DRUMMOND CARPENTER

FSA ANNUAL CONFERENCE · JUNE 2026

Flooding Futures: Exploring TUFLOW's Role in Flood Management in Florida

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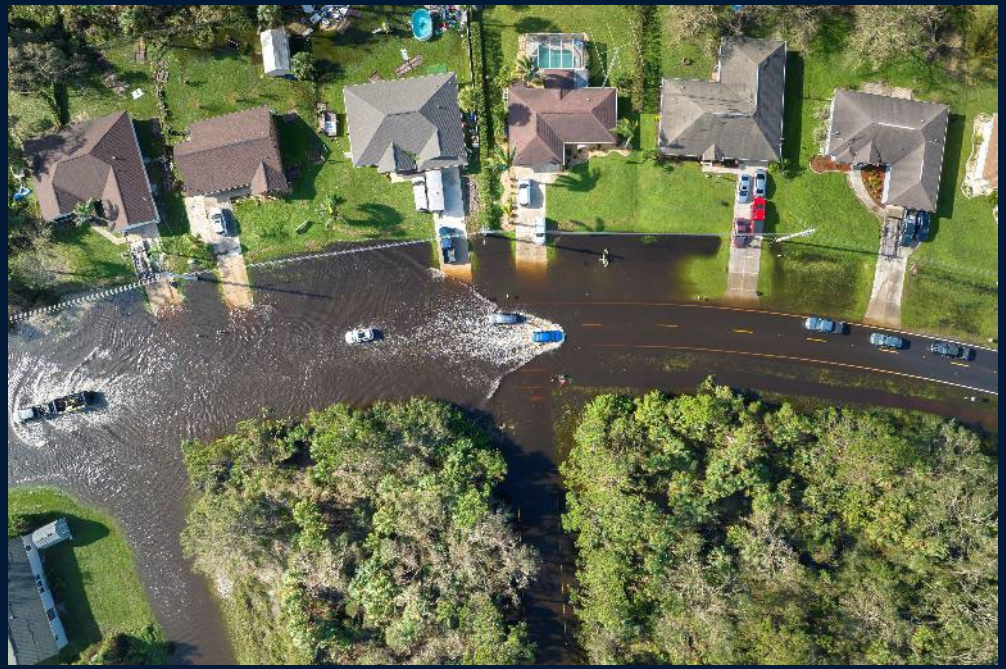
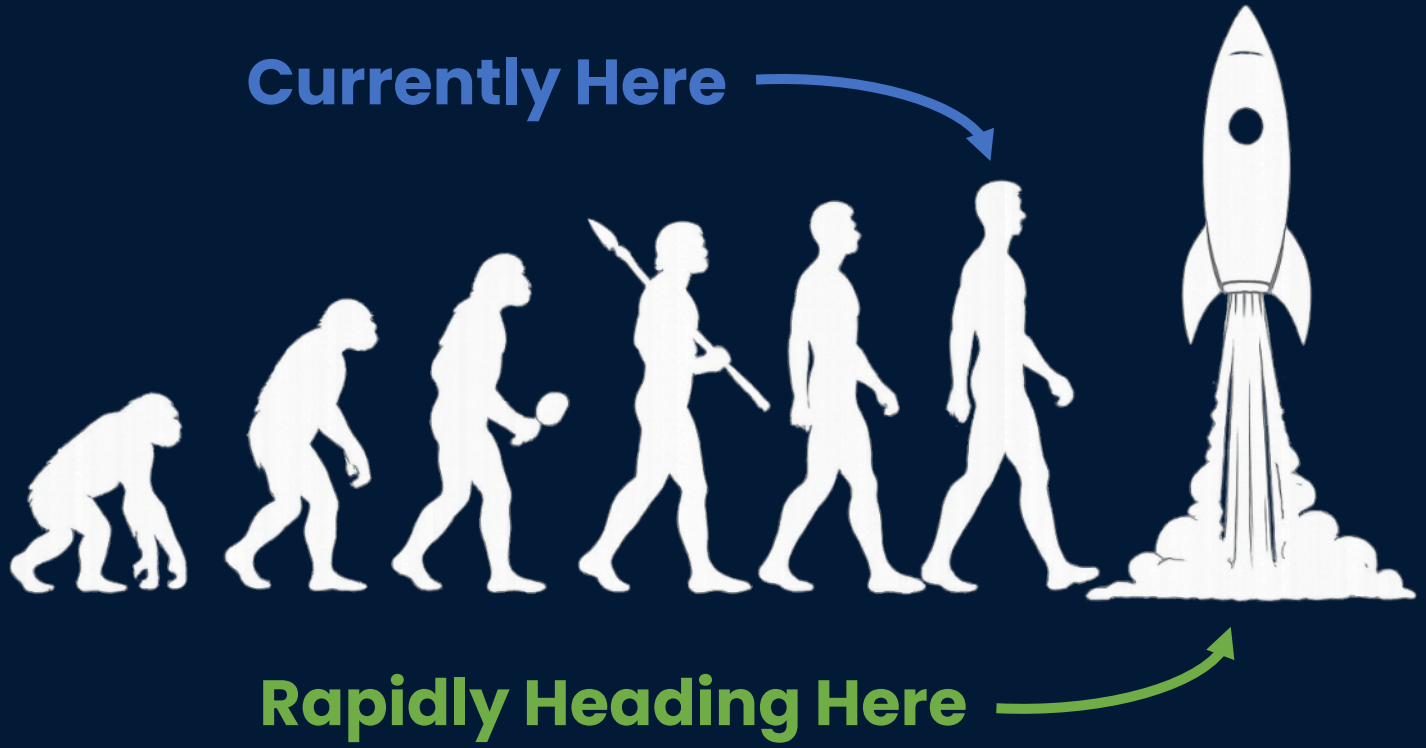
SBA
U.S. Small Business Administration
SERVICE-DISABLED VETERAN-OWNED CERTIFIED

