Modeling the Complex Hydraulic Interactions of Wetland Systems, Tidal Creeks, and Municipal Stormwater Infrastructure in the Church Creek Basin of Charleston, South Carolina

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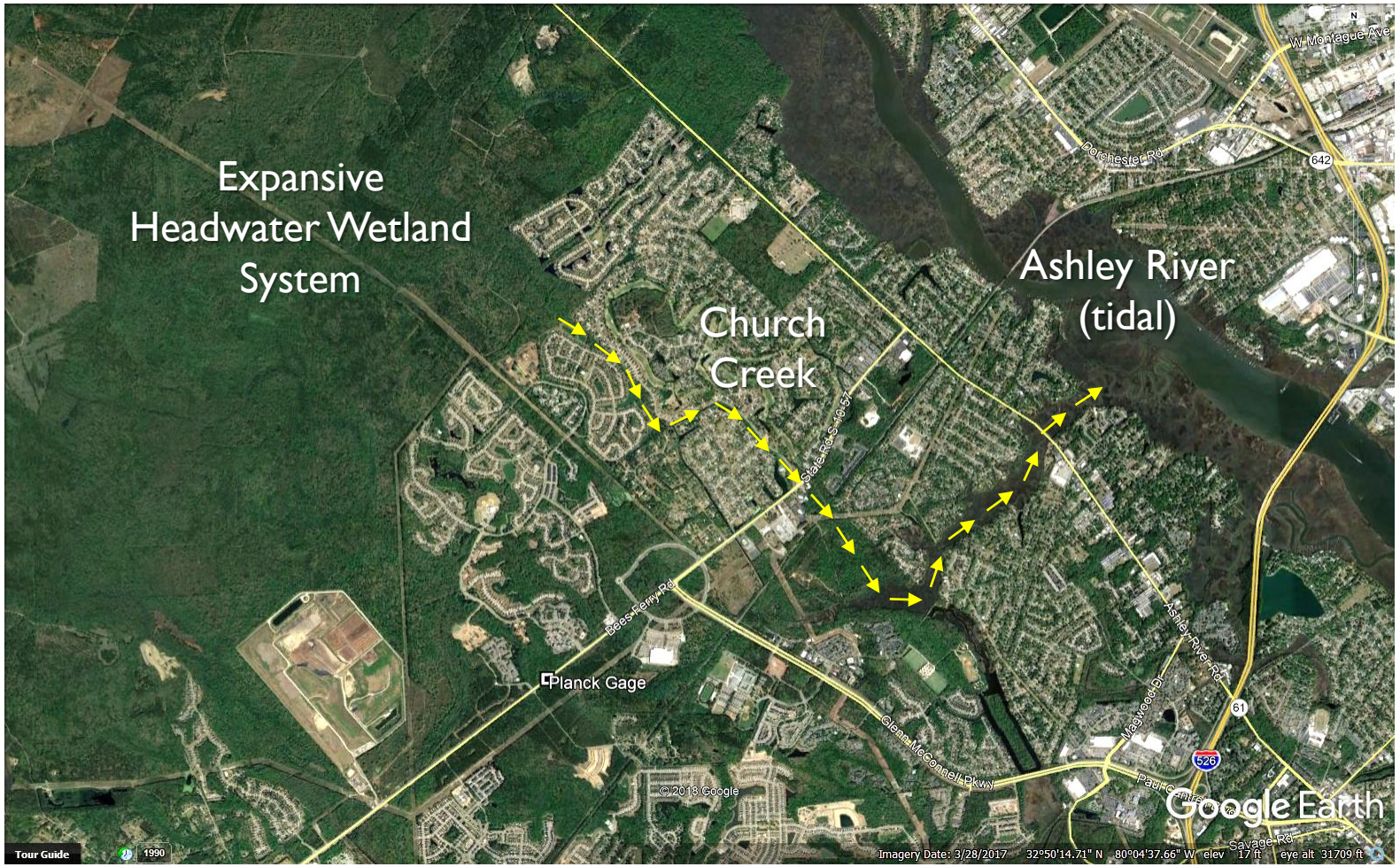
Church Creek – Charleston, S.C.

