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# Habitat Suitability and Hydraulic Signatures of Geomorphological Units in a Restored Channel

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# What does good habitat look like?





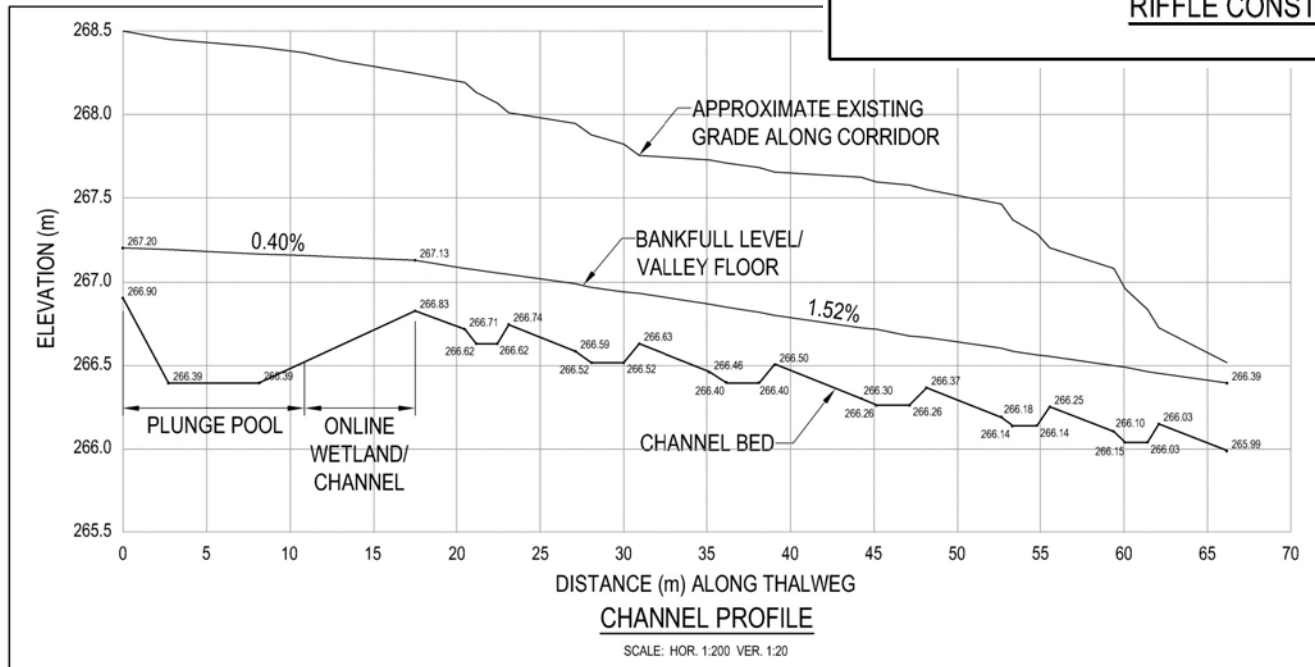
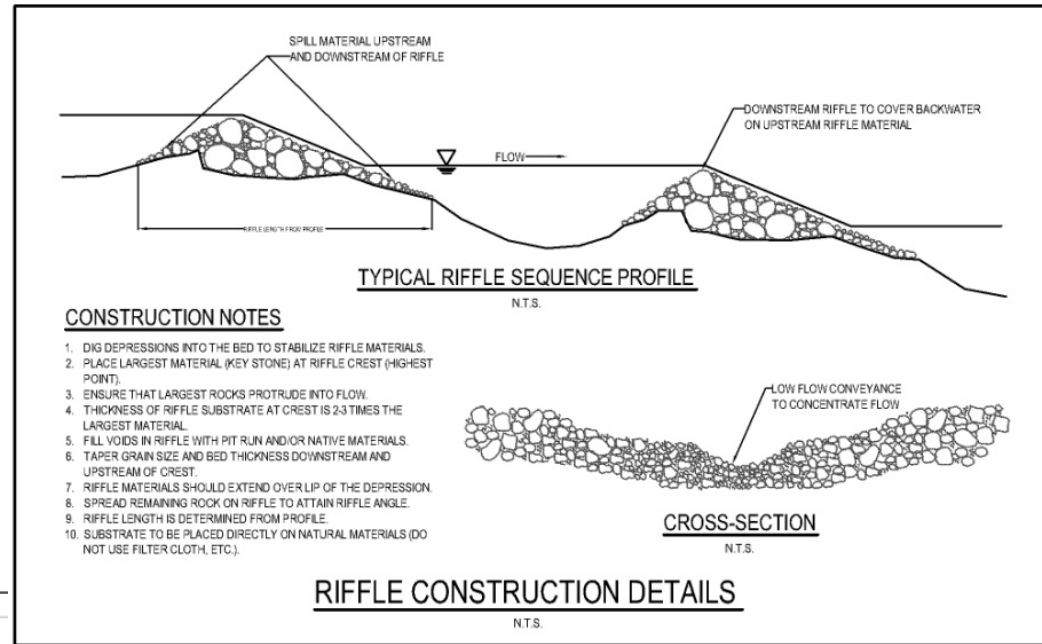
# Geomorphic units, hydraulic signatures and fish

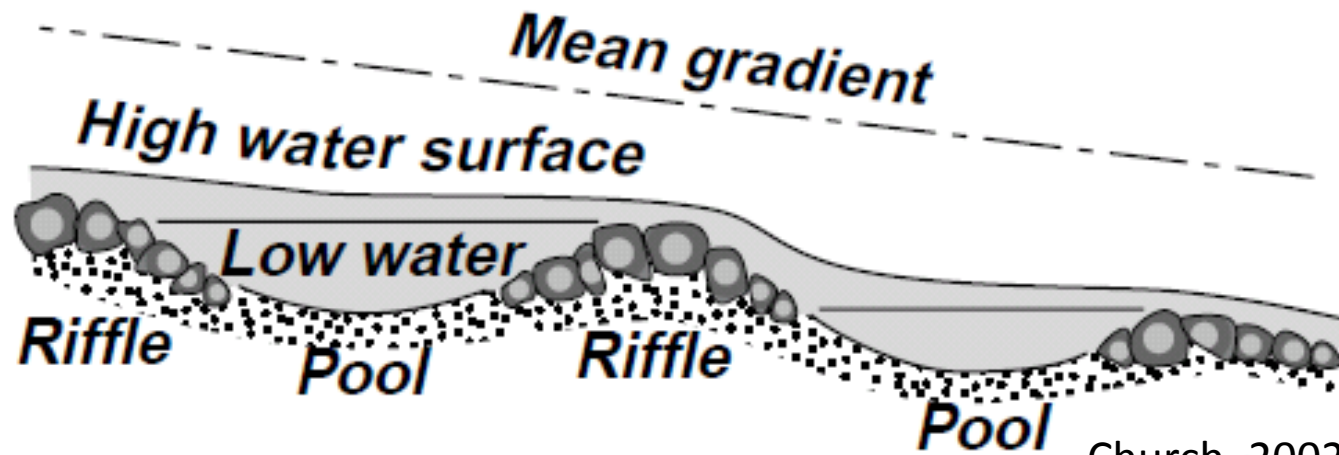
- Channel reaches consist of a series of geomorphic units
- In many 'restored' and natural channels these consist of riffles and pools
- Geomorphic units such as pools, riffles and transitions have morphological, sedimentological and hydraulic signatures
- Many fish require specific hydraulic conditions
- We can use hydraulic signatures as one tool to evaluate suitability of points in the channel for target fish species

