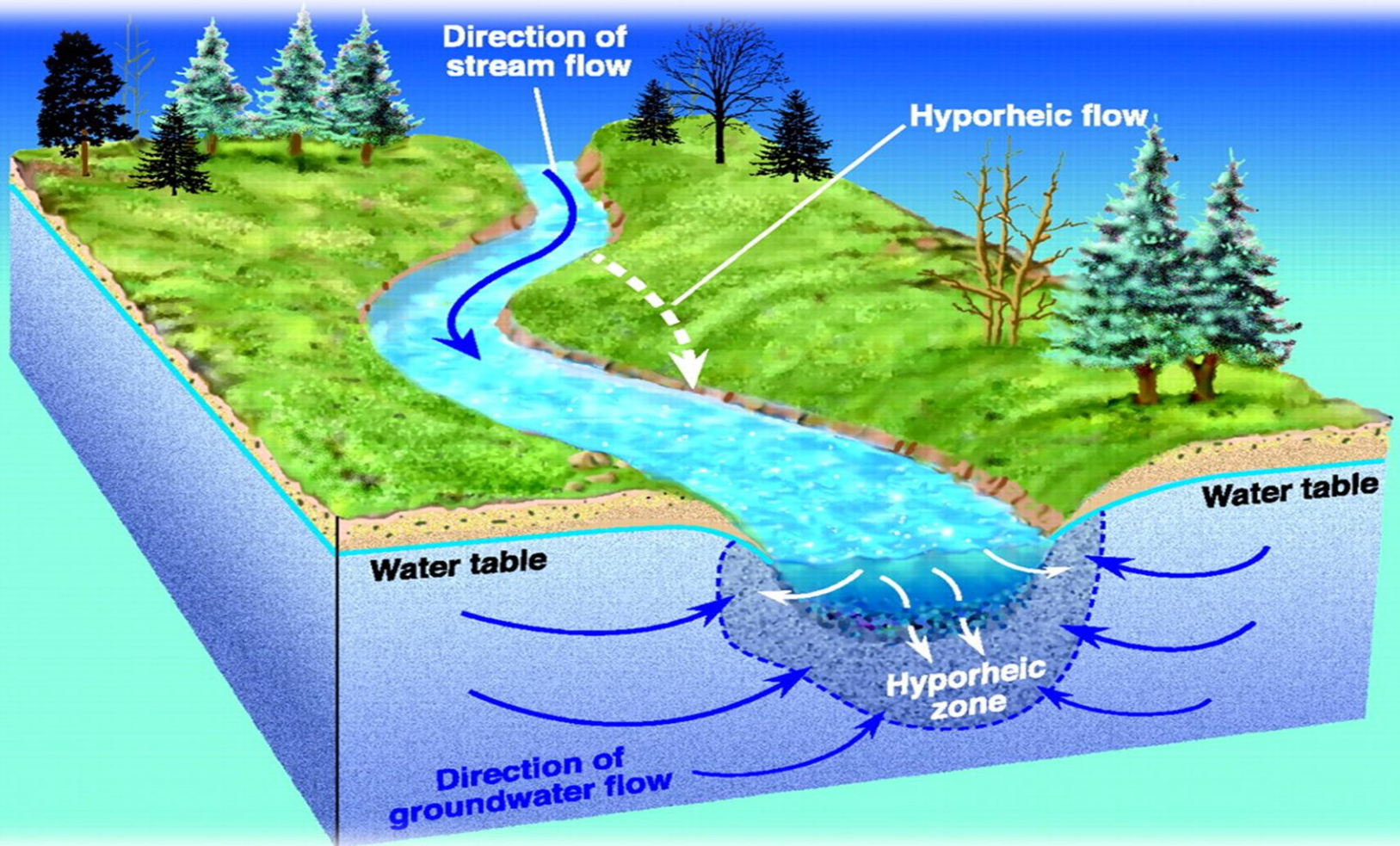
Form and Function

- Replicate channel planform
- Maintain Thermal Regime (Cold/Cool water, groundwater discharge)
- Maintain suitable substrate (diversity of particle size, no erosion)
- Provide suitable conditions for aquatic life

