A Hydrological and Sedimentological Study of the Pointe at Jamestown Retention Pond

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Overview

- Impact of urbanization
- Retention Ponds: Structure and Function
- Hydrology of Pointe at Jamestown
- Suspended Sediment at Pointe

IMPACT: Urbanization

-Higher discharge

-Lower Baseflow

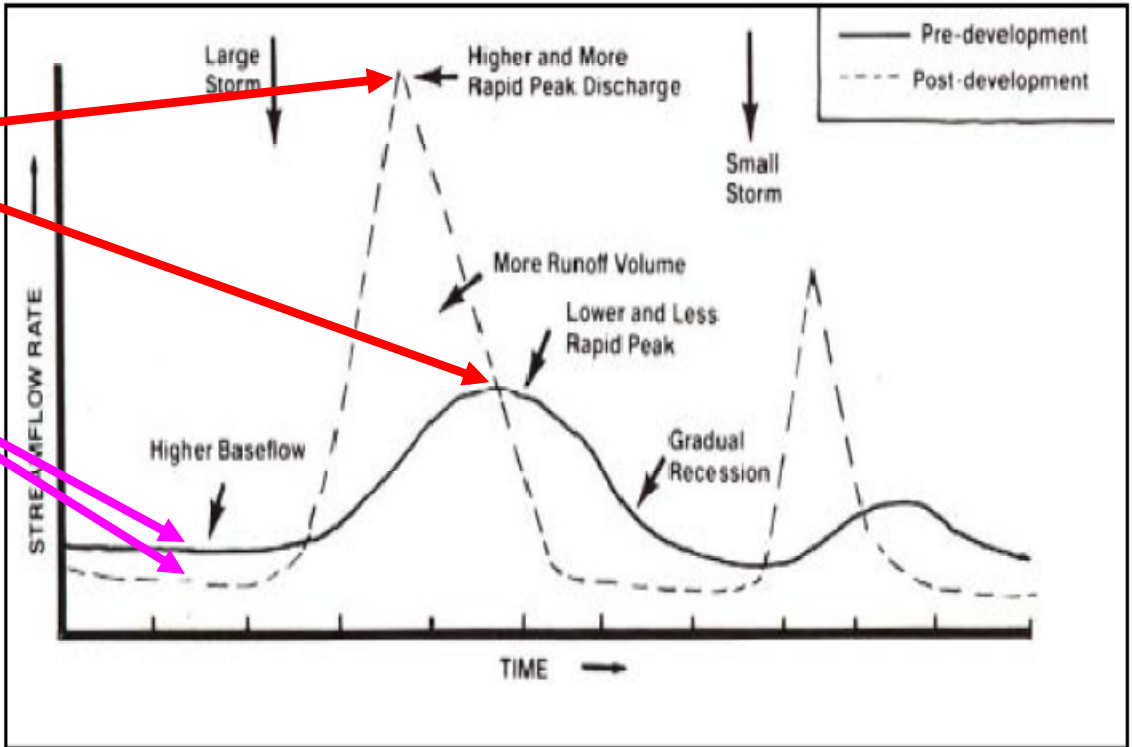


Figure 6: Altered Hydrograph in Response to Urbanization
(Schueler, 1987)

SOLUTION: Retention Ponds!

