Effectiveness of Stormwater Retention Ponds in Controlling Urban Runoff

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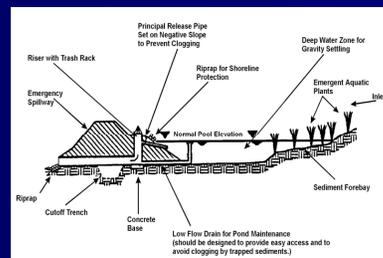
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This presentation discusses the effectiveness of stormwater retention ponds and their impact on stream temperature

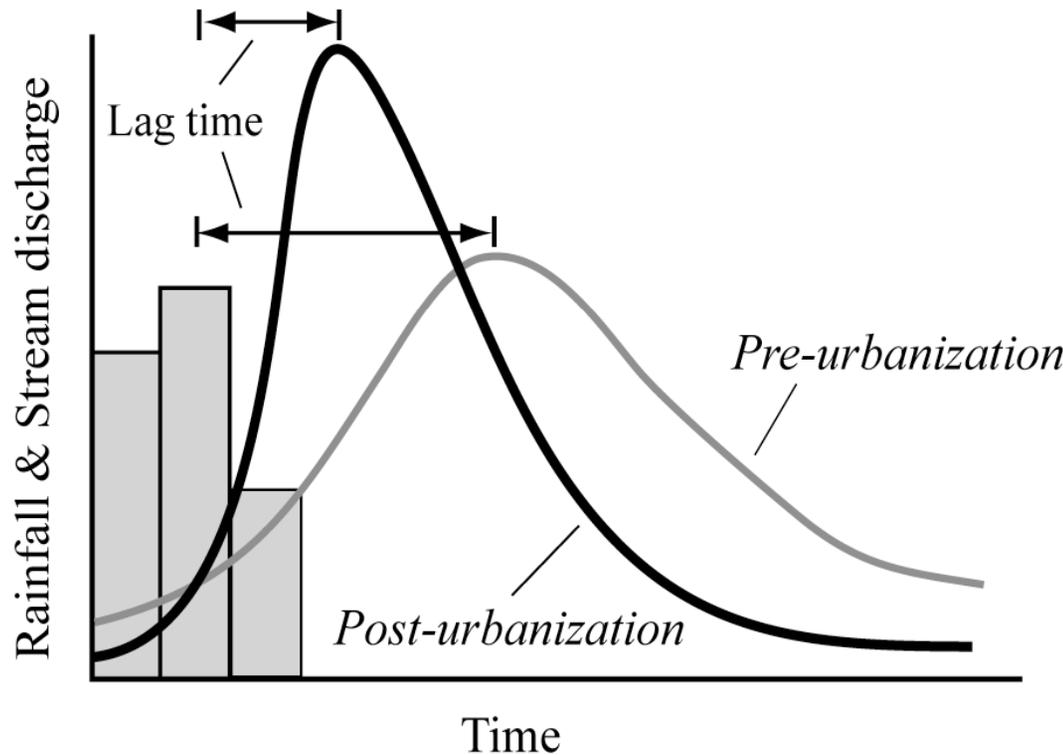**Role of retention ponds in controlling urban runoff**

Empirical evaluation of pond at Kensington Woods
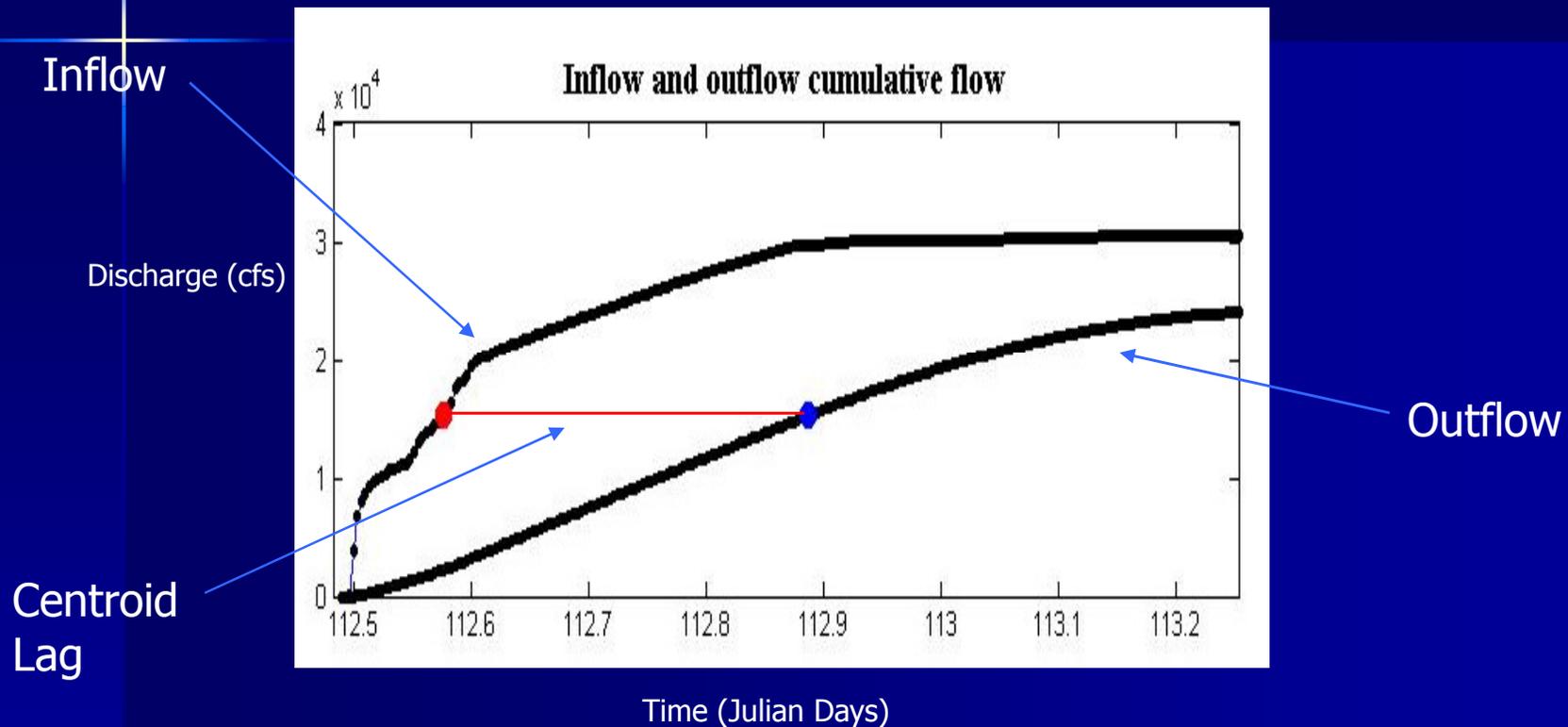

