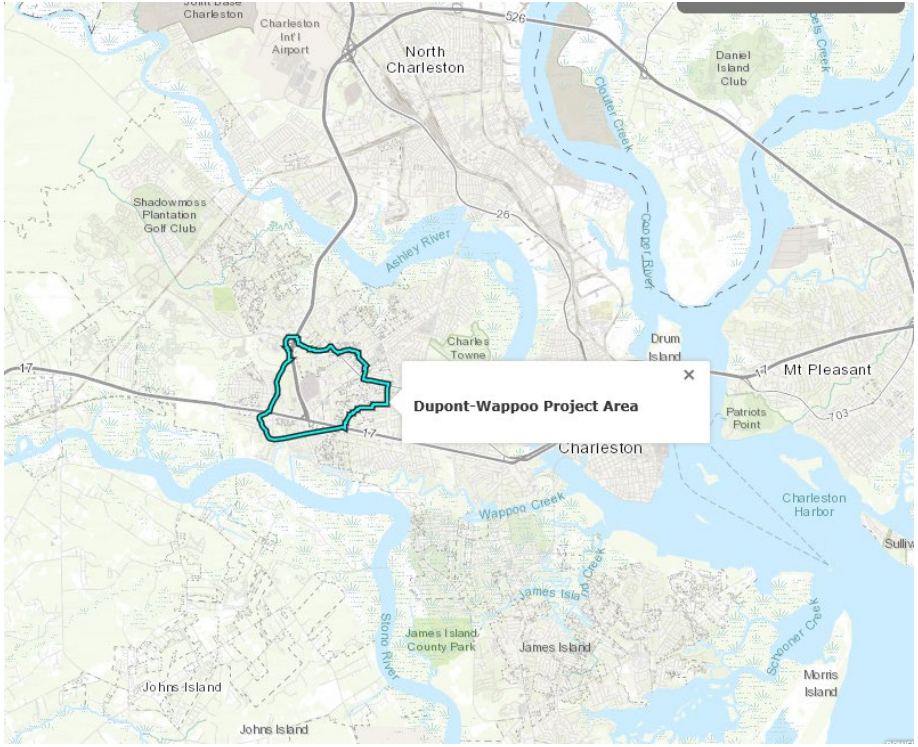
City of Charleston
Dupont- Wappoo Watershed
Master Plan

Agenda

1. Purpose
2. Background
3. Public Outreach & Stakeholder Engagement
4. Field Investigation/Condition Assessment
5. Hydrologic & Hydraulic Modeling
    - Watershed Characterization
    - Model Network
    - Model Calibration
    - Dynamic Boundary Conditions
    - Existing Flooding Location Maps
    - Level of Service
6. Proposed Improvements
7. Prioritization Matrix
8. Summary and Conclusions



Purpose

Purpose

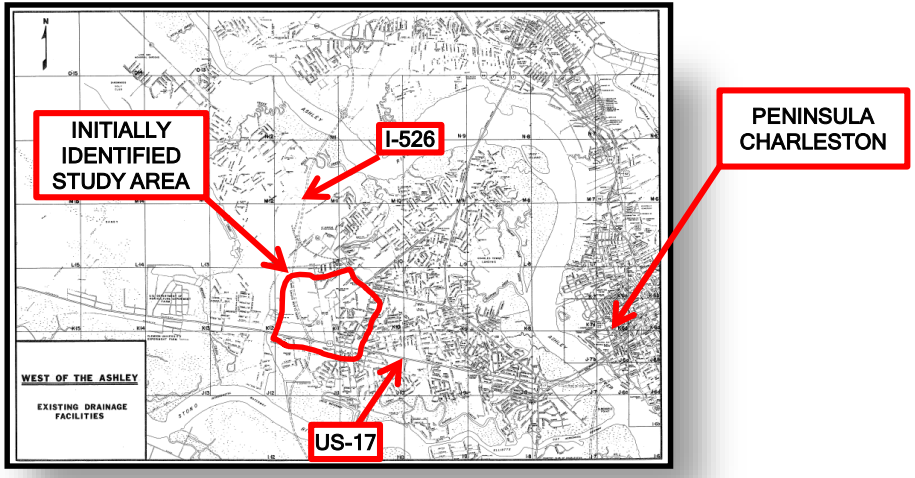
- Infrastructure Condition Assessment
  - For defects
- Hydrologic & Hydraulic Modeling
  - Develop Model Network for Dupont-Wappoo Watershed
  - Calibrate the model to high water marks
- Identify Major Areas of Flooding
  - Based on Defined Roadway Level of Service
- Propose Improvements
  - Water Quantity and Ancillary Water Quality Improvements
- Maintenance Plan

Citadel Mall parking lot during Hurricane Irma, 2017

CHARLESTON COUNTY SOUTH CAROLINA AECOM

Background

Background – Location Map



BACKGROUND – Defining the Watershed

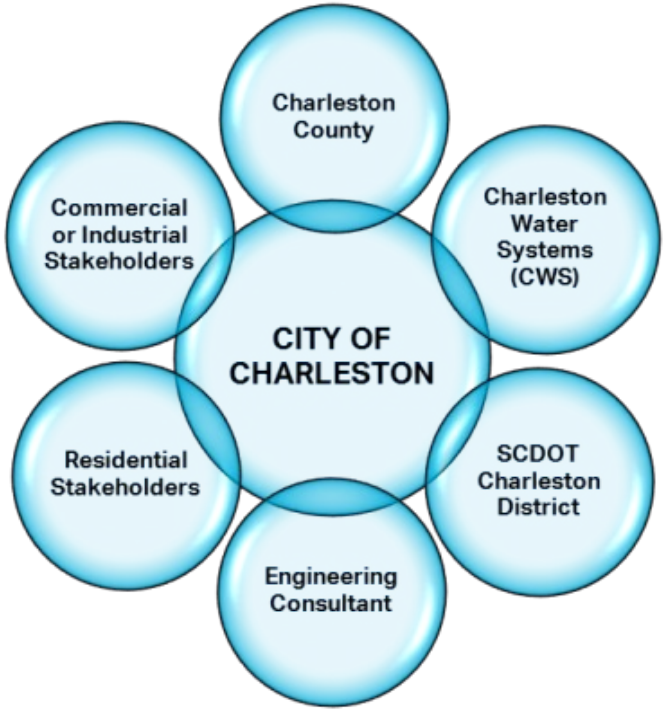
DuWap Characteristics:

- 1600 acres
- Mixed Land Use (75% Residential and Commercial, Some Light Industrial)
- Citadel Mall and Major Shopping Corridors
- High Traffic Area
- Highly Urbanized with Vegetated Open Spaces