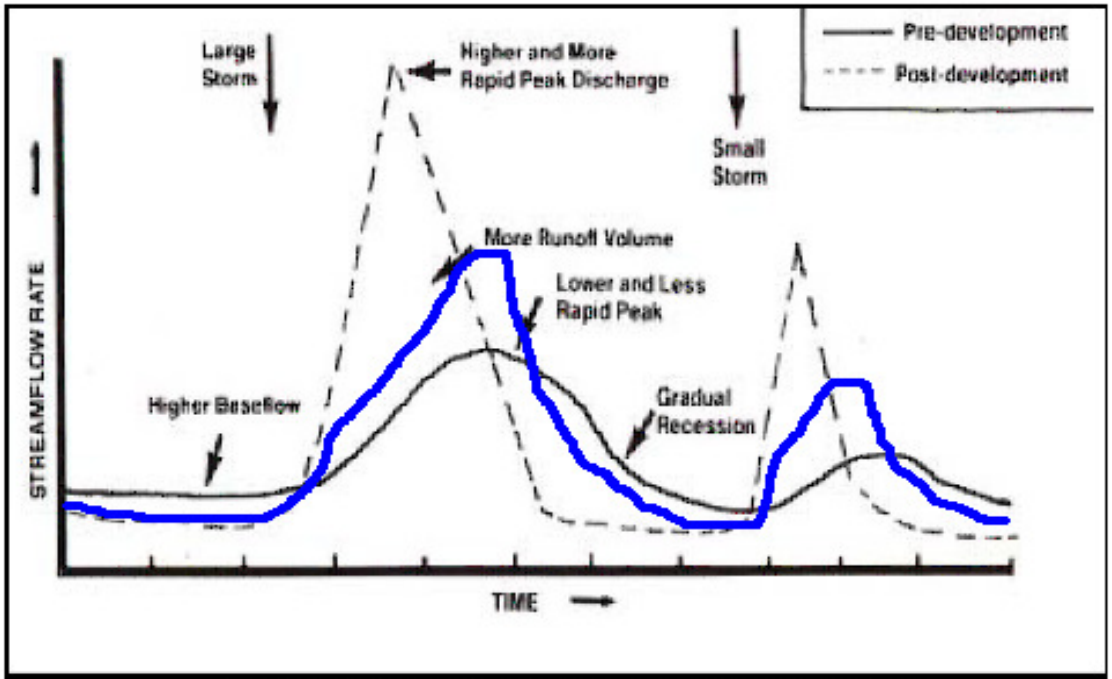


Figure 6: Altered Hydrograph in Response to Urbanization
(Schueler, 1987)

Regulations:

- **State of Virginia: 2-YR Post-Development flow cannot exceed 2-YR Pre-Development flow**
- **James City County, VA: 1-YR, 24-HR Storm rainfall must be retained for at least 24 hrs. in pond**

Research Questions

1. Is Pointe at Jamestown in compliance with state and county regulations?
2. Does Pointe perform as specified in design plans?
3. Does Pointe perform according to model design software?
4. How effectively does the Pointe retention pond capture suspended sediment from inflow?

Study Site:
The Pointe at Jamestown

Mulberry

Ironbound

W&M

POINTE

Kensington

James City County (2005)

METHODS

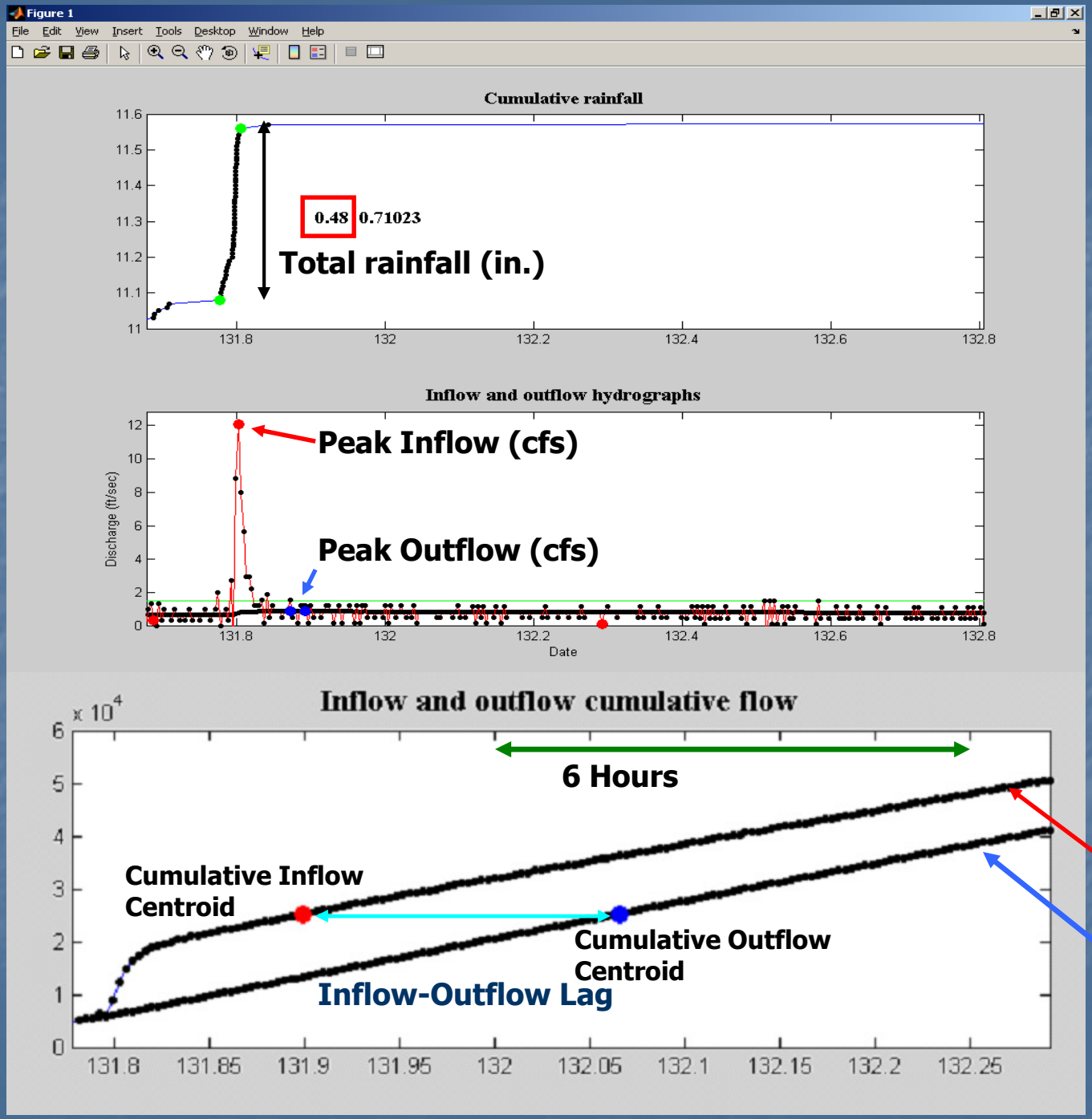
- **Datalogger (pond elevation)**
- **Rain gage (rainfall)**
- **Conversion to Inflow, Outflow, Storage (= Volume in – Volume out)**

