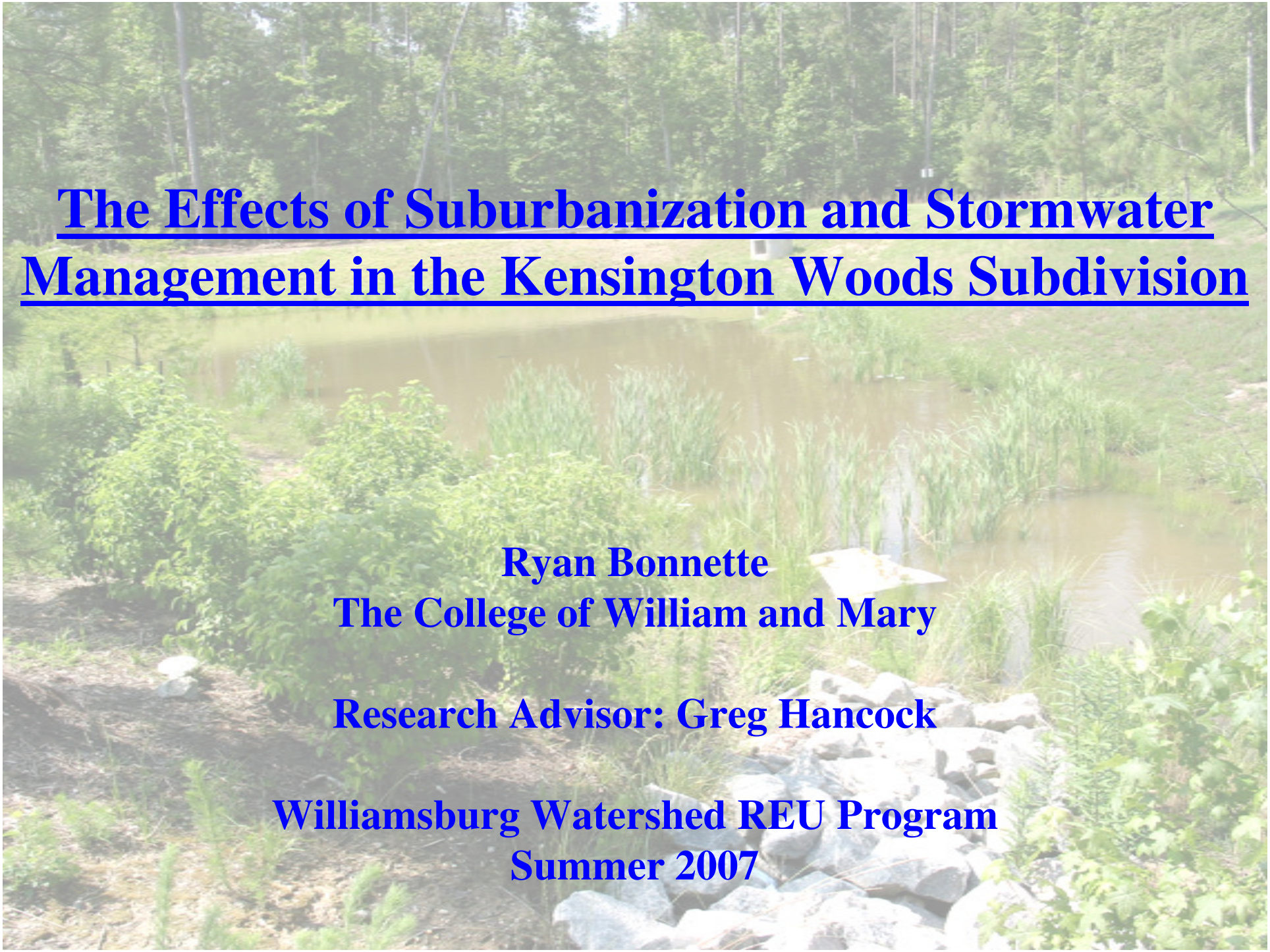


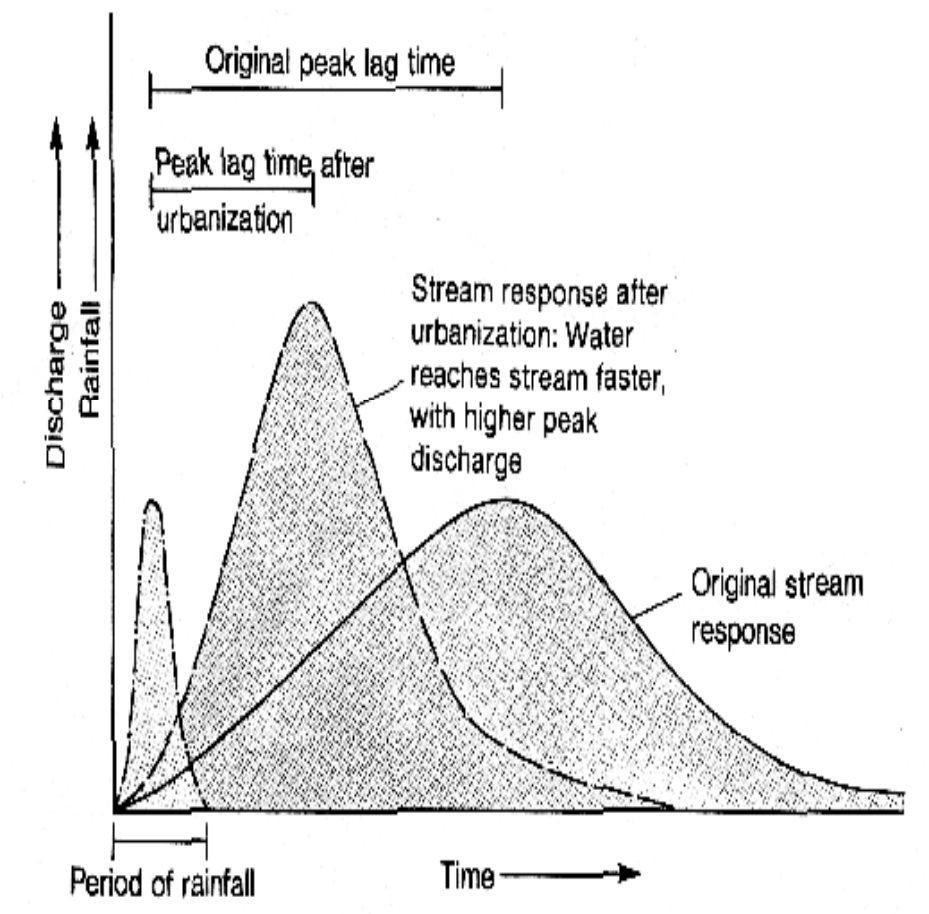
The Effects of Suburbanization and Stormwater Management in the Kensington Woods Subdivision

Ryan Bonnette
The College of William and Mary

Research Advisor: Greg Hancock

Williamsburg Watershed REU Program
Summer 2007

Effects of Urbanization



www.wesleyan.edu/.../StreamFlowDuration.html

-Increase in impervious surfaces

-Decrease and compaction of pervious surfaces

-Increase in runoff and overland flow

-Increase in sediment load

-Increase in erosion of stream systems

Stormwater Management Requirements

Virginia State Stormwater Management Policy:

-**MS-19: The 2-year post-development peak flow must be less than or equal to the 2-year pre-development peak flow**

James City County Stormwater Management Policy:

-A Retention Pond must retain the runoff water from a 1-year/24 hour storm for a period of 24 hours

Research Questions

1. How do the pond's as-built storage volumes compare to the pond design storage volumes? Does the pond as-built meet the suggested criteria for design of the EPA?