Public Outreach & Stakeholder Engagement

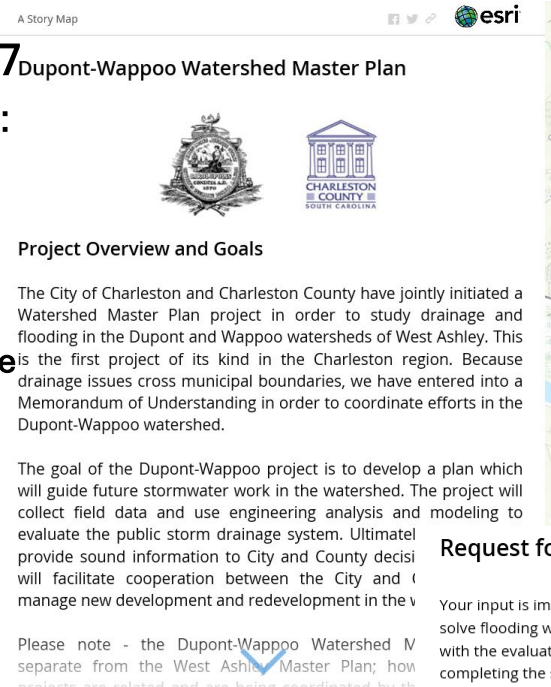
Public Outreach & Stakeholder Engagement

- City/County Memorandum of Understanding
- SCDOT Coordination for Survey Encroachments
- Stakeholder Identification and Involvement
  - Public Meetings
  - StoryMap project website
  - SurveyMonkey community survey



Public Outreach & Stakeholder Engagement

- Public Meeting held on May 16, 2017
  - Obtain public input on following areas:
    - Flooding
    - Water quality and trash/debris concerns
    - Unsightly areas of drainage
  - Citizens were asked to help
    - Marked problem areas on maps to provide input
    - Filled out surveys
    - Submitted photos / videos of flooding
- StoryMap available online with a Survey link


A Story Map

esri

Dupont-Wappoo Watershed Master Plan

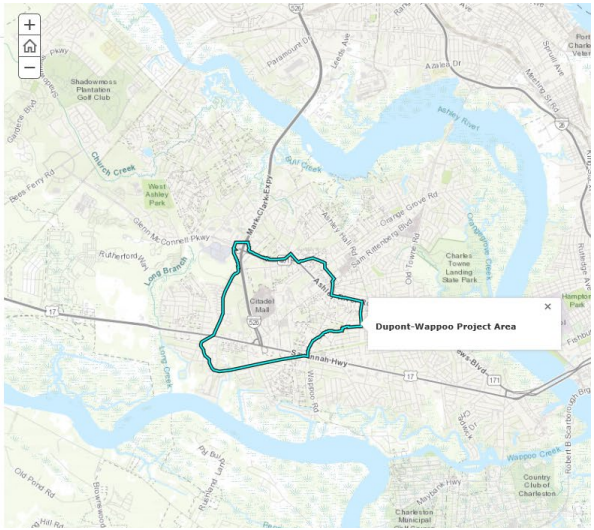
CHARLESTON COUNTY SOUTH CAROLINA

Project Overview and Goals

The City of Charleston and Charleston County have jointly initiated a Watershed Master Plan project in order to study drainage and flooding in the Dupont and Wappoo watersheds of West Ashley. This is the first project of its kind in the Charleston region. Because drainage issues cross municipal boundaries, we have entered into a Memorandum of Understanding in order to coordinate efforts in the Dupont-Wappoo watershed.

The goal of the Dupont-Wappoo project is to develop a plan which will guide future stormwater work in the watershed. The project will collect field data and use engineering analysis and modeling to evaluate the public storm drainage system. Ultimatel provide sound information to City and County decisi will facilitate cooperation between the City and manage new development and redevelopment in the

Please note - the Dupont-Wappoo Watershed M separate from the West Ashley Master Plan; how



Request for Input

Your input is important and will help the City and its consultants develop solutions to help solve flooding within the Dupont-Wappoo project area. If you have information that may help with the evaluation of existing flooding or water quality problems, please let the City know by completing the survey on this screen.

The survey can also be found here.

If you have photos or videos showing problem areas, or high water marks from large storms or hurricanes, we would like to see them! You can contact the Dupont-Wappoo project team by clicking here.

Thank you for your input.

Field Investigation/Condition Assessment

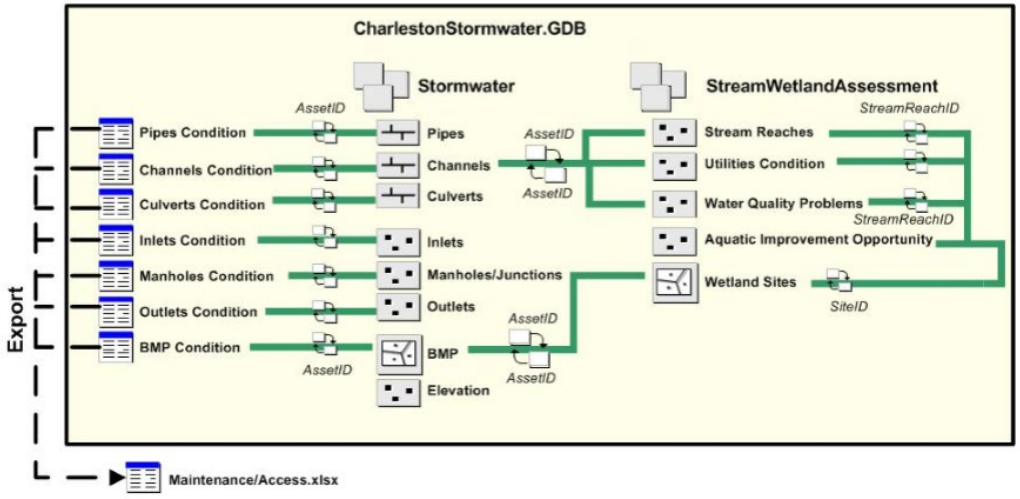
Field Investigation and Condition Assessment

- Inventory of Stormwater Assets
  - 3000 Assets Recorded
- Parameters
  - Dimensions
  - Inverts
  - Structural Defects (Joint Separation/ Collapse etc.)
  - Operations and Maintenance Defects (Blockage/Sediments etc.)
  - Connectivity

CHARLESTON COUNTY SOUTH CAROLINA AECOM

Field Investigation and Condition Assessment

- Selection of Stormwater Assets
  - 1208 Pipes, Culverts, and Channels
  - 330 Manholes and Inlets
  - Minor Roads
  - Important Buildings
- Maintenance and Repairs
  - City of Charleston actively repaired the drainage system during the Field Investigat and Condition Assessment