Datalogger

Rain Gage

Lopez (2006)

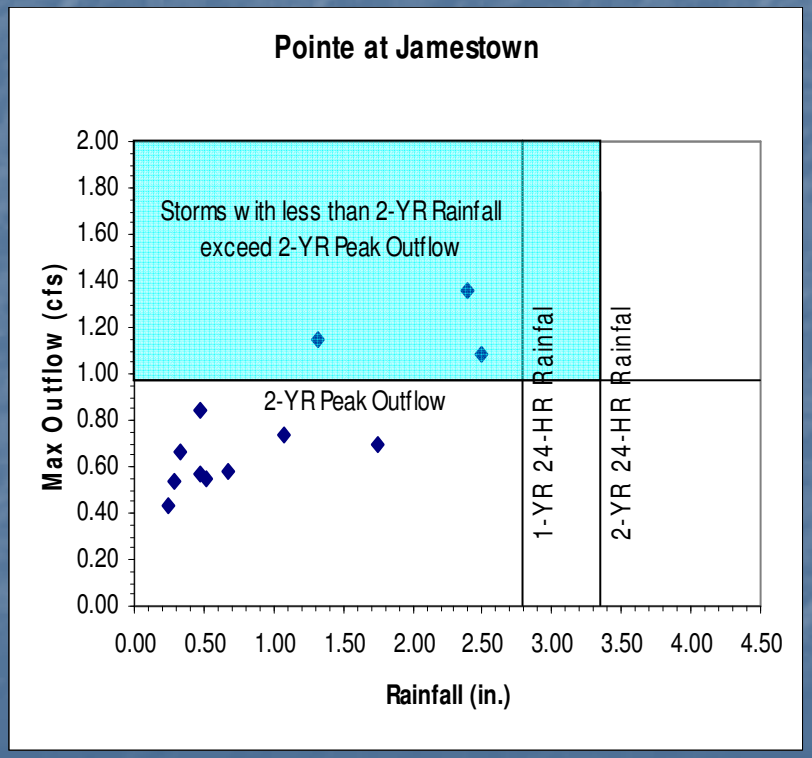
Data Analysis



Results: Does Pointe Pass?