Introduction

Increasing flood risk demands innovative solutions



Evolution of Watershed Planning

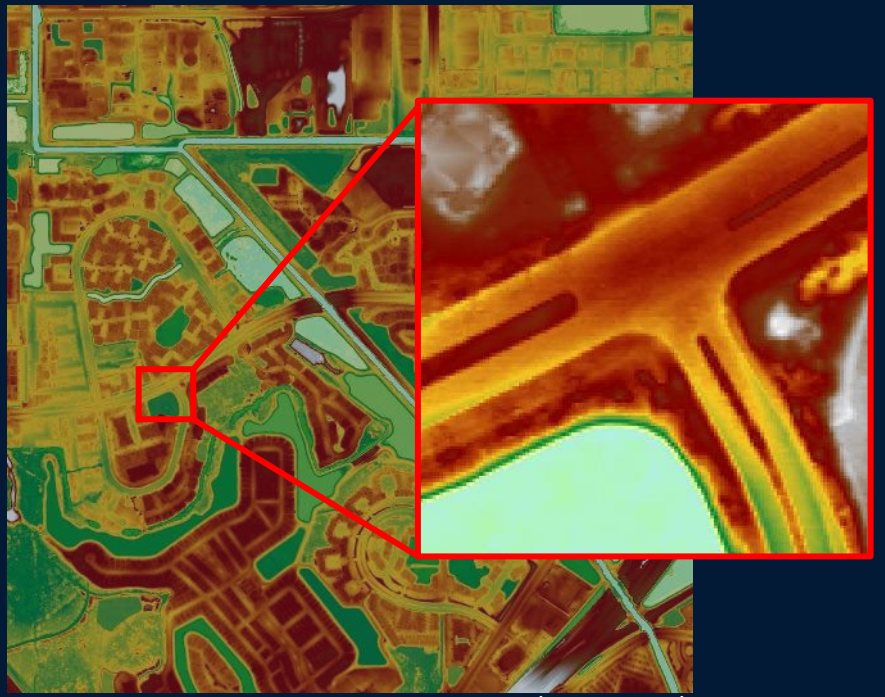


Data Advancements

Historic Topographic Detail

Source: USGS

Current Topographic Detail

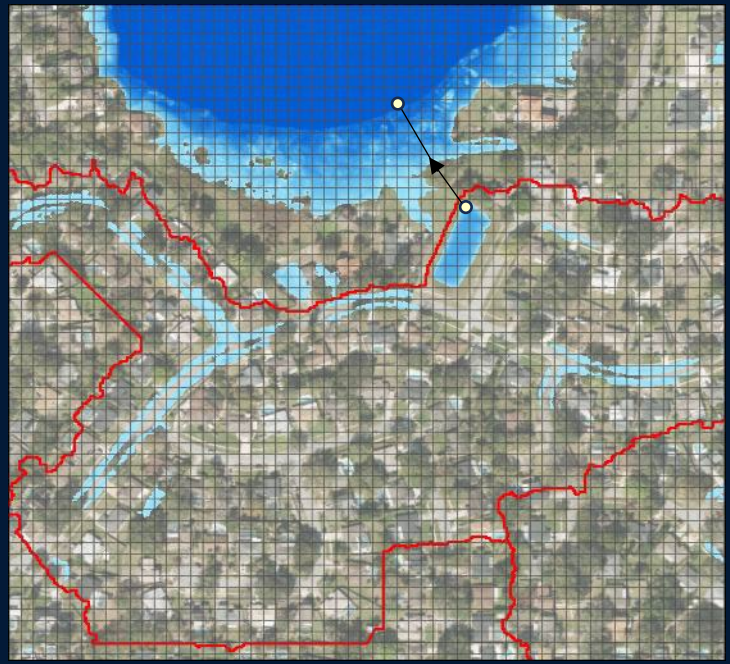


Source: USGS (FL Peninsular)

1D vs 2D Model

Lumped 1D Model

2D Model



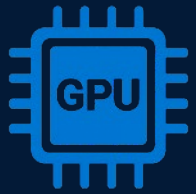
Important Capabilities of a 2D Model

Advanced Hydrodynamics

physics-based 2d flow

Scalable & Flexible

regional to local scale with flexible grid sizing



GPU Acceleration

10-100x faster simulations

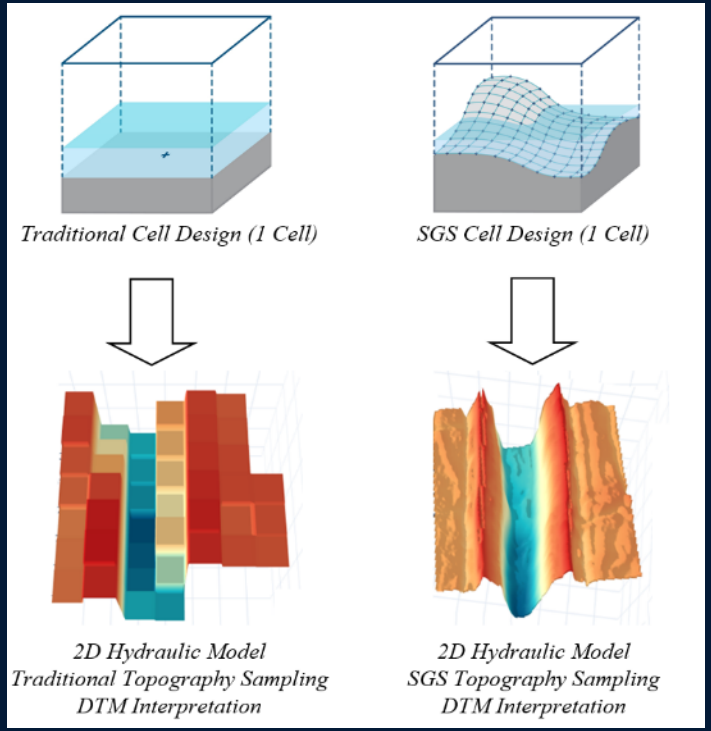
FEMA

FEMA National Acceptance

gaining greater national recognition

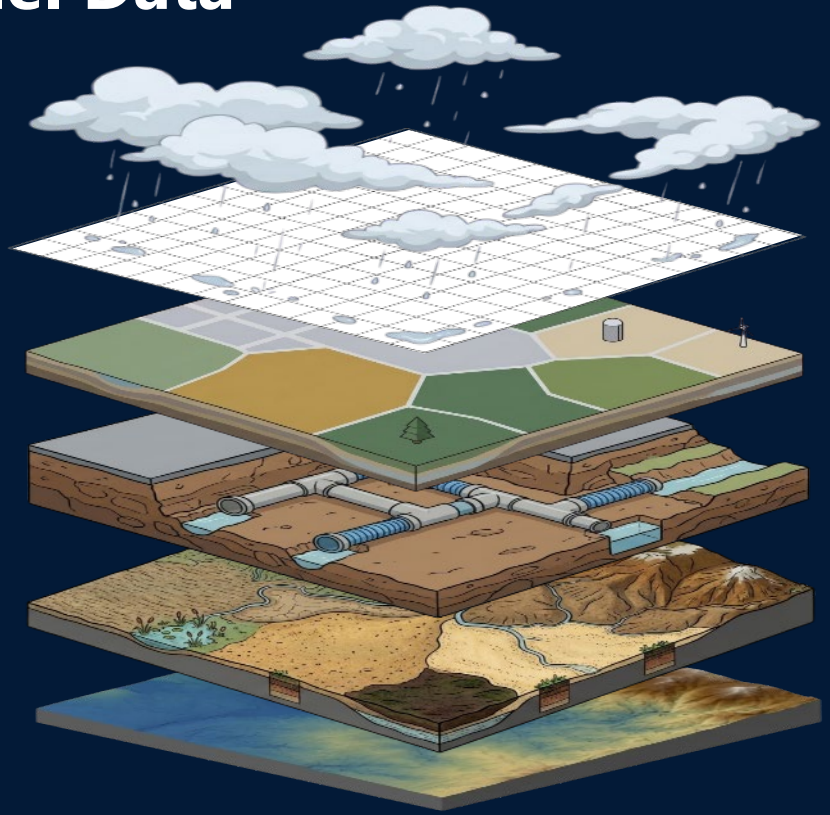
TUFLOW Attributes

- Full SWE (momentum & turbulence)
- Automated grid generation
- Sub grid sampling
- Seamless 1D integration (SWMM)
- Automated high-resolution mapping
- Non-proprietary inputs & outputs
- GPU enabled to optimize run times