Hydrologic/Hydraulic Modeling

Hydrologic/Hydraulic Modeling – Watershed Characterization

Sub-basin Delineation

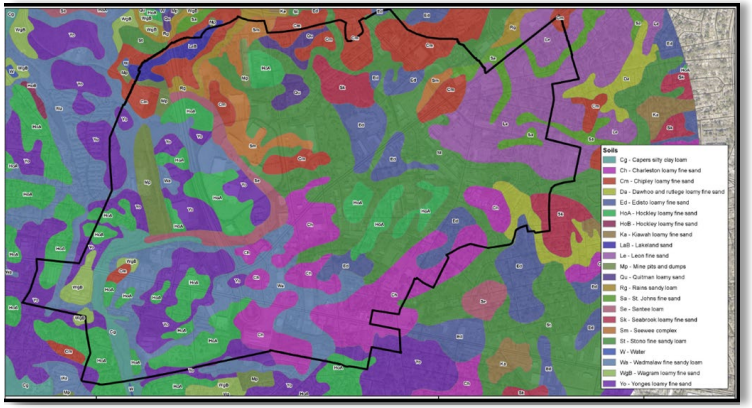
- 125 Total Sub-basins
- 105 Watershed Basins
- 20 Pond Basins

Topography

- 2007 LiDAR

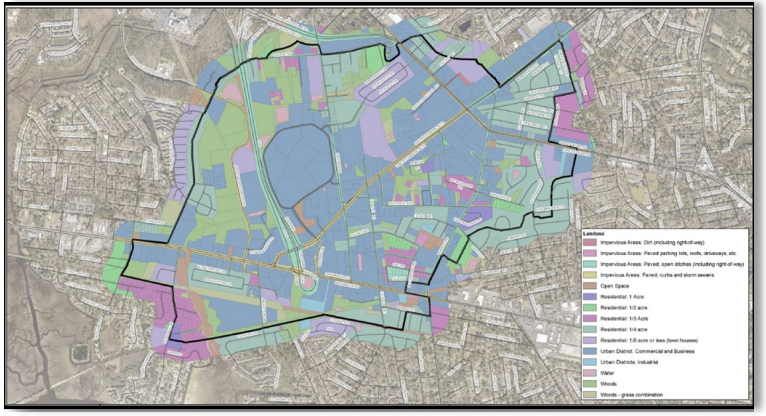
Hydrologic/Hydraulic Modeling – Watershed Characterization

Soil Map



- WSS – NRCS
- 53% Dual HSG (A/D)
  - Used D for Modeling analysis

Land Use/Land Cover Map



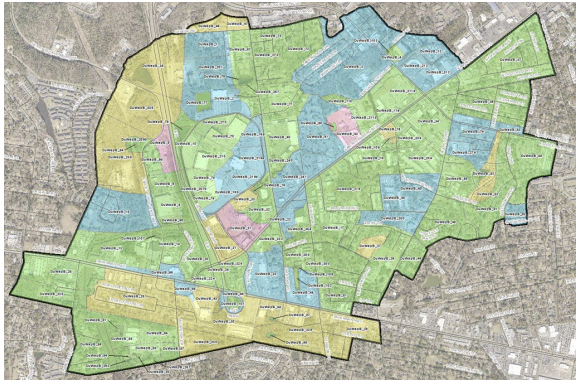
- City/County Zoning Map
- Mixed Land Use (75% Residential and Commercial)

CHARLESTON COUNTY SOUTH CAROLINA AECOM

HYDROLOGIC/HYDRAULIC MODELING - Watershed Parameterization

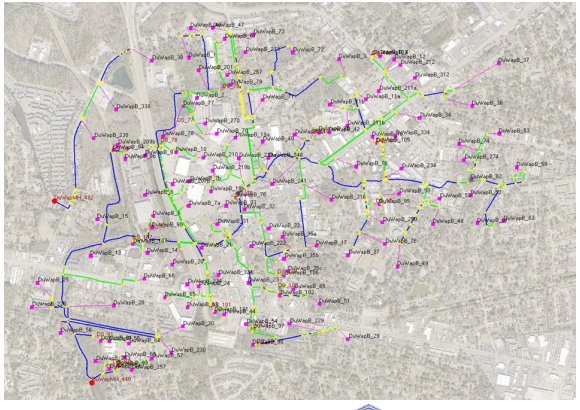
Hydrology

- Curve Numbers (AMC III)
- Time of Concentration (TR-55)
- Stage-Area Relationship