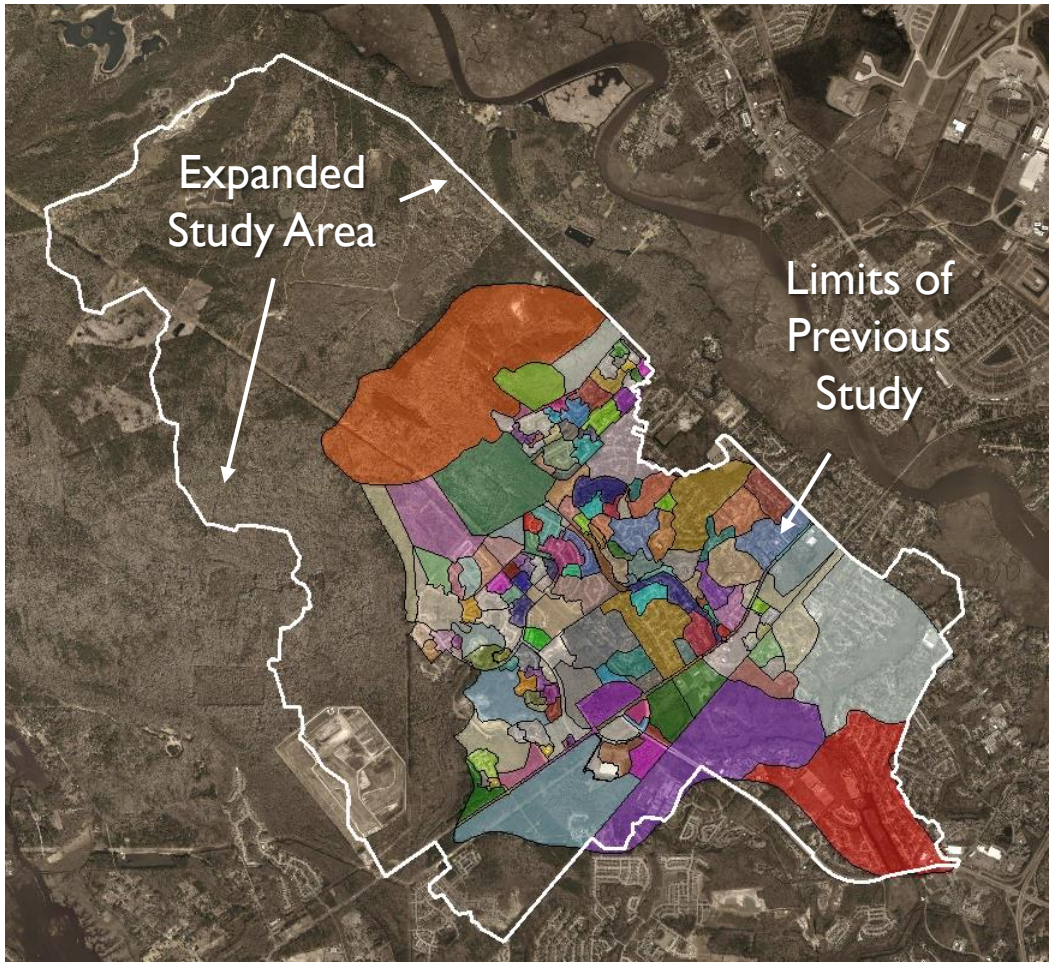


Frequent and Extensive Flooding

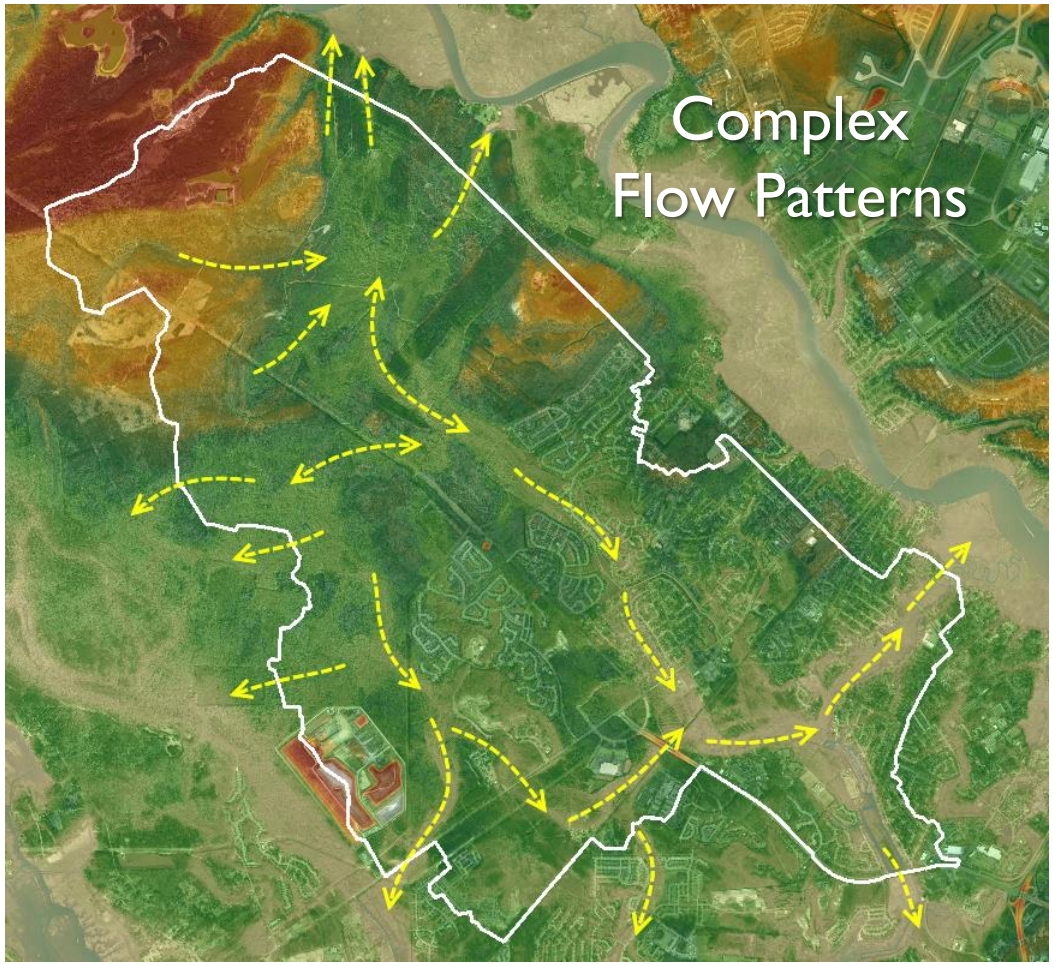
Review of Tasks

- Public Outreach – 14^{+} Meetings
- Field Verification of Key Assets
- Upgrade and Expand Hydraulic Model to ICPR4
- Develop and Test Alternatives to Prevent Flooding
- Develop Opinions of Probable Cost
- Review Past Efforts
- Provide Policy Recommendations

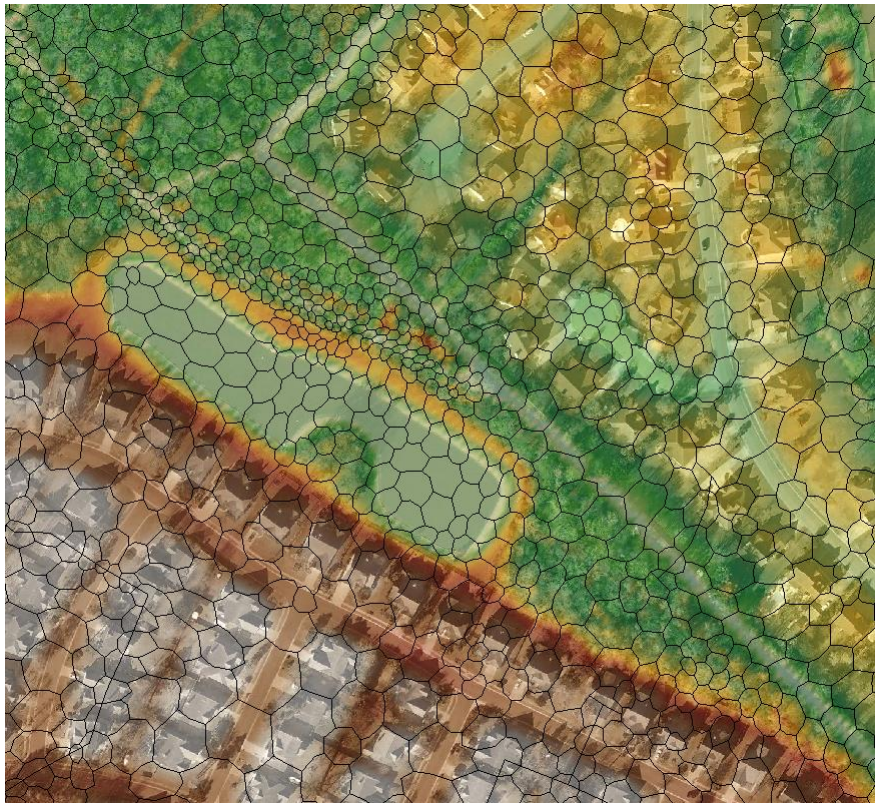
Expanded Study Area



Why 2d Modeling?

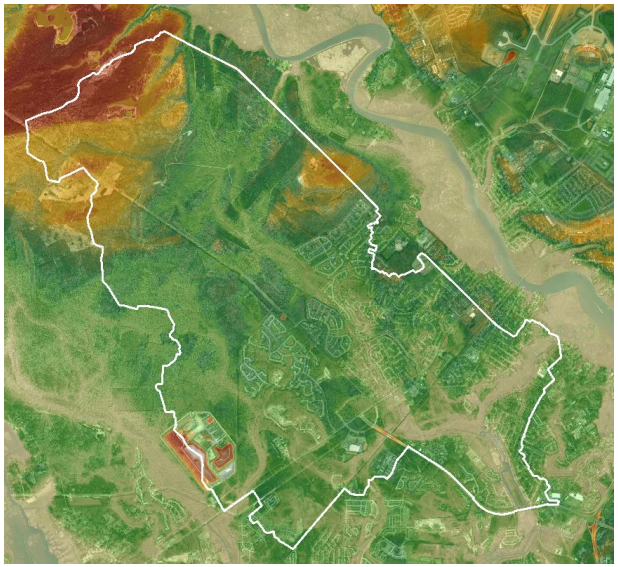


Why ICPR4?

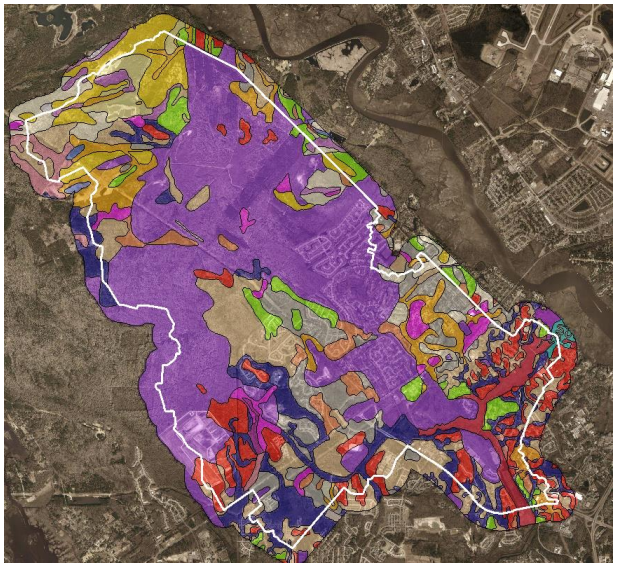


- Fully integrated 1d/2d surface hydraulics
- Flexible computational mesh
- "Rain-on-grid" hydrology
- 64-bit application
- Parallel processing