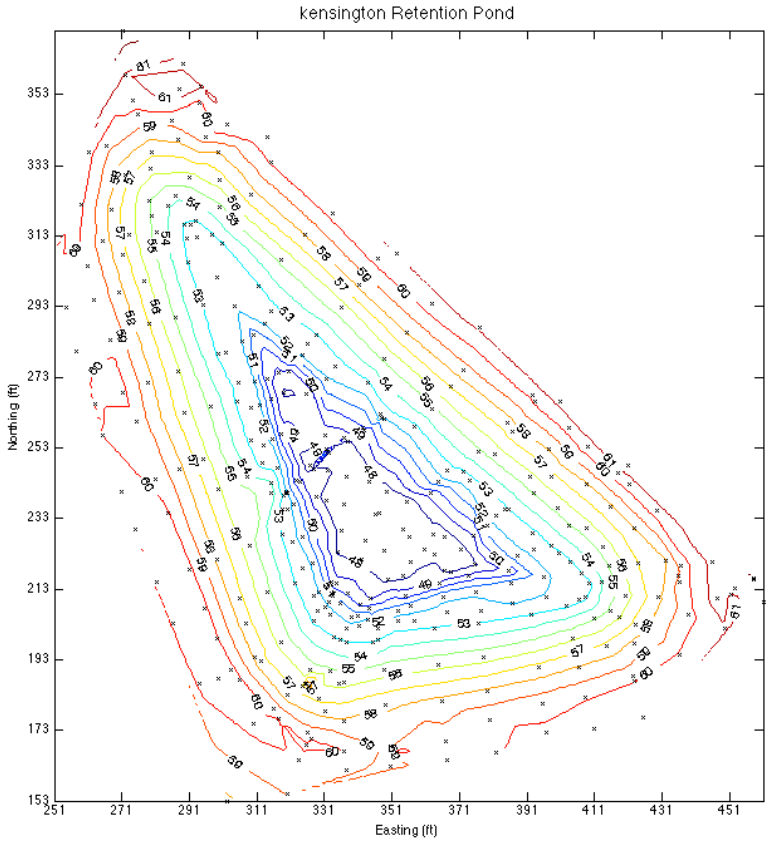
2. How do the observed inflows and outflows compare with those used in the design? Do the centroid lags observed tend to meet the 24 hour regulation set forth by James City County? Are the calculated runoff coefficients consistent with the runoff coefficient used in the design plans?

3. Is the pond successful at maintaining stream stability downstream of its outflow?

Methods:Pond As-built vs. Pond Design

-Survey pond to create a topographic map

-Use planimeter to calculate surface area at each contour



-Use contour area and elevation to obtain pond volumes

-Compare the volumes to design volumes

-Compare the volumes EPA suggestions

Methods: Flow Evaluation

-Collect pond elevation from a pressure transducer

-Create hydrographs from pond elevation

-Calculate peak inflow, peak outflow, centroid lag, and runoff coefficient from hydrographs

-Collect rainfall quantity from tipping bucket rain gauge

-Use rainfall data to calculate intensity of storm events

Methods: Downstream Channel Evaluation

-Rosgen method

-Created cross-sections to determine bank-full width, bank-full depth, and mean depth

-Used bank-full width and depth to find entrenchment ratio and width/depth ratio

-Measured channel and valley lengths to determine sinuosity

-Calculated channel slope by measuring elevations

Results: Pond As-built vs. Pond Design

	Design Volumes	Pond Volumes
Wet Storage	17,985 cubic feet	18,640 cubic feet
Dry Detention Storage	82,755 cubic feet	81,790 cubic feet
Total Pond Storage	100,740 cubic feet	100,430 cubic feet