Hydraulics

- 1-D Model Network
  - ICPR 4.0
- Dynamic Boundary Conditions

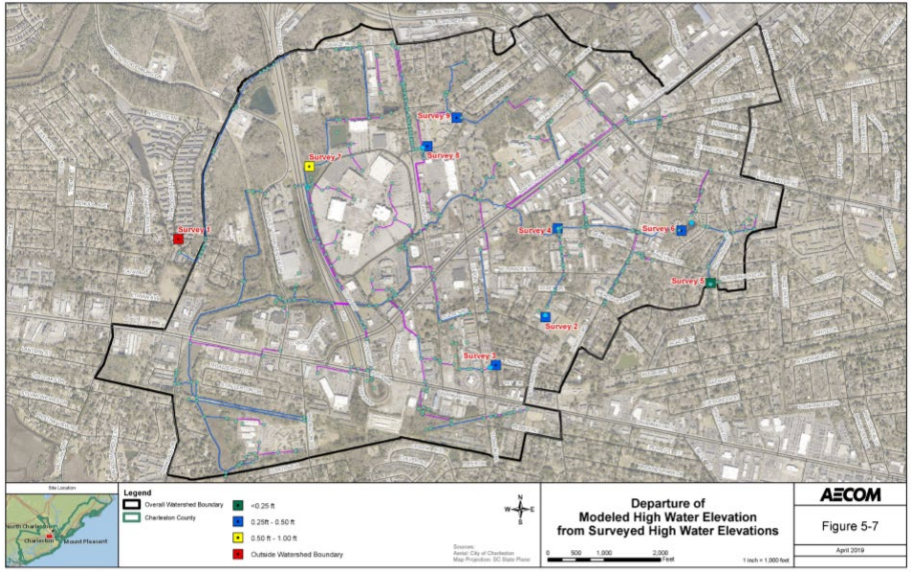


HYDROLOGIC/HYDRAULIC MODELING

Model Calibration

Calibrated against

- High Water Marks recorded for Hurricane IRMA



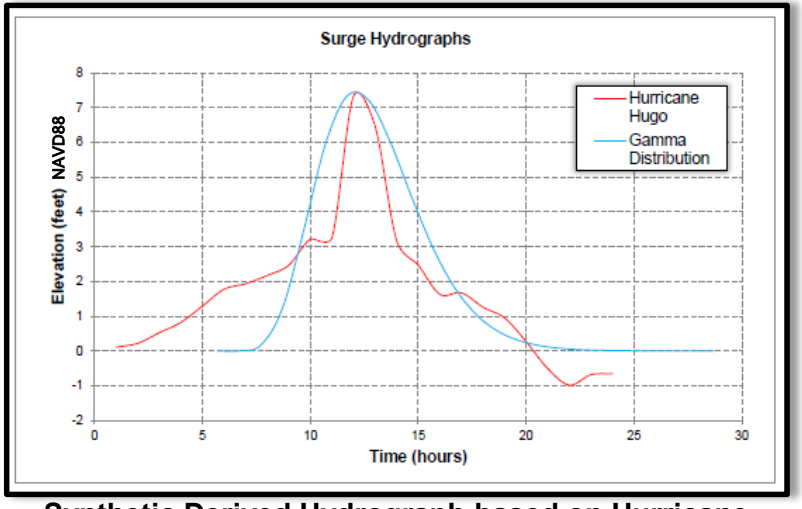
CHARLESTON COUNTY SOUTH CAROLINA

AECOM

Dynamic Boundary Conditions

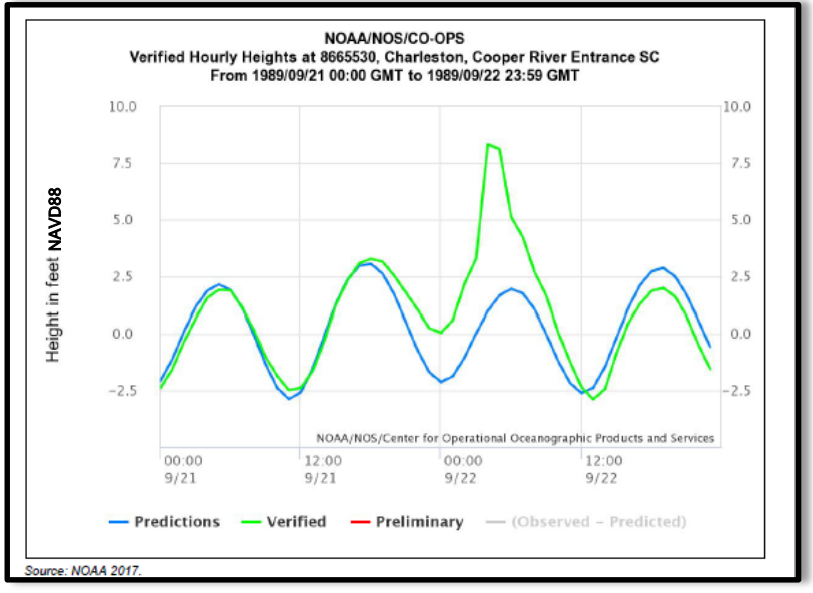
Dynamic Boundary Condition – Storm Surge Elevation in (NAVD88)

Hybrid Approach: Fitting mathematical distribution to actual hurricane data.



Synthetic Derived Hydrograph based on Hurricane Hugo

Hurricane Hugo Storm Surge Data

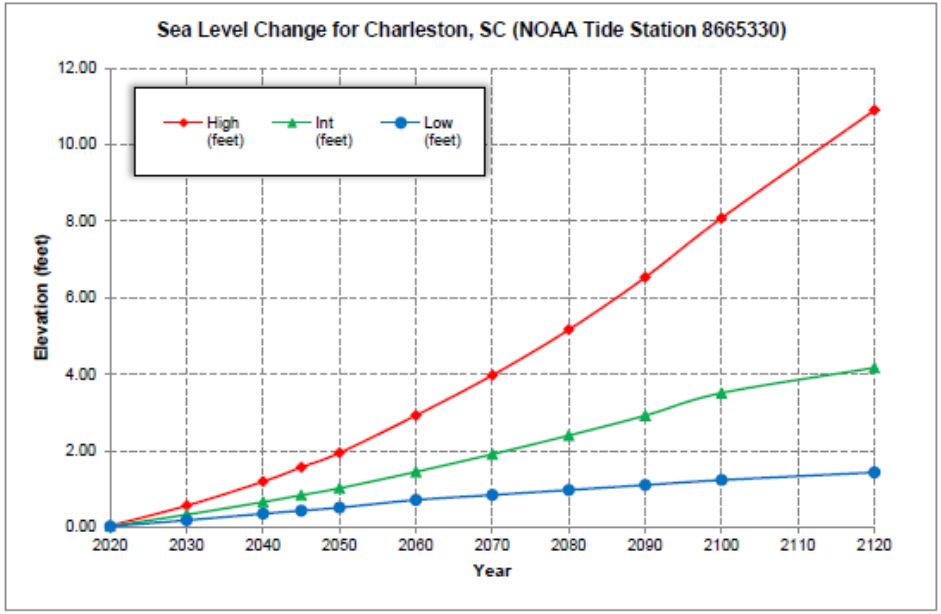


Hurricane Hugo Measured Water Levels (i.e., actual time series of flood levels)

Dynamic Boundary Condition – Sea Level Rise (Above 2019 Reference)

DuWap Watershed Sea Level Change for Charleston, SC (NOAA Tide Station 8665330)			
Year	Low (feet)	Inttermediate (feet)	High (feet)
2019	0.00	0.00	0.00
2020	0.02	0.03	0.04
2030	0.18	0.33	0.56
2040	0.35	0.66	1.19
2045	0.43	0.84	1.57
2050	0.51	1.02	1.94
2060	0.71	1.45	2.92
2070	0.84	1.91	3.97
2080	0.97	2.40	5.16
2090	1.10	2.92	6.53
2100	1.23	3.51	8.08
2120	1.43	4.17	10.90