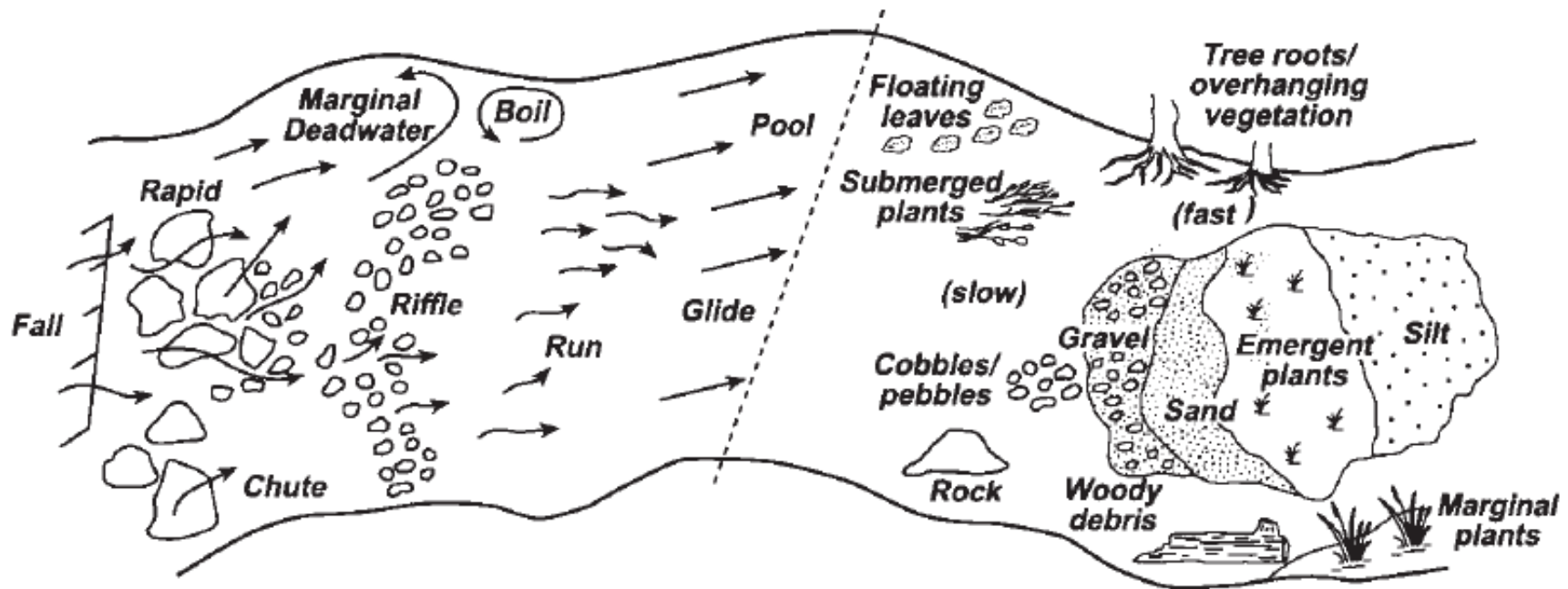


# Channel designs

- Morphology and sediment characteristics of a constructed riffle-pool sequence







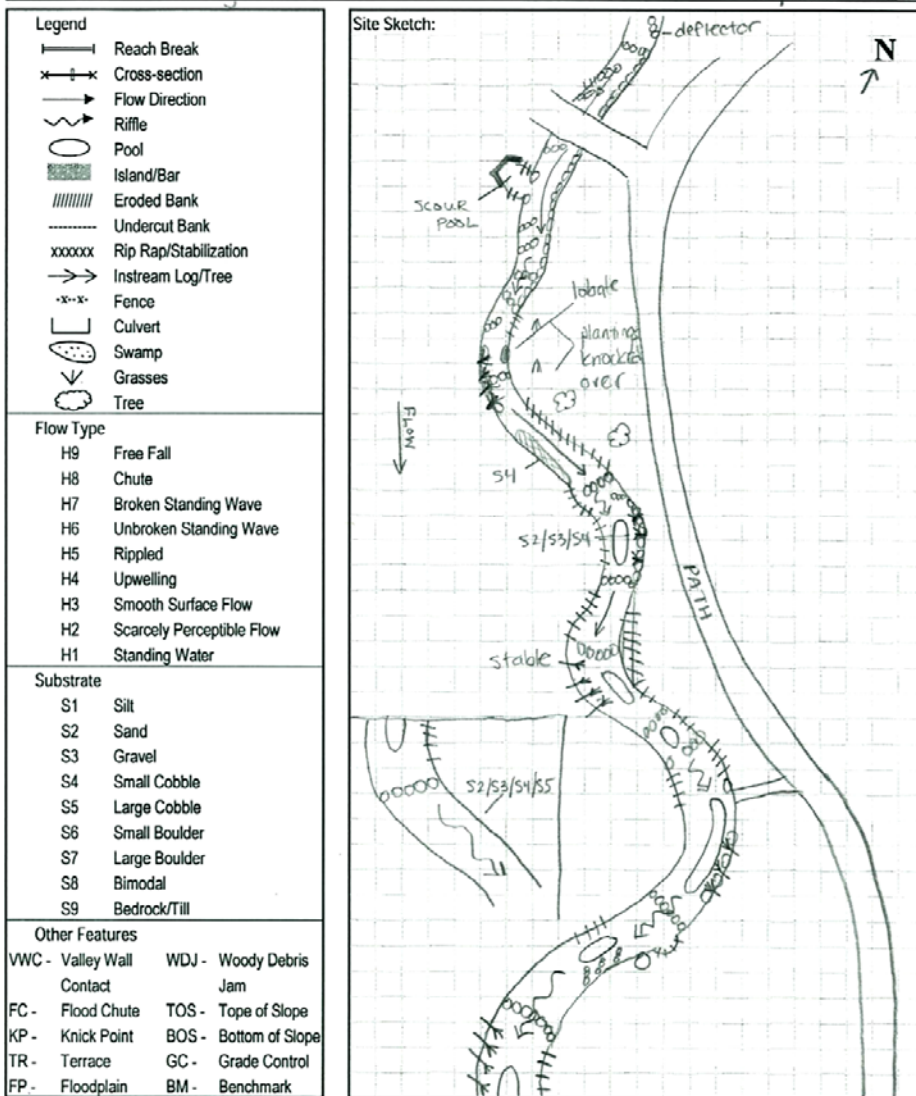
Newson and Newson, 2000



- Substrate
- Morphology – geomorphic units and micro-habitat
- Hydraulics



Date: July 29, 2013 Weather: rain/cloud, cool Recorder/Crew: CH/ER  
 Stream/Reach: #2 Little Etobicoke Creek Watershed/Subwatershed: Etobicoke Creek  
 Location: Mississauga Project Code/Phase: N/A



