Large Scale Problems Require Large Scale Solutions

or

The Need to go beyond Political Boundaries in the Mystic River Watershed

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Presentation Overview

1 Cambridge CCVA

2 The Alewife Brook Area

3 Hydraulic Model Integration

4 Hydraulic Model Calibration and Validation

5 Model Uses

6 Conclusions

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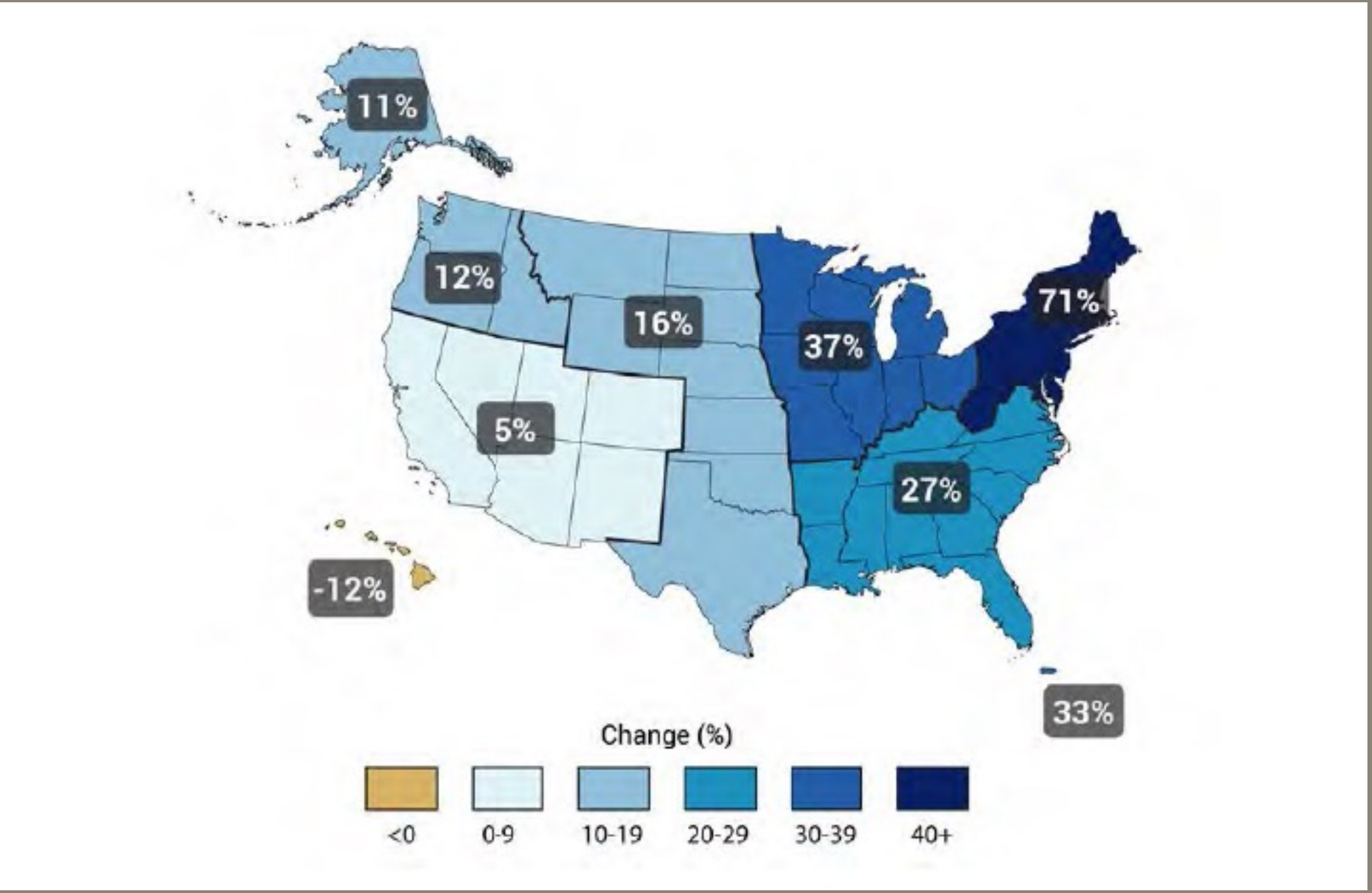
1 Cambridge CCVA*