Implications for pond modeling and design

# Urbanization increases stormwater runoff rates and volume

Virginia specifies that 2 yr/24 hr storm post development peak outflows must be at 2 yr/24 pre development levels

Ponds are designed to increase inflow to outflow lag times

Inflow

Discharge (cfs)

Centroid Lag

Inflow and outflow cumulative flow

x 10⁴

Outflow

Time (Julian Days)

James City County stipulates a 24 hr centroid to centroid retention rate for 1 yr, 24 hr storms

Anatomy of a wet stormwater retention pond
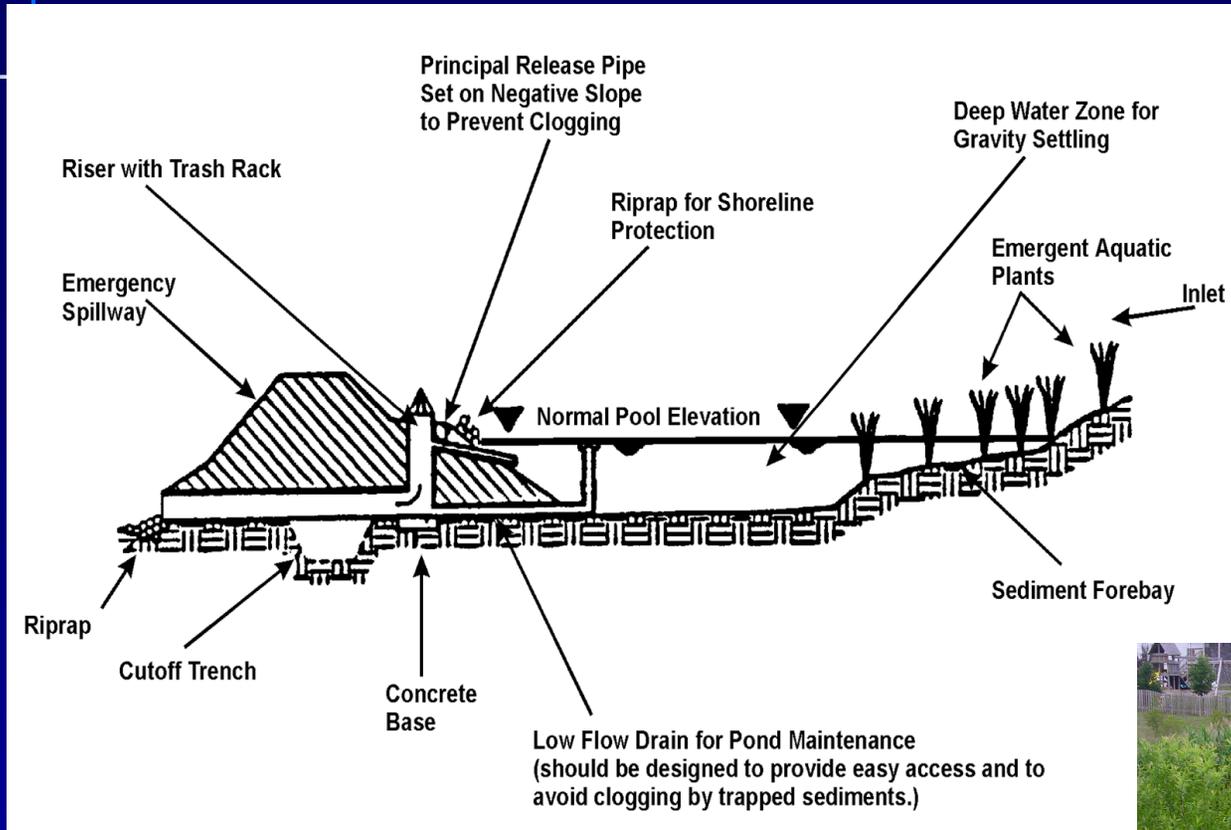
Little oversight of ponds after they are built