# Sub-reach sketch maps

- Sub-reach scale reach maps provide appropriate resolution to identify hydraulic units, substrate type, and bioengineering structures (Villard and Ness, 2006)
- Uniform hydraulic units, morphological units, uniform patches of substrate and micro-habitat are sketched onto pre-drawn planform including all significant design elements, bioengineering, geomorphological units

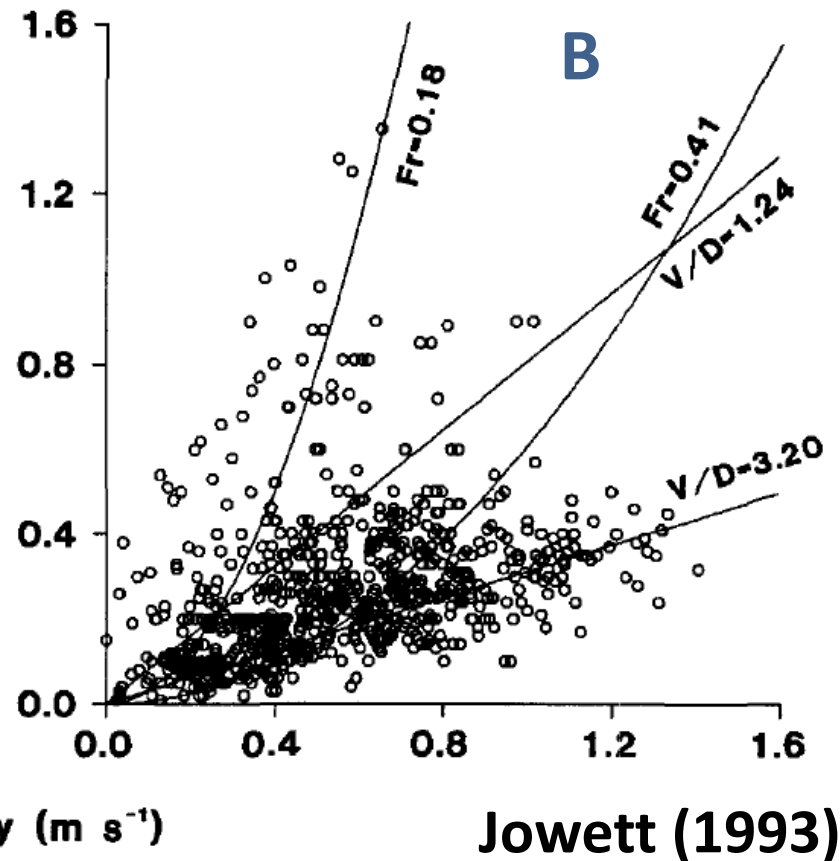
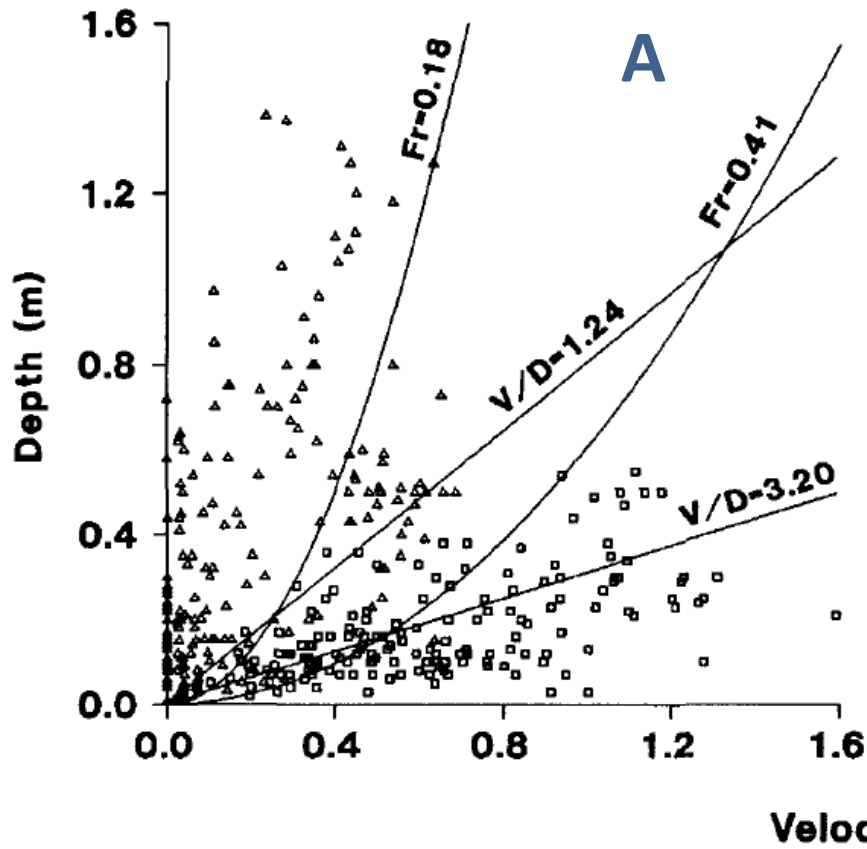


