What is the largest source of water pollution in the nation?

Industrial Effluent

Agricultural Runoff

Construction Runoff

Urban Runoff

Gaseous Emissions

Wastewater Effluent

"Agricultural runoff is the single largest source of water pollution in the nation's rivers and streams, according to the E.P.A." – New York Times

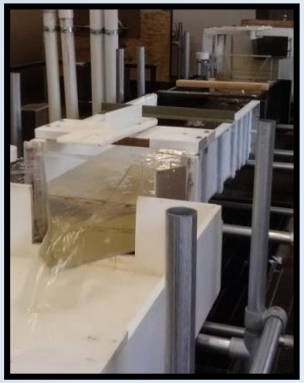
Passive Stormwater Agricultural Runoff Sampling

Parker, Philip J., Busch, Dennis L.,
Fitzgerald, Kyra C., and Dana Gibson

American Water Resource Association (AWRA) – Wisconsin Section 38th Annual Meeting Student Presentation, Chula Vista Resort, Wisconsin Dells, WI, March 14, 2014.

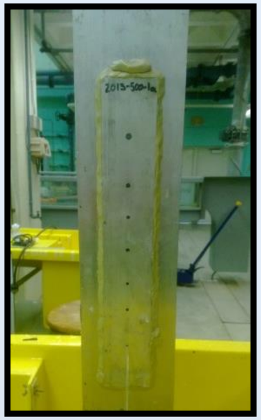
Overview

0. Agricultural Runoff Monitoring Background



1. Splitting Accuracy "Volume" of Multi-Orifice Passive Samplers

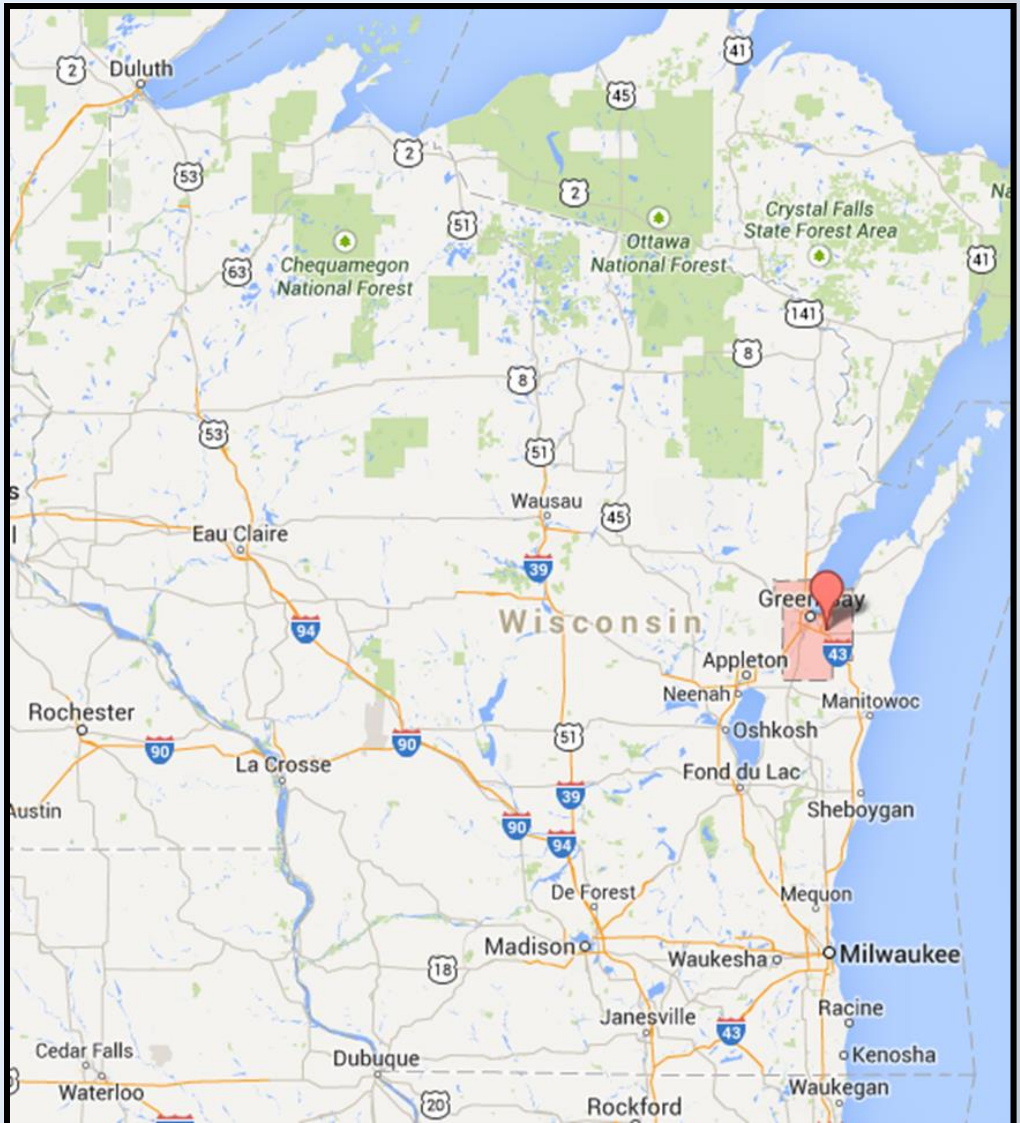
2. Representativeness of Samples from Multi-Orifice Passive Samplers