Our goal was to monitor actual retention ponds

Mulberry *(Cristina)*

Chambrel

Ironbound *(Greg)*

Pointe *(Brent)*

W&M

Kensington *(Lauren)*

Rainfall, pond elevation, and pond designs were used to establish discharge rates
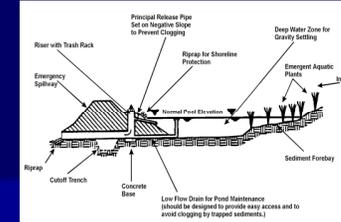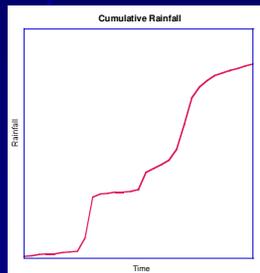

Tipping bucket rain gauge

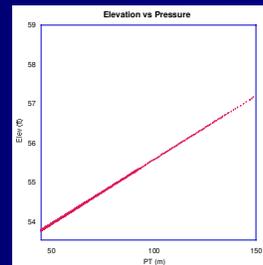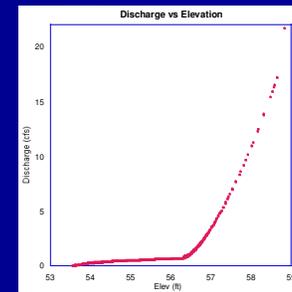Pressure Transducer

+
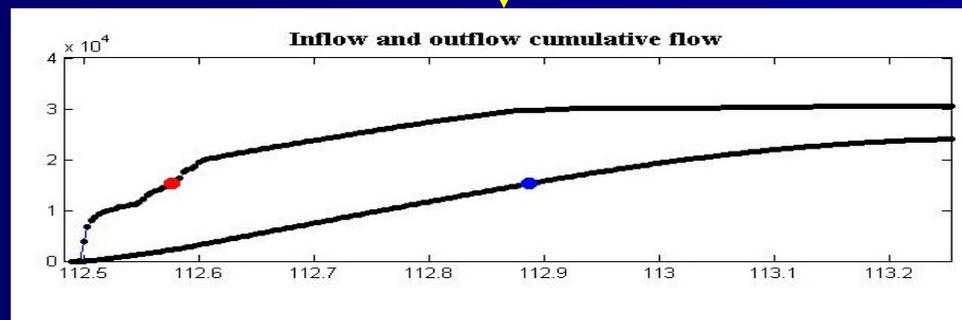

Staff Gauge

Pond Designs

Rainfall

Pond Elevation
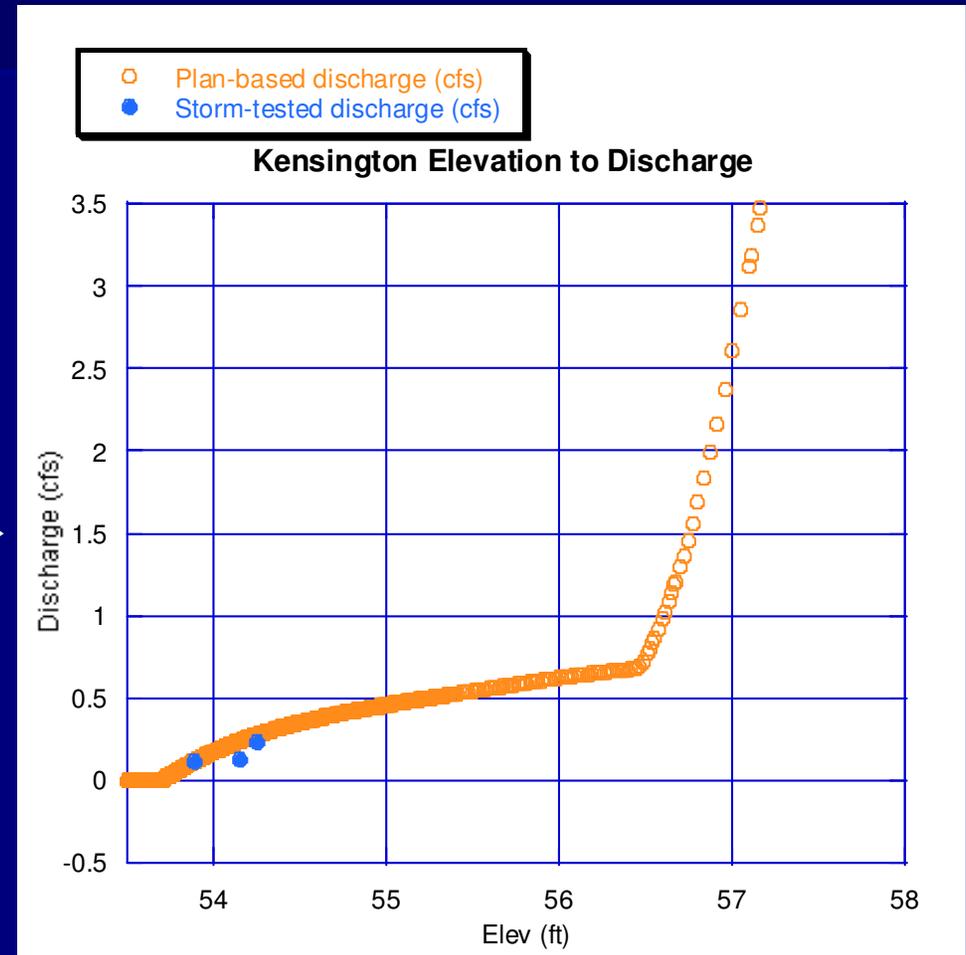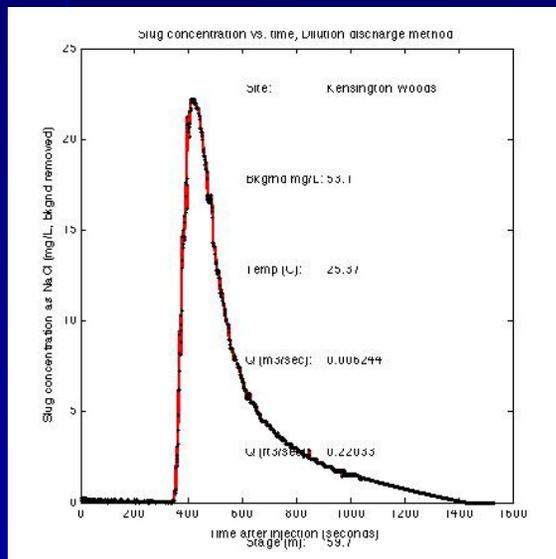