# Hydraulic signatures

A – Pools (triangles)  
Riffles (squares)

$$Fr = \frac{V}{\sqrt{gd}}$$

B – Runs/transitions (circles)



# Target fish species – Redside dace (*Clinostomus elongates*)

- Species-at-risk / Endangered species
- Examine overall habitat and spawning habitat requirements

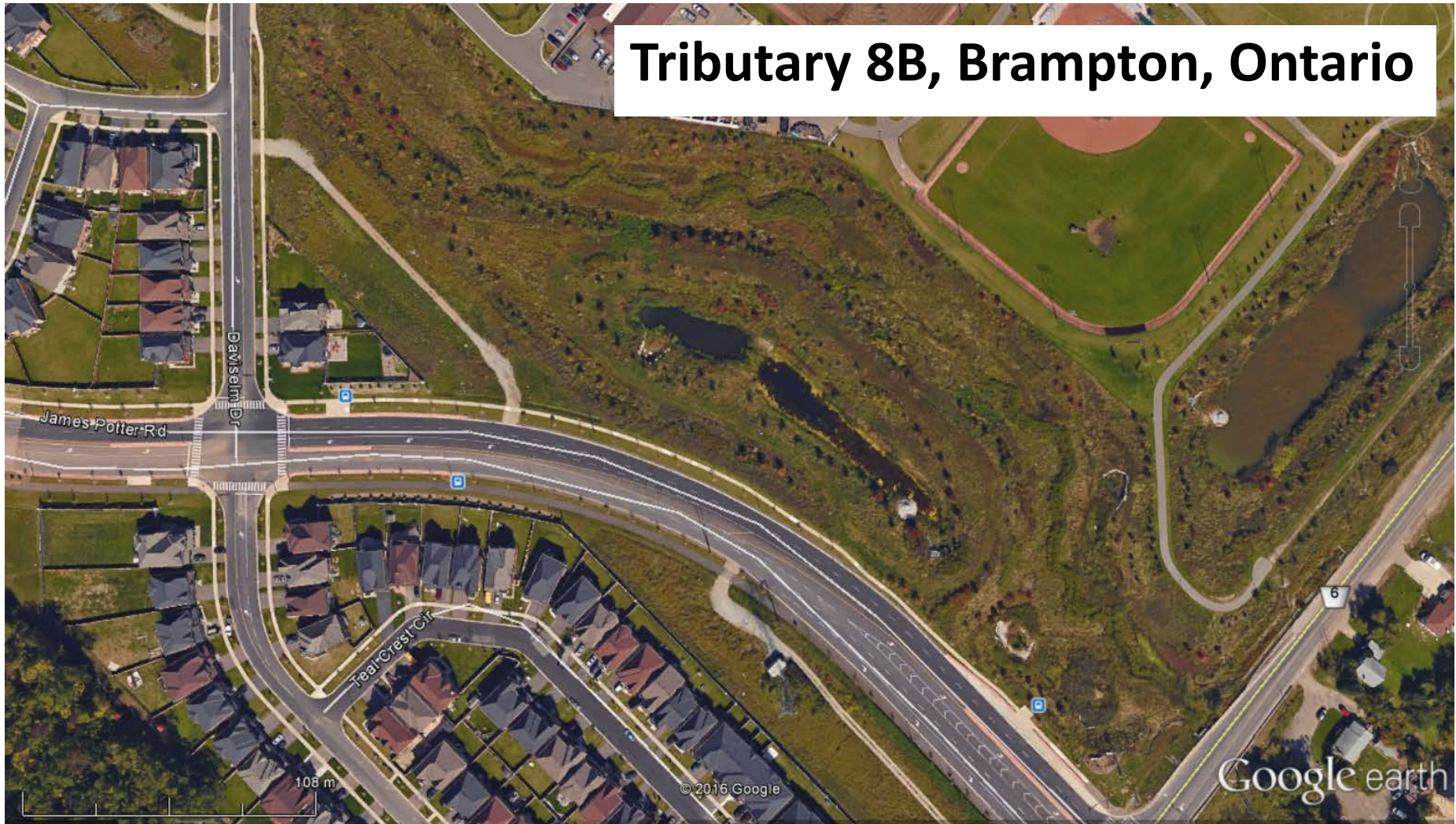


Timing	Water Depth (m)	Velocity (m/s)	Water Temperature (°C)
Overall	0.05 – 2.00	0.0 – 0.35	13.5 – 24.4
Spawning	0.05 – 0.10	0.05	< 18.0

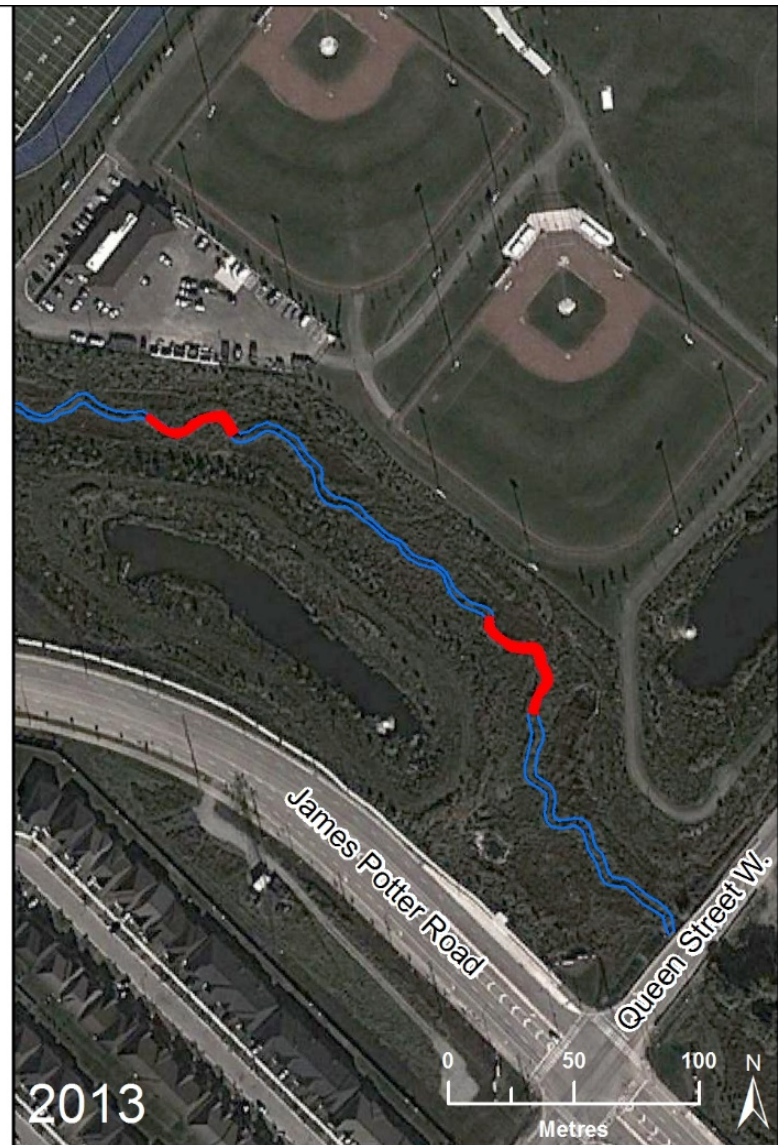
Koster, 1939; McKee and Parker, 1982; Novinger and Coon, 2000;  
Zimmerman, 2009