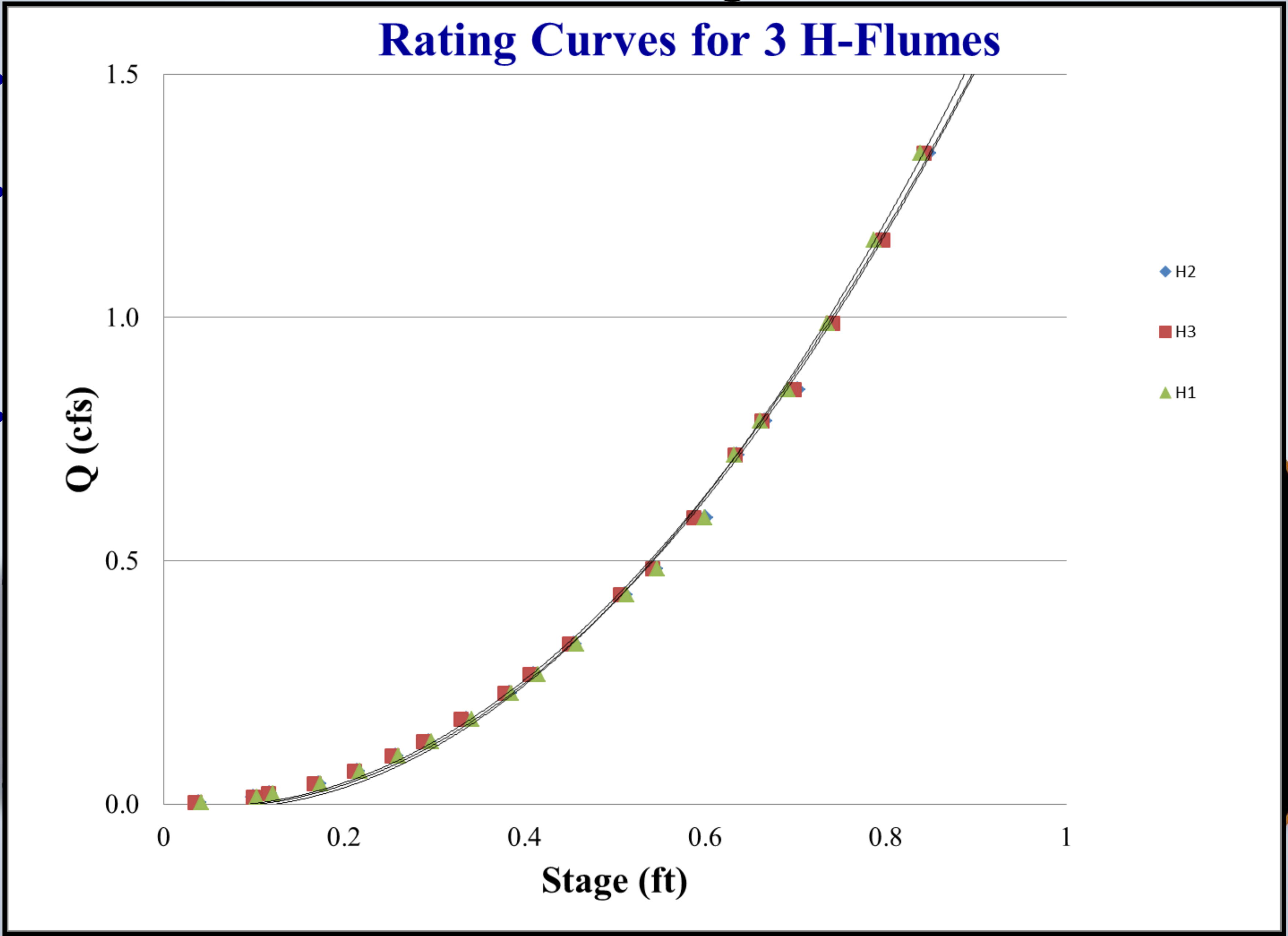
3. Plate Sampler –coefficients of discharge experiments

"In 2006, an early thaw in Brown County melted frozen fields, including some that were covered in manure. Within days, more than 100 wells were contaminated with coliform bacteria, E. coli, or nitrates — byproducts of manure or other Fertilizers..."

-New York Times (2009)



Flume Background



Agricultural Runoff Monitoring

- **Why?-Estimate pollutant loading**
- **What?-Automated samplers**
- **What's new?-Researching a less expensive agricultural runoff sampling method**

Advantages and Disadvantages of an Automated Sampler and a Passive Sampler

Automated Sampler

- (+) Remotely triggered
- (+) Refrigerated samples
- (+) Programmed to sample at a certain time or volume
- (+) Obtains a discrete sample
- (-) Requires power
- (-) Routine maintenance
- (-) May be "overkill" in some instances
- (-) Costly

Both Require

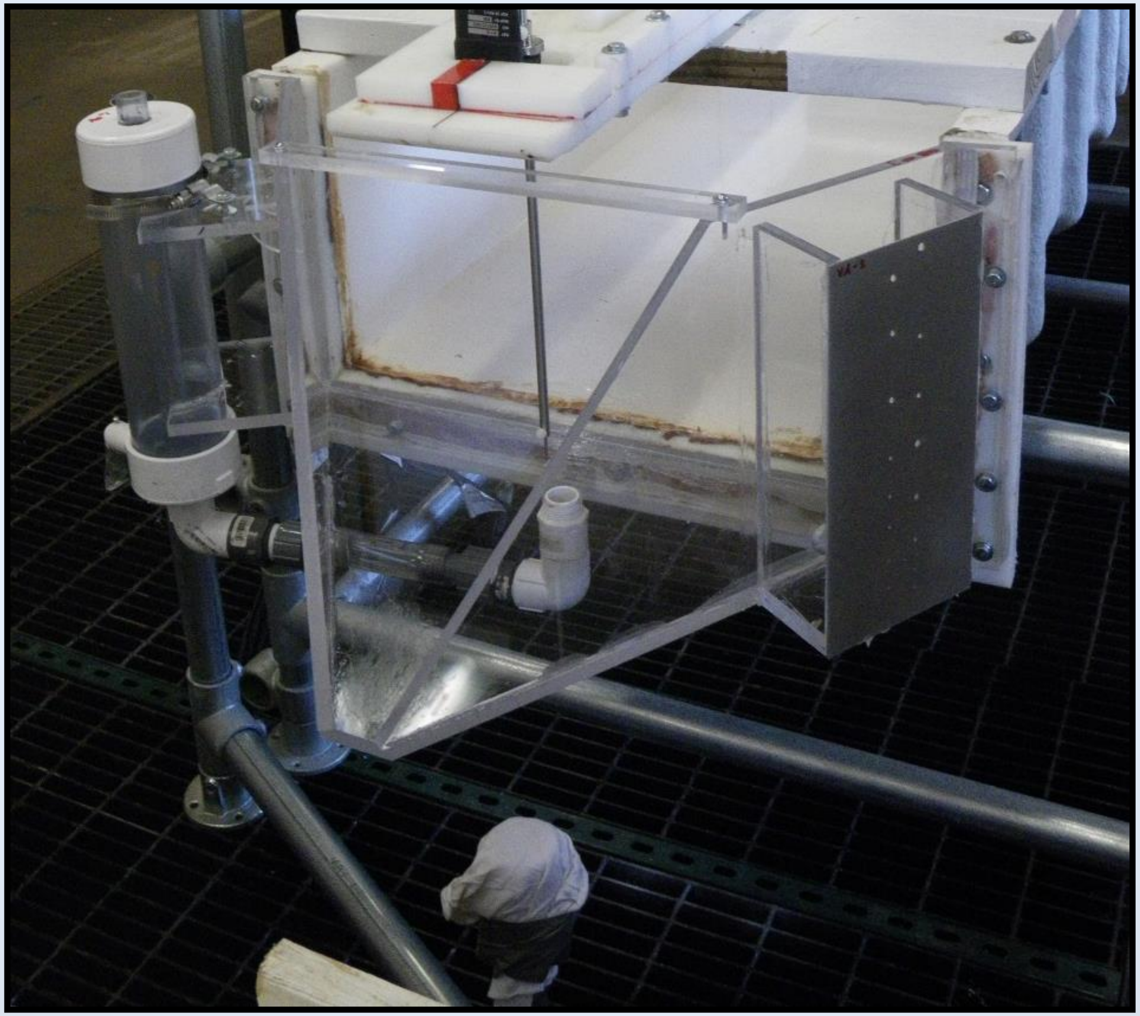
- A person to collect sample
- A person to analyze sample
- Routine maintenance