Discharge to Elevation Curve

Inflow and Outflow Hydrographs

Design-based elevation to discharge curves were verified with the salt dilution method
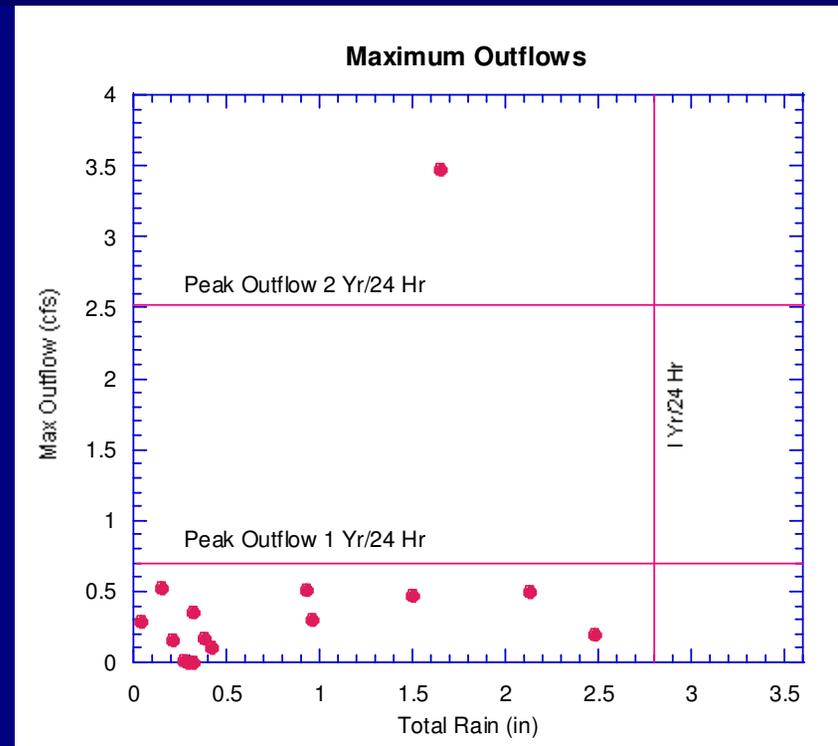