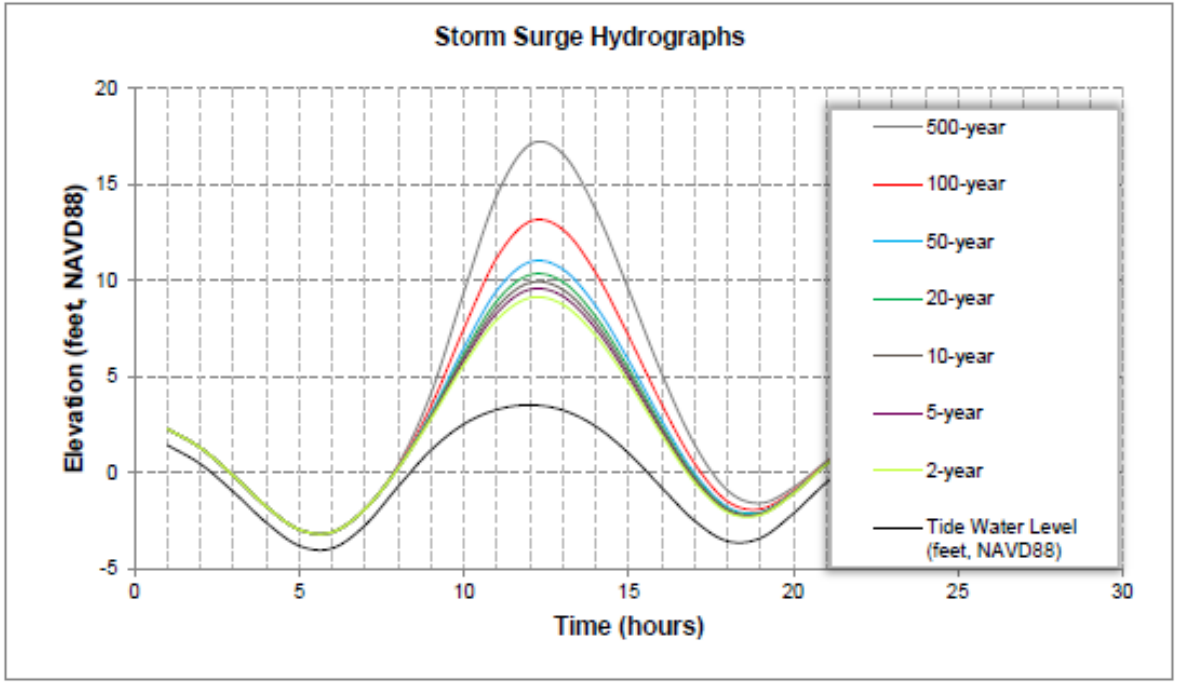
Source: NOAA 2017.
Note: NOAA2017 VLM: 0.00417 feet/year



Source: NOAA 2017.

Dynamic Boundary Condition – Tailwater for ICPR

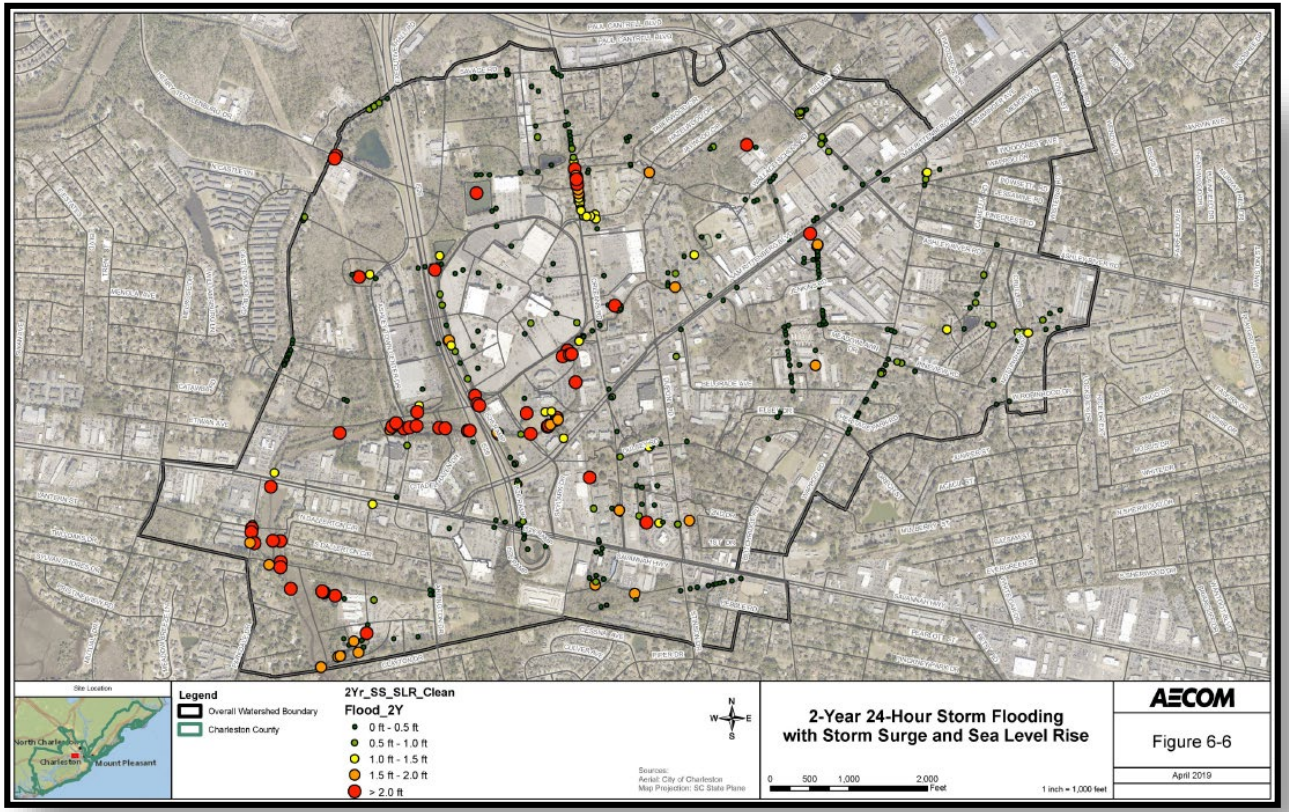
- Calibrated Model with Dynamic Tailwater.
- Tailwater Includes Sea Level Rise and Storm Surge