Groundwater Discharge to Surface Water



Hyporheic Zone



R.J. Burnside's Innovation

- Created a customized perforated precast box culvert allowing for precise groundwater upwelling
- Incorporate Natural Channel Design concepts within culvert, inlet and outlet
- Improve/maintain aquatic conditions
- Ensure structural integrity for transportation design standards



1st Barefoot Installed - Township of Melancthon - Pine River - 2015



Degraded “cast in place” open foot culvert

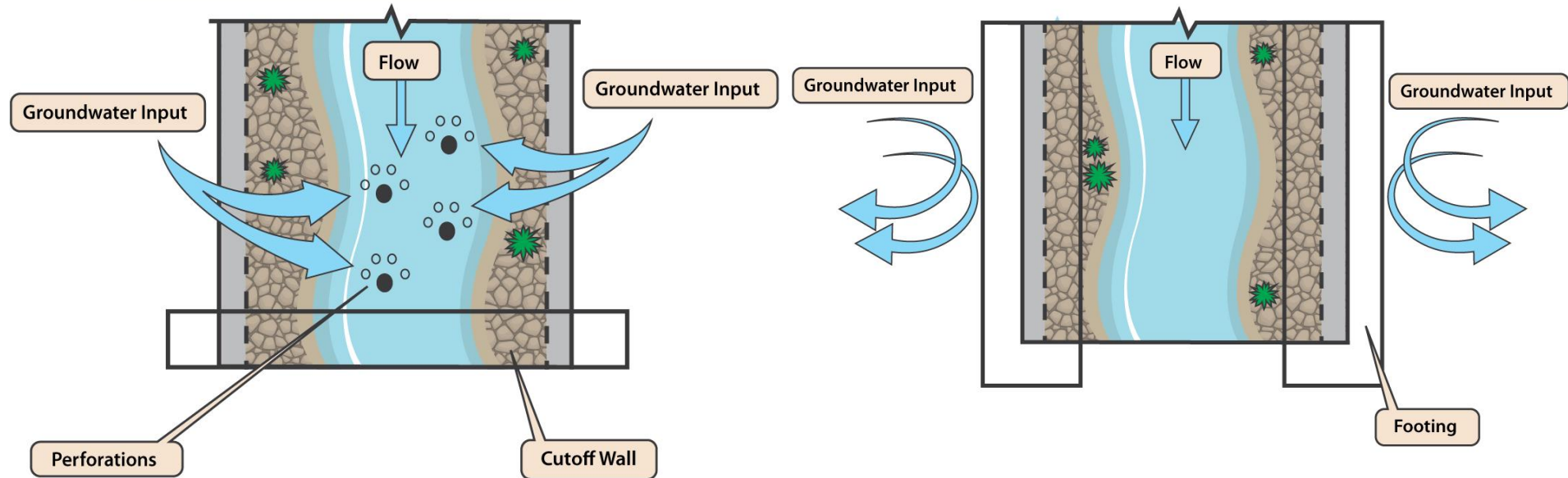


Replaced with the Barefoot Box Culvert™



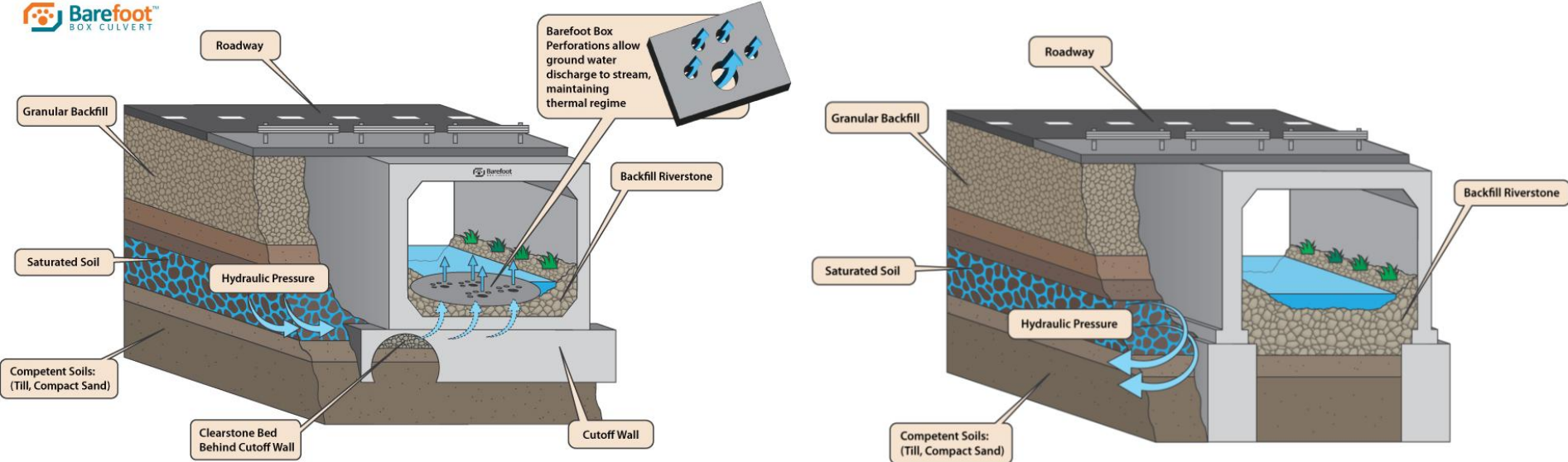
Barefoot Box Culvert™ vs Clearspan with Footings

Plan View



Barefoot Box Culvert™ vs Clearspan with Footings

Profile



“The Good”

- Creating critical habitat that support aquatic conditions habitat
- Taking time to educate and share knowledge
- Developing collaborative teams
- Advancing the science and understanding
- Setting new goals



Seepage Well Monitoring of Perforations in BBC Culverts



“The Bad”

- Challenges accepting new approaches and innovation
- Mis-understanding the Design and Concept
- Lack of awareness (Regulatory Agencies, Municipalities)



“The Ugly”

- Mis-interpreting the design and key installation details
- Limited contractor experience in culvert installation and channel construction
- Unforeseen events and conditions
- Understanding the reason for the conditions observed