Passive Sampler

- (+) No power required
- (+) Less expensive
- (+) No moving parts
- (+) Ability to obtain composite sample
- (-) No refrigeration
- (-) New method less known
- (-) Cannot generate hydrograph

Multi-Orifice Samplers

Stevens Sampler **Plate Sampler**



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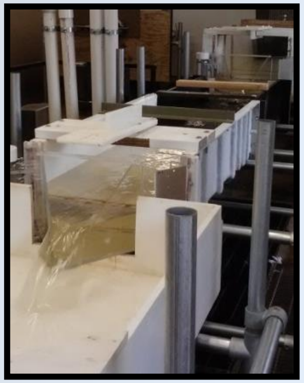

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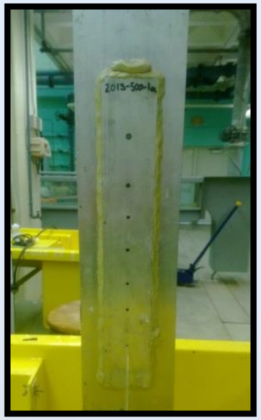

3. Plate Sampler – coefficients of discharge experiments

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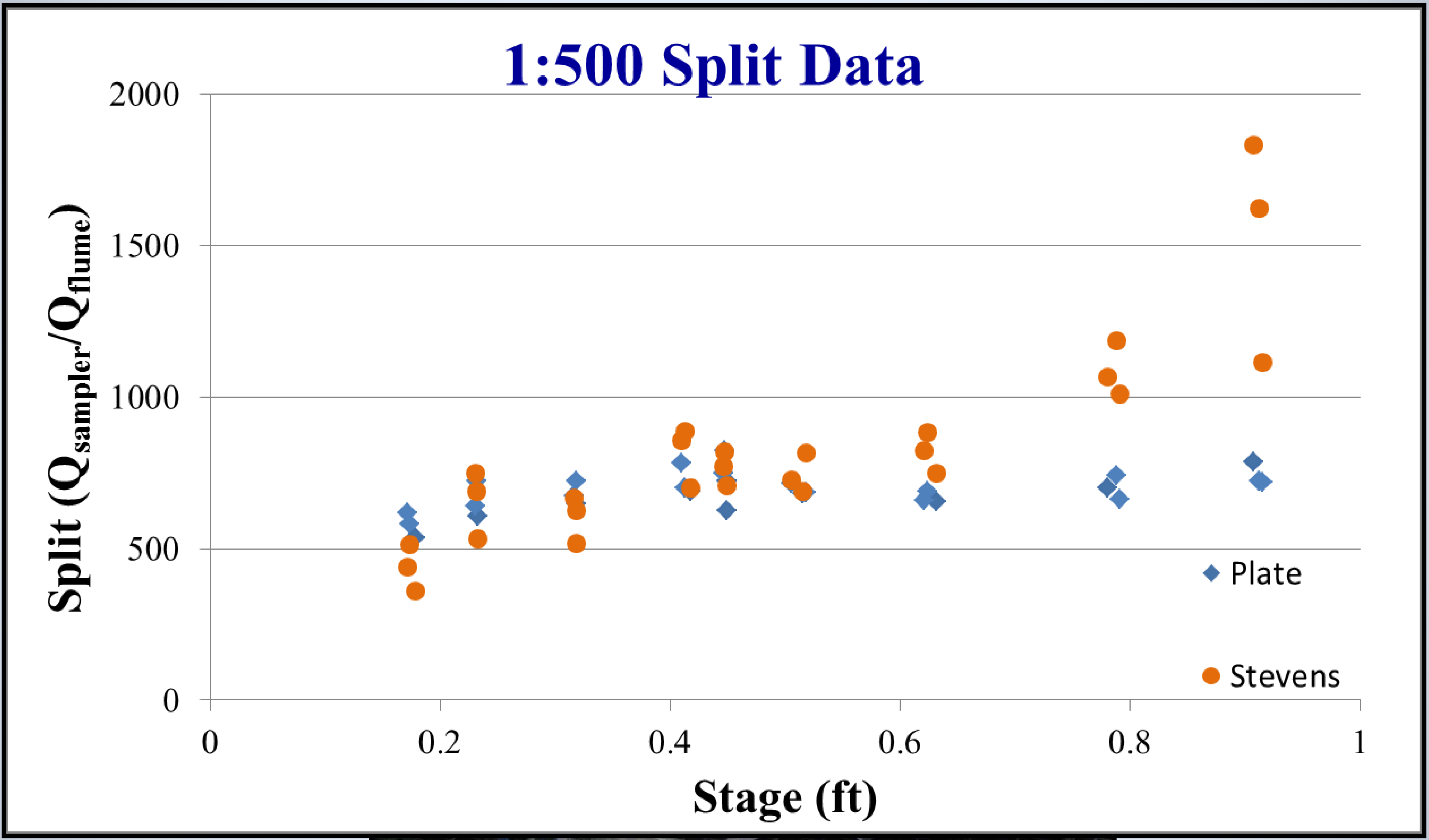