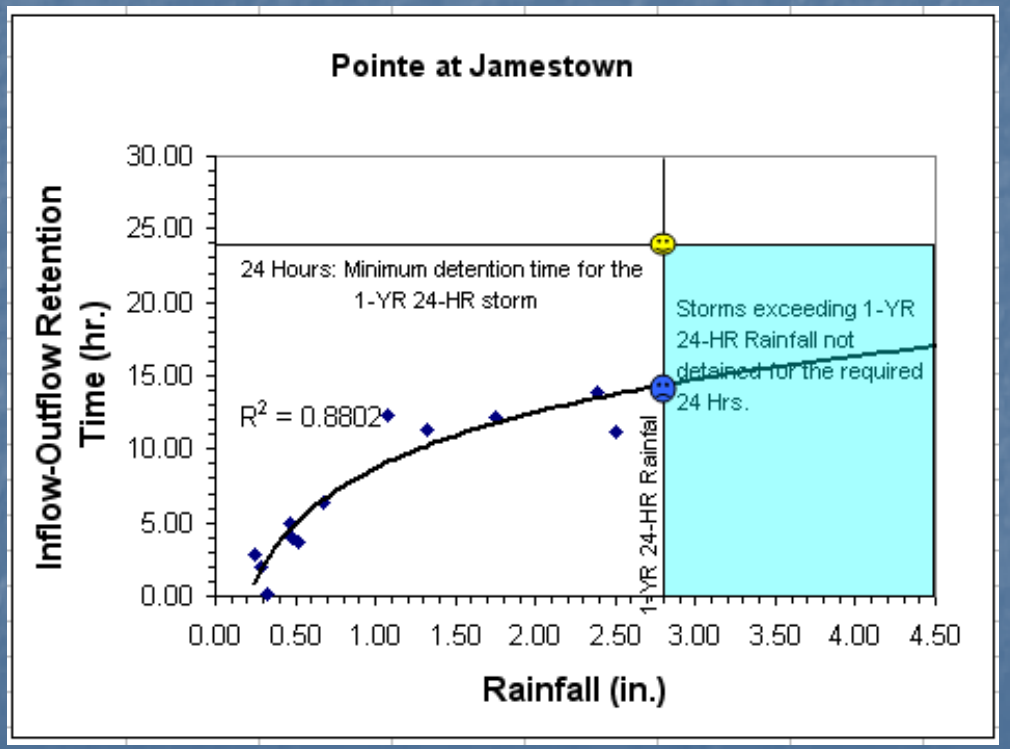
Peak Flow Standard

2006 Storm Data

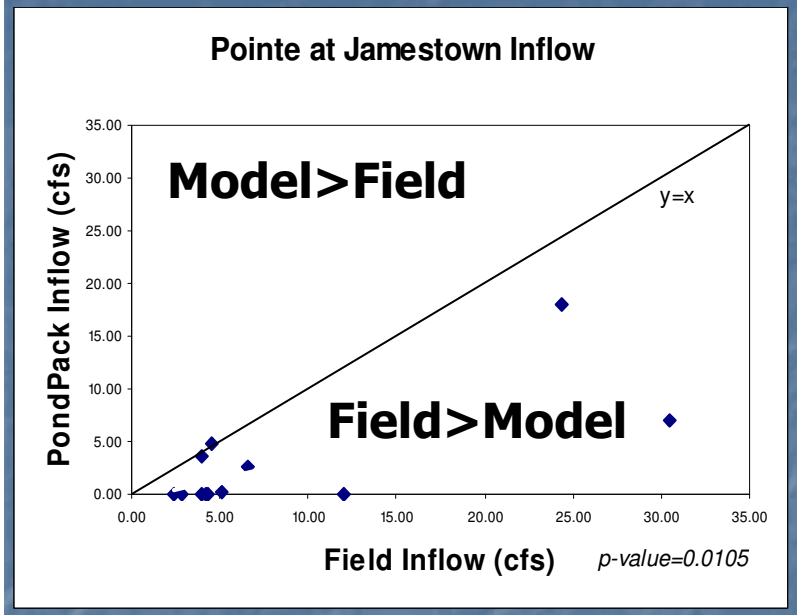


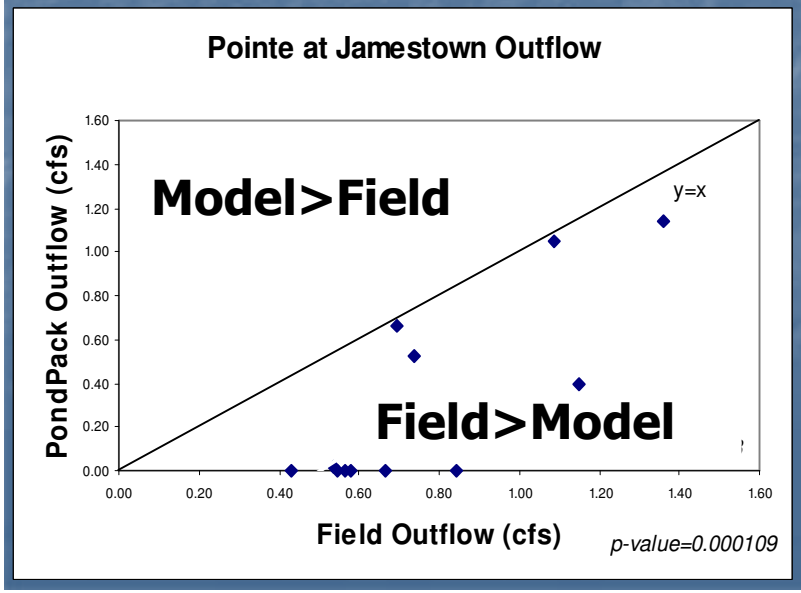
Duration Standard

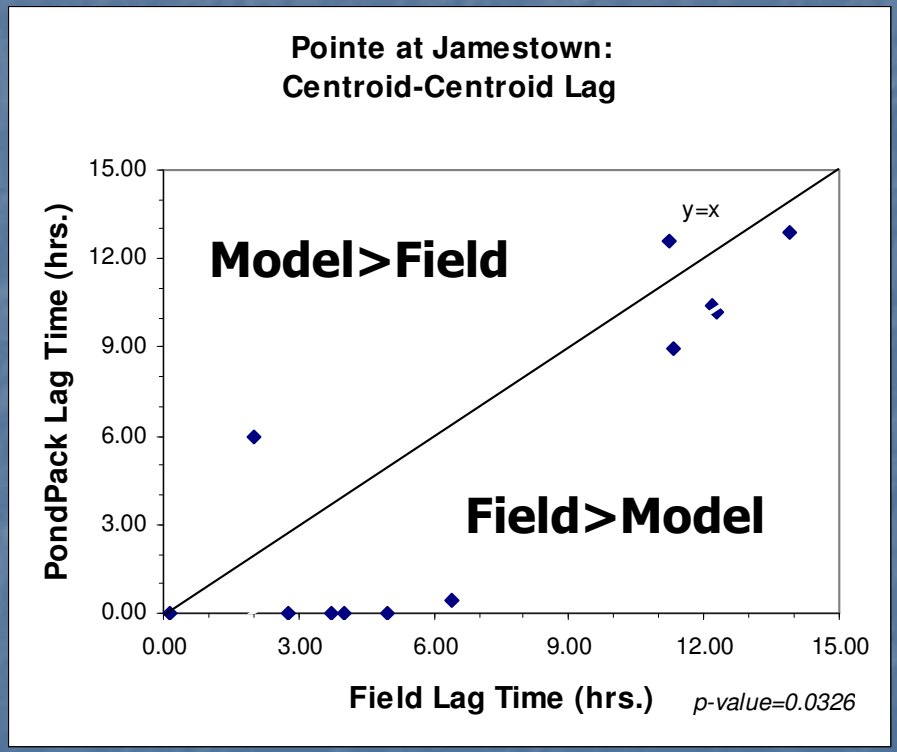
2006 Storm Data



Field Data vs. Model Data







Conclusions

- Pointe at Jamestown did not meet Virginia's 2-yr peak outflow standard.
- Pointe does not hold water for at least 24 hours.
- Modeling software underpredicts inflow and outflow to and from the pond.
- Modeling software underpredicts inflow-outflow lag times.

Part II: Suspended Sediment

Question: How effectively does Pointe at Jamestown capture suspended sediment from inflow?