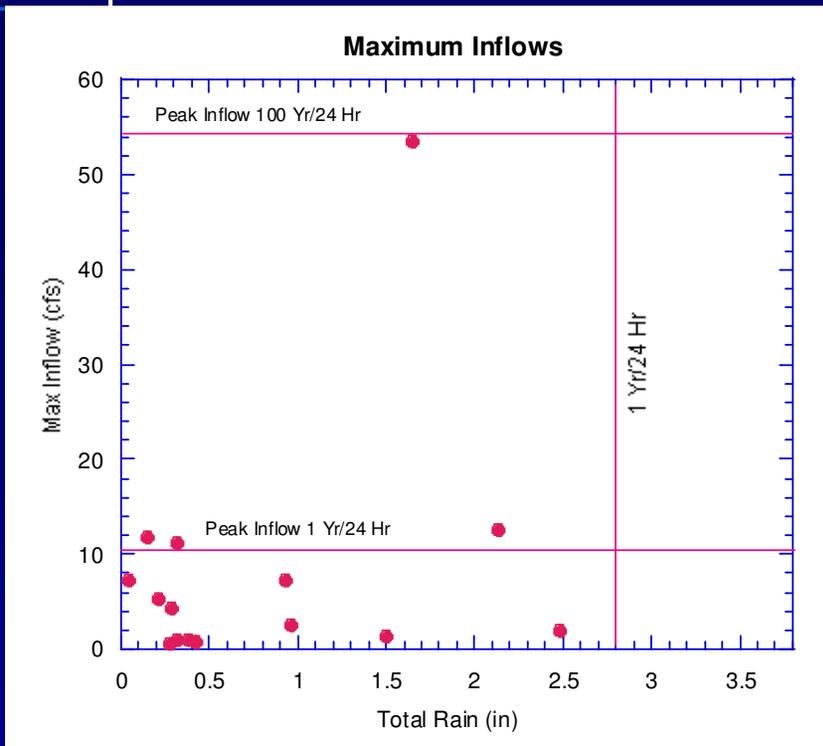Storm-time conductivity measurements

Salt Concentration / Time
=> Volume / Time

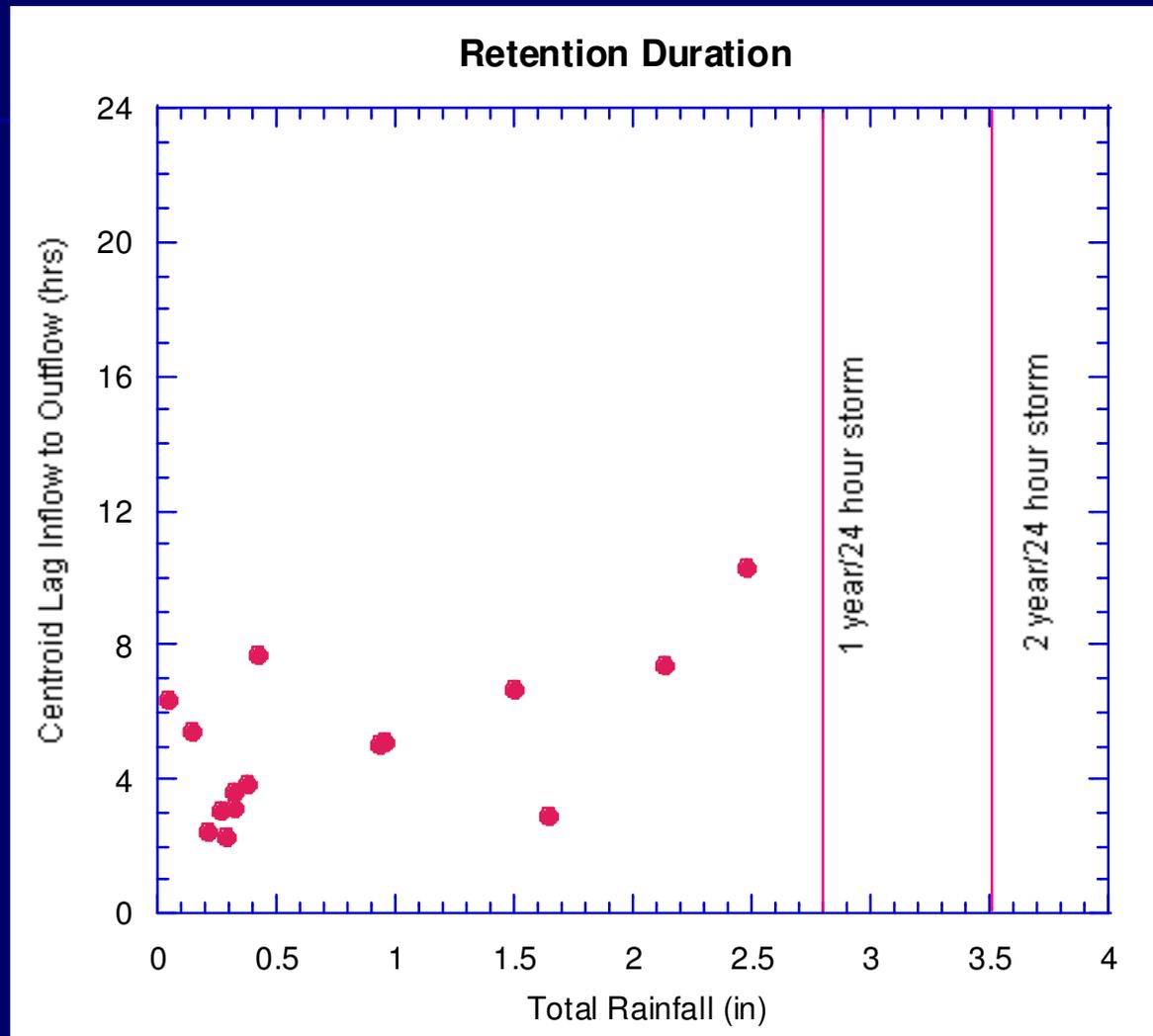Field results compared to plan predictions