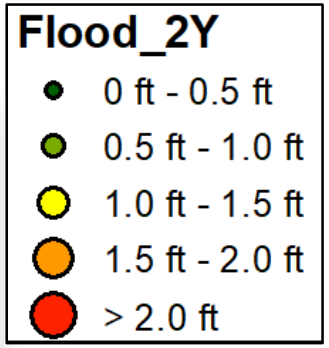


Dynamic Boundary Conditions for 24-hour Simulations

Existing Flooding Locations

Current Condition 2-Yr 24-Hr Storm Flooding Locations

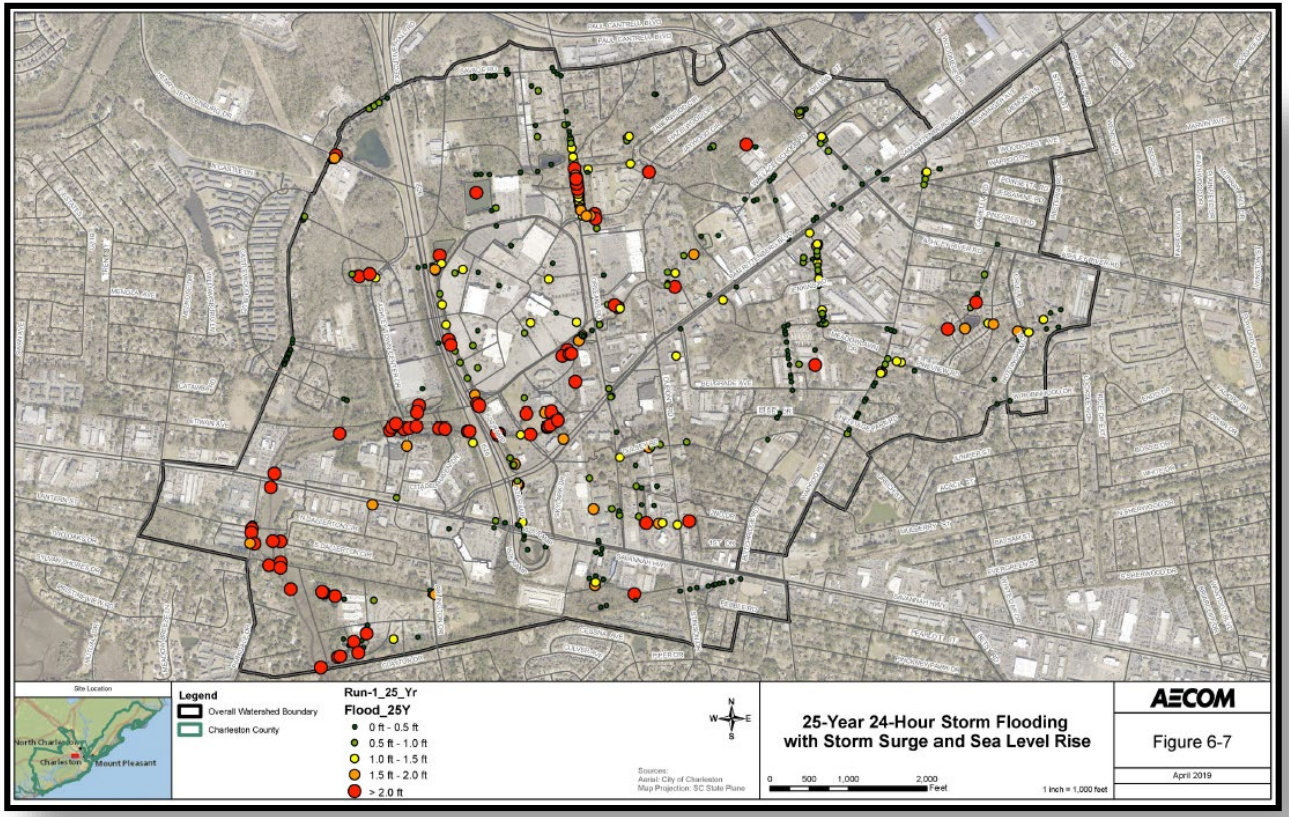




CHARLESTON COUNTY SOUTH CAROLINA

AECOM

Current Condition 25-Yr 24-Hr Storm Flooding Locations



Flood_25Y

- 0 ft - 0.5 ft
- 0.5 ft - 1.0 ft
- 1.0 ft - 1.5 ft
- 1.5 ft - 2.0 ft
- > 2.0 ft

CHARLESTON COUNTY SOUTH CAROLINA

AECOM

Level of Service

Roadway Level of Service

- City of Charleston Stormwater Design Standards Manual, March 15, 2013
- City of Charleston Redevelopment Standards for Stormwater (Executive Report),September 12, 2016
- City of Charleston, Church Creek Basin Ordinance, Rev. 2018

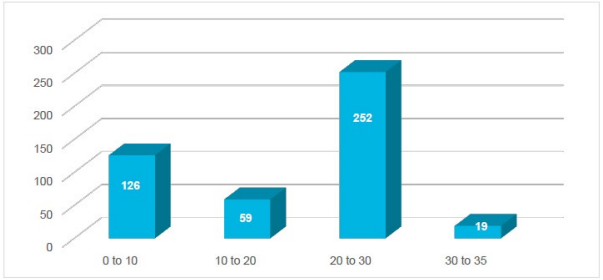
Description	5-Year	10-Year	25-Year	100-Year
Roadway: Evacuation	None	None	None	None
Roadway: Collectors	None	None	6 inches	9 inches
Roadway: Neighborhood	None	6 inches	9 inches	12 inches

Prioritization

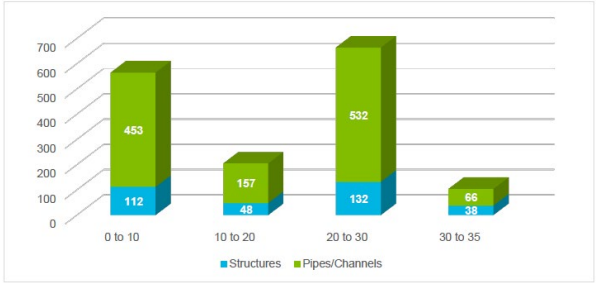
Condition assessment Scoring Matrix

	Defects	Descriptors	Modifiers	Condition Grade			
				No Mod.	Minor	Moderate	Severe
Structural Defects	Crack		Minor, Moderate, Severe		2	3	4
	Fracture		Minor, Moderate, Severe		3	4	5
	Broken		Minor, Moderate, Severe		3	4	5
	Hole		Minor, Moderate, Severe		3	4	5
	Deformed (≤40%)			4			
	Collapse (>40%)			5			
	Joint	Offset	Minor, Moderate, Severe		2	3	4
		Separated	Minor, Moderate, Severe		3	4	5
	Surface Damage	Spalling		2			
		Aggregate Visible		3			
		Rebar Exposed		4			
		Corrosion		5			
		Lining Failure		3			
		Other	Minor, Moderate, Severe		1	3	5
	Brick/Block /Rock	Displaced		3			
		Missing		4			
		Missing Mortar		2			
	Decayed		Minor, Moderate, Severe		2	3	4
				No Mod.	**<30%**	**30-50%**	**>50%**
	Sag		(<30%), (30-50%), (>50%)		2	3	4

Flood Resiliency Scoring Matrix



Total Flood Resiliency Scores at Model Nodes



Flood Resiliency Scores at Pipes, Channels, and Structures

Category	Flood Metrics	Criteria Score
Flood Frequency [a]	Floods in 2-year Storm	6
	Floods in 5-year Storm	5
	Floods in 10-year Storm	4
	Floods in 25-year Storm	3
	Floods in 50-year Storm	2
	Floods in 100-year Storm	1
Depth of flooding during 25-year storm	>2.0 feet	4
	1-2.0 feet	3
	0.5-1.0 feet	2
	0-0.5 foot	1
	No flooding	0
Major Evacuation Routes impacted [b]	Yes	10
	No	0
Critical Facilities impacted [c]	Yes	10
	No	0

[a] *Flood frequency was considered cumulative, a maximum flood frequency score of 21 was assigned to links/junctions with impacts during the 2-year through 100-year storms.*