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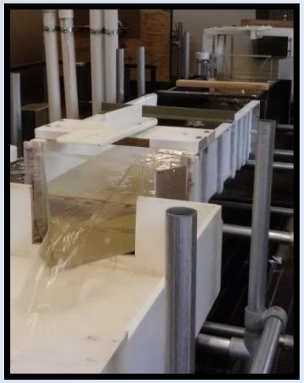

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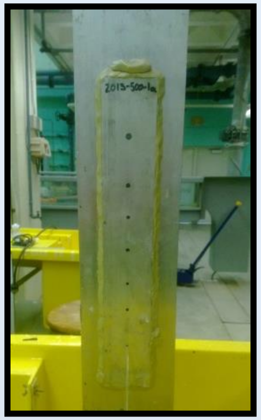

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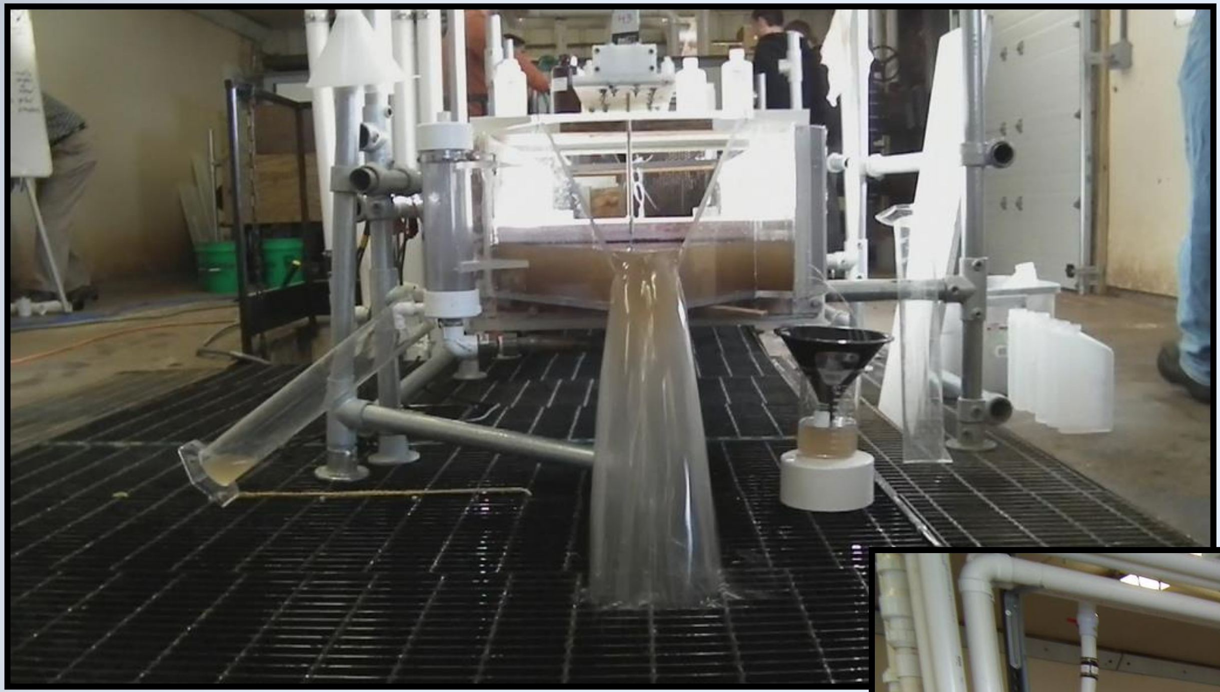
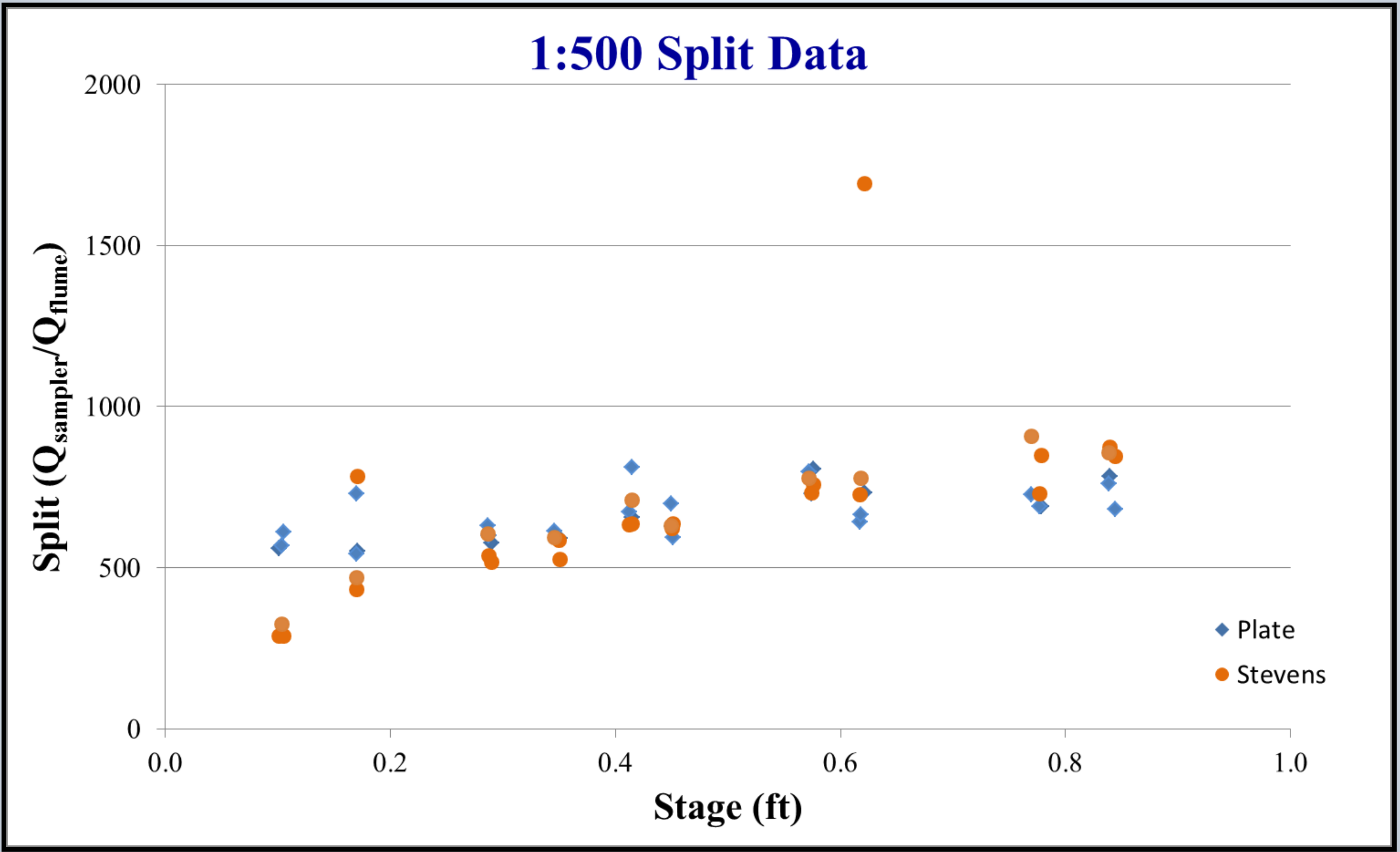
Representativeness of the Multi-Orifice Passive Sampler