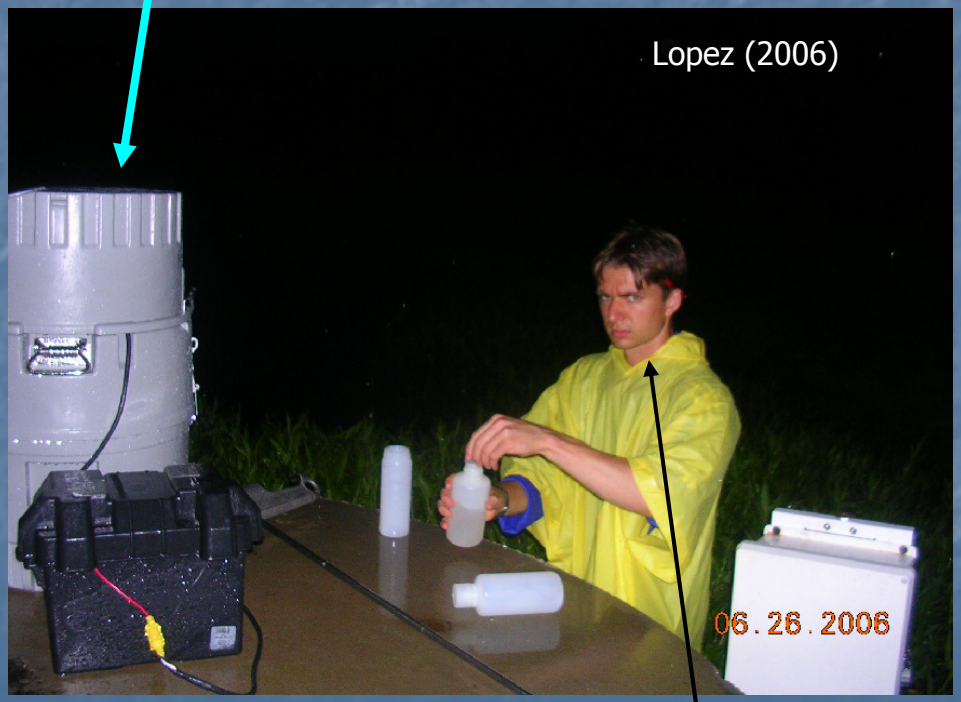
Retention Pond Inlet

Methods and Data Collection

ISCO Automated Sampler

Inflow