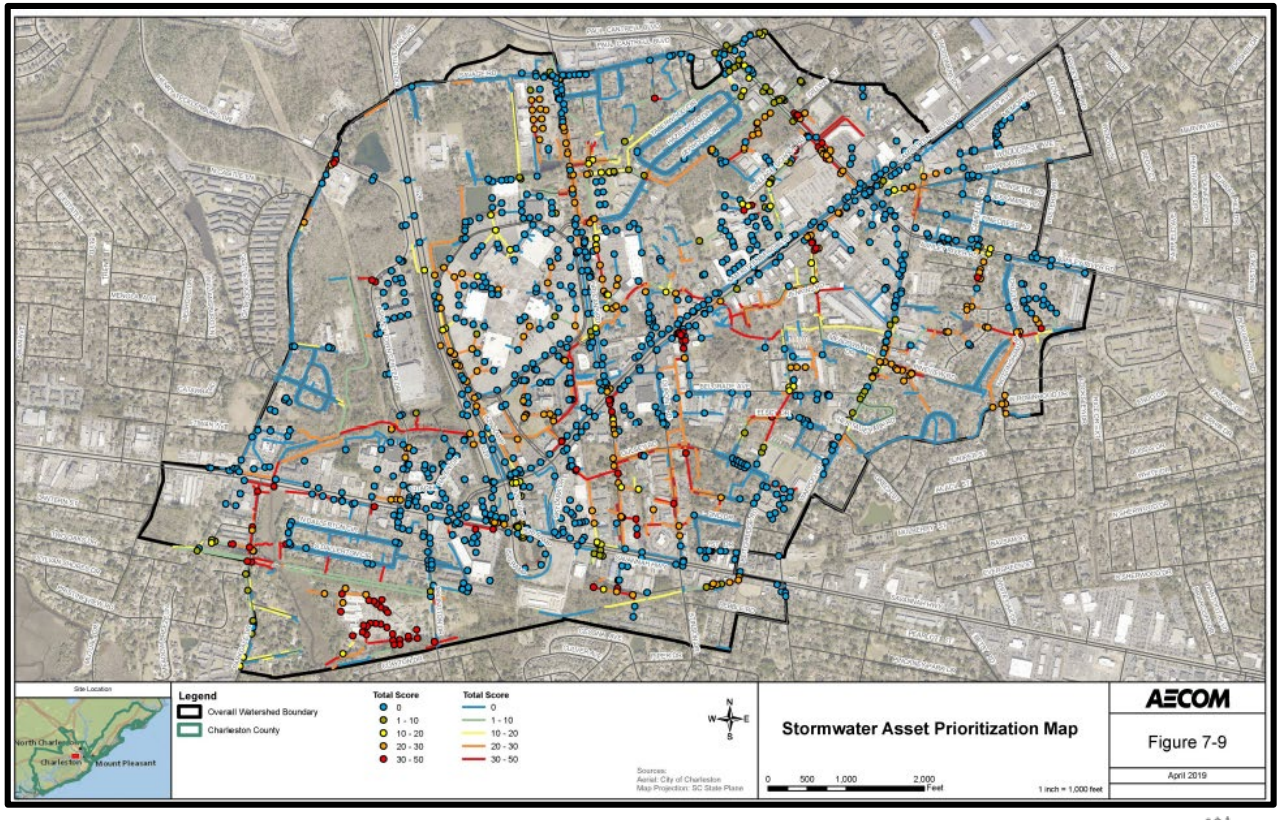
[b] *Any State or US Highway within 50 feet was considered a potentially impacted evacuation route.*

[c] *Any school, military installation, government office, hospital, or airport within 50 feet was considered potentially impacted.*

Prioritization Scoring

- Condition assessment scores totaled a maximum of 5 and multiplied by a factor of three, increasing the maximum value to 15 points
- Flood assessment scores totaled a maximum of 35
- **Total maximum possible score (flood resiliency + condition assessment) is 50 points**