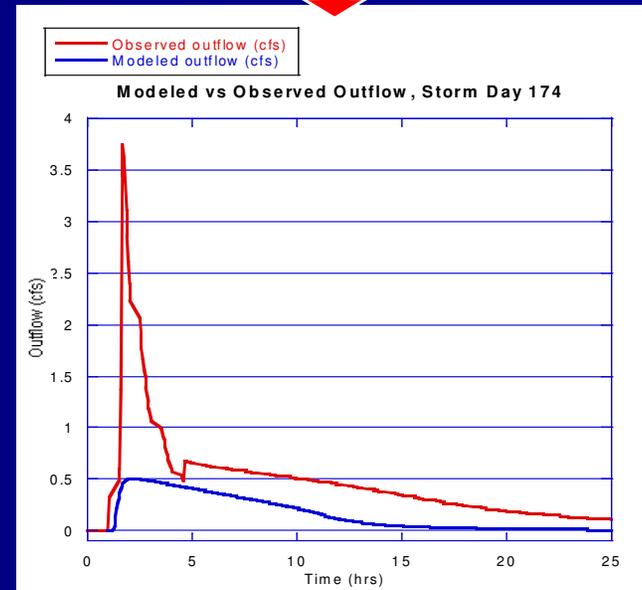# No 1 yr/24 hr storms occurred, yet peak flows frequently neared 1yr/24 hr levels
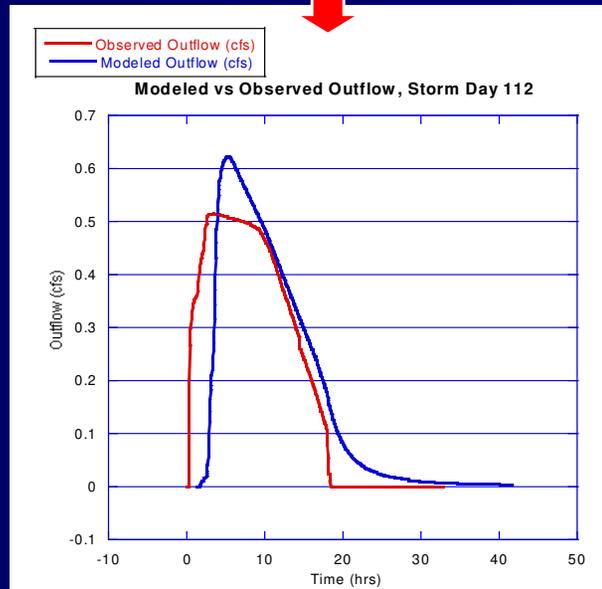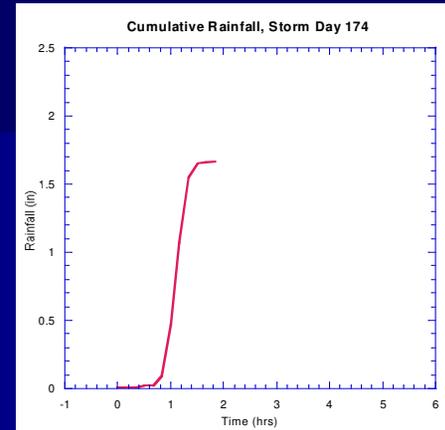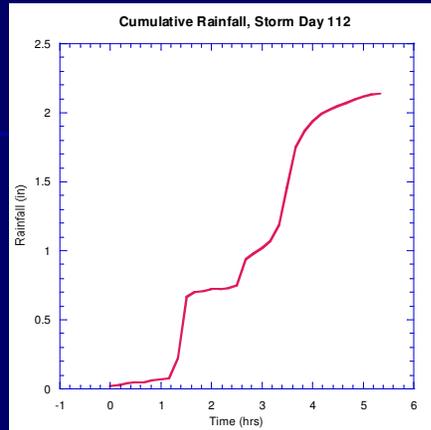
Kensington Storms, 2006

Occasional extreme maximum inflow and outflow points were also observed

Centroid to centroid lag times were low and project to be below regulations

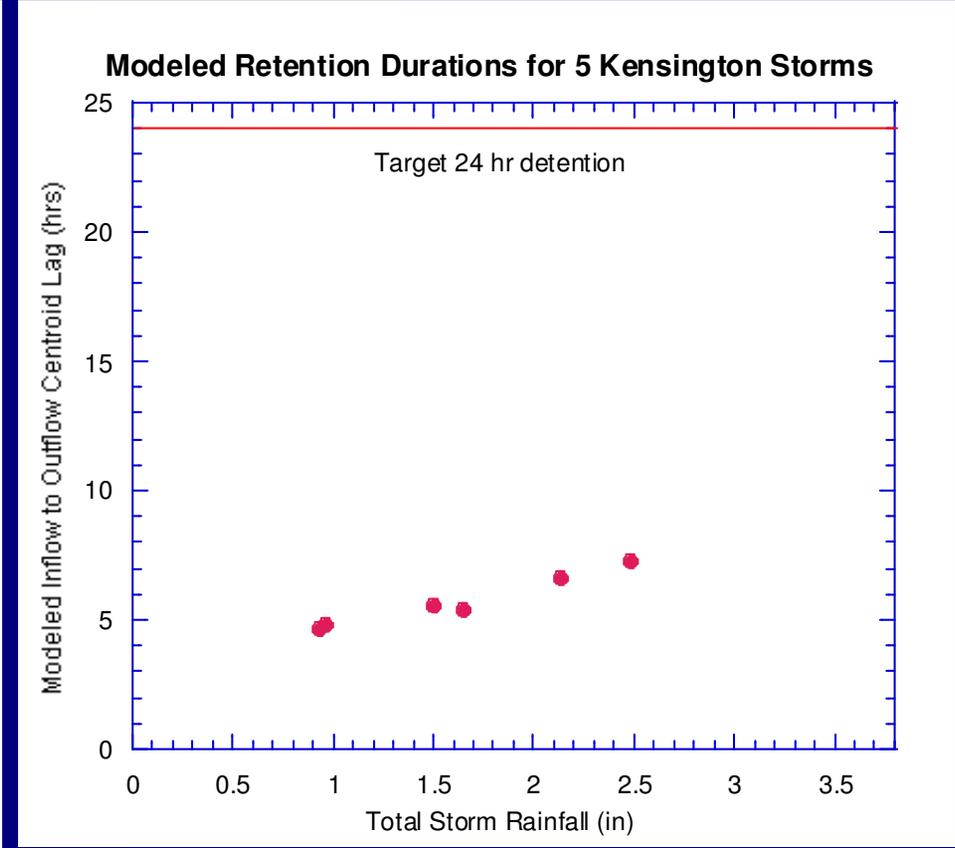Kensington Storms, 2006

Model better predicted ideal-type storms than non-ideal

Ideal-type: Day 112   Non-Ideal: Day 174

Design storms used in plans and modeled 2006 storms had below-regulation centroid lag times