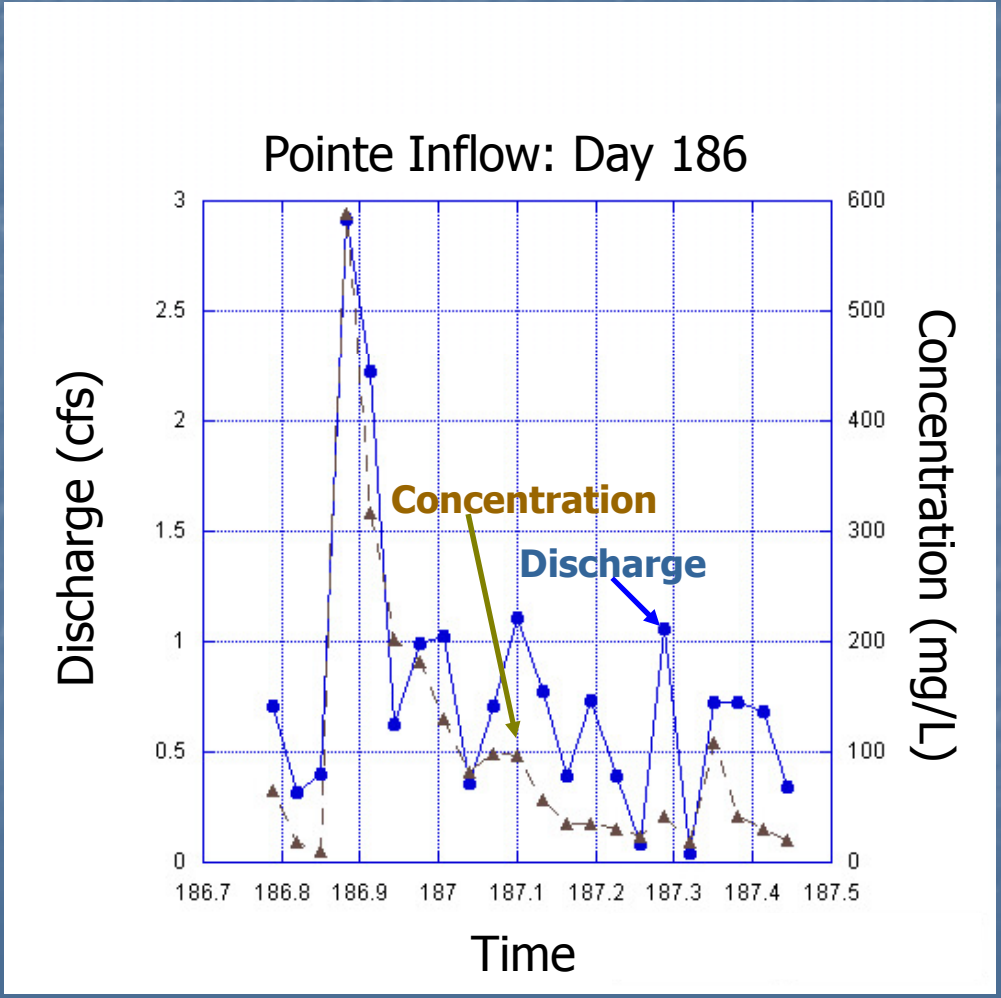
Outflow



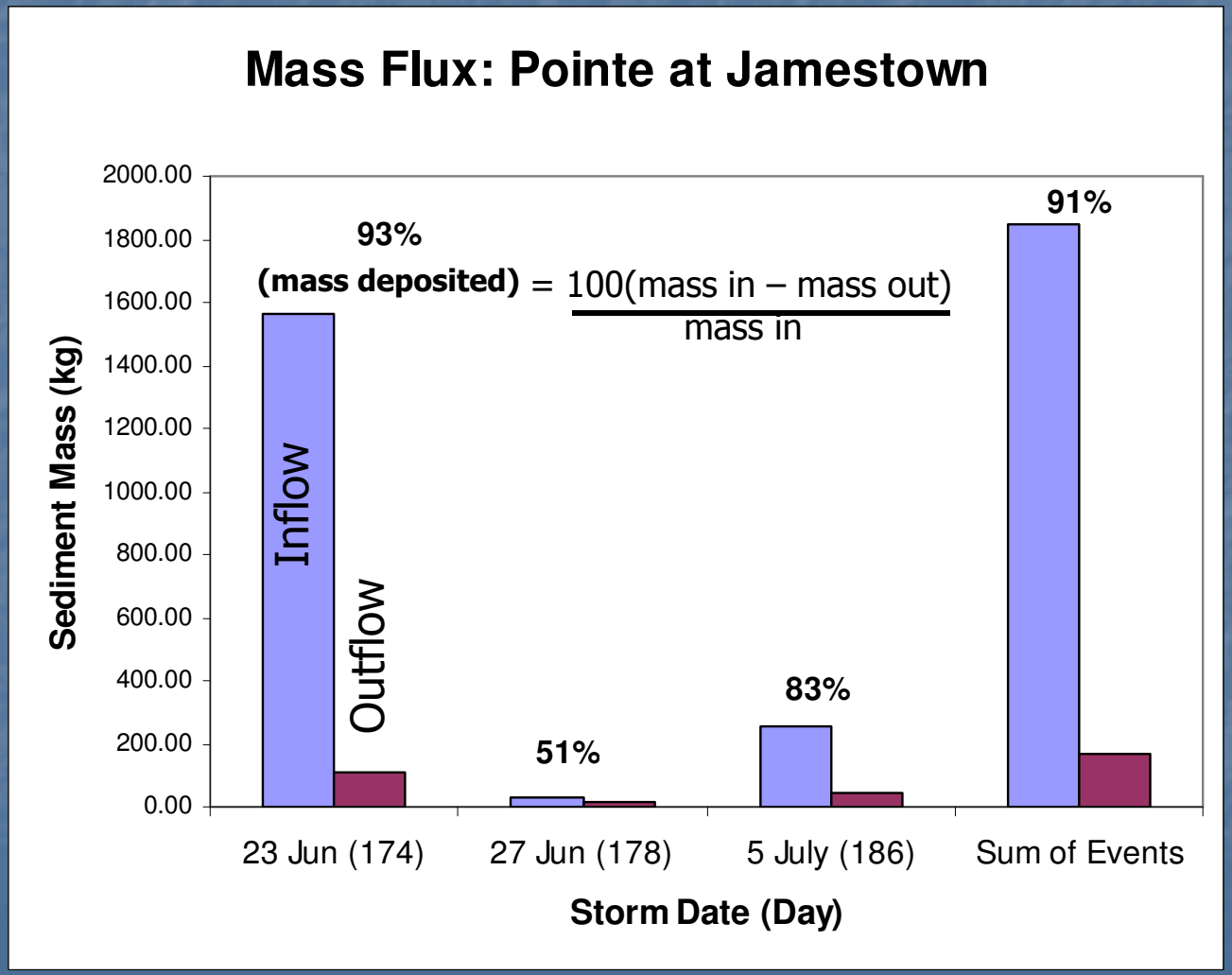
Me (I'm not really mad)