# Tributary 8B, Brampton, Ontario

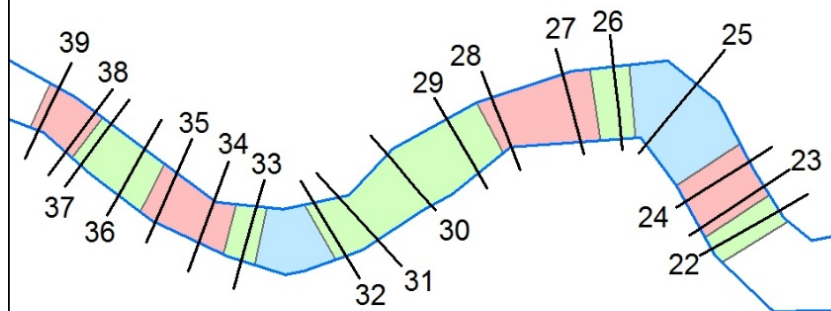






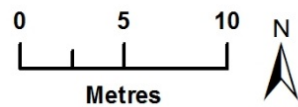
**Tributary 8B, Brampton, Ontario**

## Upstream

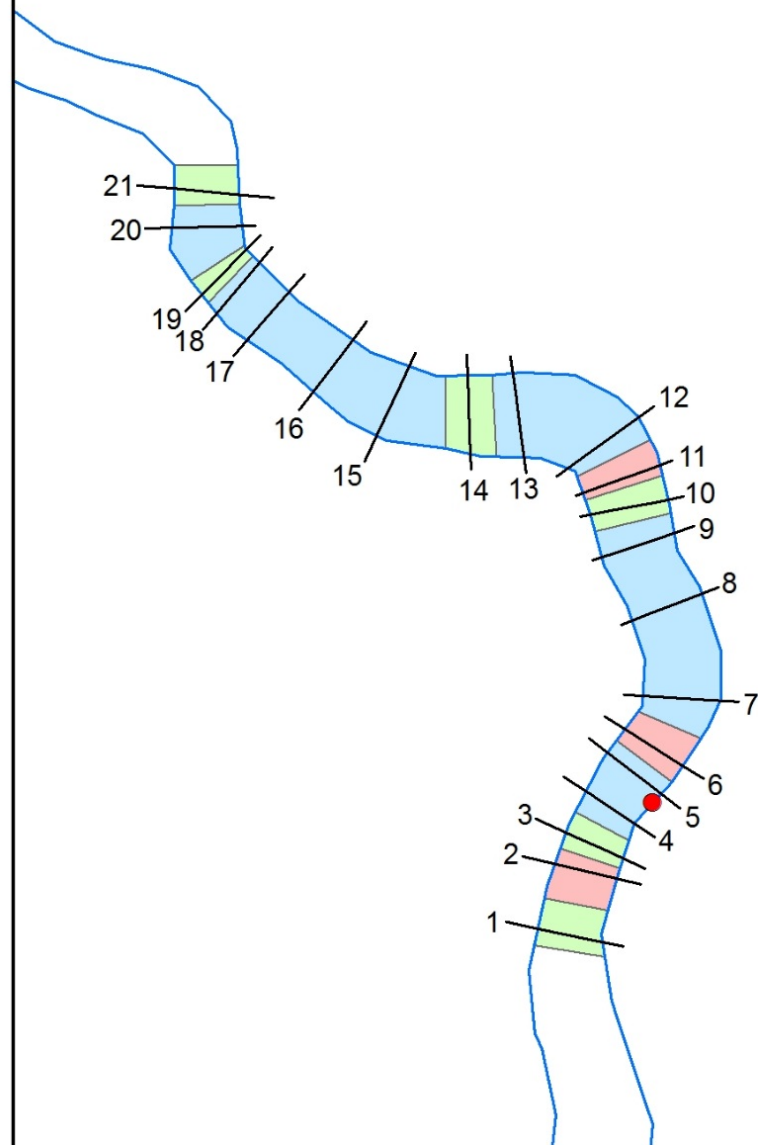


### Legend

- Channel Edge
- Cross Section
- Water Level Logger
- Pool
- Riffle
- Run



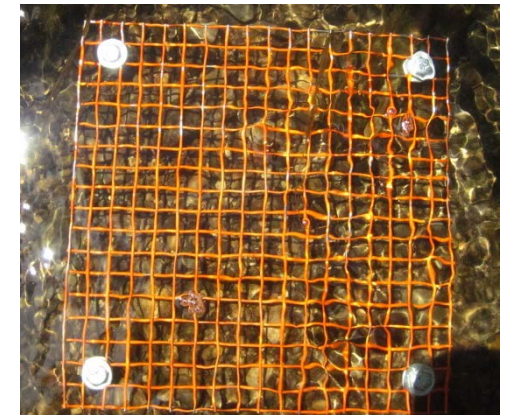
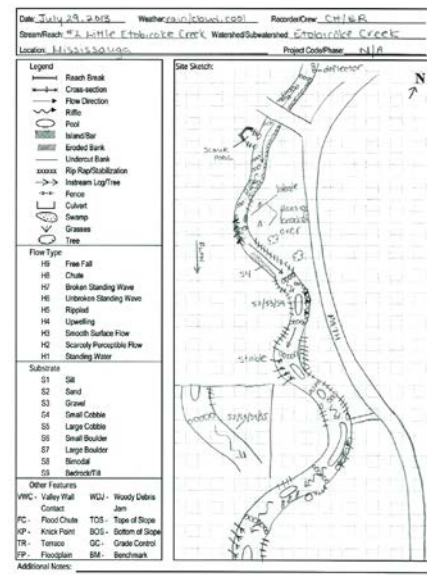
## Downstream