Source: TUFLOW

Model Data



- Rainfall/Boundary Conditions
- Computational Grid
- Land Use/Imperviousness
- Storm Network
- Soils Data
- High-Resolution DEM

Eliminated Processes (1-D)

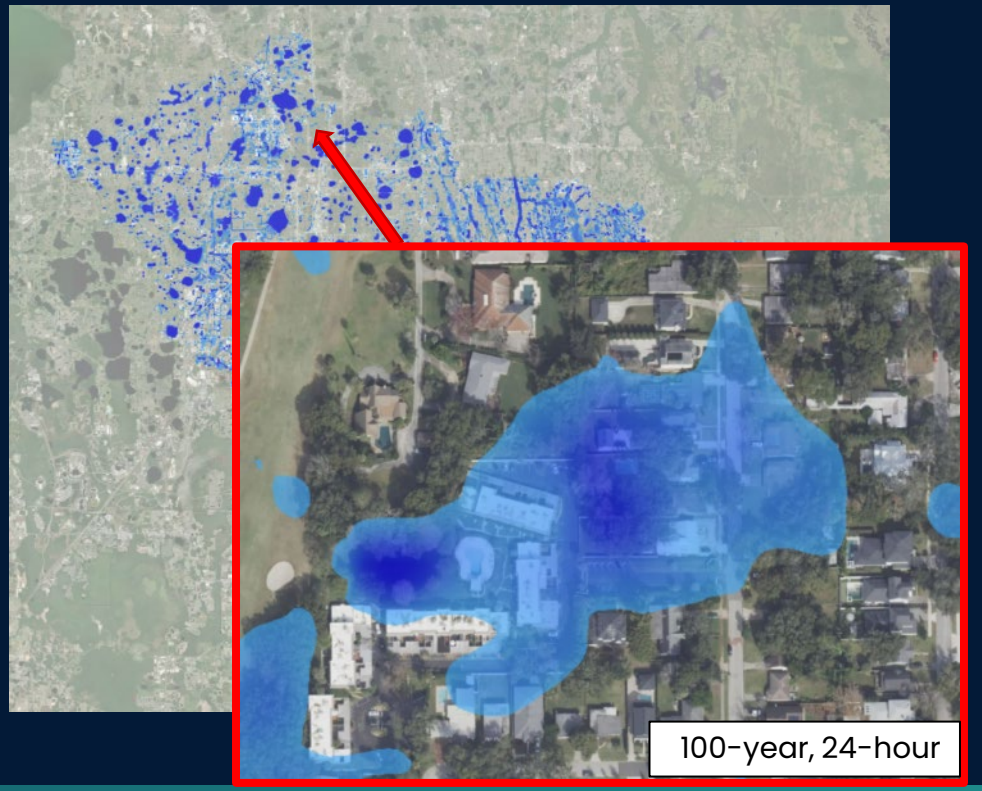
- Subbasin delineation
- Time of concentration
- Imperviousness/curve number calculation
- Full model schematic
- Stage-area extraction
- Floodplain delineation

Reduction in error potential due to elimination of manual processes

CASE STUDY 1

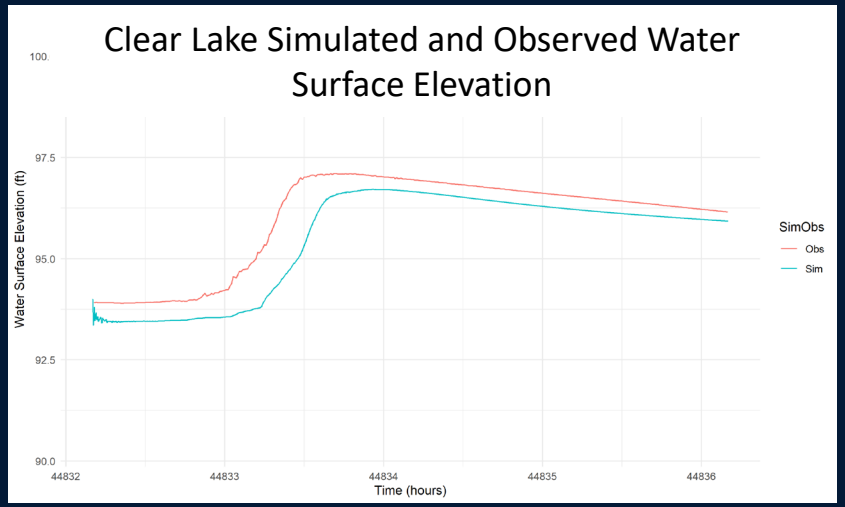
Orlando City-Wide

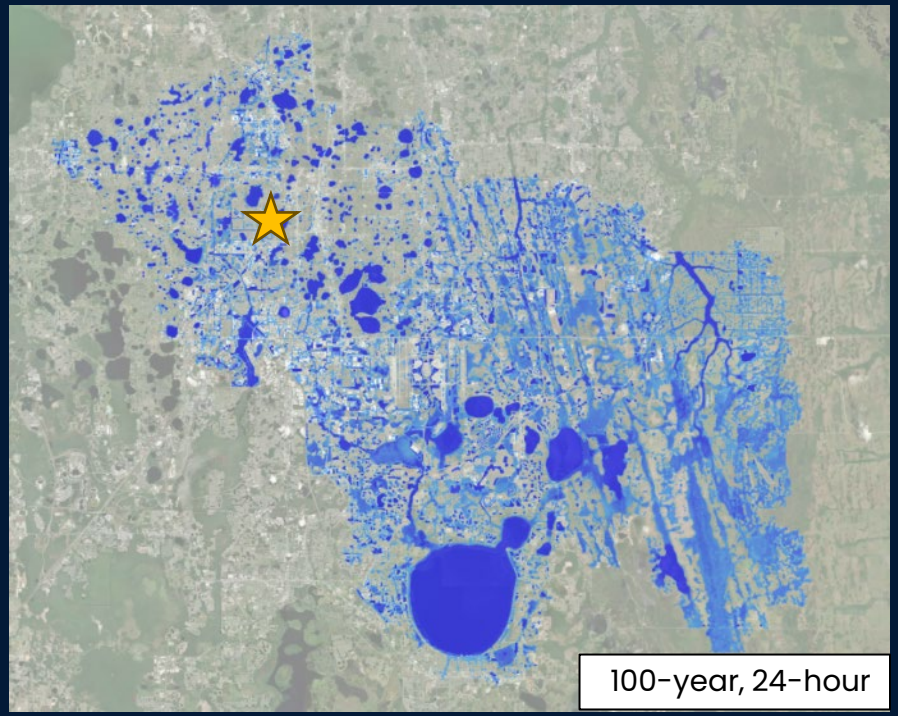
- City-wide critical asset flood vulnerability assessment
- Features:
  - Model domain: ~450 mi^2
  - ~7.1M computational cells
  - 20-40h run time per scenario
- High resolution results at a large scale