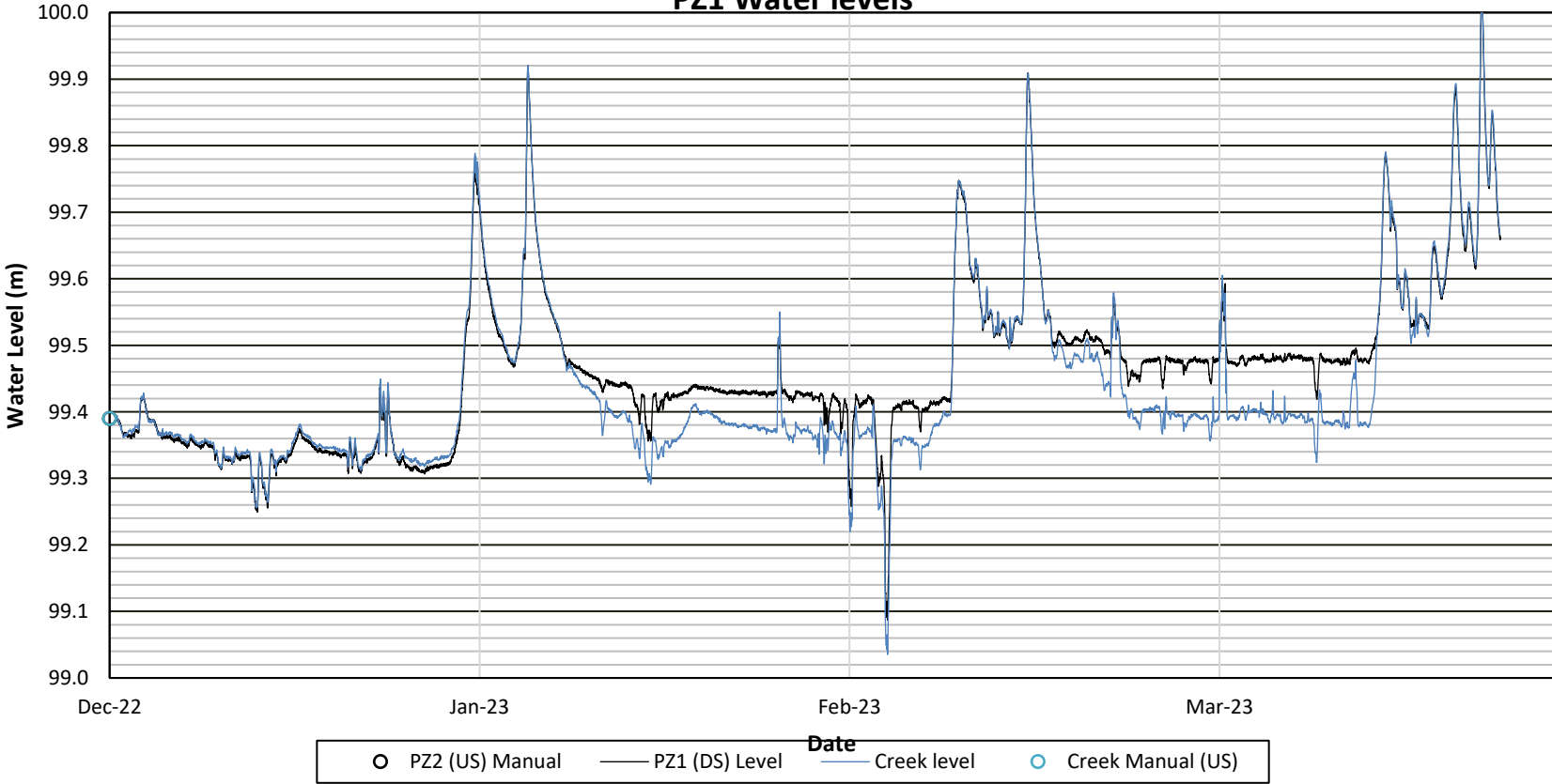


Barefoot Box Culvert™ Performance Monitoring