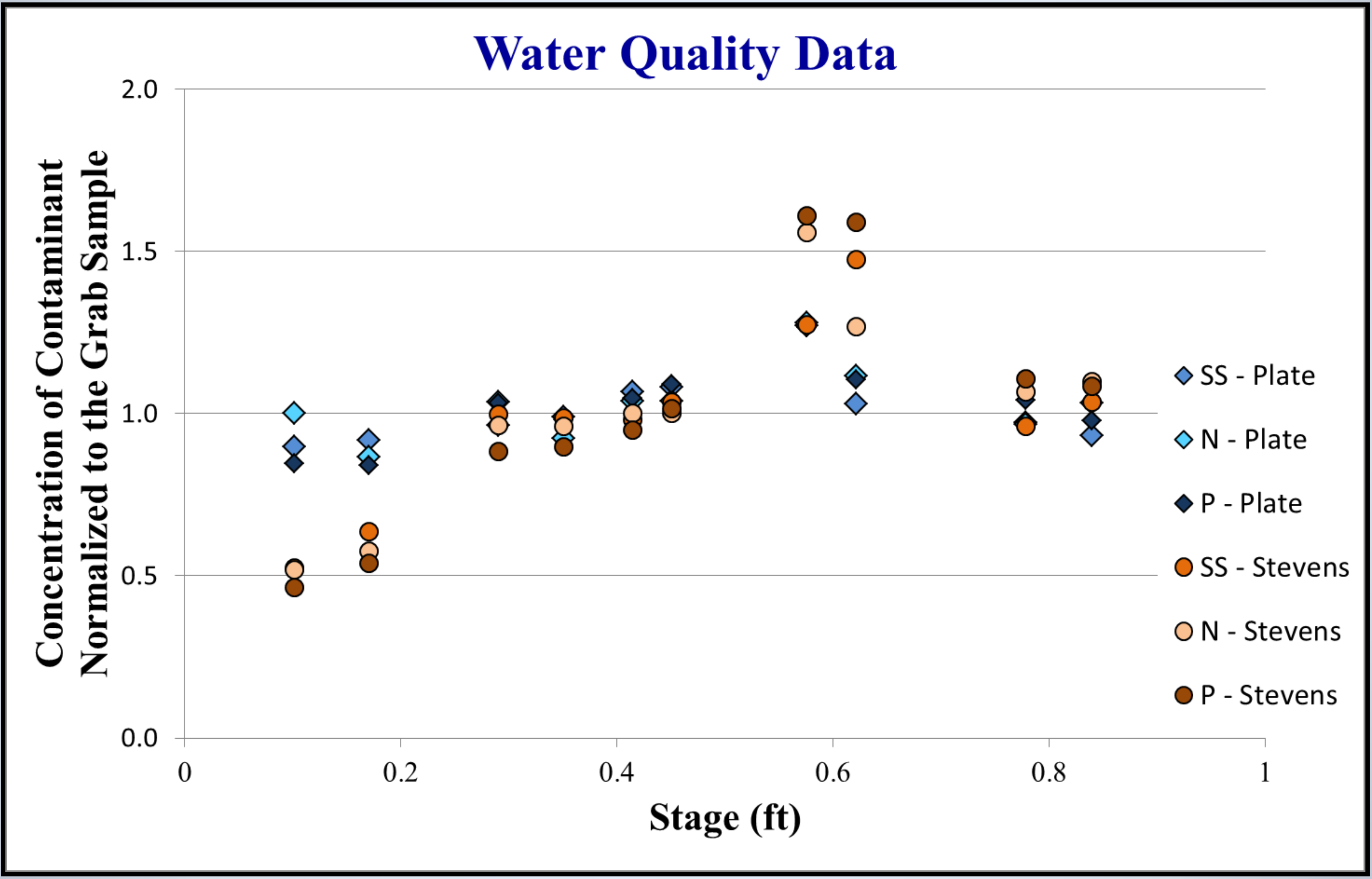


Runoff Quantity
Runoff Quality
- **SS**
- **Nutrients**
- **Particle Size**

Runoff Quantity Results

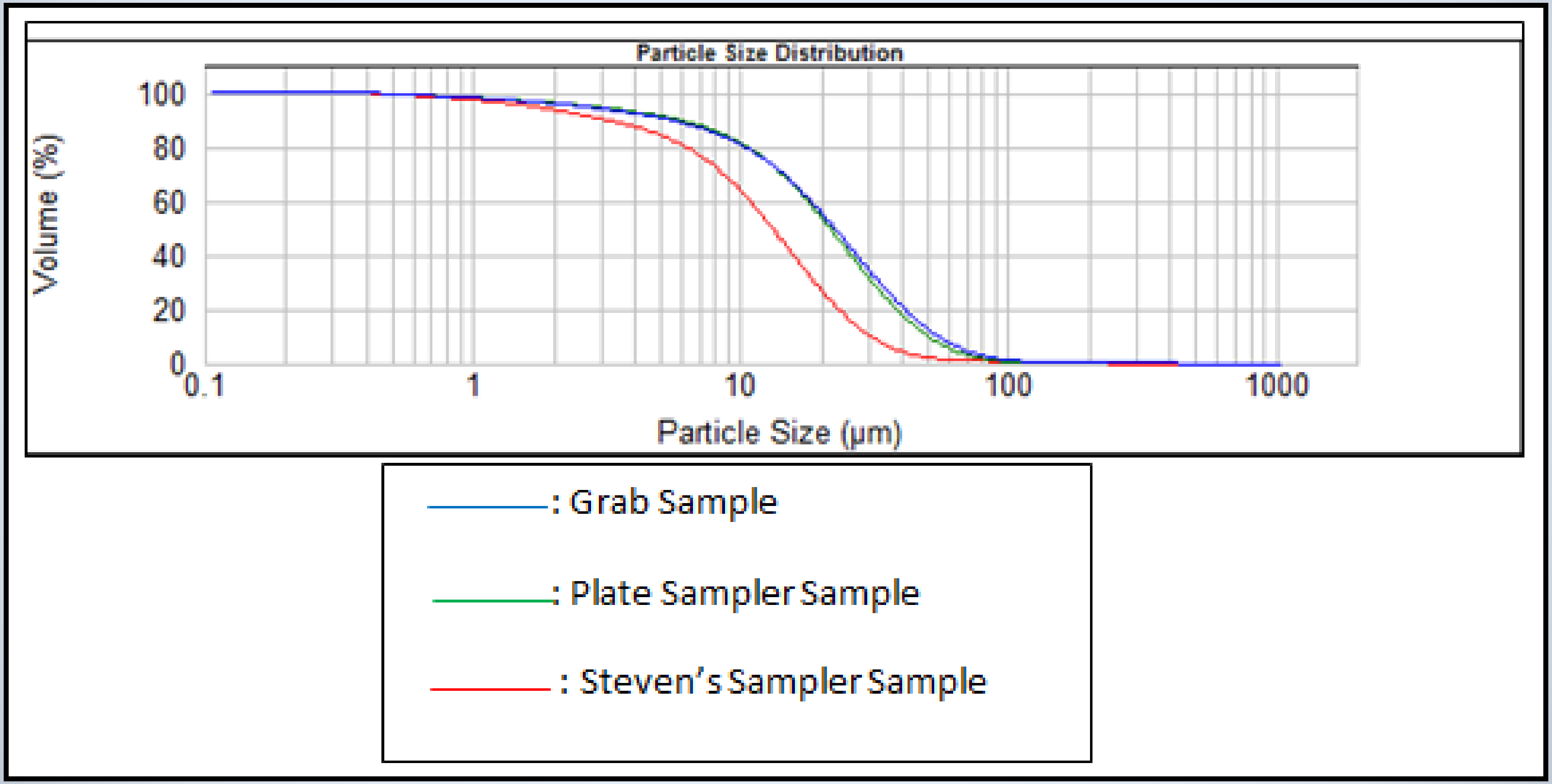


Runoff Quality Results



Runoff Quantity Results

Particle Size



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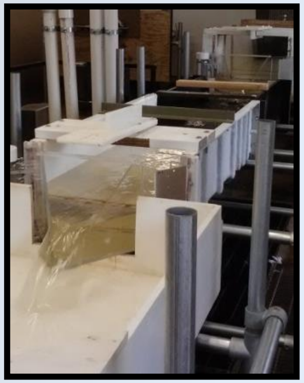

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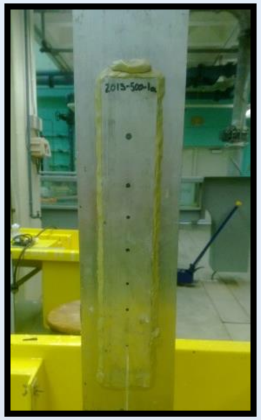