Source: 2014 U.S. National Climate Assessment Report
*Kleinfelder is prime contract holder, Stantec performed flood risk and hydraulic modeling

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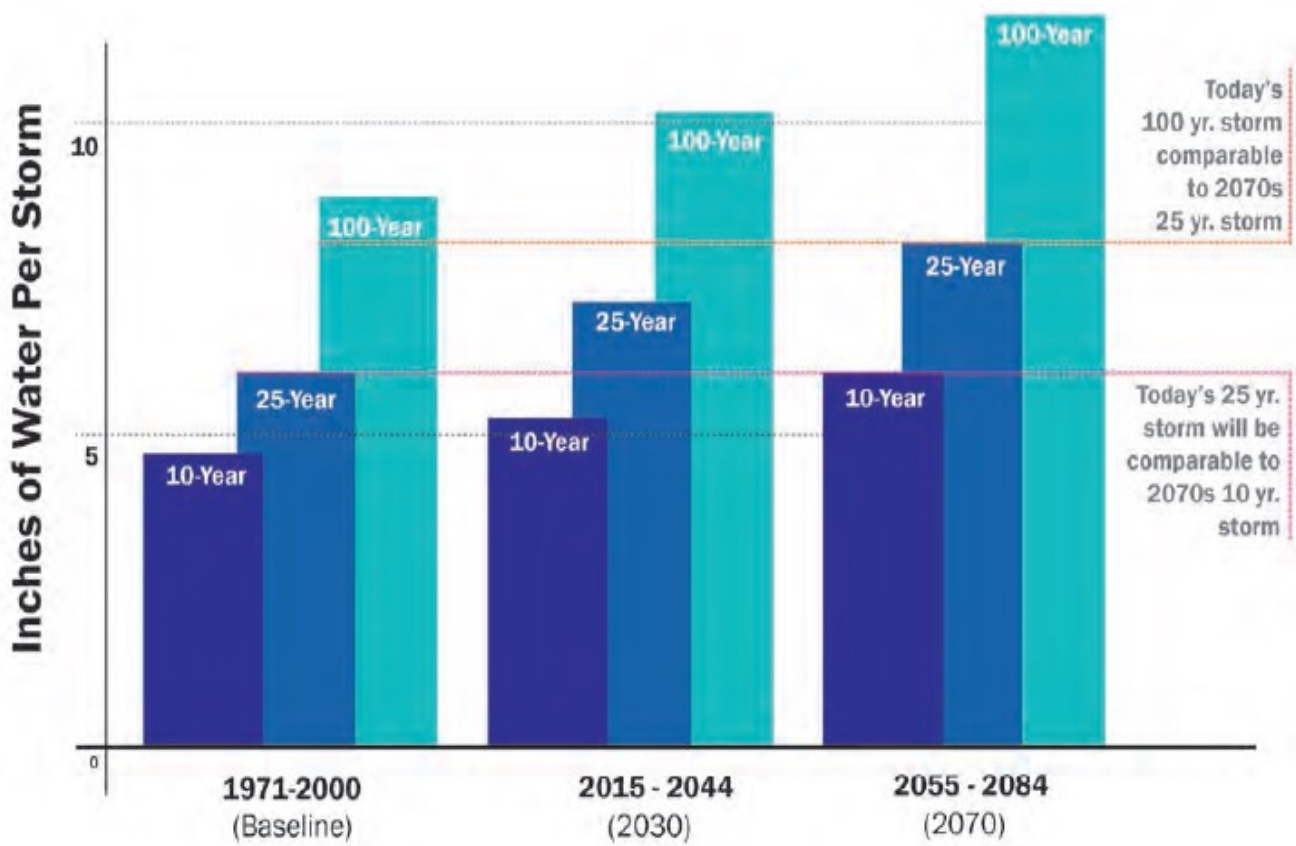
Cambridge CCVA