CASE STUDY 1

Orlando City-Wide





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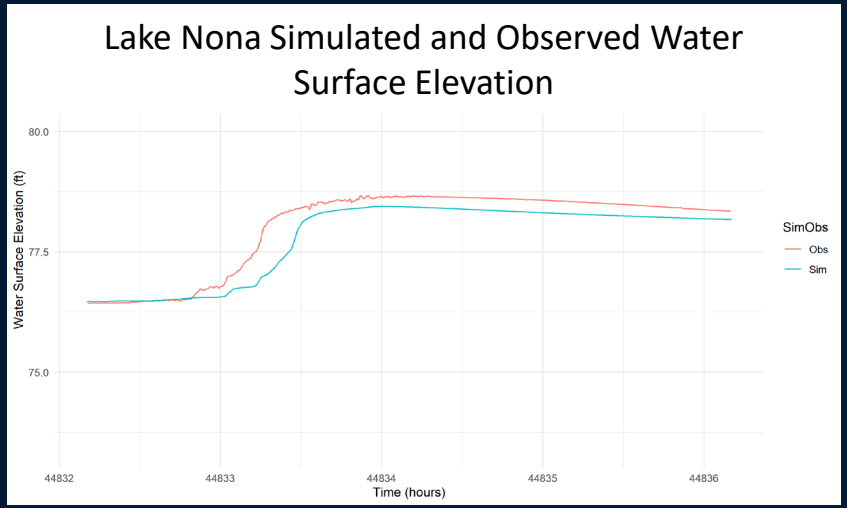

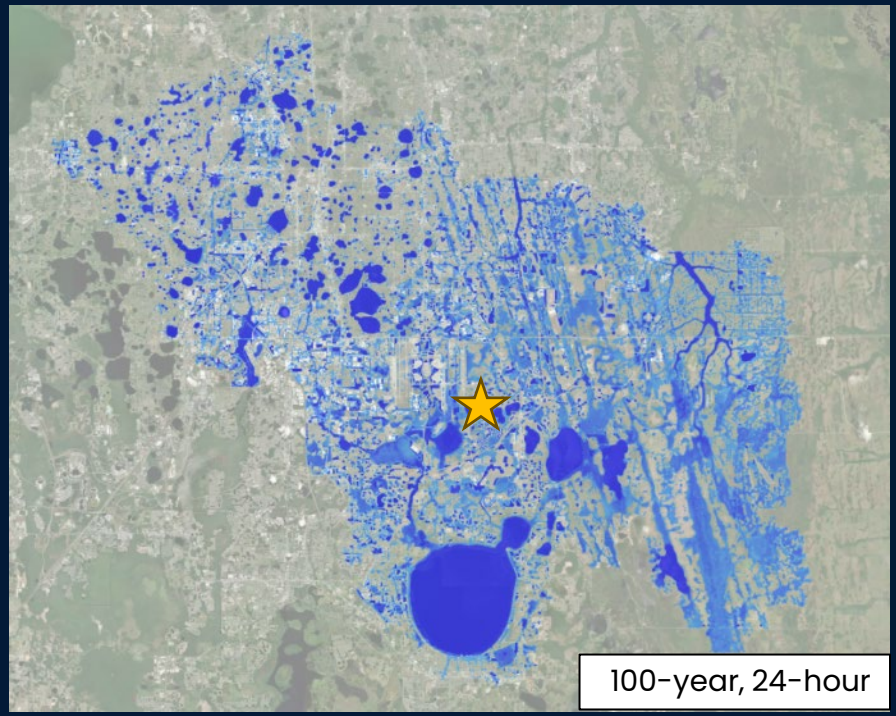

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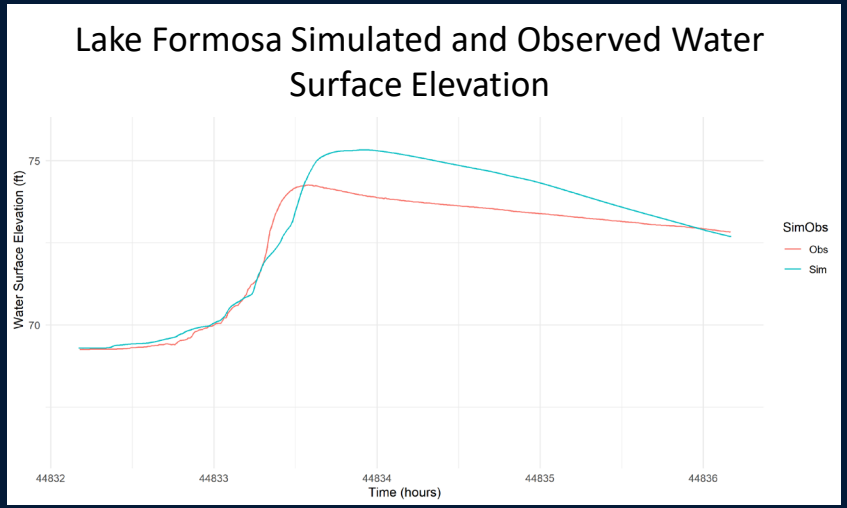
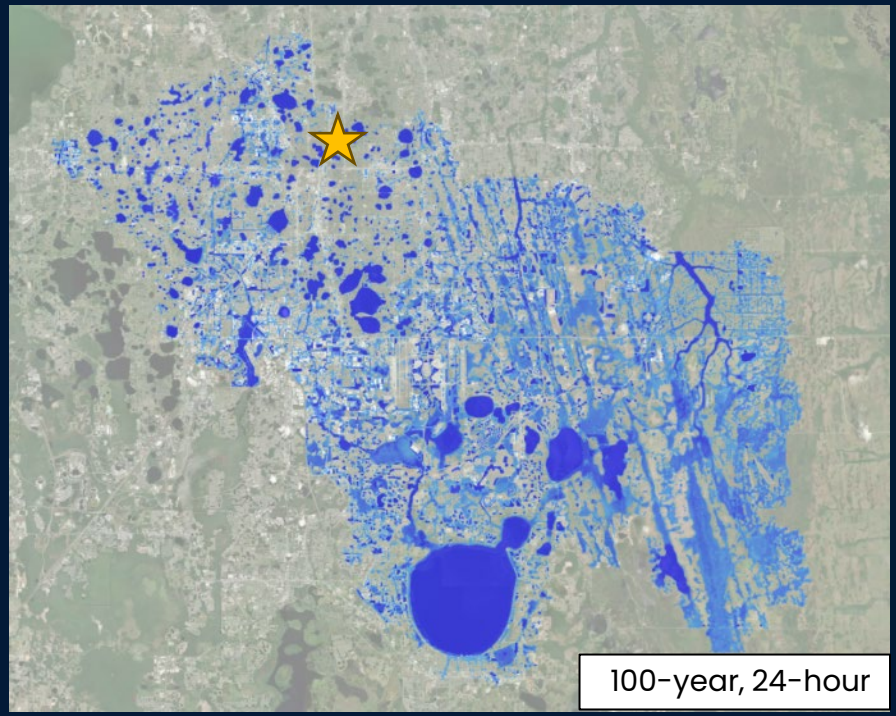
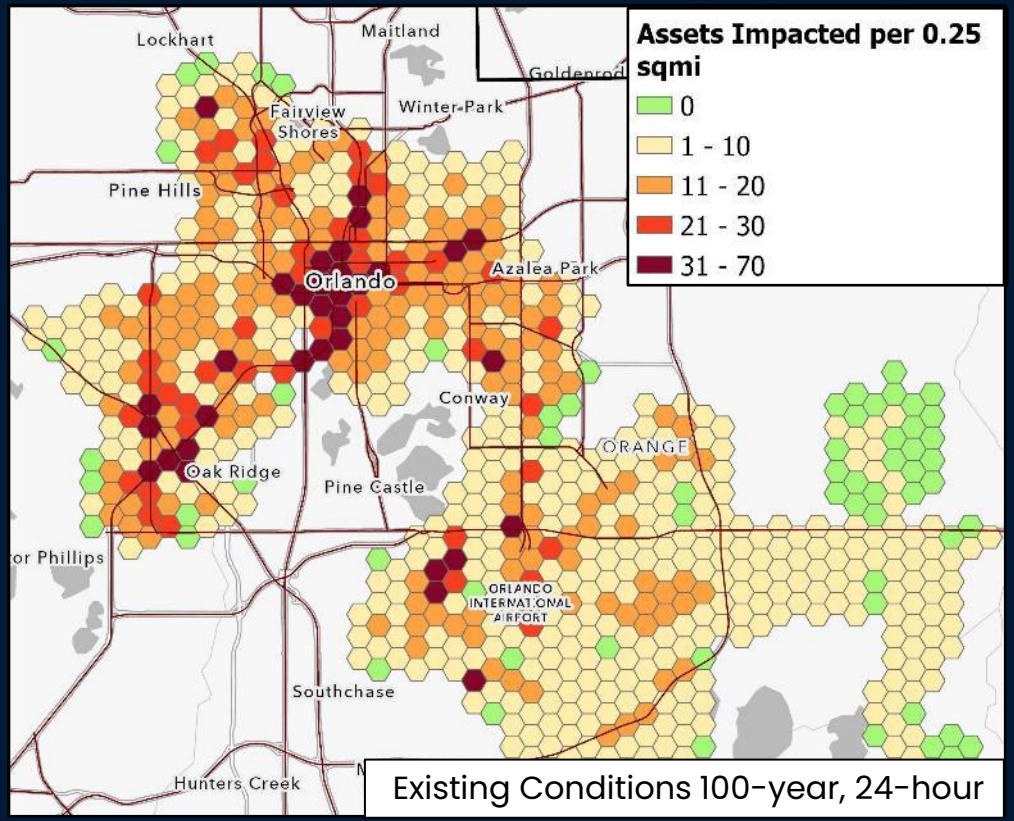