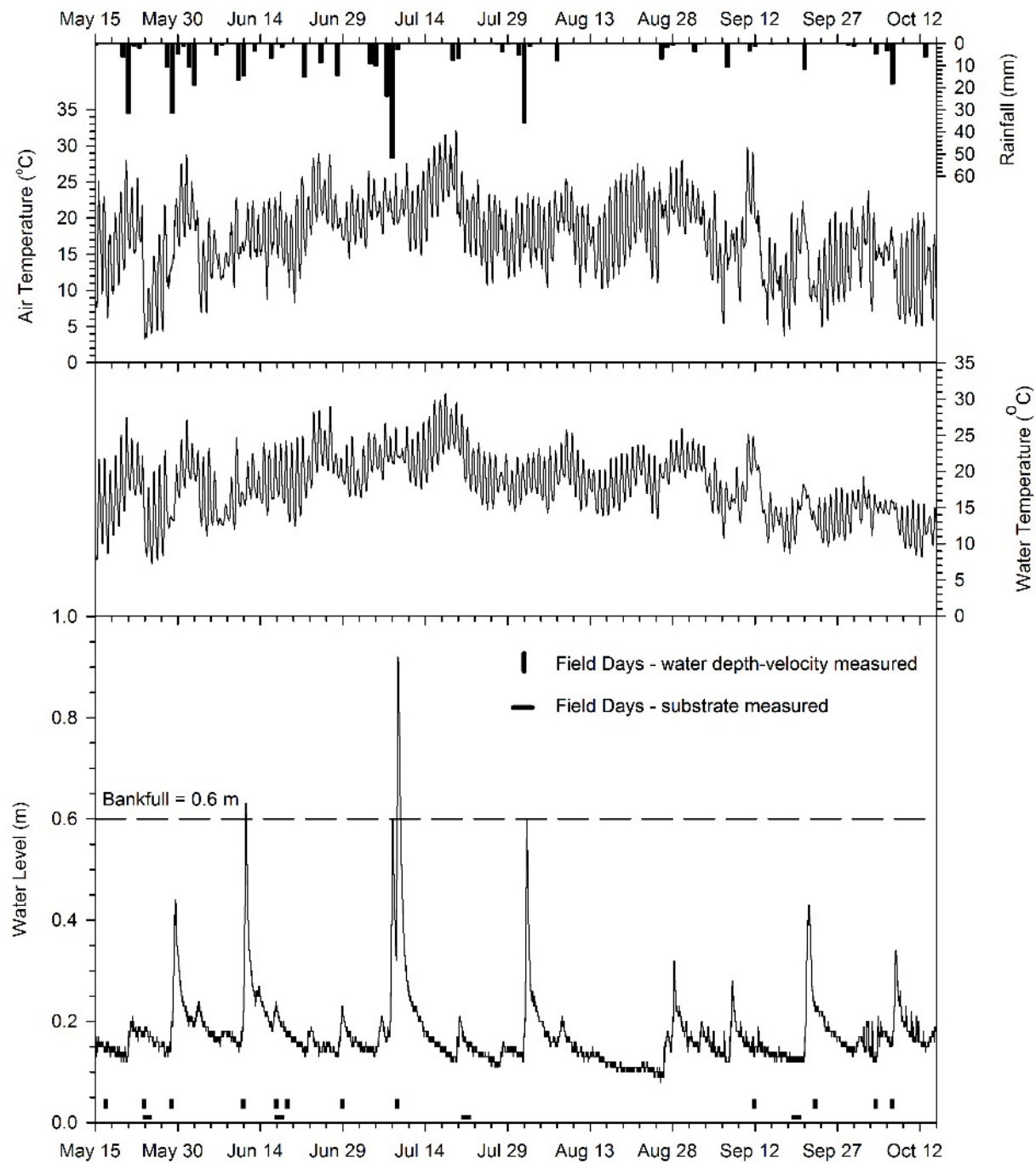


# Summer monitoring

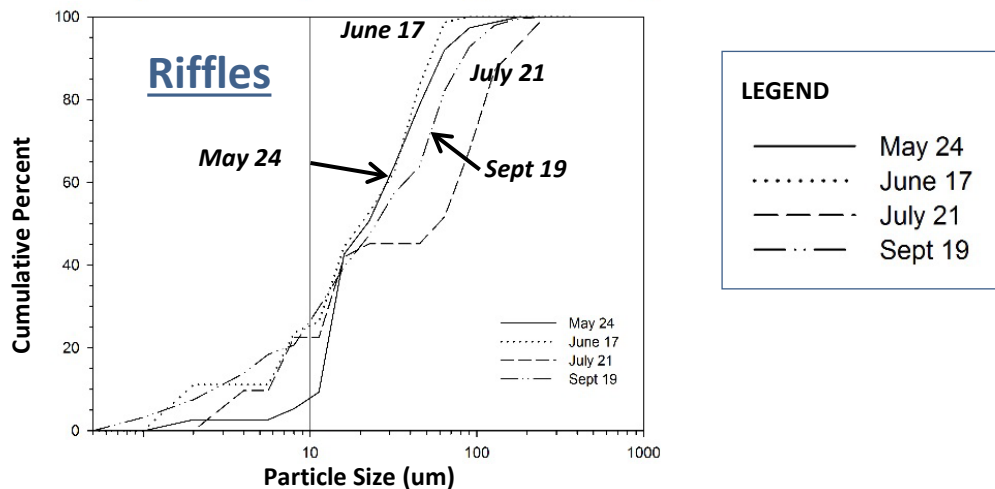
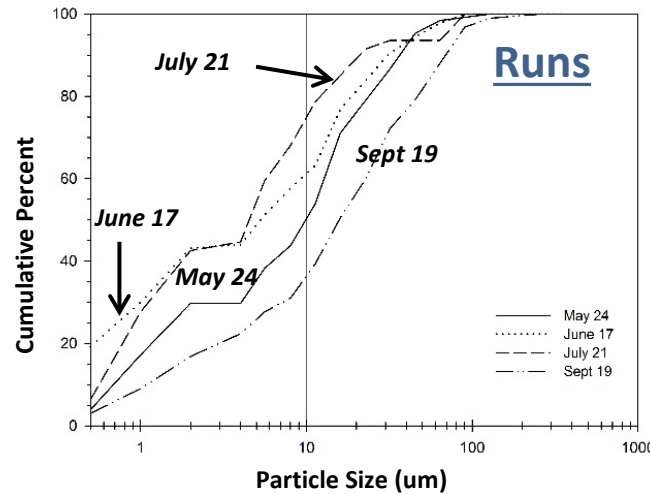
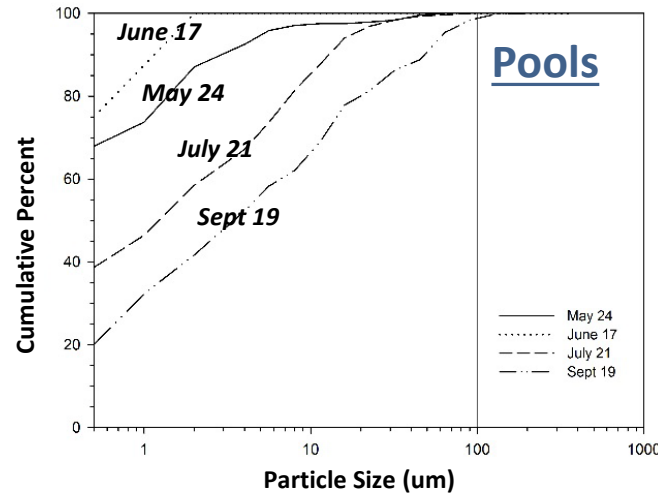
- Weather, water level and temperature data recorded
- Site visits at various flow conditions to evaluate depth and velocity along cross-sections in different geomorphic units:
  - 0.10 m intervals
  - ADV
  - Depth