Increase in Precipitation



Source: Kleinfelder, 2015 Cambridge CCVA, Part 1

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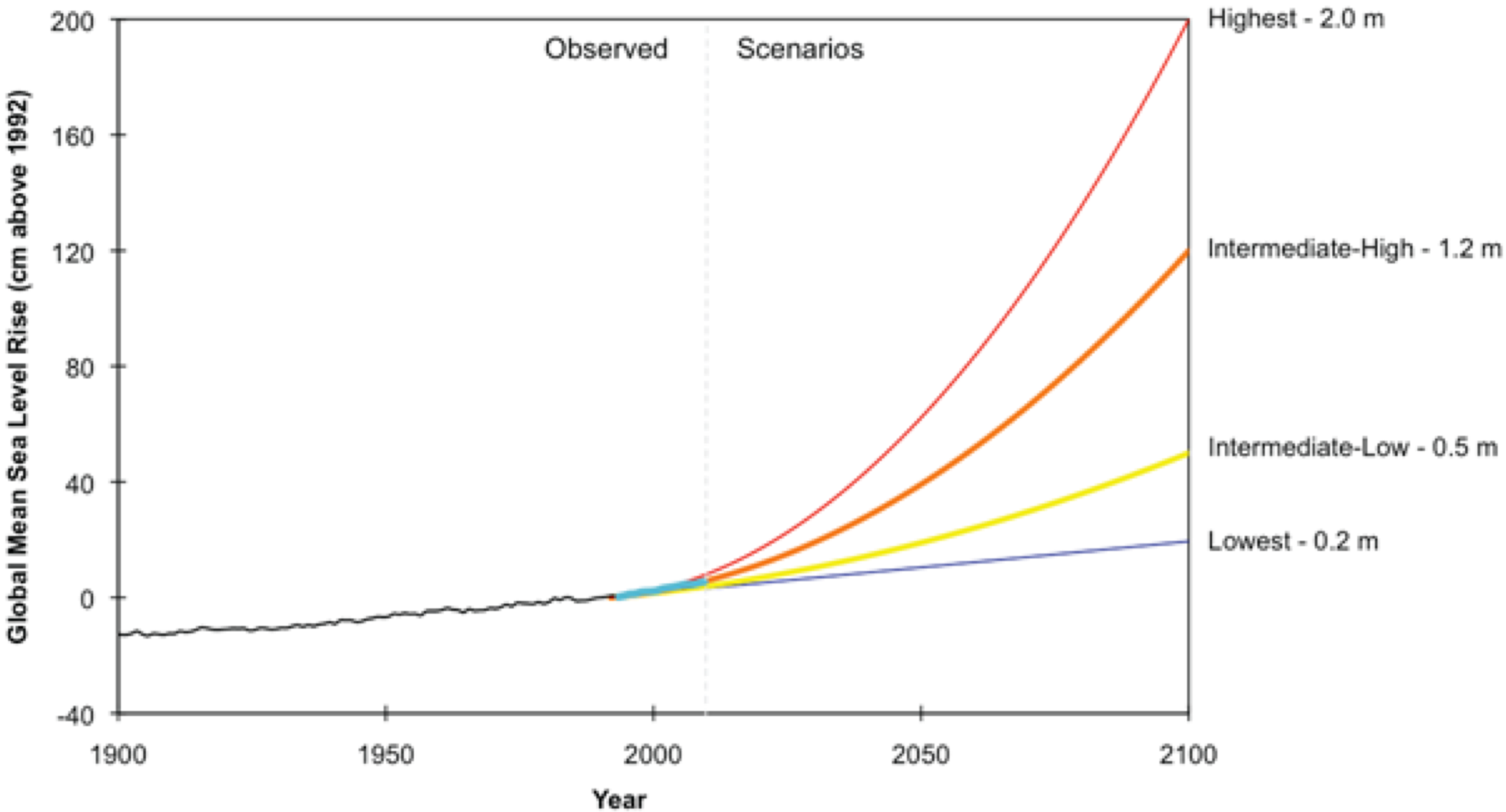
Cambridge CCVA

SLR/SS



Source: NOAA (2012). Global Sea Level Rise Scenarios for the United States National Climate Assessment

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2 The Alewife Brook Area

- This region of Cambridge is the most vulnerable to flooding under climate change
- Flooding risk is augmented by increased precipitation up to mid-century as well as SLR/SS at the end of the century
- The Alewife area will be impacted by both riverine and sewer system flooding