Orlando City-Wide

- Automated workflows developed to evaluate model results and compare City assets
- Identified ~4,500 assets impacted by the modeled 100-year, 24-hour event



Existing Conditions 100-year, 24-hour

CASE STUDY 1

Orlando City-Wide

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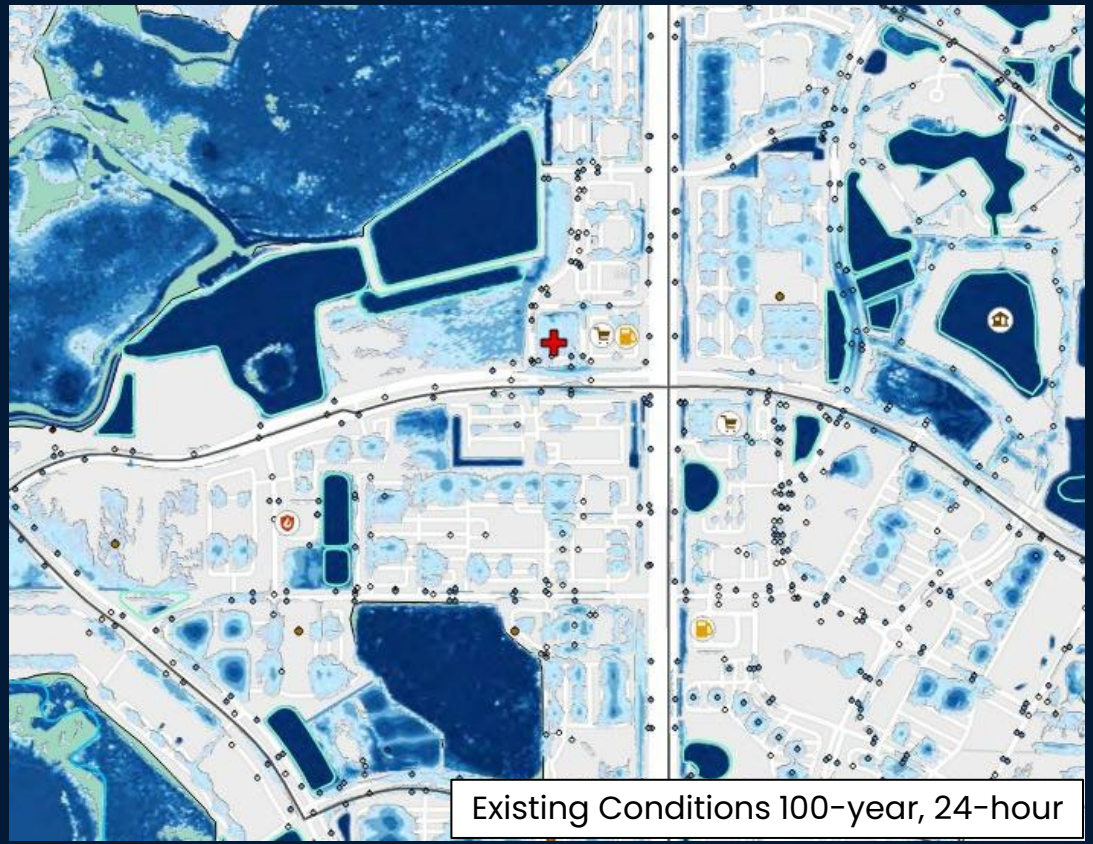