3. Plate Sampler – coefficients of discharge experiments


1/16
3/32
1/8

Discharge Coefficients

Theoretical flow from an orifice is dependent upon

- **The area of the orifice,**
- **Thickness of the plate,**
- **The head of the fluid above the orifice.**

$$Q_{Theoretical} = A_{orifice}\sqrt{2gh}$$

$$Q_{Actual} = C_d A_{orifice}\sqrt{2gh}$$

$$Q_{Theoretical} > Q_{Actual}$$

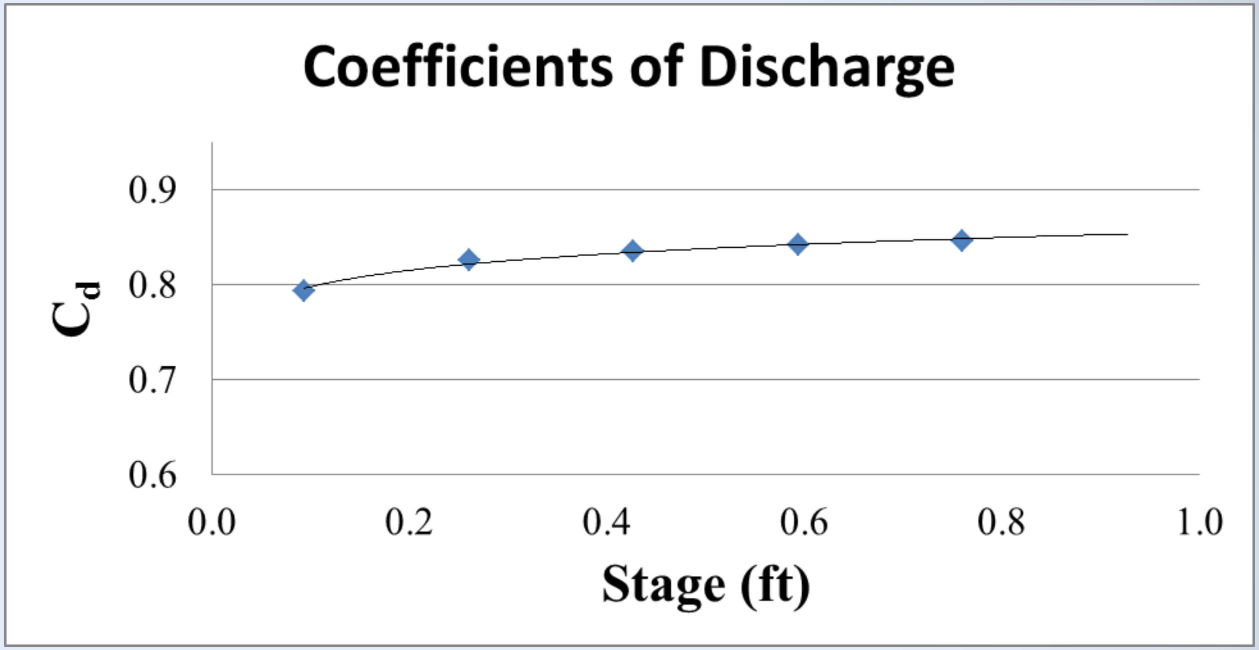
$$C_d = \frac{Q_{Actual}}{Q_{Theoretical}}$$