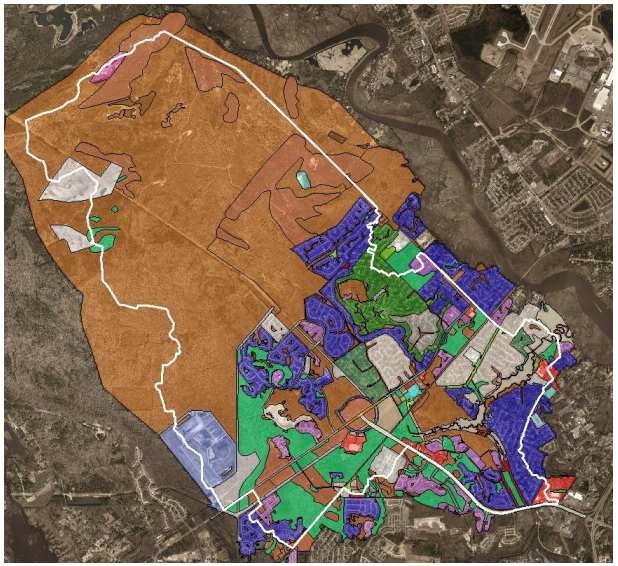
Model Setup – Base Data



Terrain

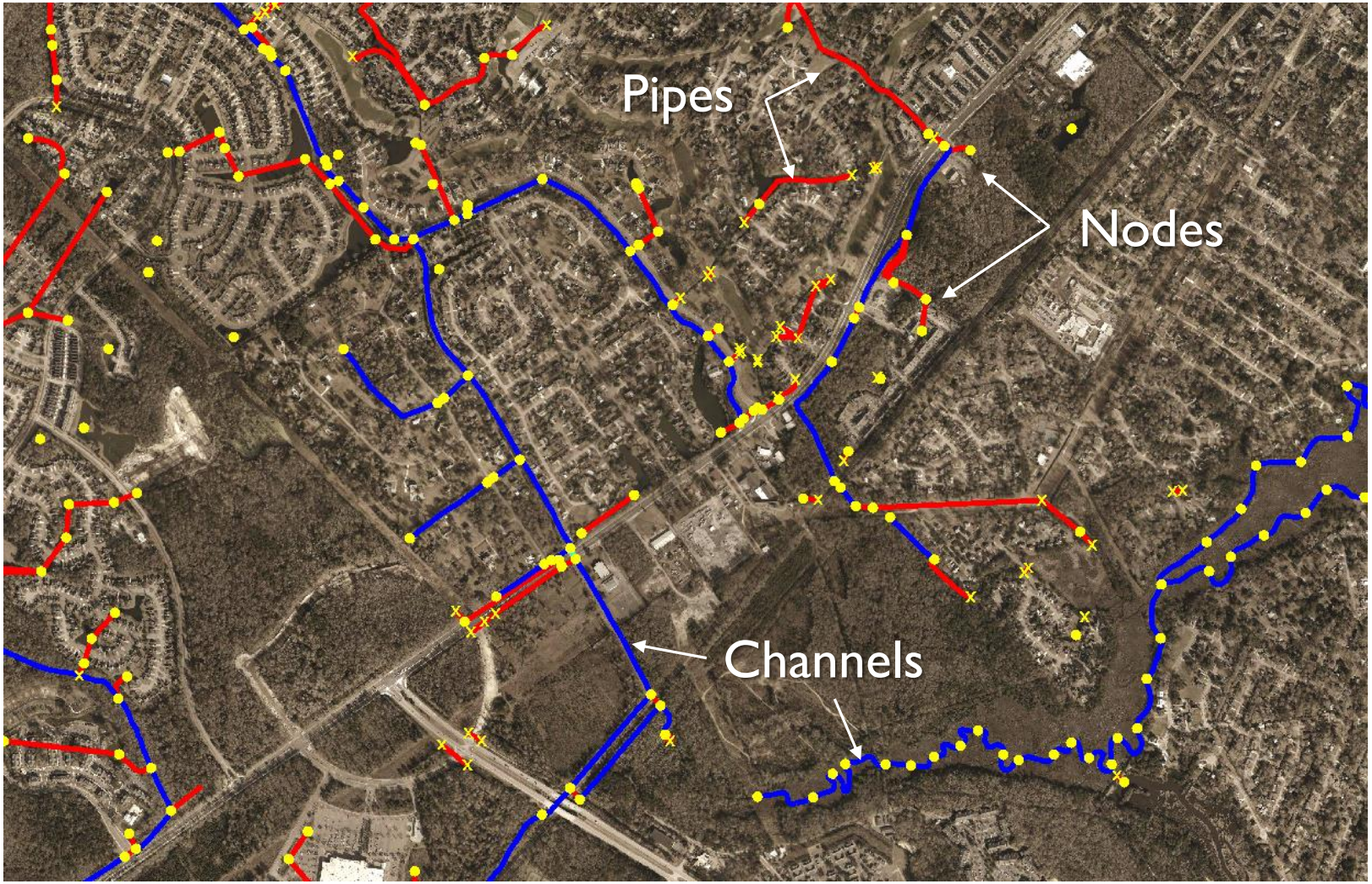


Soils

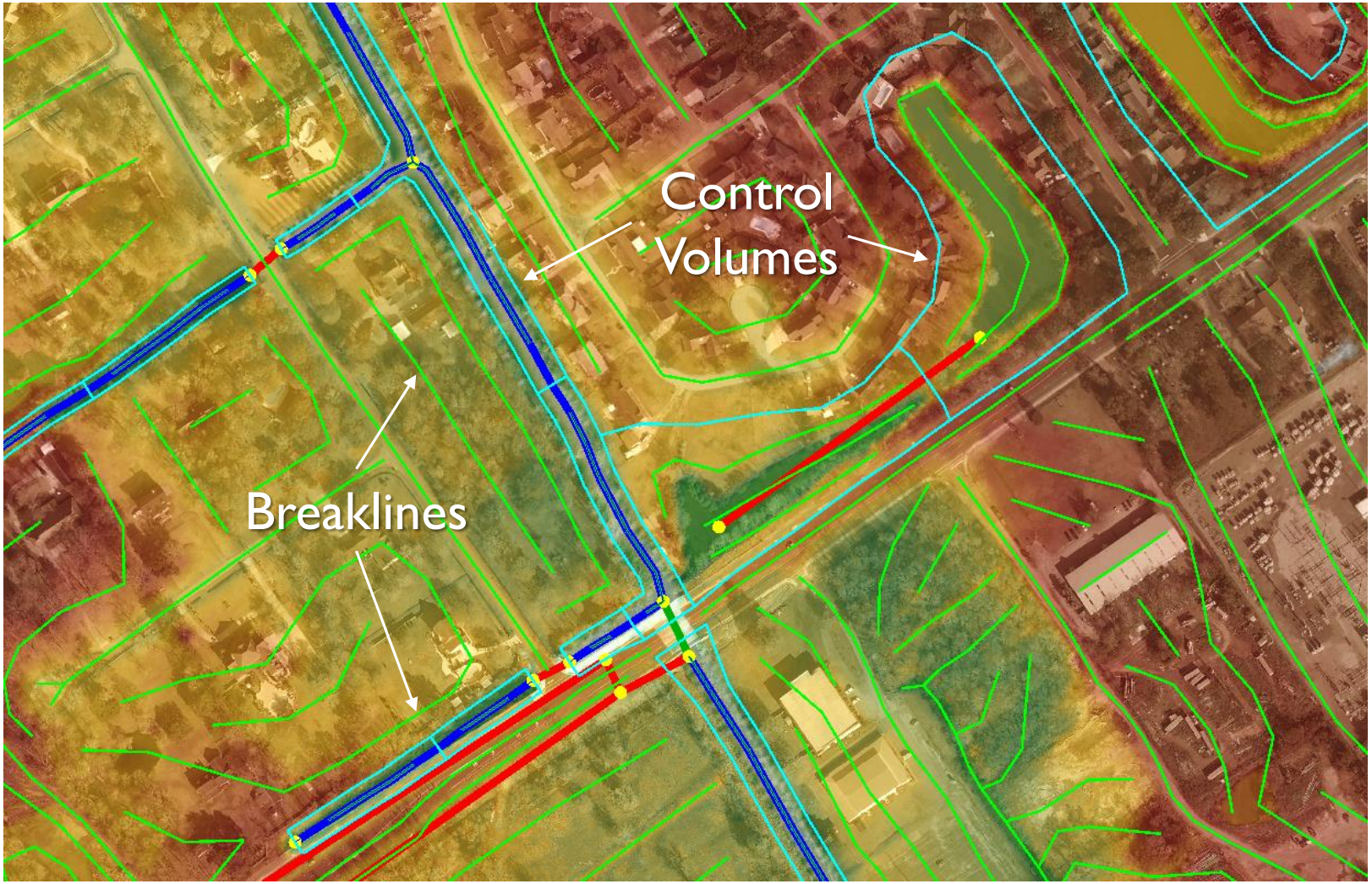


Land Use

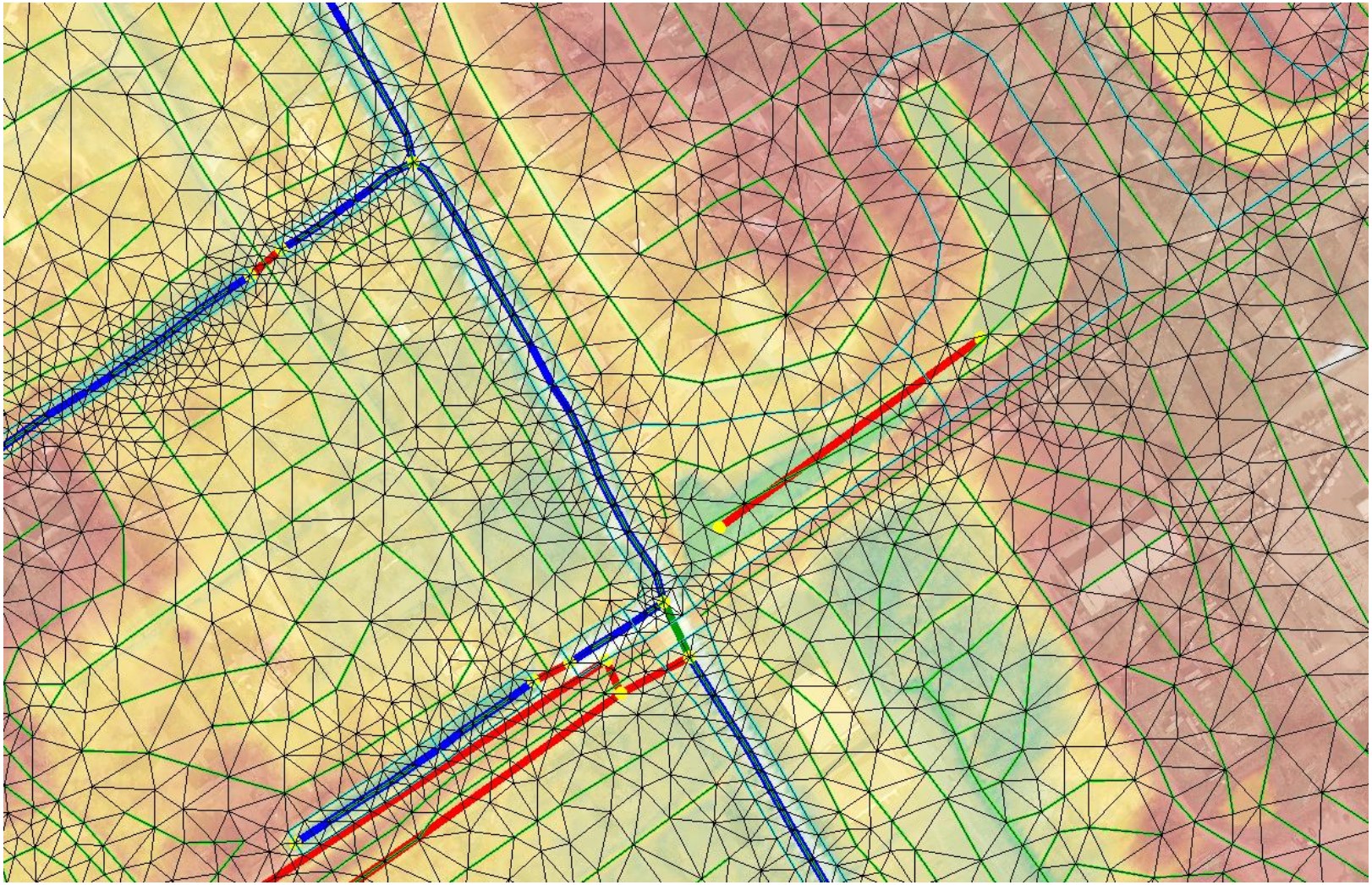
Model Setup – 1D Components