James City County (2005)

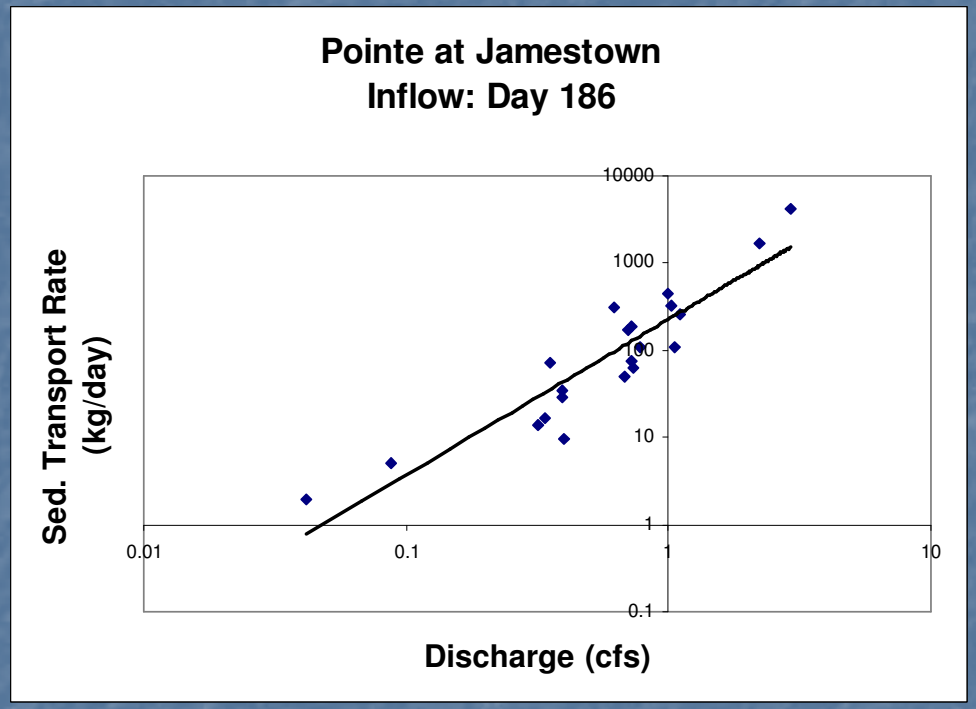
Sediment and Discharge Throughout a Storm

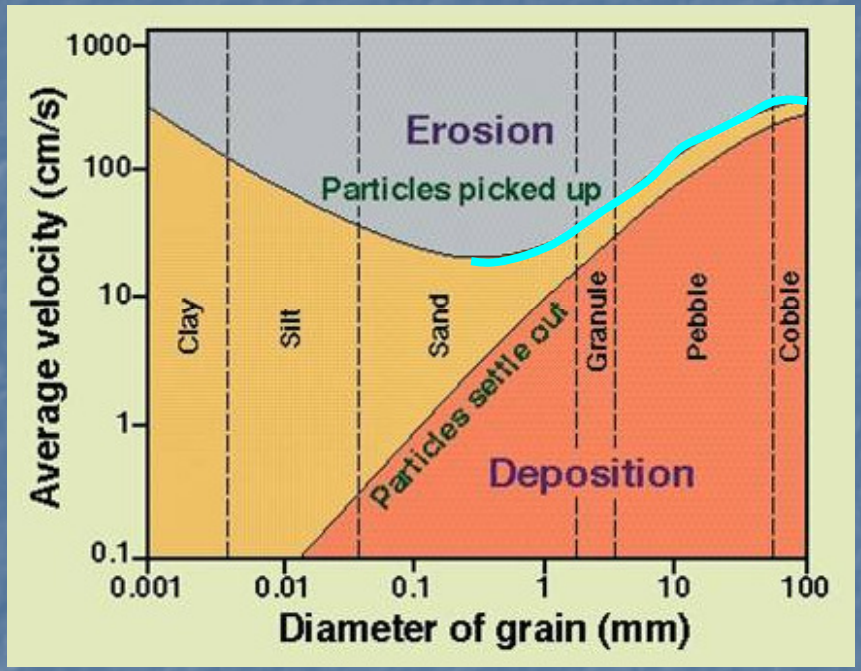


Results


Mass Flux: Pointe at Jamestown
2000.00
1800.00
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
Sediment Mass (kg)
93%
(mass deposited) = 100(mass in – mass out) / mass in
Inflow
Outflow
51%
83%
91%
23 Jun (174)
27 Jun (178)
5 July (186)
Sum of Events
Storm Date (Day)

Why does Removal Efficiency Increase with Storm Size?