Which is a function of orifice diameter and accounts for flow restriction associated with the equipment (i.e. loss due to friction)

Coefficients of Discharge

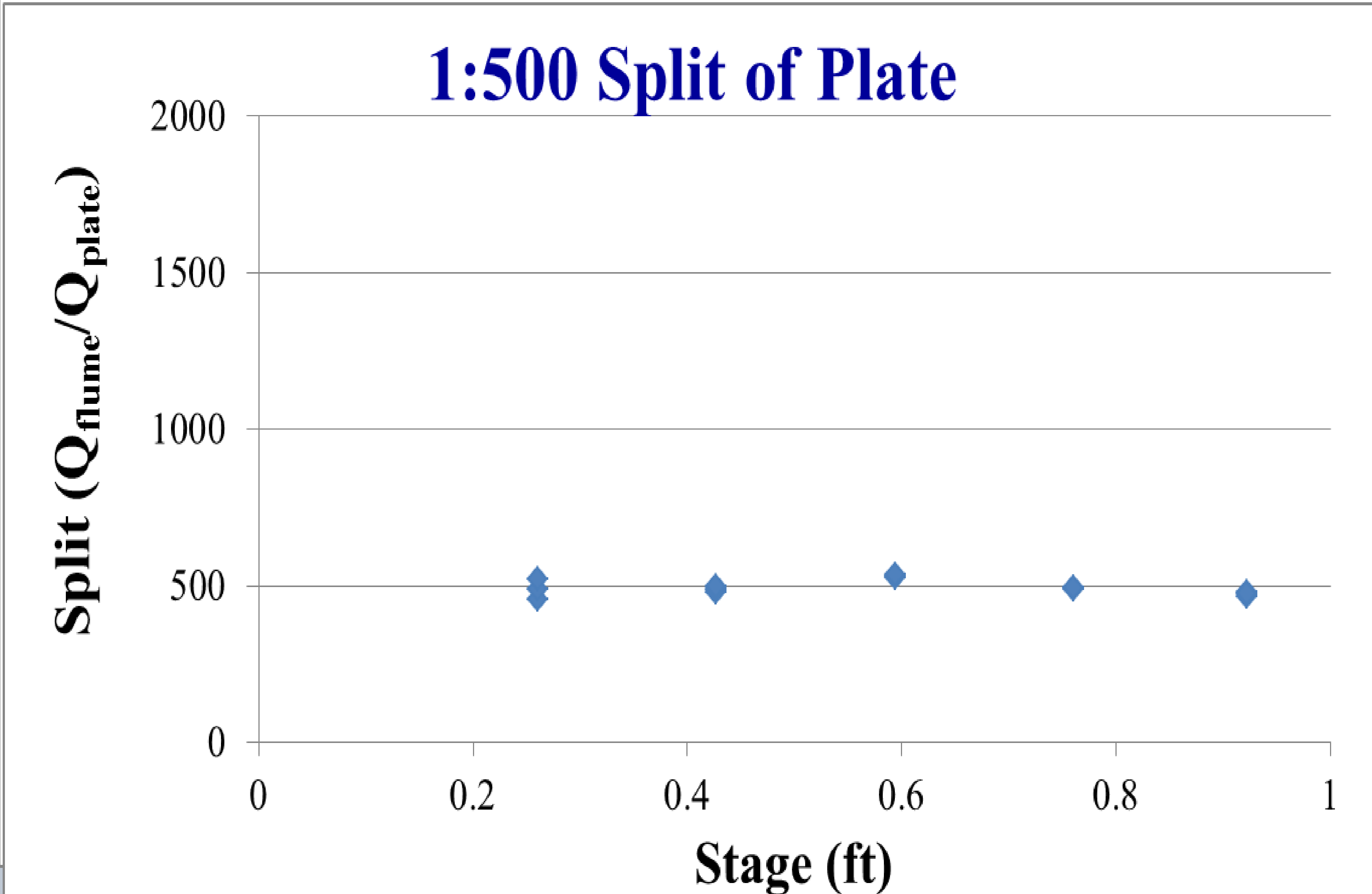
- >400 trials were performed
  - ➢ Diameter
  - ➢ Head
  - ➢ Thickness
  - ➢ Entrance type

- Procedure
  - ➢ Tare water collecting beaker
  - ➢ Collect a timed water sample
  - ➢ Weigh sample
  - ➢ Repeat 3 trials for 1 stage
  - ➢ Repeat for multiple stages