Existing Conditions 100-year, 24-hour

CASE STUDY 2

Flooded Residential Area

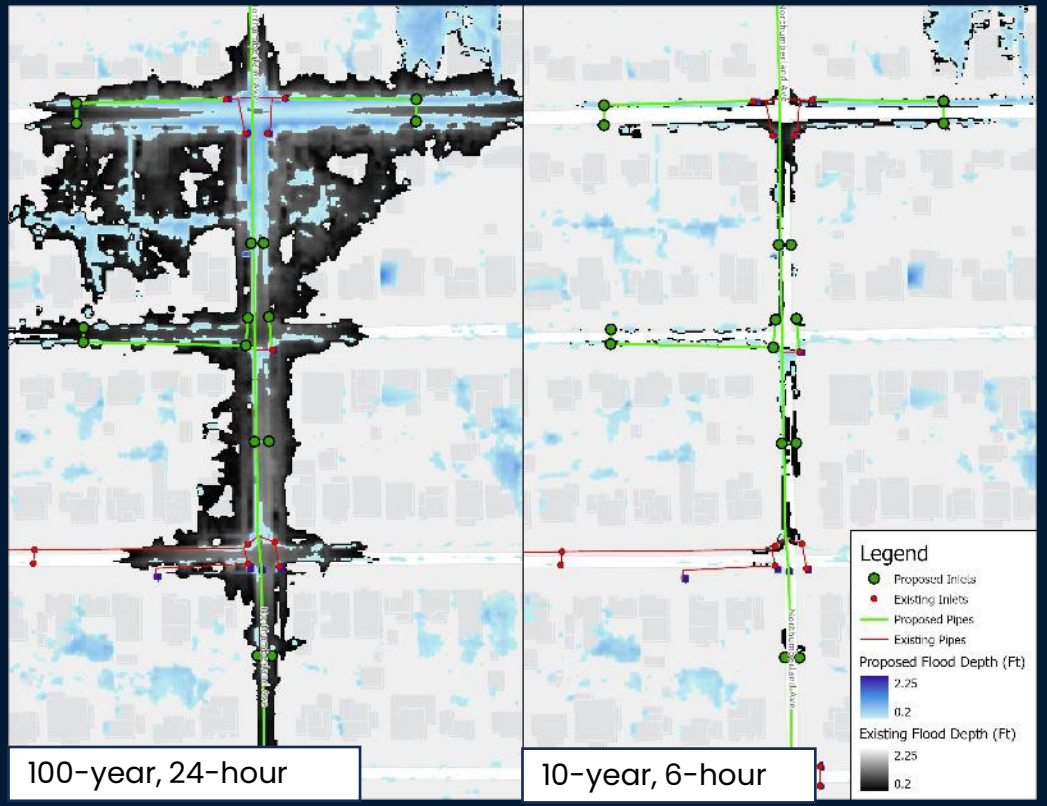
- Localized flood improvement study
- Developed from Orlando model

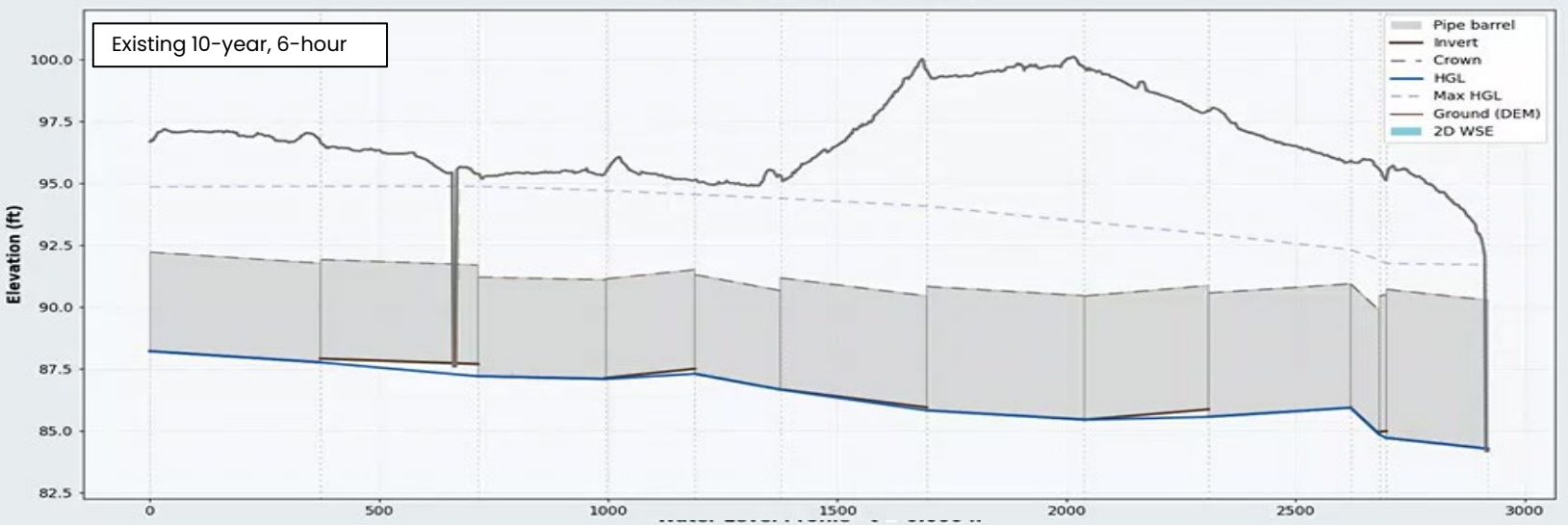
Regional Model → **Localized Flood Retrofit Model**

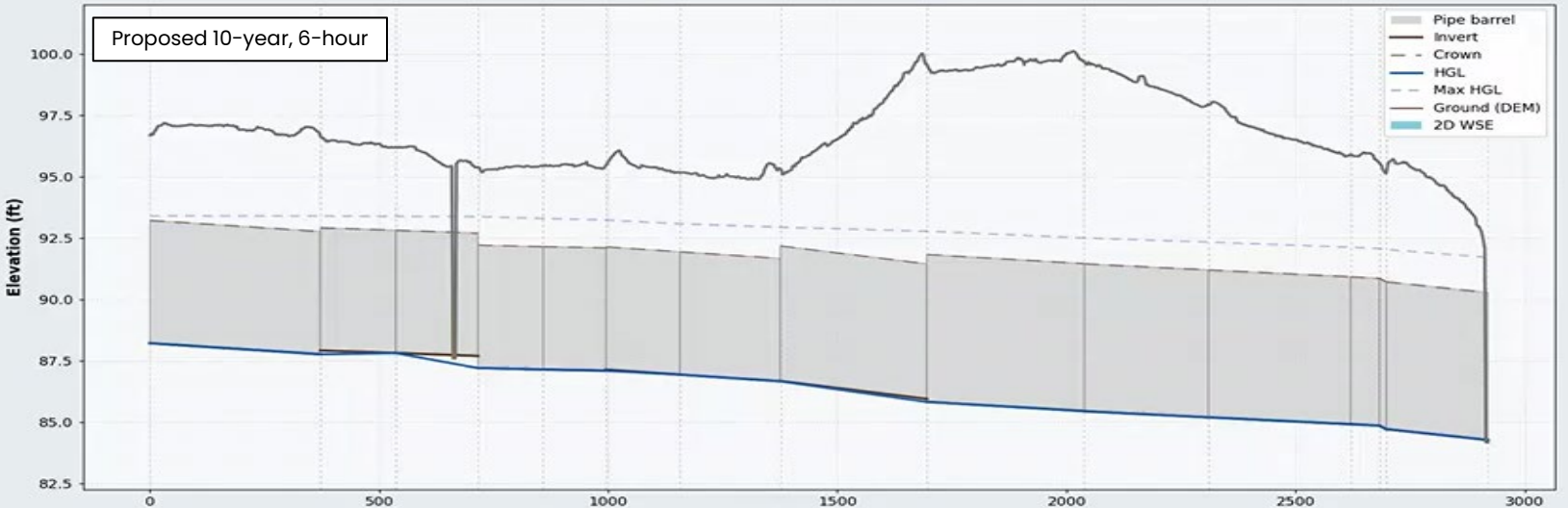
CASE STUDY 2

Flooded Residential Area

- Rapid evaluation of alternatives
- Domain: ~2 mi^2
- Grid: ~600,000 cells
- Run time: ~2h
- High-resolution inundation extent