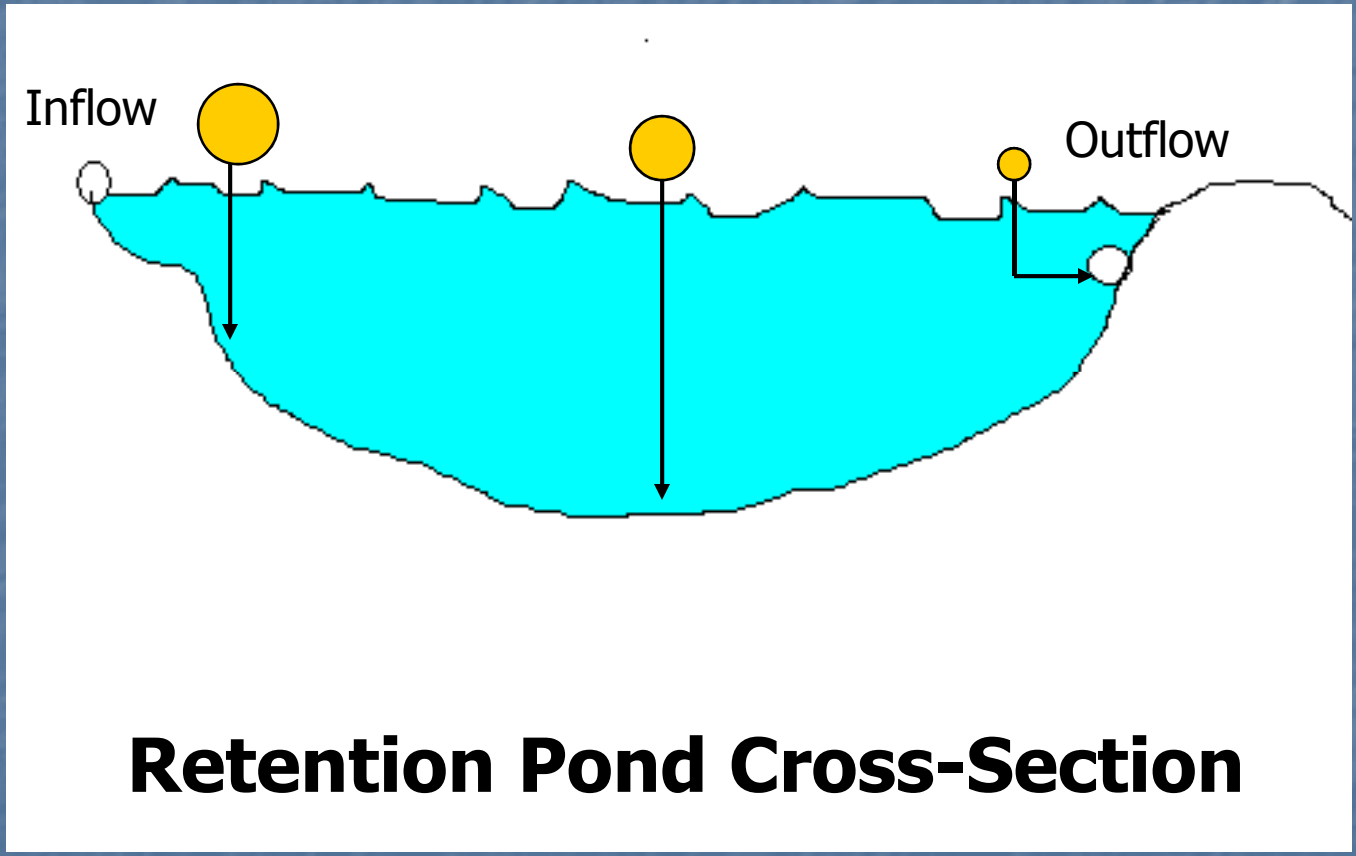
http://earth.unh.edu/esci402/docs/docs.htm

Higher Discharge: More sediment brought to pond.

Higher Velocity: bigger grains are transported.

LARGER STORMS BRING IN MORE, COARSER SEDIMENT

Why does Grain Size Matter in Removal Efficiency?



Retention Pond Cross-Section

Larger grains settle from suspension more quickly (settling velocity).

Conclusions

- Most suspended sediment (~91%) deposited before outflow.
- Larger storms have a greater removal efficiency.

Further Considerations

- Pointe at Jamestown not completed.
- Wolman (1967): Construction sediment concentrations greater than post-construction.

- Submit data summary to Homeowners Association

When entering a dangerous rainstorm, ALWAYS wear protection.