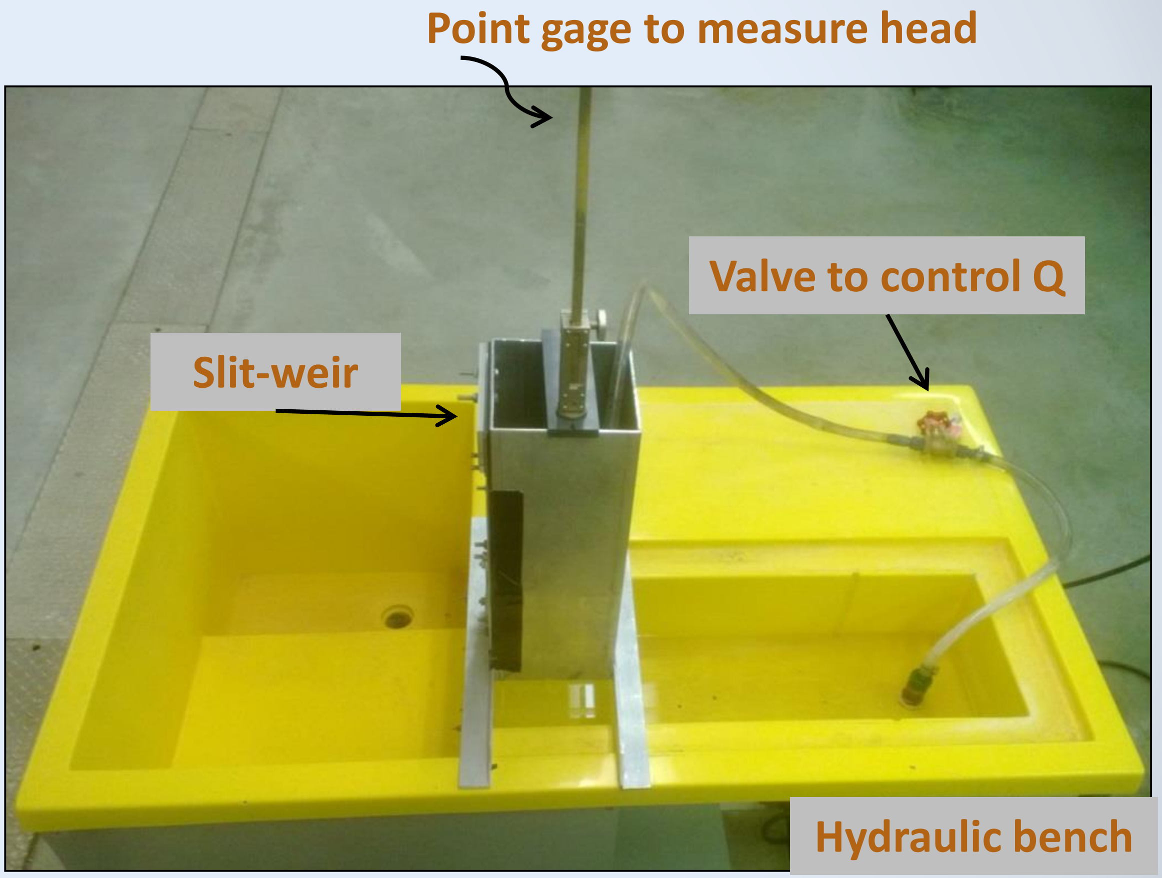


Cd values ranged from 0.6 to 0.9

More Recently



Ongoing Research



Summary

Plate Sampler:

- **Consistent flow splits**
- **Representative water quality samples (particulate and dissolved contaminants)**
- **Range of Cd values for varied parameters**

Ongoing research: currently slit-weir plate sampler coefficients of discharge to use in the design of a V-notch – weir plate sampler (infinite orifices)

References

Parker, P. J., and D. L. Busch. "Field-scale Evaluation of a Multislot Passive Sampler." *Journal of Soil and Water Conservation* 68.2 (2013): 83-88. *Soil and Water Conservation Society*. Web. 5 Feb. 2014.

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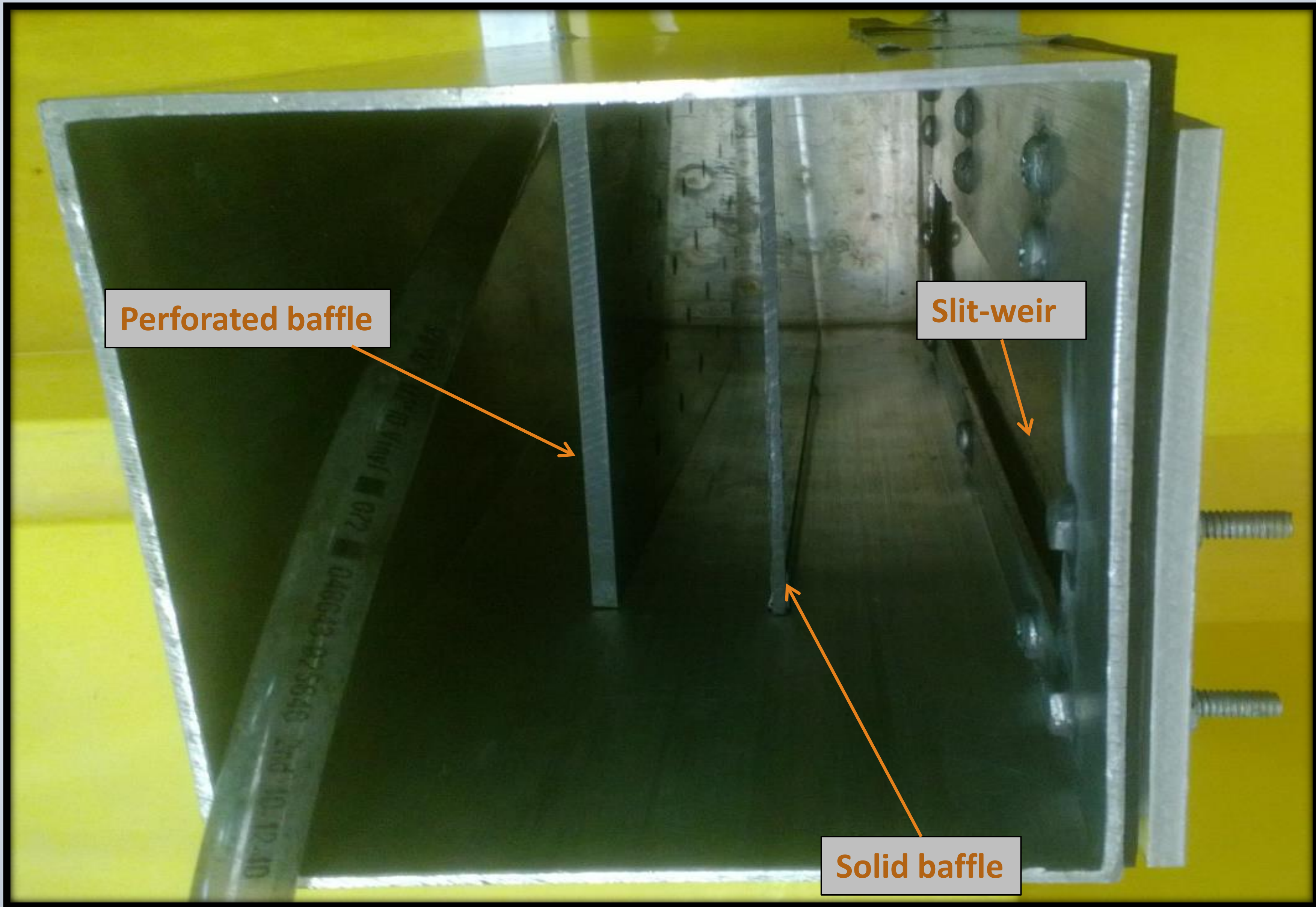
Questions?



Perforated baffle
Slit-weir
Solid baffle