Modeled Design Storm Centroid Lag Times

Target 24 hr detention

Inflow to Outflow Centroid Lag Time (hrs)

Total Storm Rainfall (in)

Modeled Retention Durations for 5 Kensington Storms

Target 24 hr detention

Modeled Inflow to Outflow Centroid Lag (hrs)

Total Storm Rainfall (in)
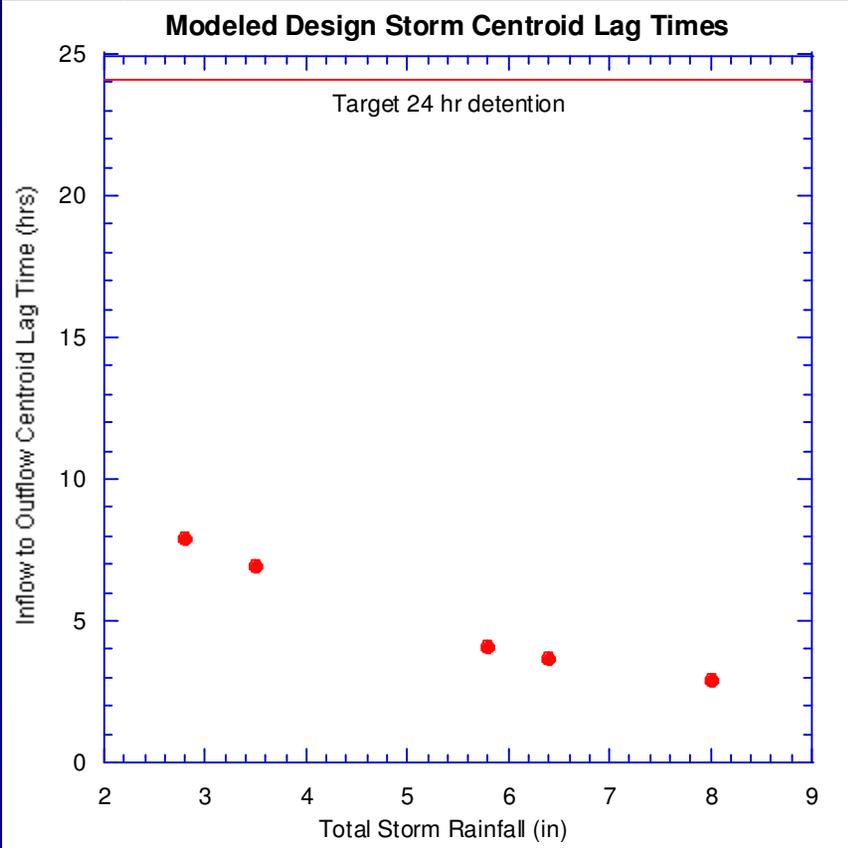
Outflow from Ironbound warmed downstream temperatures

Ironbound temperatures were much higher than in Chambrel, the control stream

Mulberry outflow temperatures were lower than upstream and downstream

Legend (left chart):
- Temp Water Mulberry Out
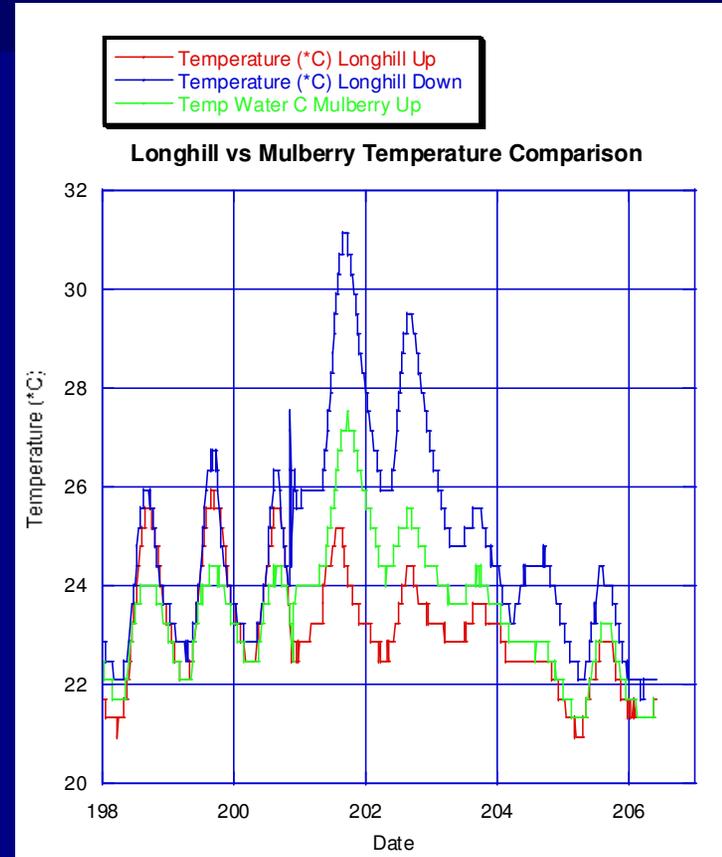- Temp Water C Mulberry Up
- Temp Water C Mulberry Down
- Discharge (cfs)
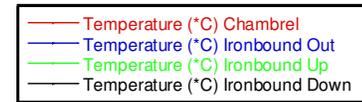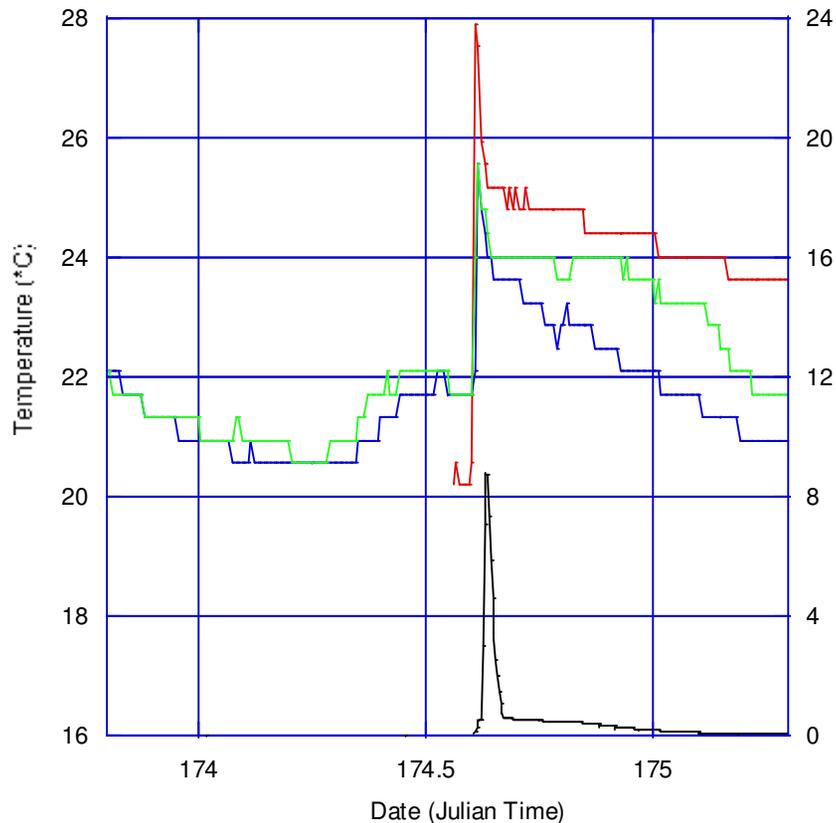
Mulberry Temperature, Storm Day 174