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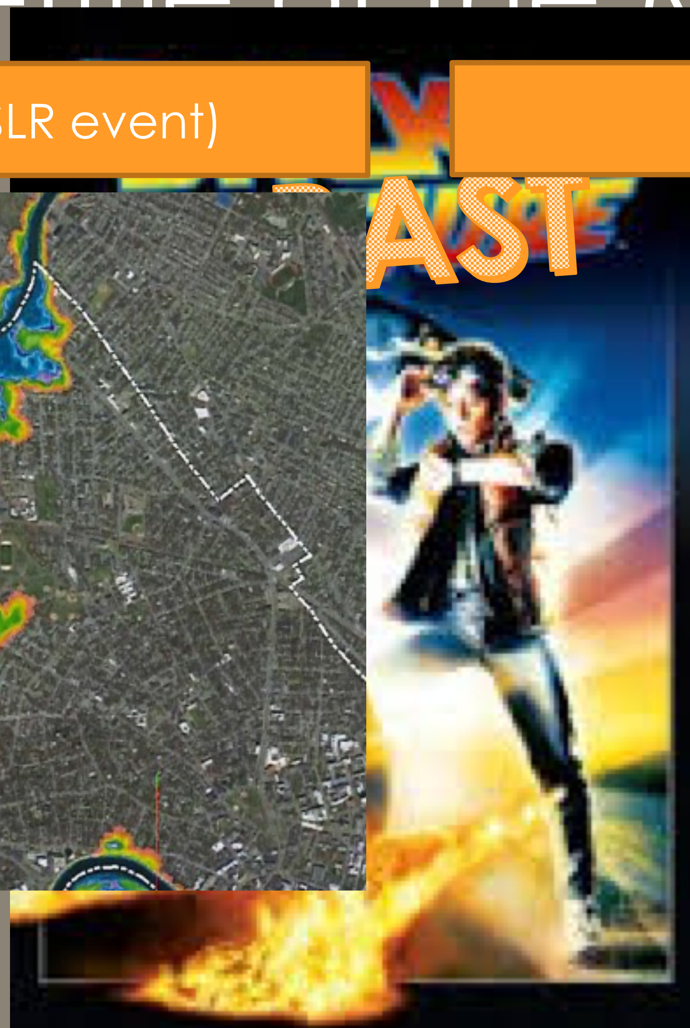
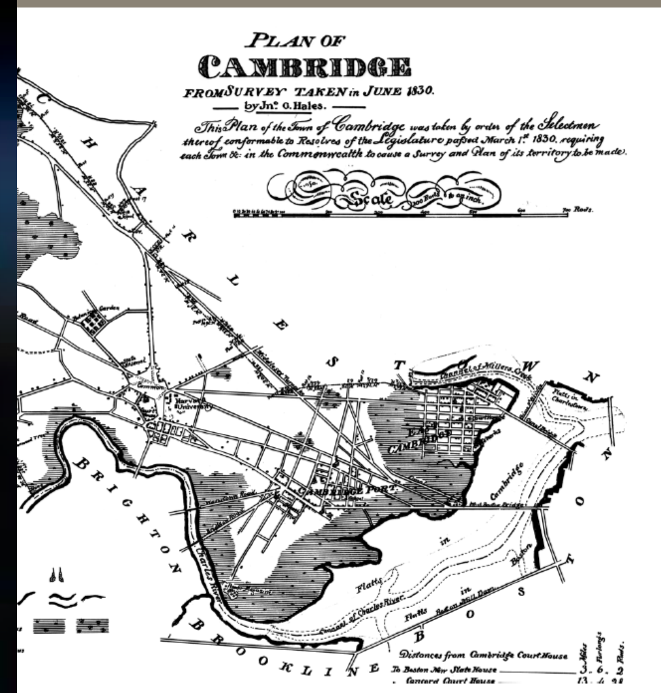
The Alewife Brook area in the Future –Title of the Movie?