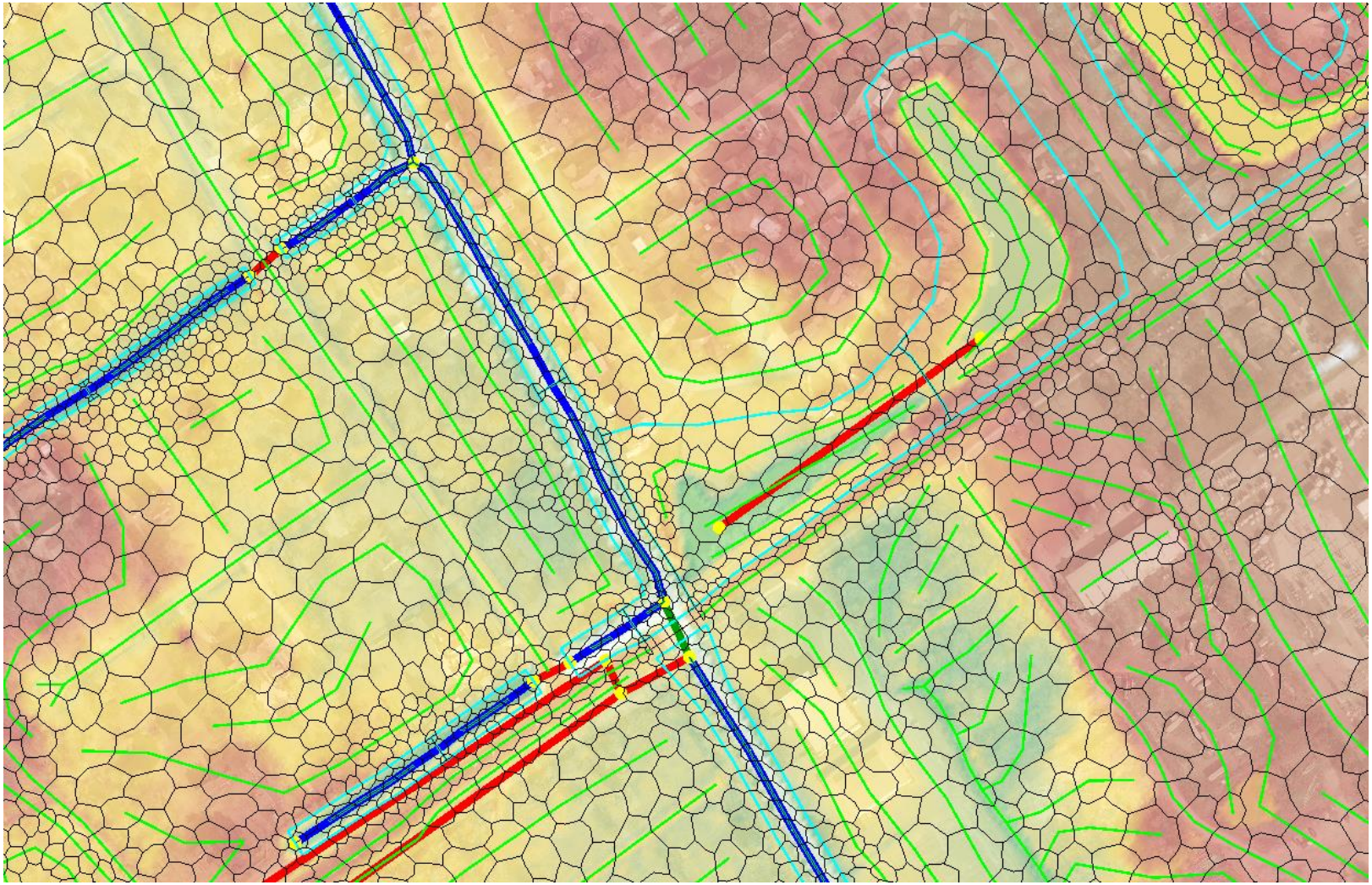
Model Setup – 2D Components

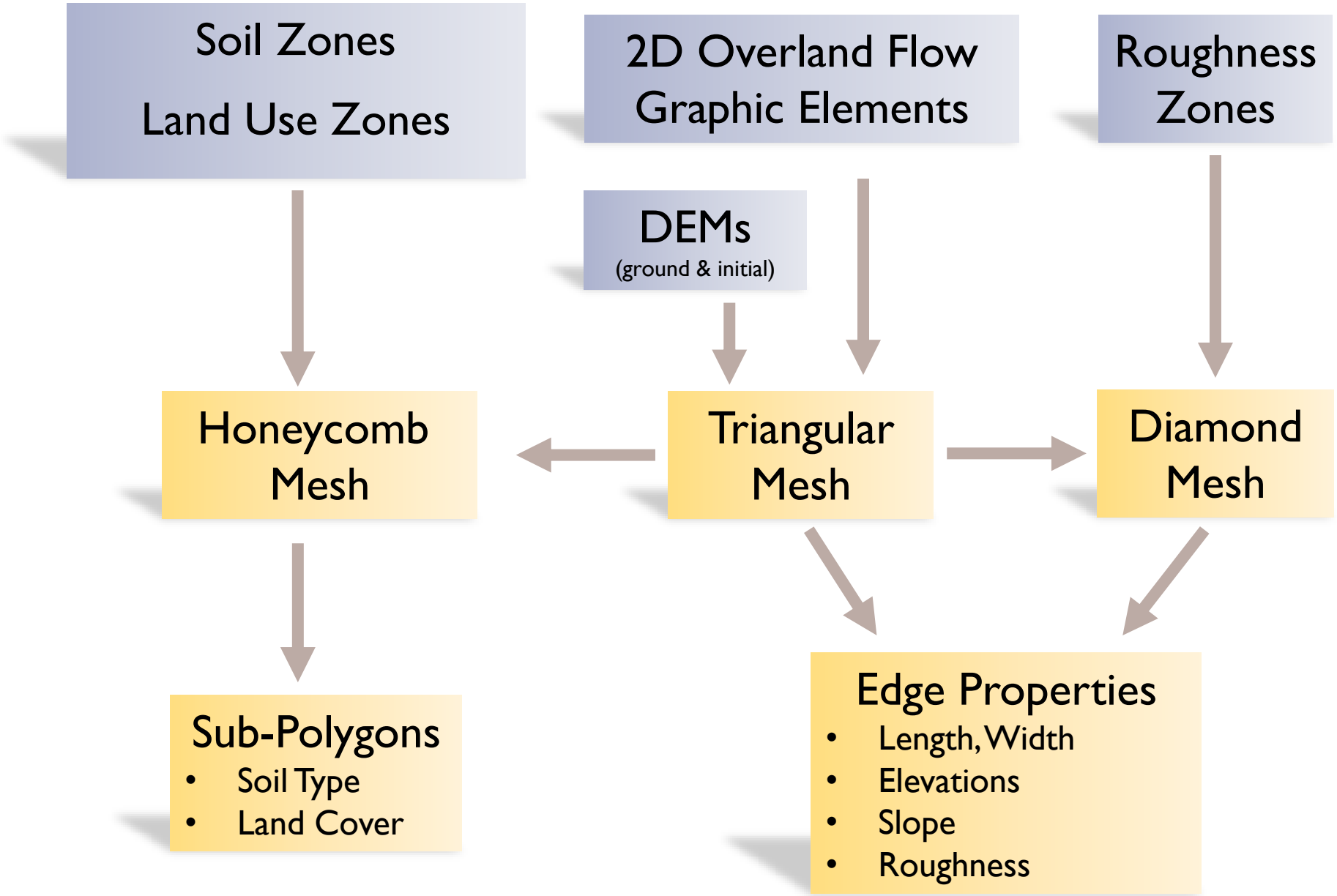


Model Setup – Triangular Mesh

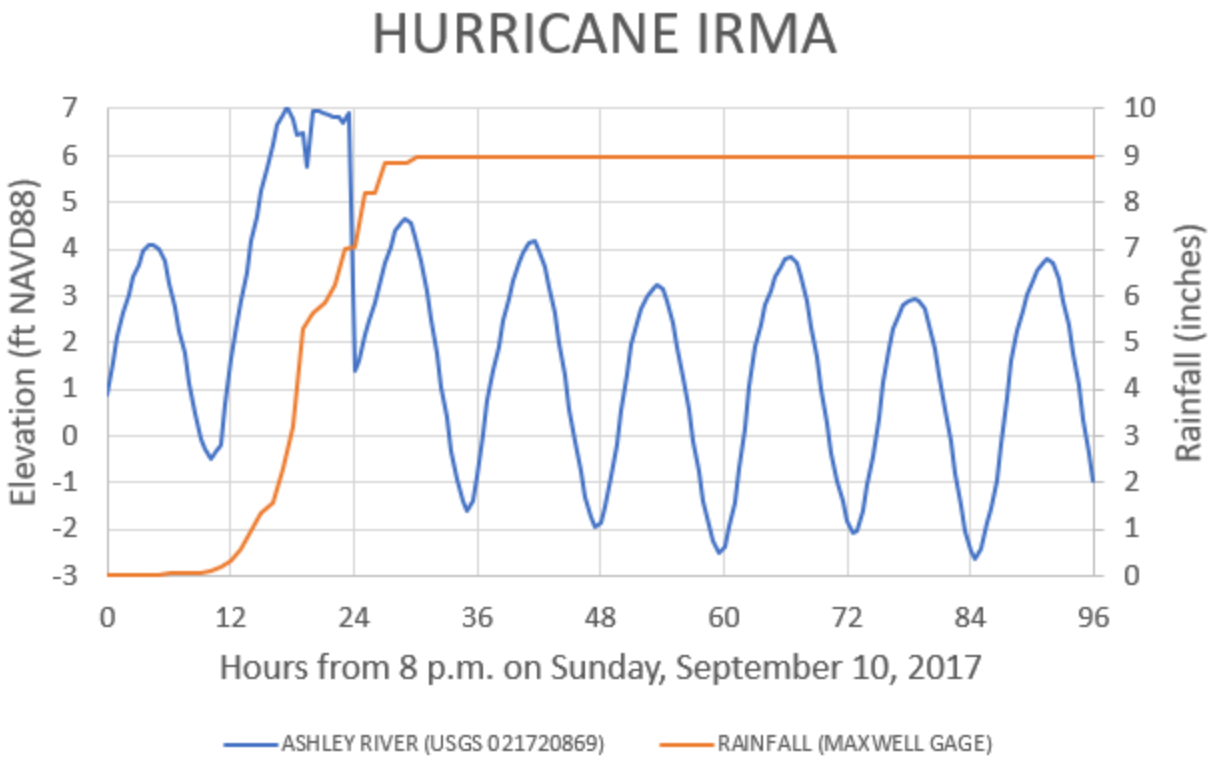


Model Setup – Honeycomb Mesh

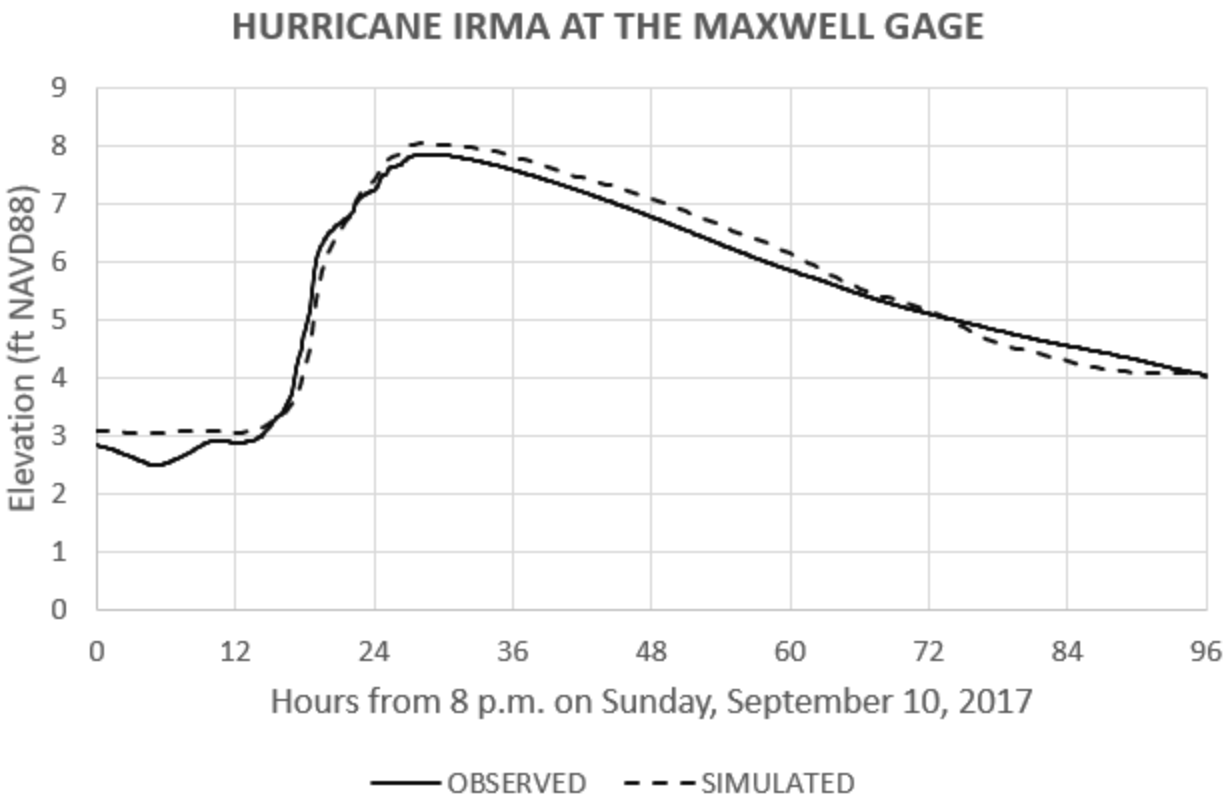



Soil Zones
Land Use Zones
2D Overland Flow Graphic Elements
Roughness Zones
DEMs
(ground & initial)
Honeycomb Mesh
Triangular Mesh
Diamond Mesh
Sub-Polygons
• Soil Type
• Land Cover
Edge Properties
• Length, Width
• Elevations
• Slope
• Roughness