- Substrate measurements
- Sketch mapping







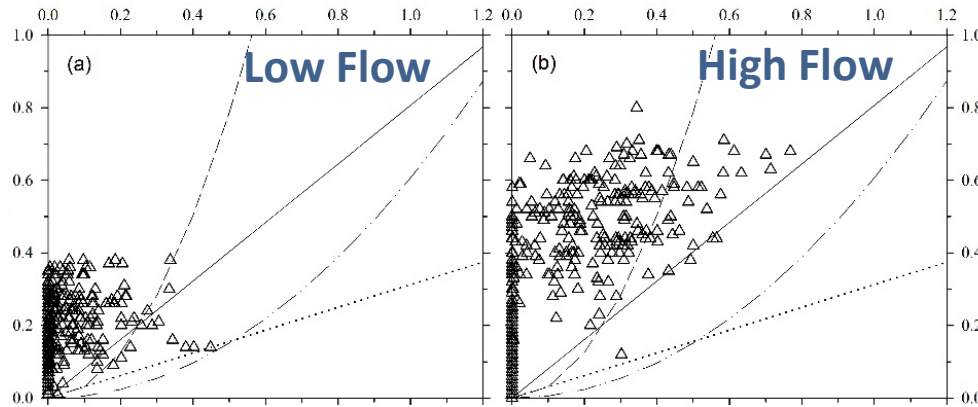
# Varied substrate observed



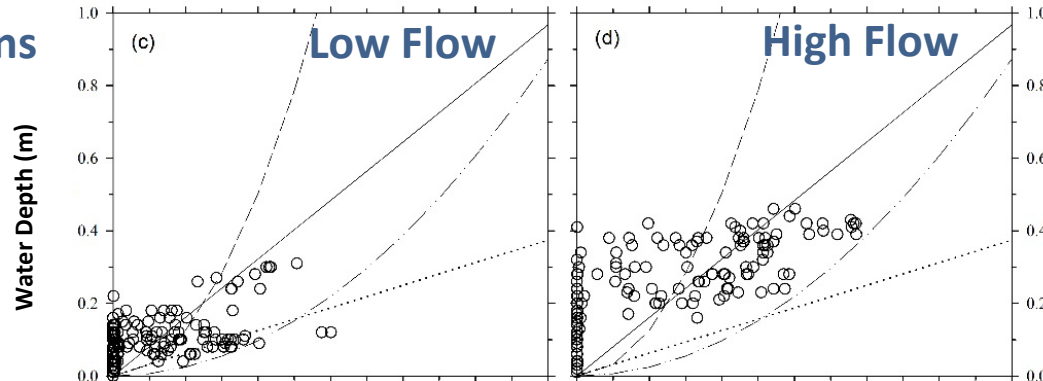
## *By geomorphic unit & throughout 2013*

- Fine-grained material in pools, gradually coarsened over the season
- Riffles were coarsest and gradually coarsened over the season
- Coarsening may be caused by large flow events in July