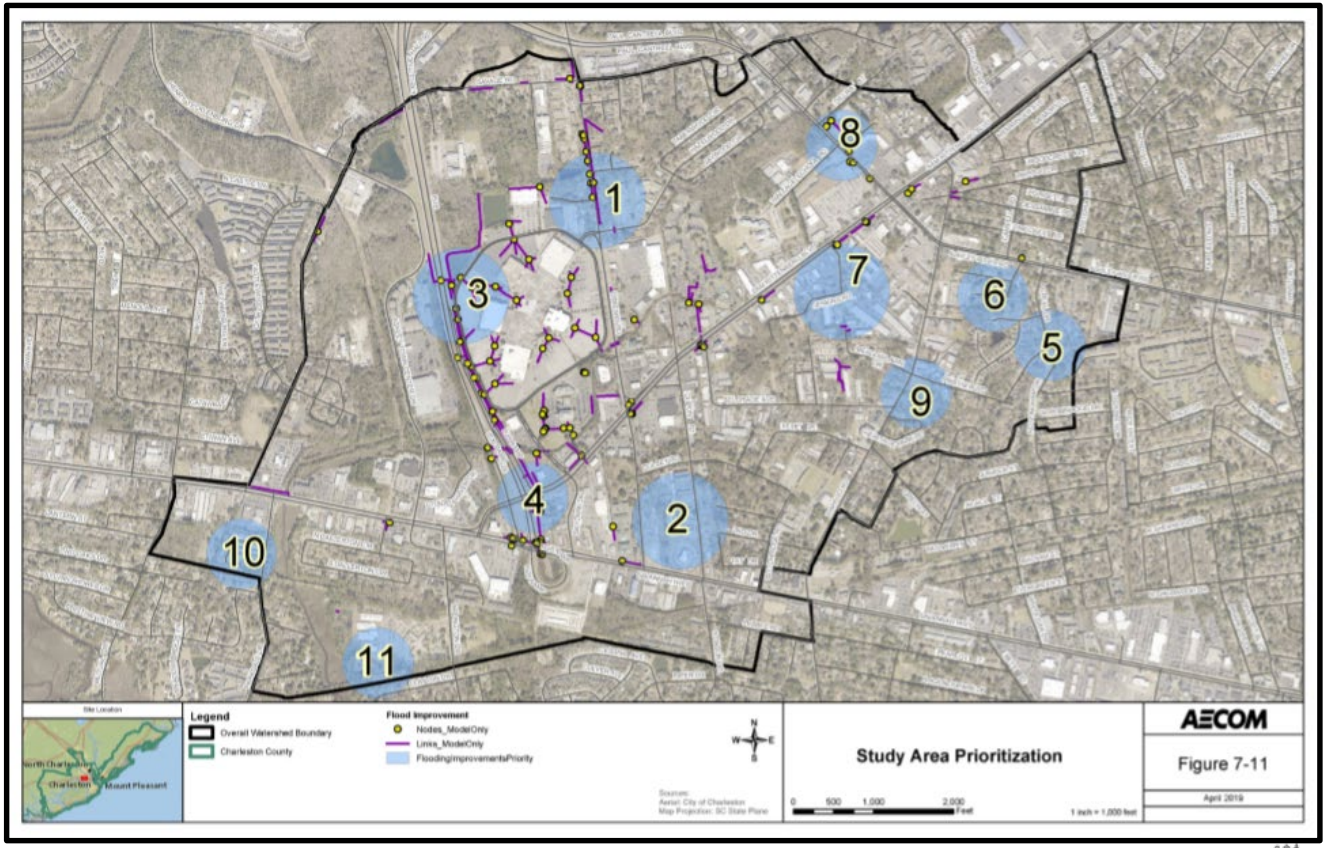
Stormwater Asset Prioritization Map



CHARLESTON COUNTY SOUTH CAROLINA

AECOM

Study Area Prioritization Map



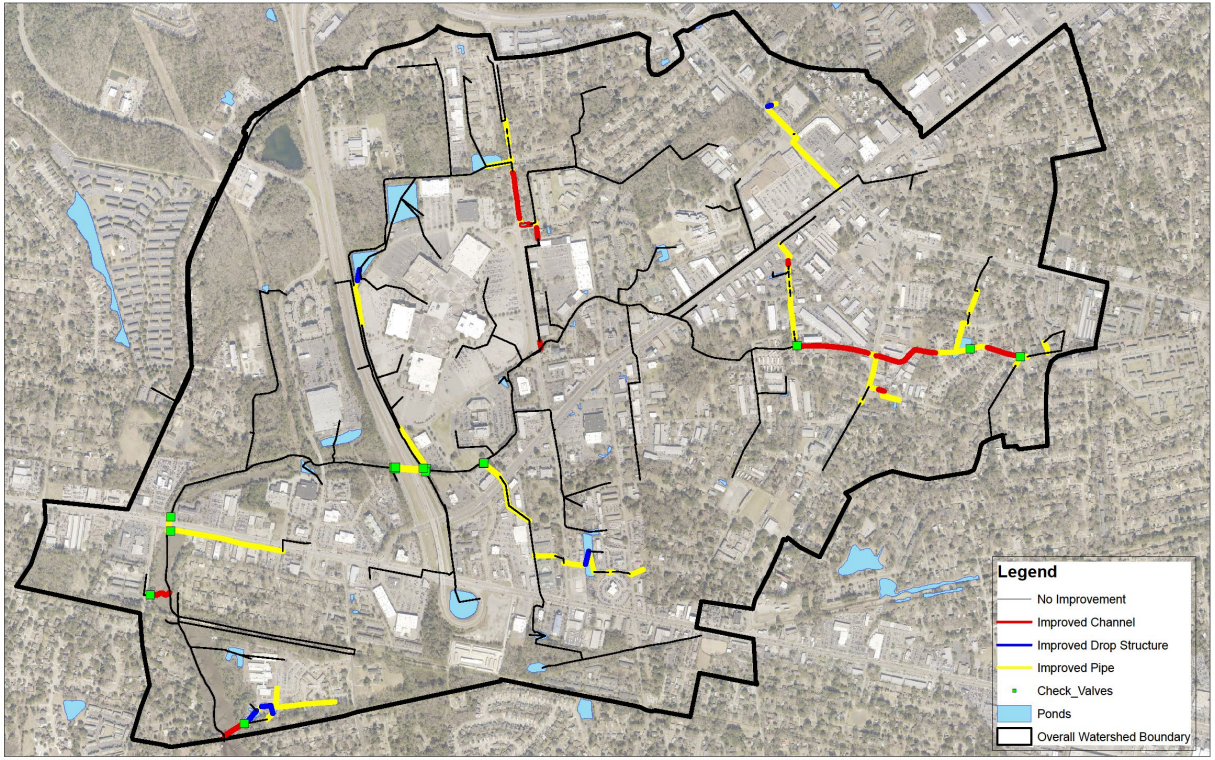
Proposed Improvements

Potential Improvements

- Clean Existing Stormwater Assets
- Increase Pipe/Culvert Diameter
- Additional Pipe/Culverts
- Increase Channel Cross Sections
- Installation of Tideflex Check Valves
- Additional Storage (Ponds)
- Improvements to Pond Drop Structures
- Stormwater Pump Stations
- Retaining Walls
- Condemn Property in Flood Prone Areas
- Green Infrastructure

Potential Infrastructure Improvements Map

Double Click the Map to Open



Cost Estimate For Improvements For Each Area

Summary of Costs							
Area	Pipe (LF)	Channels (LF)	Detention (MG)	Pipes	Channels	Detention	Total
1	661	609	0.555	$ 182,000	$ 10,000	$ 86,000	*$ 278,000*
2	2084	100	0.565	$ 443,000	$ 2,000	$ 30,000	*$ 475,000*
3	1120	0	0.229	$ 389,000	$ -	$ 8,000	*$ 397,000*
4	1073	28		$ 9,000	$ 1,000	$ -	*$ 10,000*
5	894	325	0.558	$ 221,000	$ 8,000	$ 8,000	*$ 237,000*
6	1144	1527	0.372	$ 302,000	$ 28,000	$ 13,000	*$ 343,000*
7	839	42	0.453	$ 236,000	$ 1,000	$ 67,000	*$ 304,000*
8	1361	0	0.343	$ 378,000	$ -	$ 34,000	*$ 412,000*
9	1003	64		$ 275,000	$ 1,000	$ -	*$ 276,000*
10	1494	254	1.597	$ 230,000	$ 5,000	$ 148,000	*$ 383,000*
11	1228	254	0.284	$ 334,000	$ 5,000	$ 3,000	*$ 342,000*
Total	12901 LF	3203 LF	1.9 MG	$ 2,999,000	$ 61,000	$ 397,000	**$ 3,457,000**

CHARLESTON COUNTY SOUTH CAROLINA AECOM

Summary and Conclusion

Summary and Conclusion

- 11 locations identified for improvement based on the modeling results and assessed condition of storm sewers.
- Model shows 42 roadways flooding in 11 identified locations.
- Of those 42 roadways, 36 roadways did not meet the 25-year roadway level of service (LOS) criteria.
- Capital improvement projects worth $3.5 million identified.
- Upon implementation of these projects, 30 of the 36 locations met the LOS criteria.
- 3 of the 11 areas require additional improvements.
- Even if LOS was not met with improvements at certain locations, the severity of flooding decreased.
- Additional capital projects will result in additional improvements in the basin towards meeting the 25-year roadway LOS.

Additional Future Benefits

- Watershed model adopted by the City
  - Long-term use of the model for new development and redevelopment
  - Tool for the design community to better understand effects on entire watershed, including upstream and downstream impacts
  - Beneficial impact to overall basin when regional solutions are identified in lieu of specific site solutions
  - Tool for City/County to evaluate and manage impacts/changes in the watershed and account for completed projects with model updates

- Design Standard Recommendations
  - Report includes recommendations for watershed specific criteria
  - Recommendations will be considered in the ongoing Special Protection Area project