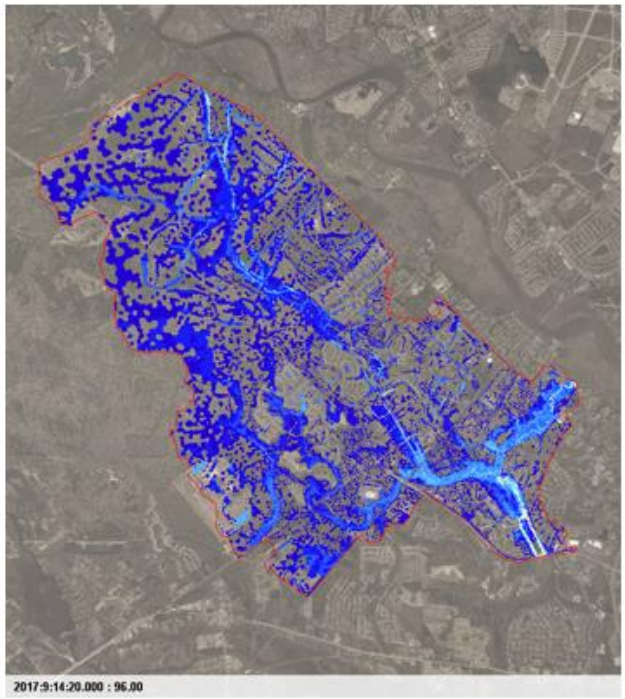
Model Calibration – Hurricane Irma



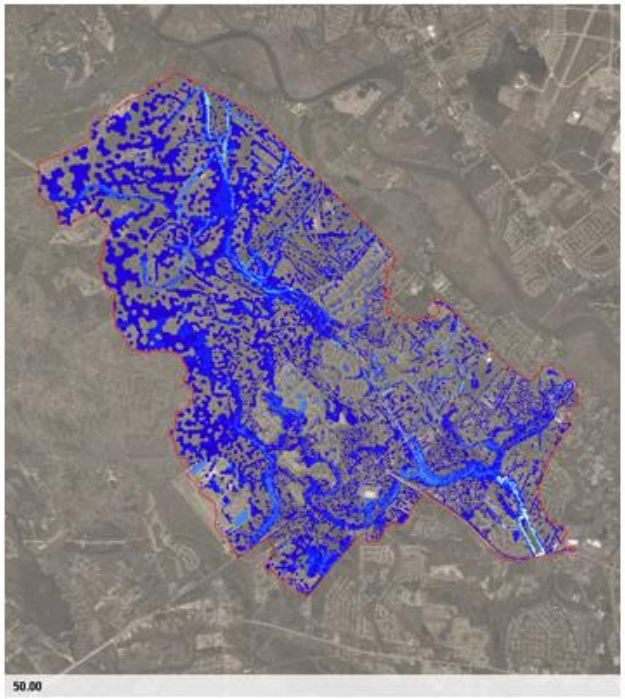
Model Calibration – Hurricane Irma



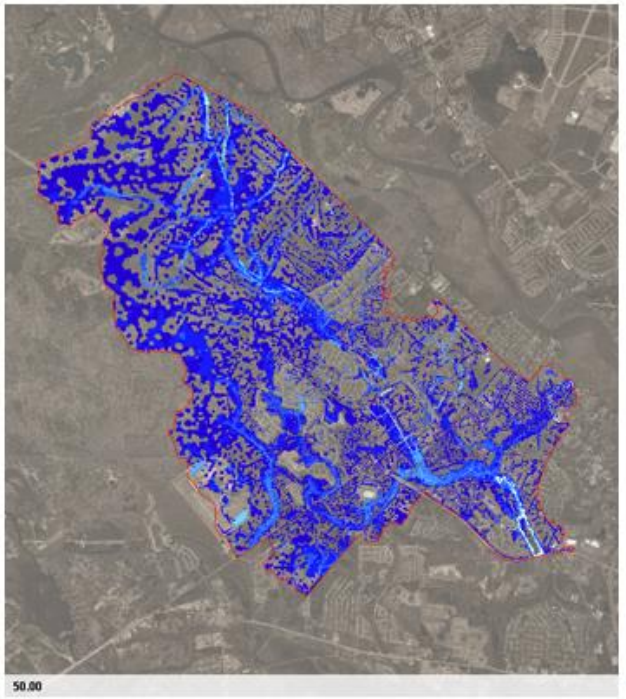
Model Results – Existing Conditions



HURRICANE IRMA



25-YEAR 24-HOUR

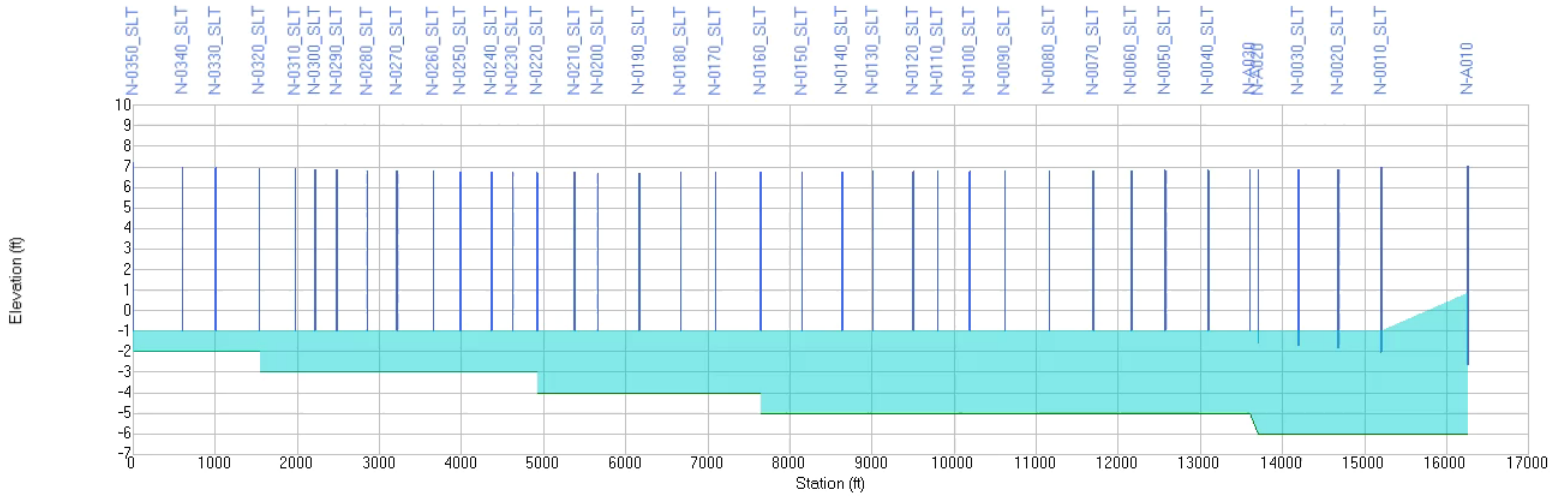


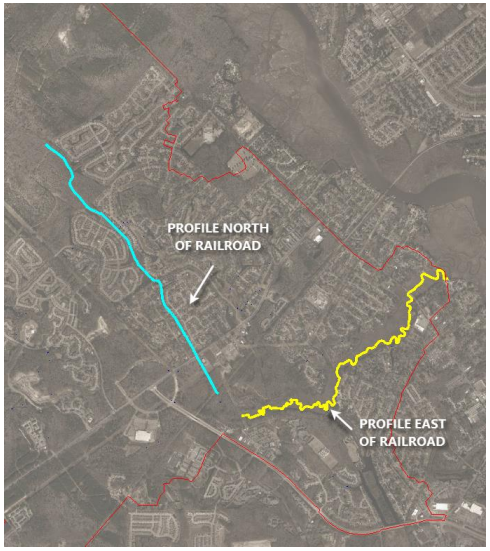
100-YEAR 24-HOUR

SIMULATED MAXIMUM FLOOD DEPTHS
GREATER THAN 3 INCHES
(EXISTING CONDITION)