Legend (right chart):
- Temperature (*C) Longhill Up
- Temperature (*C) Longhill Down
- Temp Water C Mulberry Up

Longhill vs Mulberry Temperature Comparison
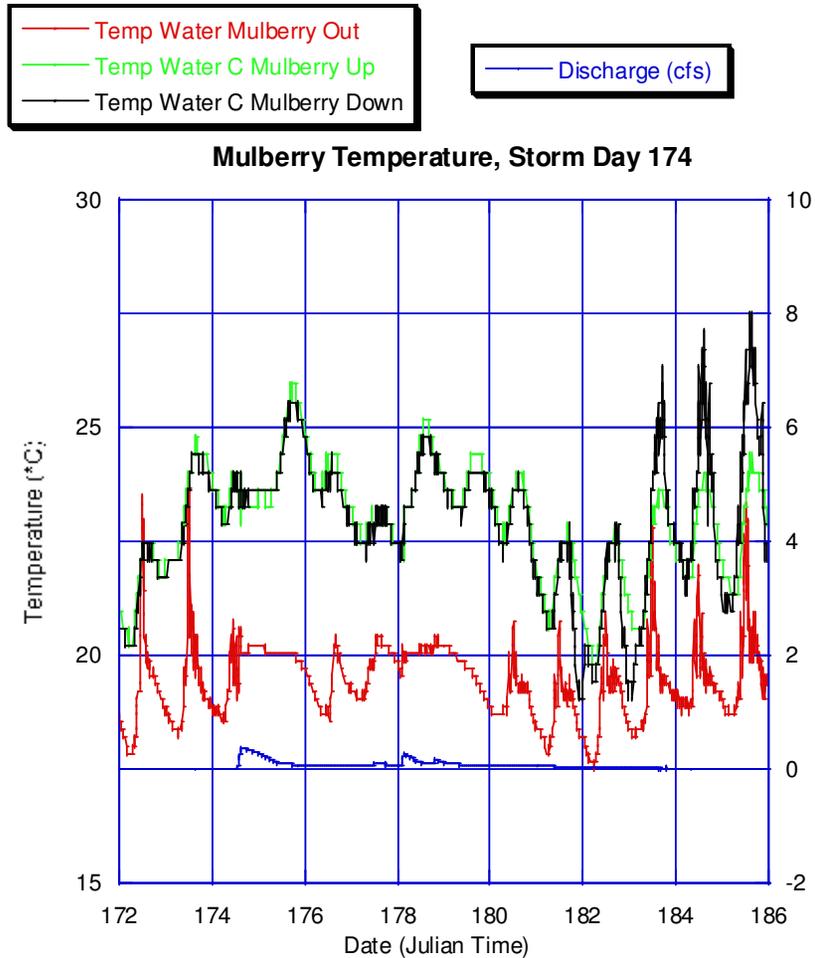
A large, unshaded retention pond is above Mulberry

Conclusions and Recommendations

Regulatory

Require centroid lags in the design plans

Future Research

Continue data collection, particularly salt dilution

Refine allowed modeling input data

Model temperature along a stream

Collect temperature data year round

Acknowledgements

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