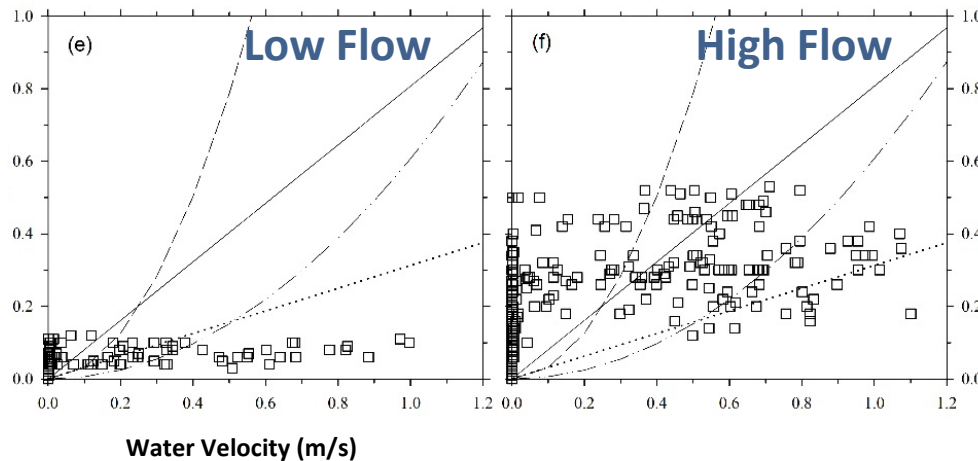
Pools



Runs



Riffles

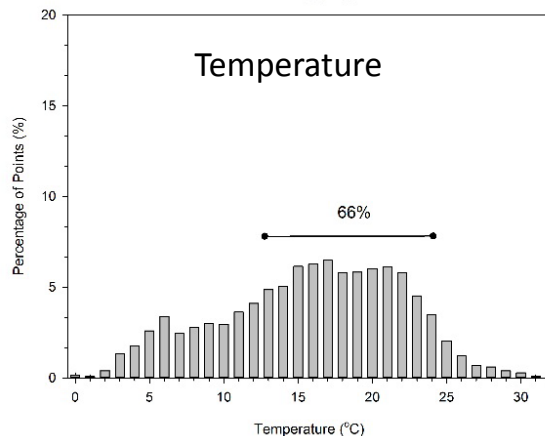
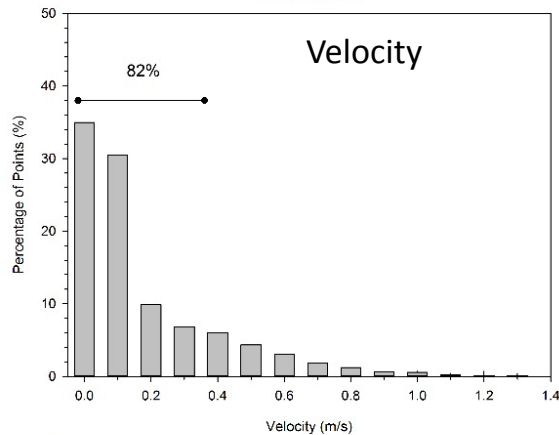
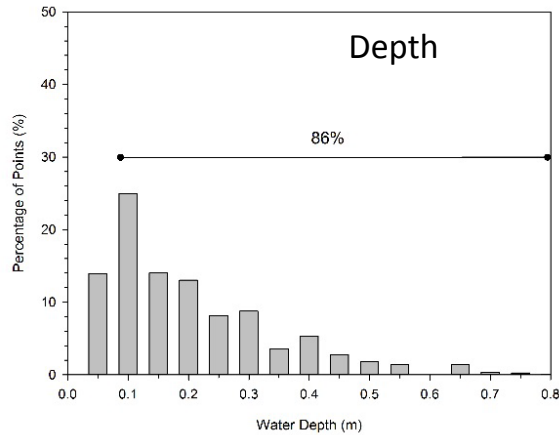


## Hydraulic signatures of geomorphic units

- Each geomorphic unit has a distinct hydraulic signature (velocity vs depth curve)
- The hydraulic signature distinction between geomorphic units decreased as flow increased

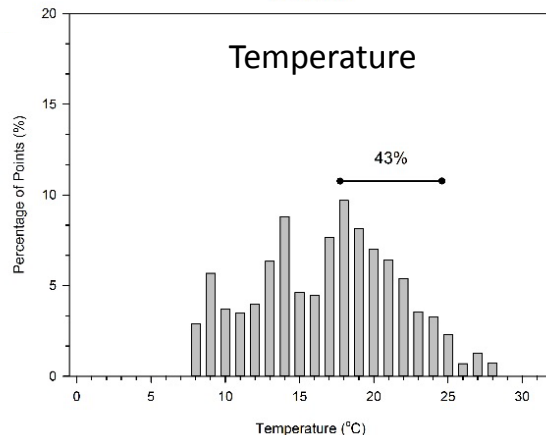
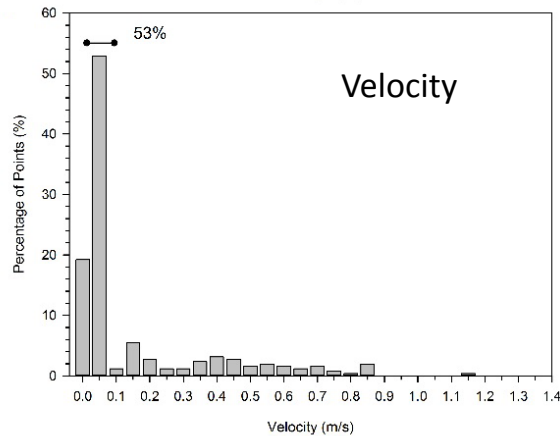
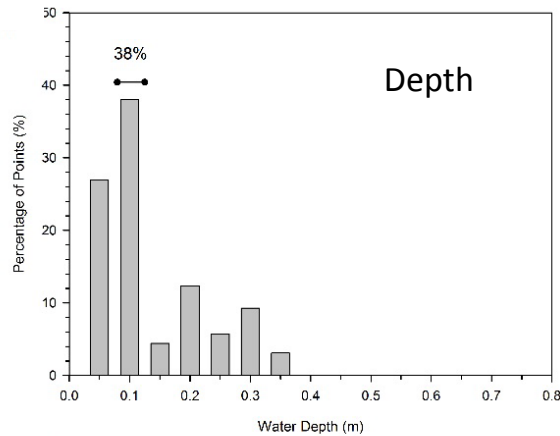
————	$U/WD = 1.24$
.....	$U/WD = 3.2$
- - - -	$Fr = 0.18$
- · - ·	$Fr = 0.41$





# Overall available habitat

- Species-at-risk, such as Redside dace, have specific habitat requirements
- Overall, Timberbank restoration project provided adequate SAR/ES habitat
  - Horizontal lines on each histogram indicate the percentage of measurements within the optimal SAR/ES habitat



# Suitable habitat during spawning season

- Suitable habitat availability during spawning was reduced
  - With respect to depth, water levels were higher than required, this does not pose a danger
  - With respect to velocity, the majority (53%) were sufficient or slower, with less than 30% too high
  - With respect to temperature, the ideal range was achieved, but dangerously warm temperatures did occur



# Conclusions

- Using the hydraulic signature provides a quantitative methodology to examine reaches and identify geomorphic units within natural and 'restored' channels
- This approach provides one tool to assess 'restored' and natural channels in relation to the proportion of different geomorphic units and in the area within the channel that is suitable for a given target fish species
- We still need a better understanding of seasonal changes in surficial sediments and methods to evaluate habitat suitability during the winter







Thank you