Animation Legend			
	0.25		9.25
	1.25		10.25
	2.25		11.25
	3.25		12.25
	4.25		13.25
	5.25		14.25
	6.25		15.25
	7.25		16.25
	8.25		17.25

Model Results – Water Surface Profiles





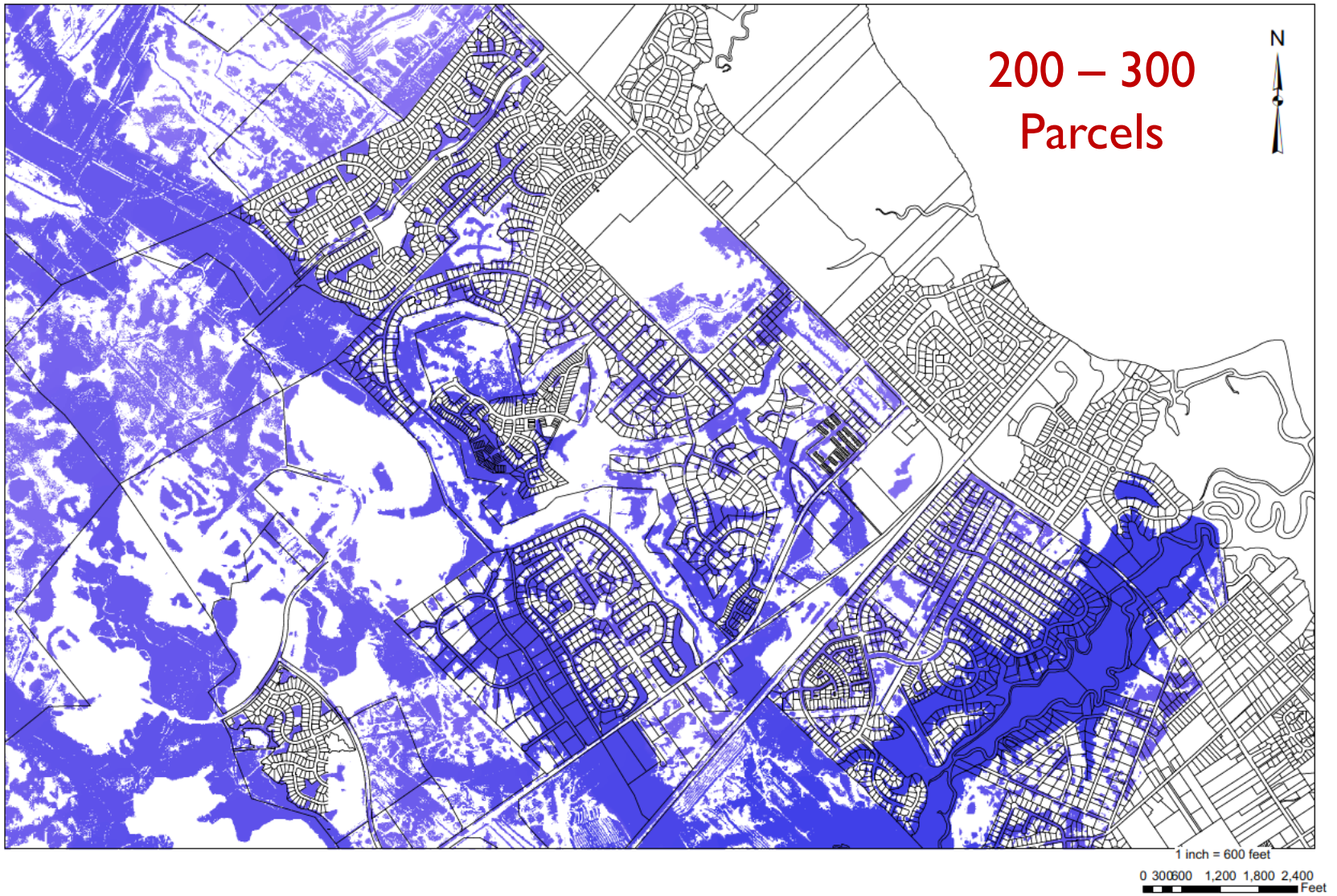
HURRICANE IRMA

CHURCH CREEK EAST OF RAILROAD
(EXISTING CONDITION)

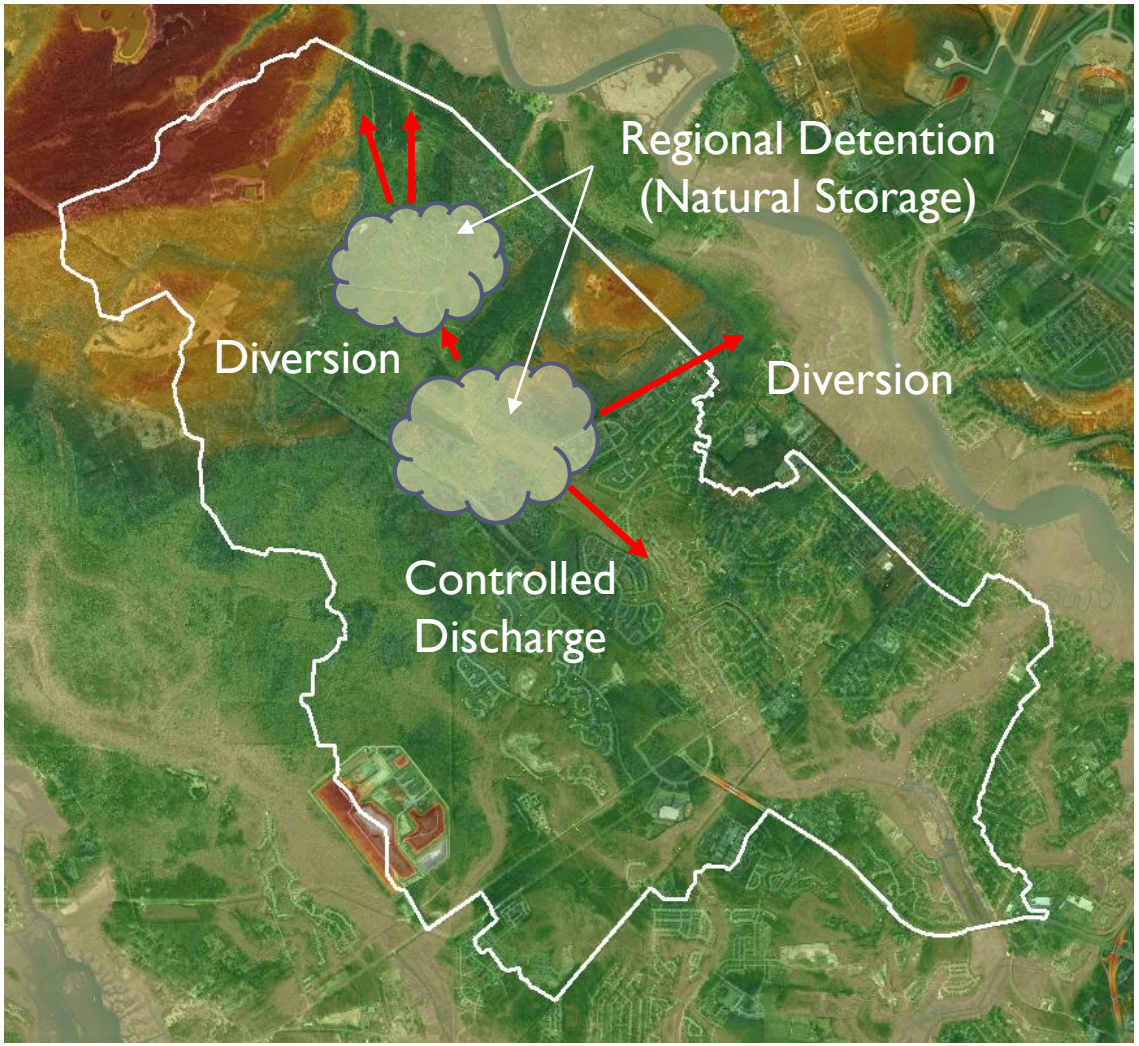
Flood Prevention Strategies

- Retreat
- Storage
- Diversion
- Maintenance
- Conveyance Improvements
- Pumping
- Tidal Surge Protection
- Stormwater Policy Revisions