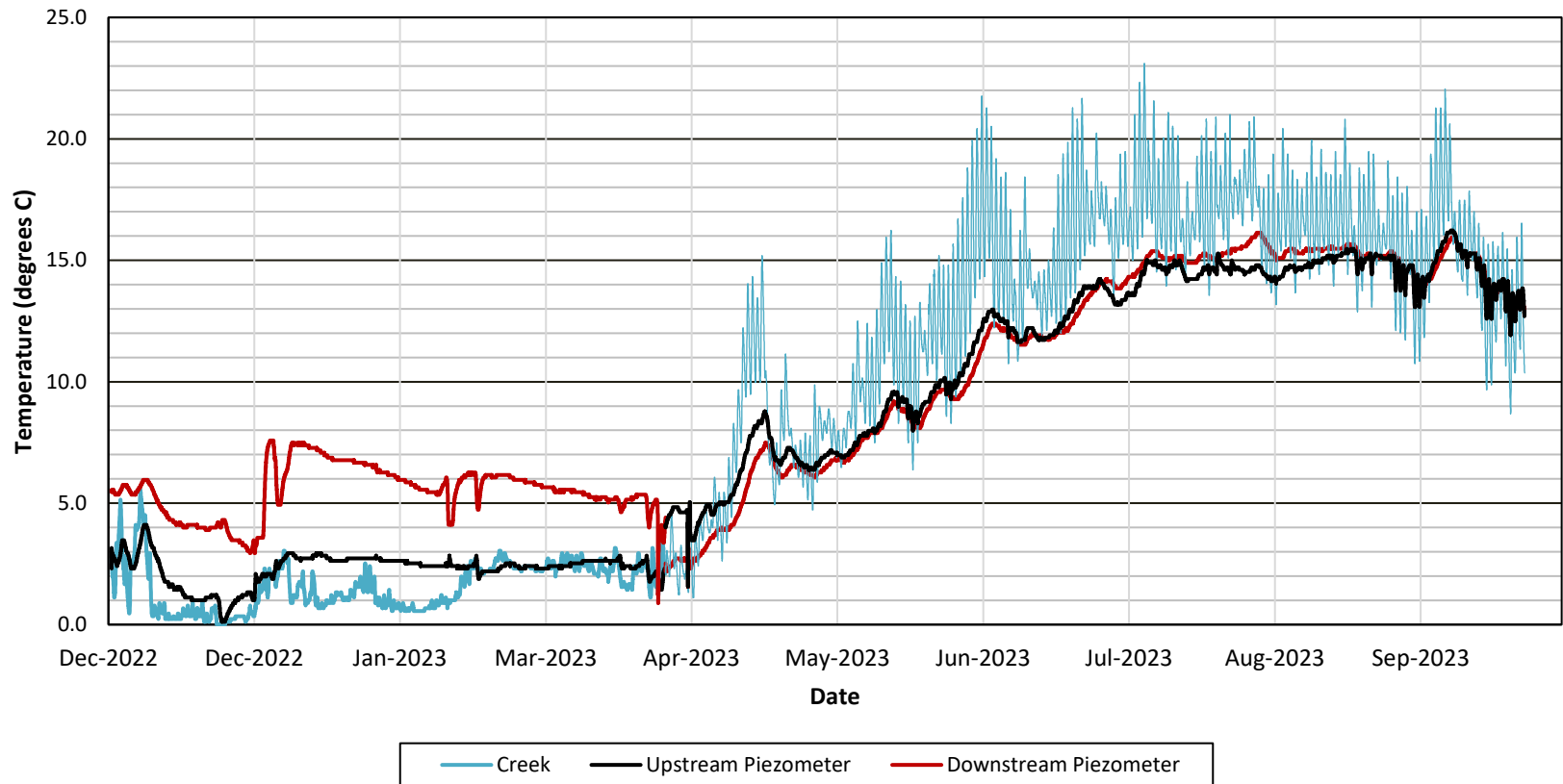
SICD - Piezometer and Creek Water Levels