-655 Cubic foot excess in wet storage

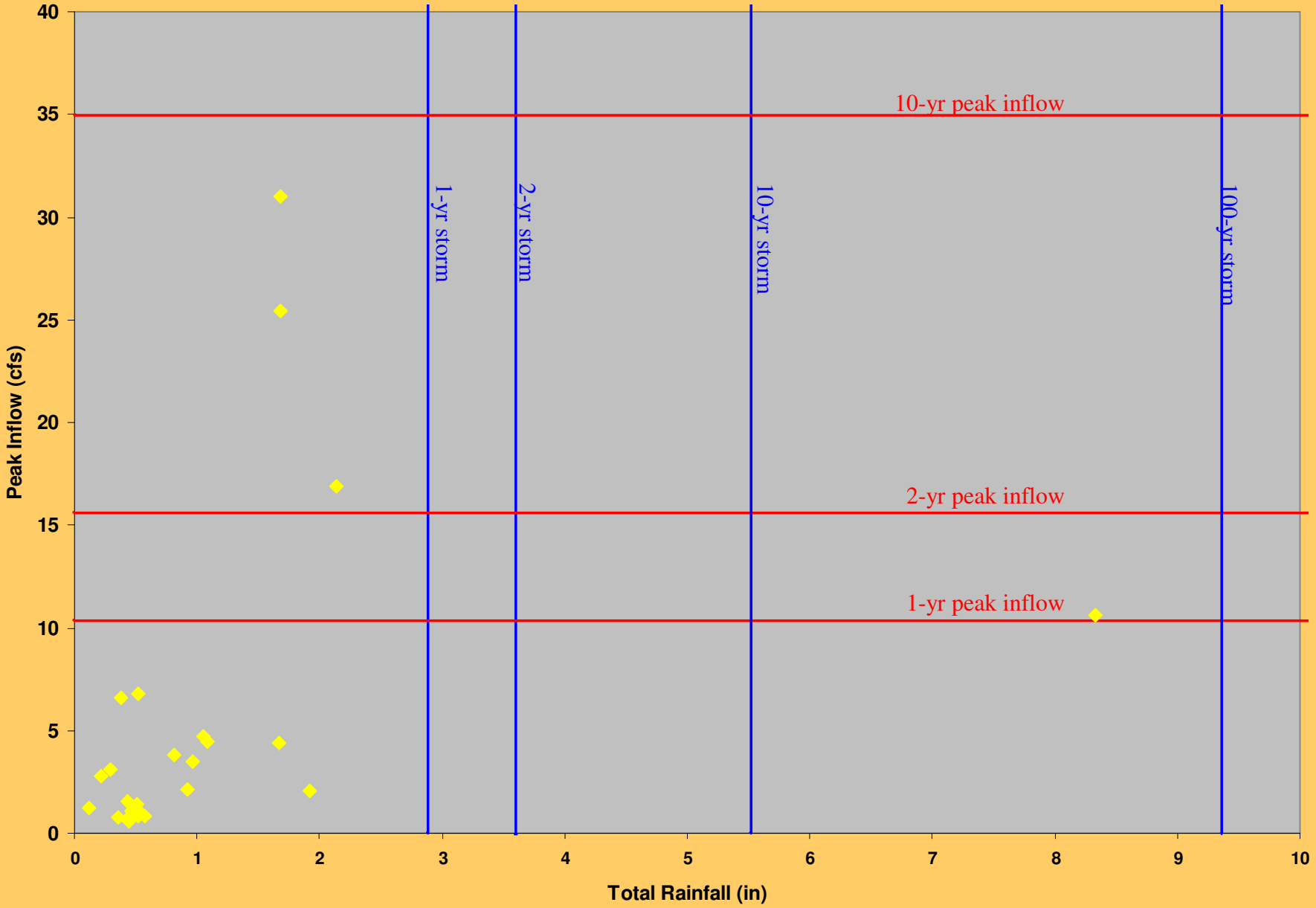
-965 Cubic foot shortage in dry storage

-310 Cubic foot shortage in total storage

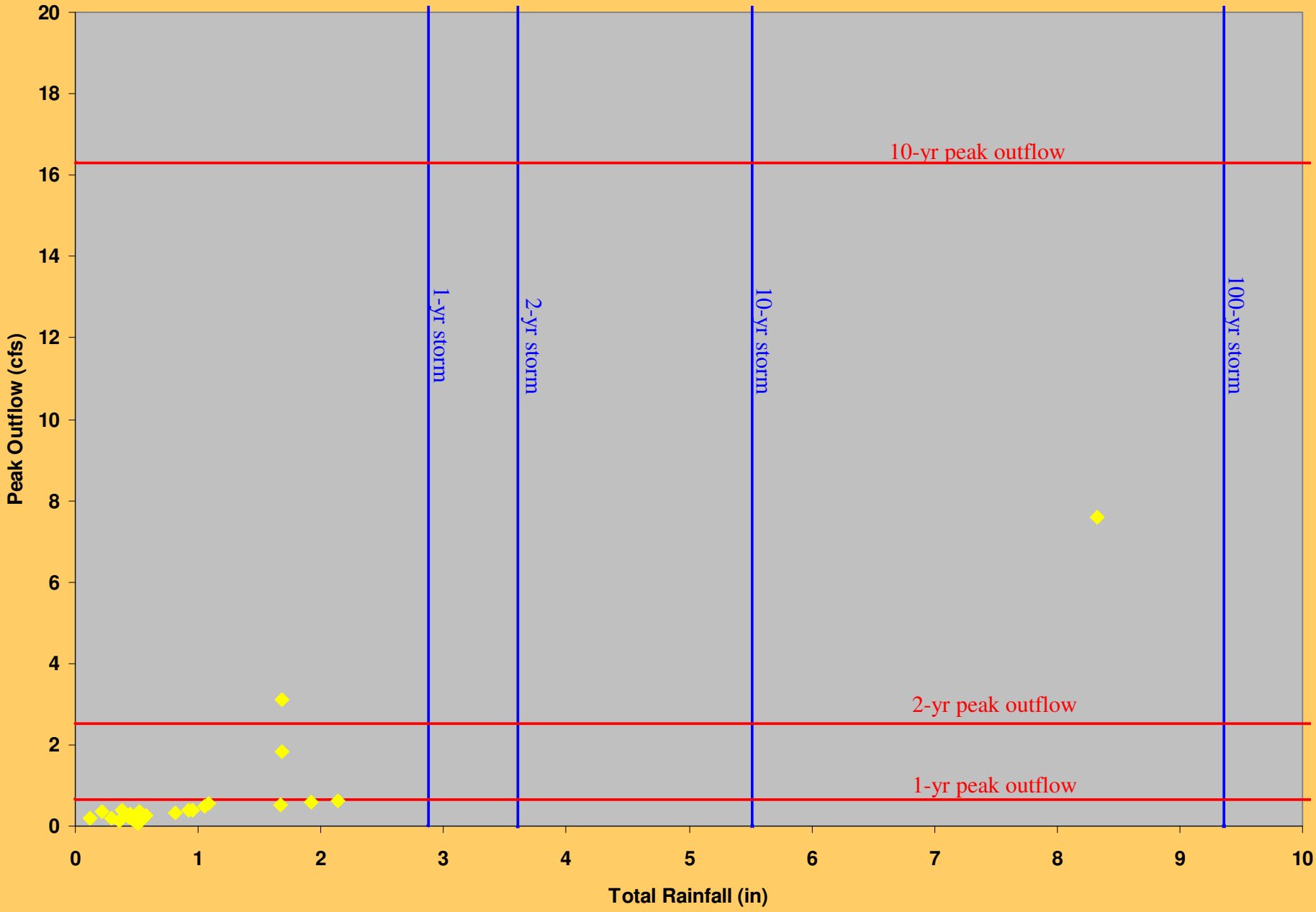
Results: Pond As-built vs. EPA Suggestions

	EPA Suggestions	Pond Structure
Pond Depth	1-3 meters for permanent pool	0.876 m
Area Ratio	Less than 100	72.8
Length/Width Ratio	Higher than 2:1	2.58:1