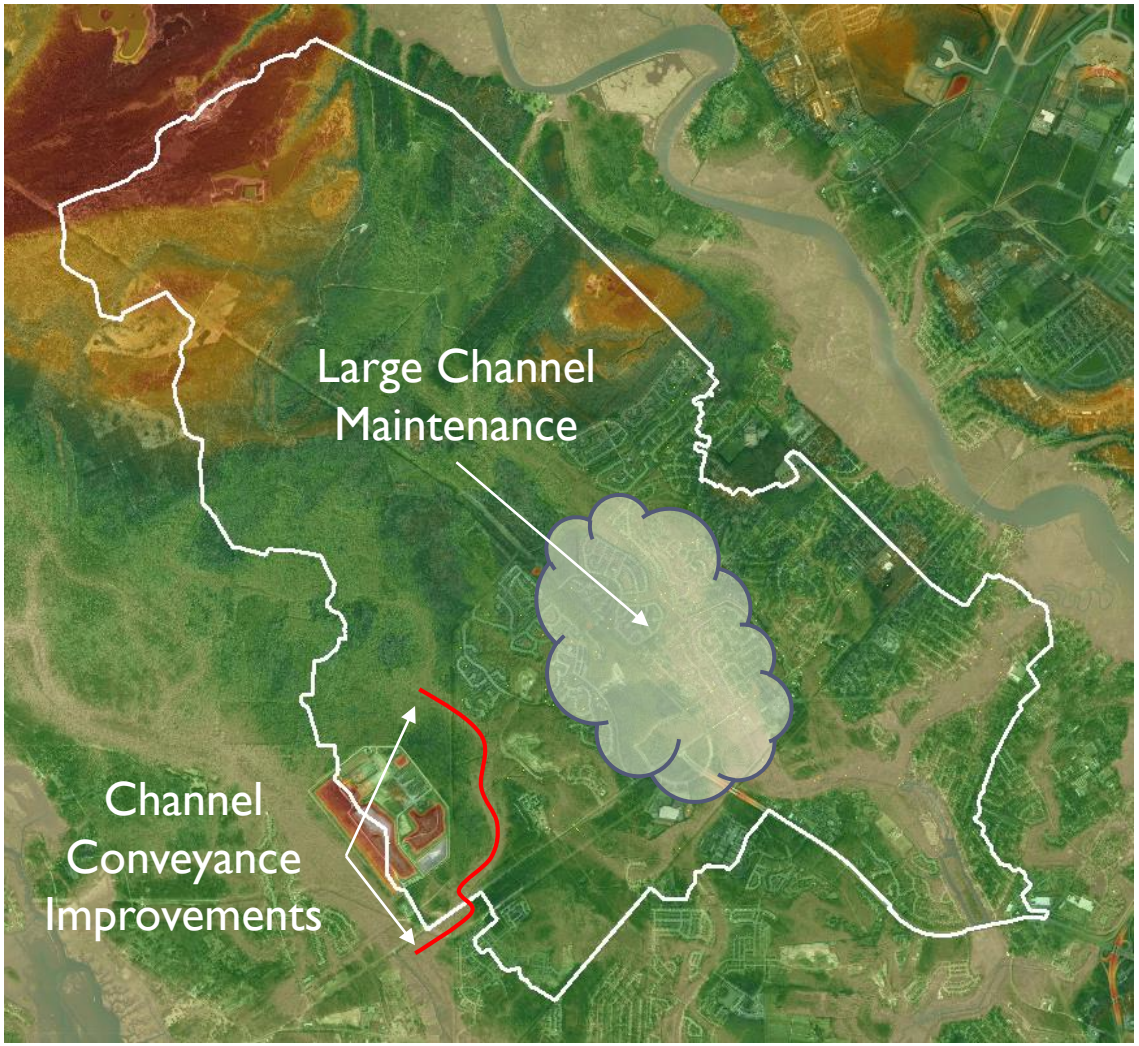
Strategies – Retreat



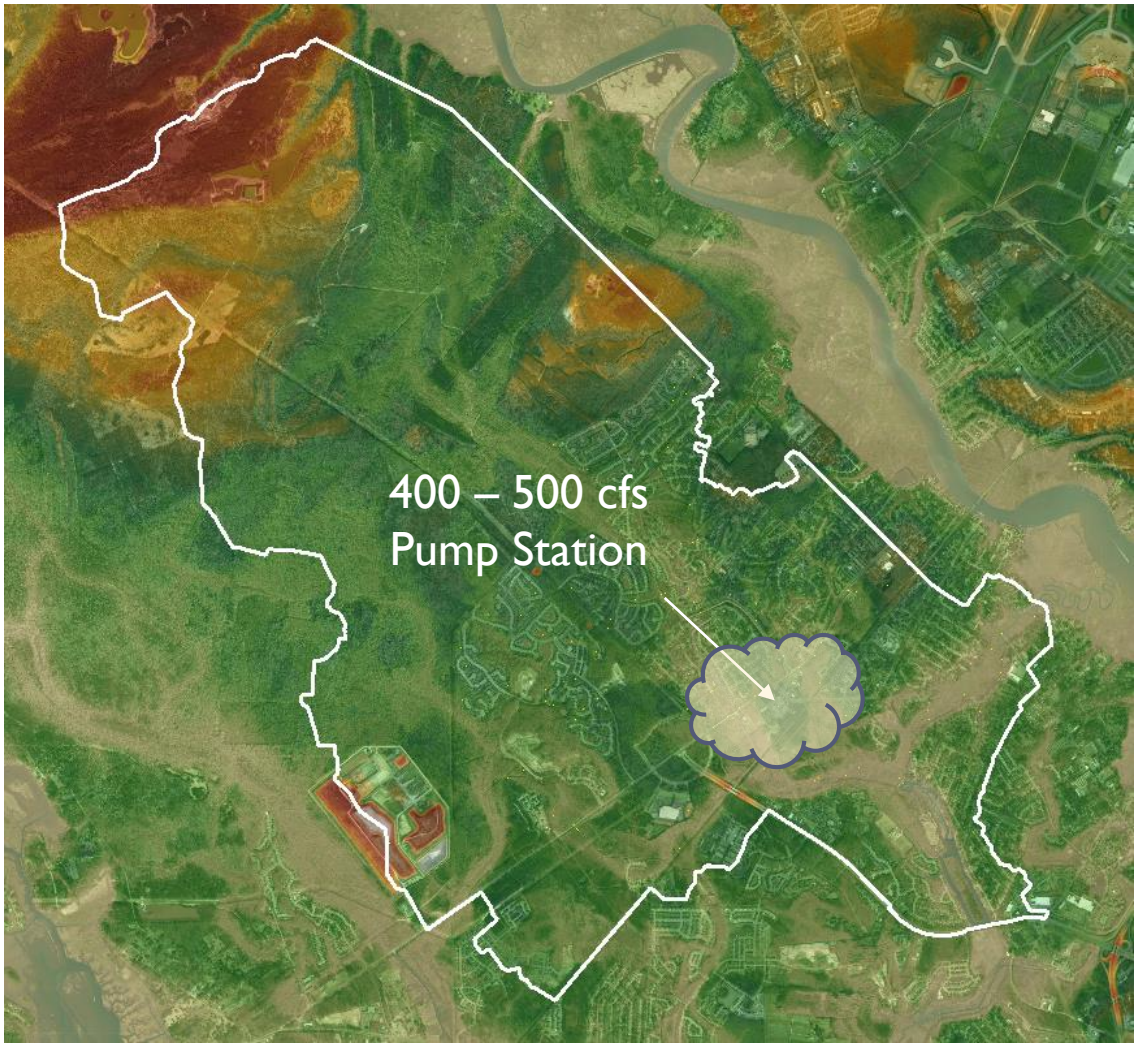
Strategies – Storage & Diversion



Strategies – Maintenance & Conveyance



Strategies – Pumping



Strategies – Tidal Surge Protection

Closing Remarks & Questions

- New approaches to Floodplain Protection, City Wide
- New Opportunities for Urban Greenspace
- Retreat when an option, Otherwise Fortify
- Review Land Use, Consider density Trading for Protection of Floodplain, update land development & SW Design Manual
- Study, Model, Plan for the Future
- Study Vulnerability
- Take a proactive approach to Sea Level changes & Changes in Weather Patterns

Opinion of Probable Cost

Summary of Improvements

Cost Opinions

Alternative	Description		OPC
1	Church Creek Channel Tidal Surge Protection		$ 1,531,650
2	Church Creek Stormwater Pump Station & Force Main		27,802,000
3	North Basin Storage Improvements		3,910,077
4	Forest Lakes & Downstream Flow Improvements		3,148,866
5	Southwest Basin Conveyance & Outfall Improvements		2,594,120
6	Hickory Farms Overland Flow Diversion		482,322
7	Large Channel Conveyance System Improvements		4,798,566
		Total	$44,267,601