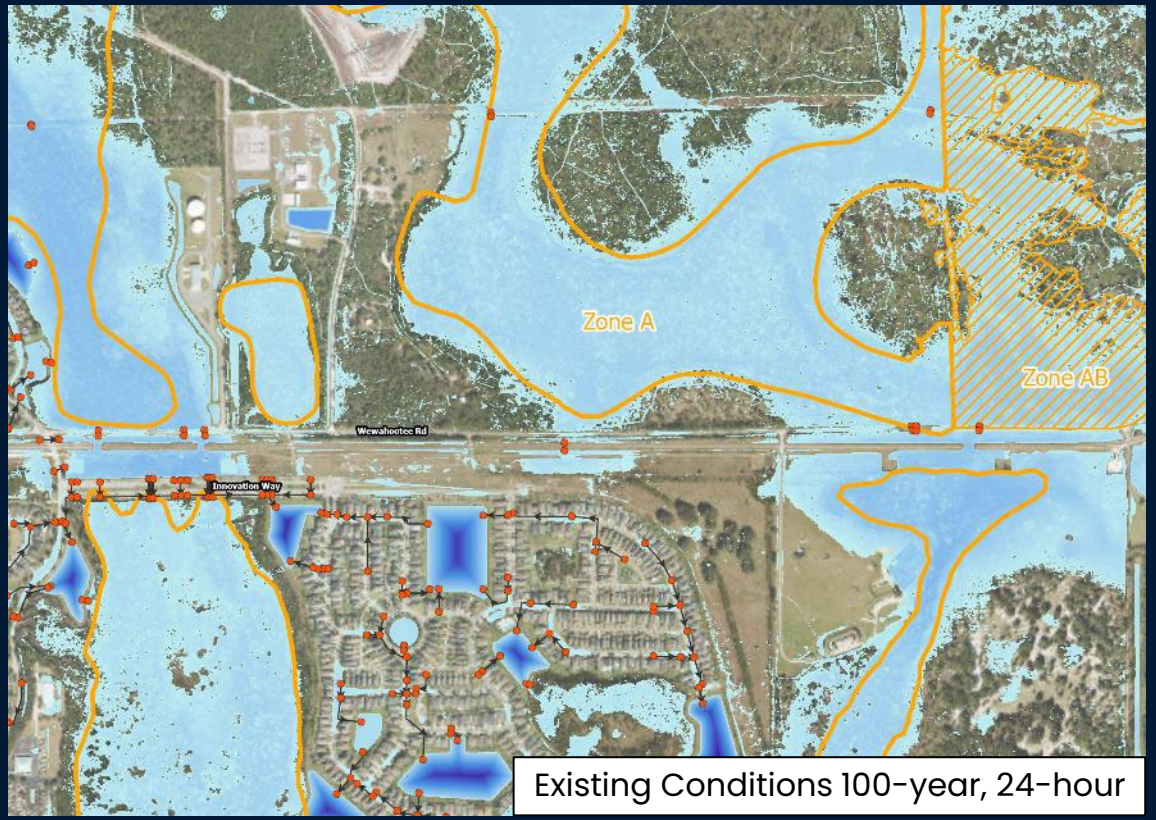

Existing 10-year, 6-hour
Pipe barrel
Invert
Crown
HGL
Max HGL
Ground (DEM)
2D WSE
Elevation (ft)
100.0
97.5
95.0
92.5
90.0
87.5
85.0
82.5
0
500
1000
1500
2000
2500
3000


Proposed 10-year, 6-hour
Pipe barrel
Invert
Crown
HGL
Max HGL
Ground (DEM)
2D WSE
Elevation (ft)
100.0
97.5
95.0
92.5
90.0
87.5
85.0
82.5
0
500
1000
1500
2000
2500
3000

CASE STUDY 3

Flooded Roadway

- Localized flood improvement study
- Developed from Orange County county-wide model
- Modeled floodplains extended beyond mapped FEMA areas