4th Line Innisfil
PZ1 Water levels



SICD 4th Line Temperature Monitoring

4th Line Innisfil
Logger Temperatures



eDNA – High Resolution Study

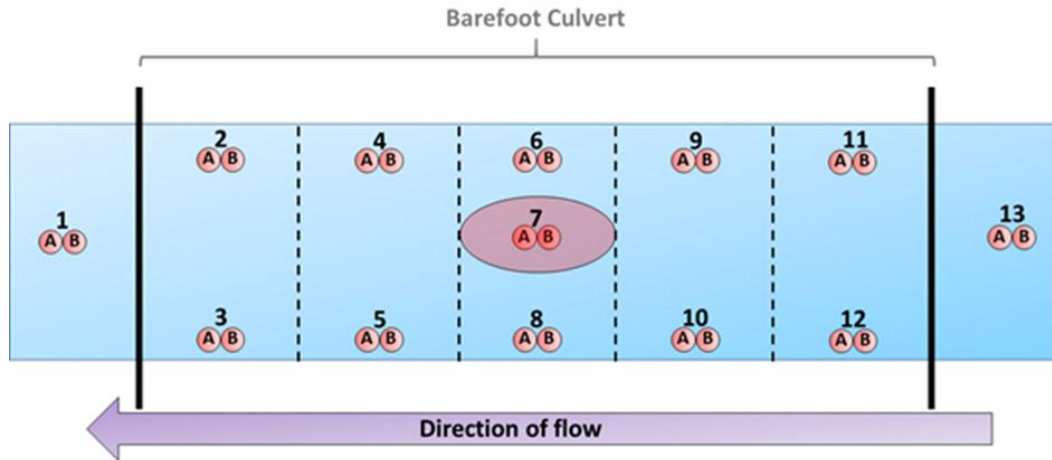


Baseline Study – March 2019



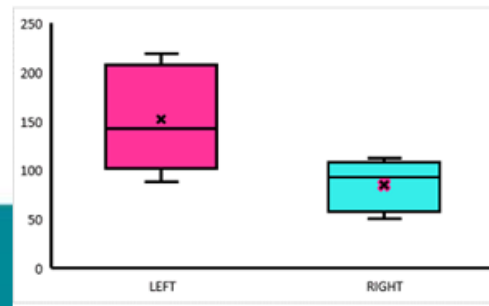
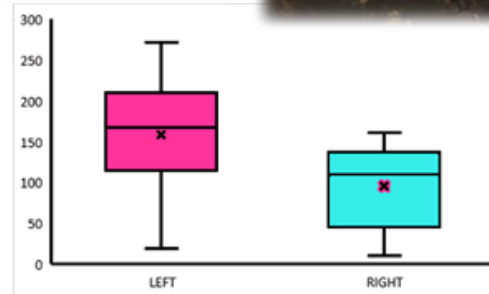
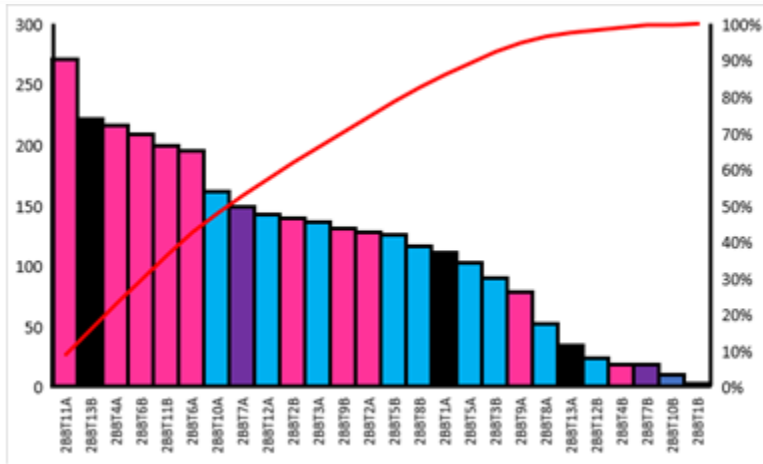
High Resolution Study – Nov 2019