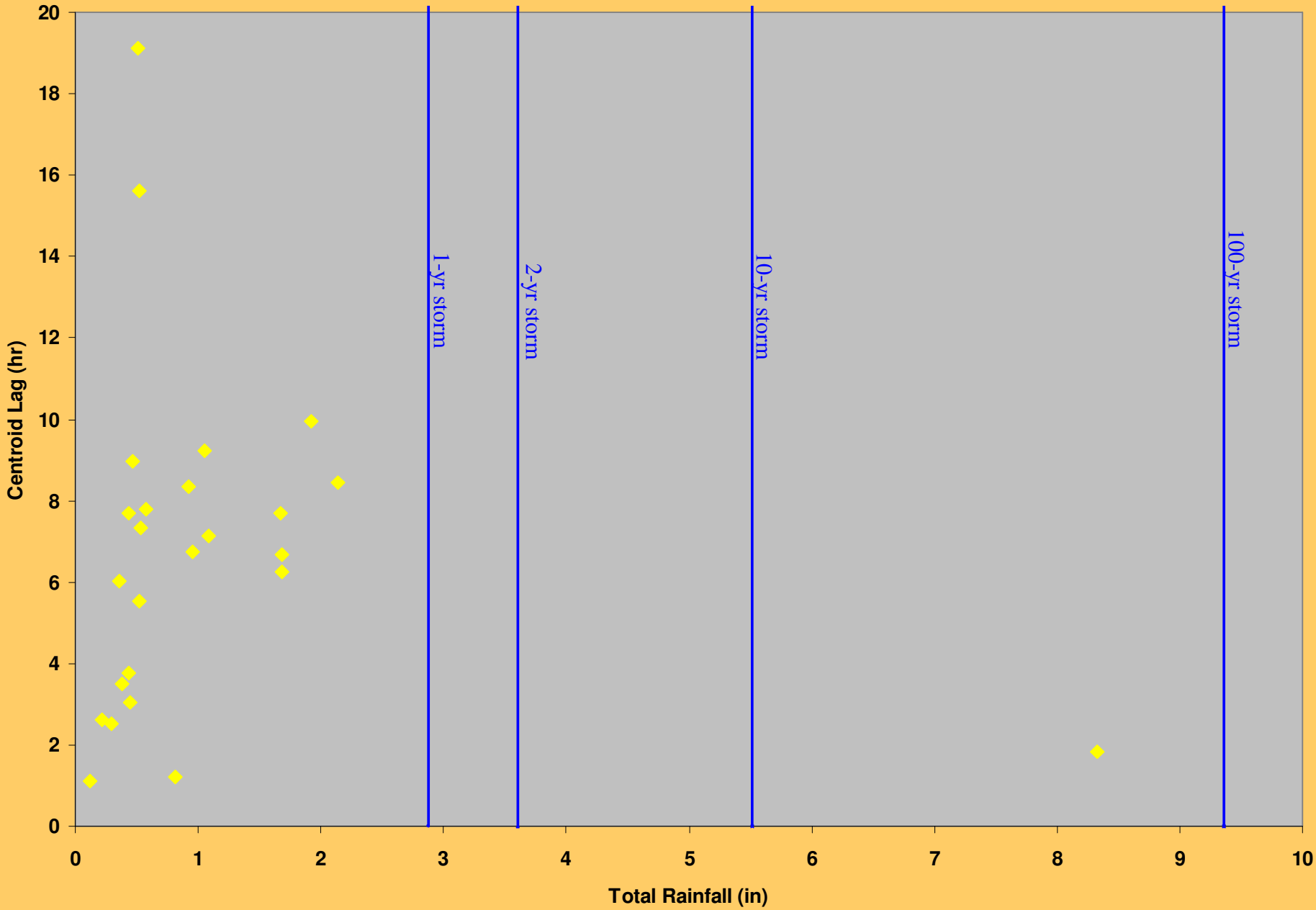
Results: Total Rainfall vs. Peak Inflow



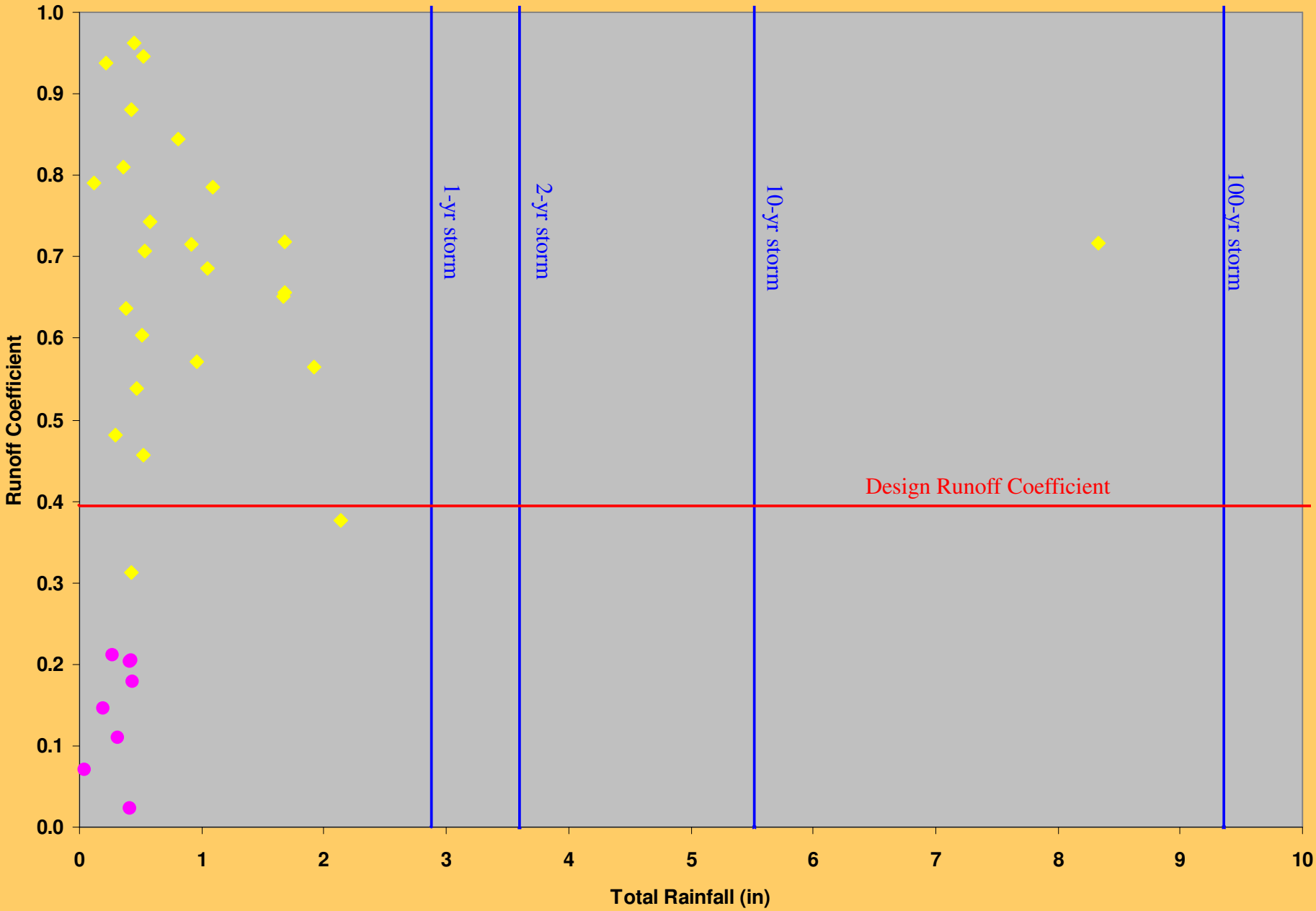
Results: Total Rainfall vs. Peak Outflow



Results: Total Rainfall vs. Centroid Lag

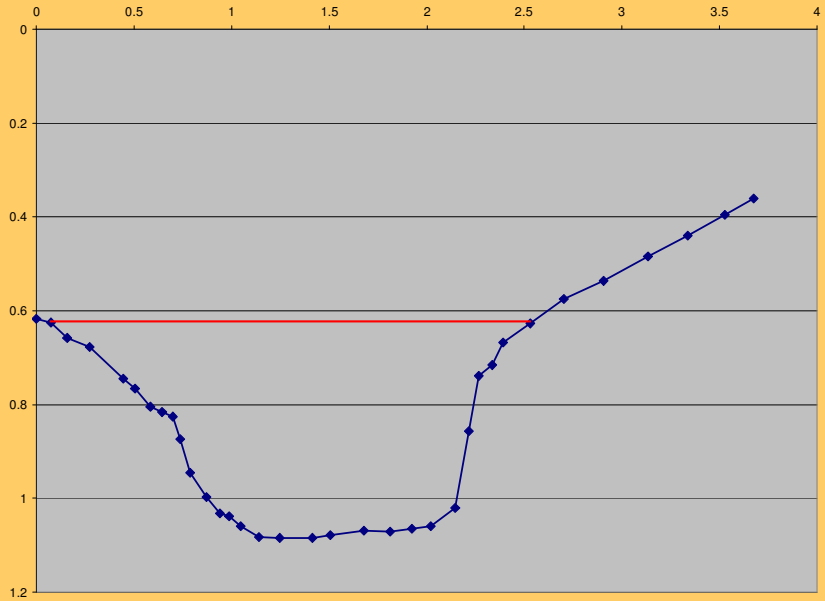


Results: Total Rainfall vs. Runoff Coefficient



Results: Downstream Evaluation

-No conclusive results when using Rosgen Method



Pogonia Cross-section

Conclusions

-Design volumes similar to as-built volumes

-Meets 2 or 3 EPA design suggestions

-Inflows and outflows are not consistent with what is determined from the designs

-Pond does not seem to meet JCC storage regulation

-Runoff coefficients higer than the one used in design of the pond

-No conclusive results from the Rosgen Method