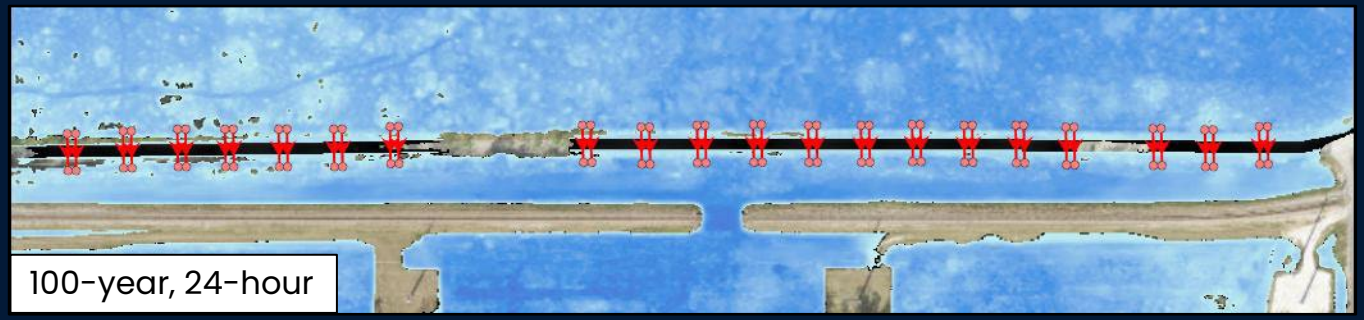


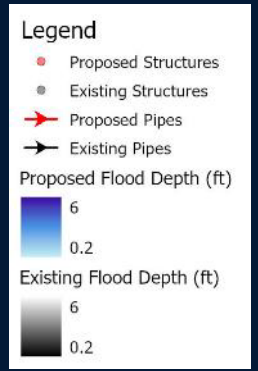
Existing Conditions 100-year, 24-hour

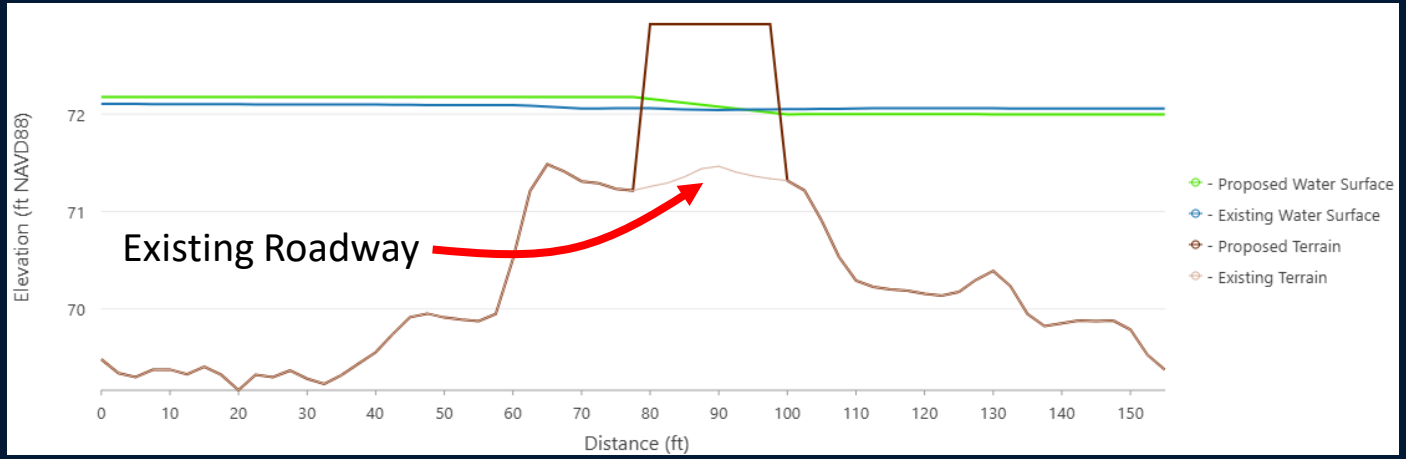
CASE STUDY 3

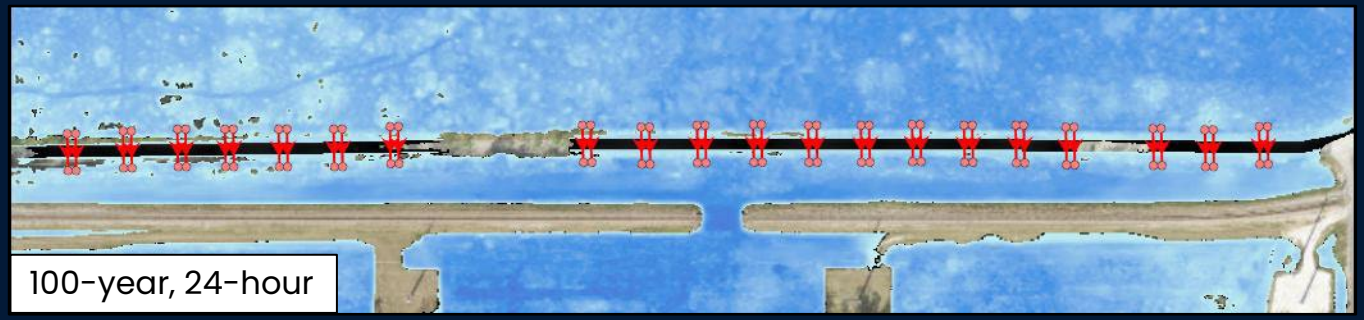
Flooded Roadway

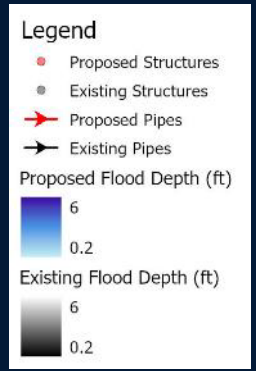
- 2D connectivity was essential to final conceptual design
- 1D modeling alone of pipe insufficiently simulated flows through the culverts
- Model well suited to rapid iteration
- Quickly determined number of pipes/dimensions required to avoid floodplain impacts






Elevation (ft NAVD88)
72
71
70
Existing Roadway
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
Distance (ft)
- Proposed Water Surface
- Existing Water Surface
- Proposed Terrain
- Existing Terrain

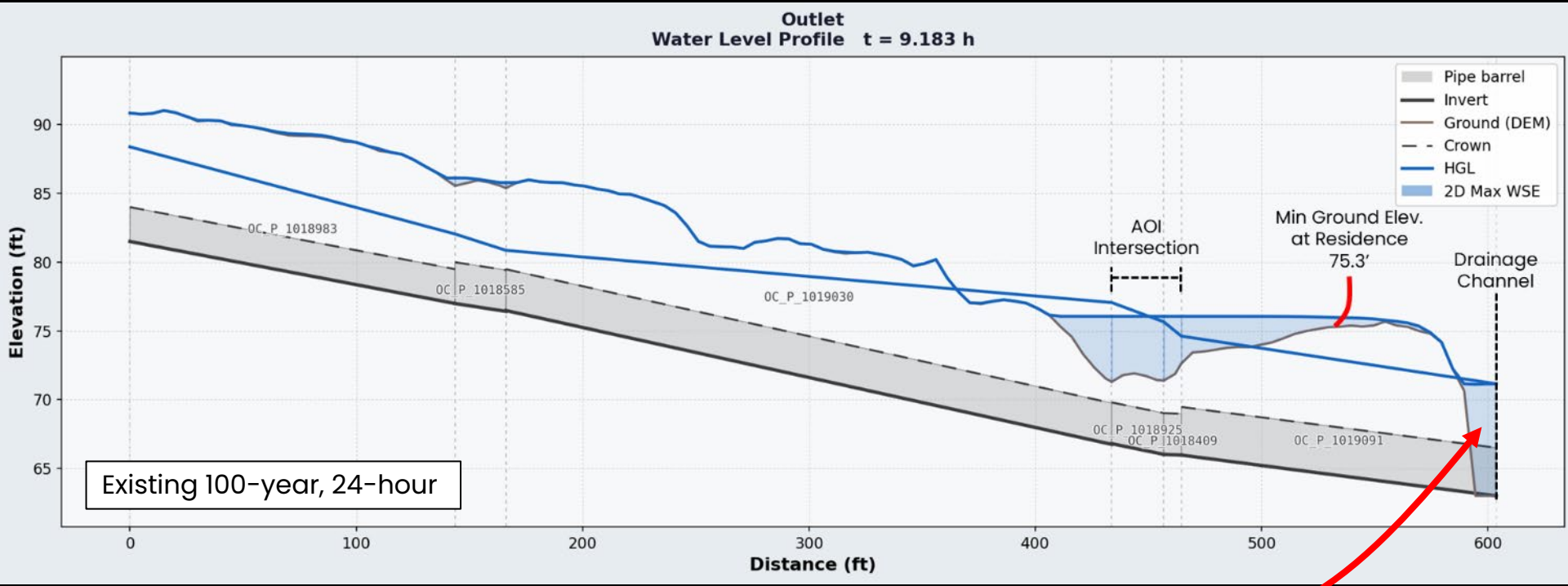

100-year, 24-hour


Legend
Proposed Structures
Existing Structures
Proposed Pipes
Existing Pipes
Proposed Flood Depth (ft)
6
0.2
Existing Flood Depth (ft)
6
0.2

CASE STUDY 4

Neighborhood Flooding

- Localized flood improvement study
- Developed from county-wide model
- Recreated significant intersection flooding



Tailwater effects captured by county-wide model

CASE STUDY 5

Lake Pollutant Loading

- Localized water quality BMP study
- Utilized **TUFLOW CATCH**
- Developed from Orange County county-wide model

CASE STUDY 5

Lake Pollutant Loading

- Proof of concept for fast screening of BMPs based on local drainage area characteristics
- Predicted soil washoff and sediment transport
- Conducted source tracking
- Per land cover type
- Per zones in drainage area

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Questions?

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