eDNA – High Resolution Study



Key

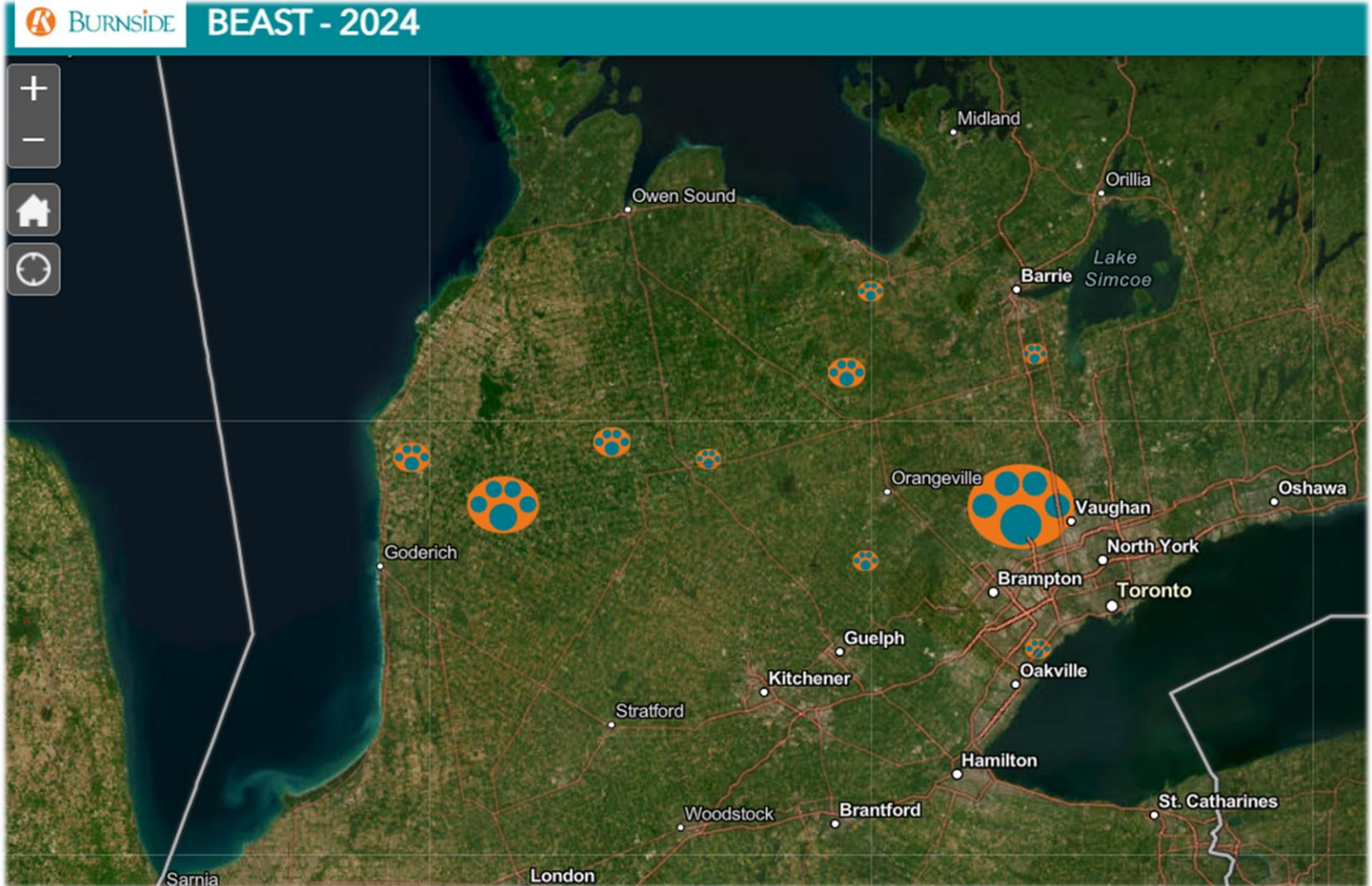
- A B** = Duplicate water samples (A and B)
- = Site of suspected elevated brook trout occupancy



Does this Barefoot™ BOX CULVERT really work?

- Positive results obtained (upwelling and temperature)
- Environmental DNA (eDNA) High Resolution Study confirmed higher levels of Brook trout DNA
- Documentation of Brook trout spawning and Young of the Year emergence in the Barefoot Box Culvert
- DFO Monitoring as built conditions for performance (channel conditions, erosion, substrate),
- Township of Melancthon saved approximately 150K using the Barefoot Box Culvert

Barefoot Box Culverts in Southern Ontario



Brook trout spawning in the Barefoot Box Culvert™



Video and Thank You!



DONNELL