Year 2070 (1% SLR event)

Source: Cambridge CCVA, Part 1



Year 1830



ullivan, Cambridge Historical Commission

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Flood Sources Identified in the CCVA

Sewer System Flooding from Precipitation

- Captured Using City's Infoworks ICM Model

Riverine Overbank Flooding from Heavy Precipitation

- Captured using HEC-RAS model

Riverine Overbank Flooding from SLR/SS events

- Captured using ADCIRC in the BH-FRM

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Scale of Urban Flood Sources

Local Flow Contributions

Backflow propagation

Sewer System

- Local scale problems (usually conveyance or storage capacity issues)
- Regional scale factors have an impact

River (overbank flooding)

- Usually a regional or watershed scale issue
- Local scale contributions have a cumulative impact

Ocean (overbank flooding)

- Global scale (but there can be regional mitigation solutions)
- Marginal impact of local scale contributions

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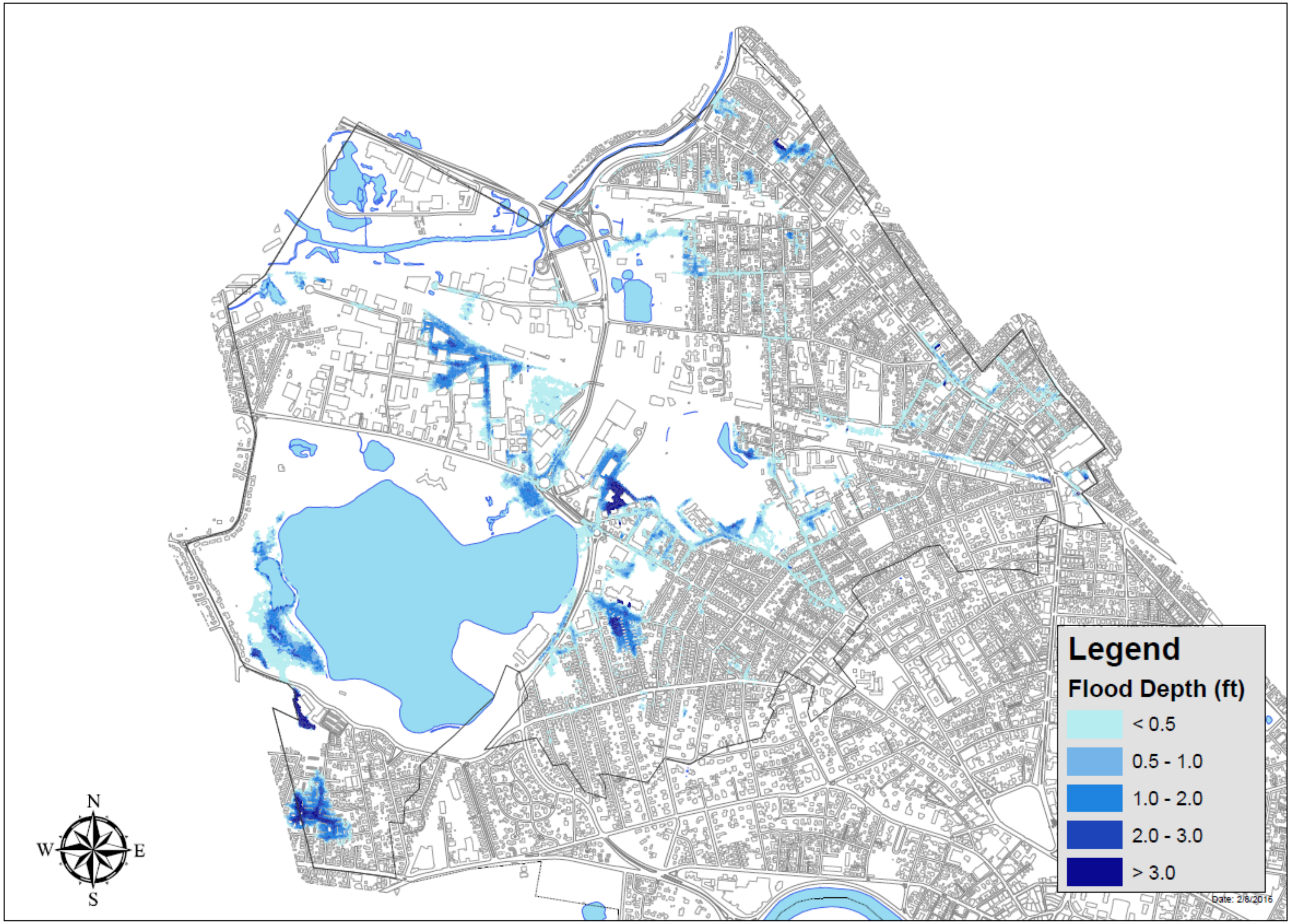
Sewer System Flooding from Precipitation



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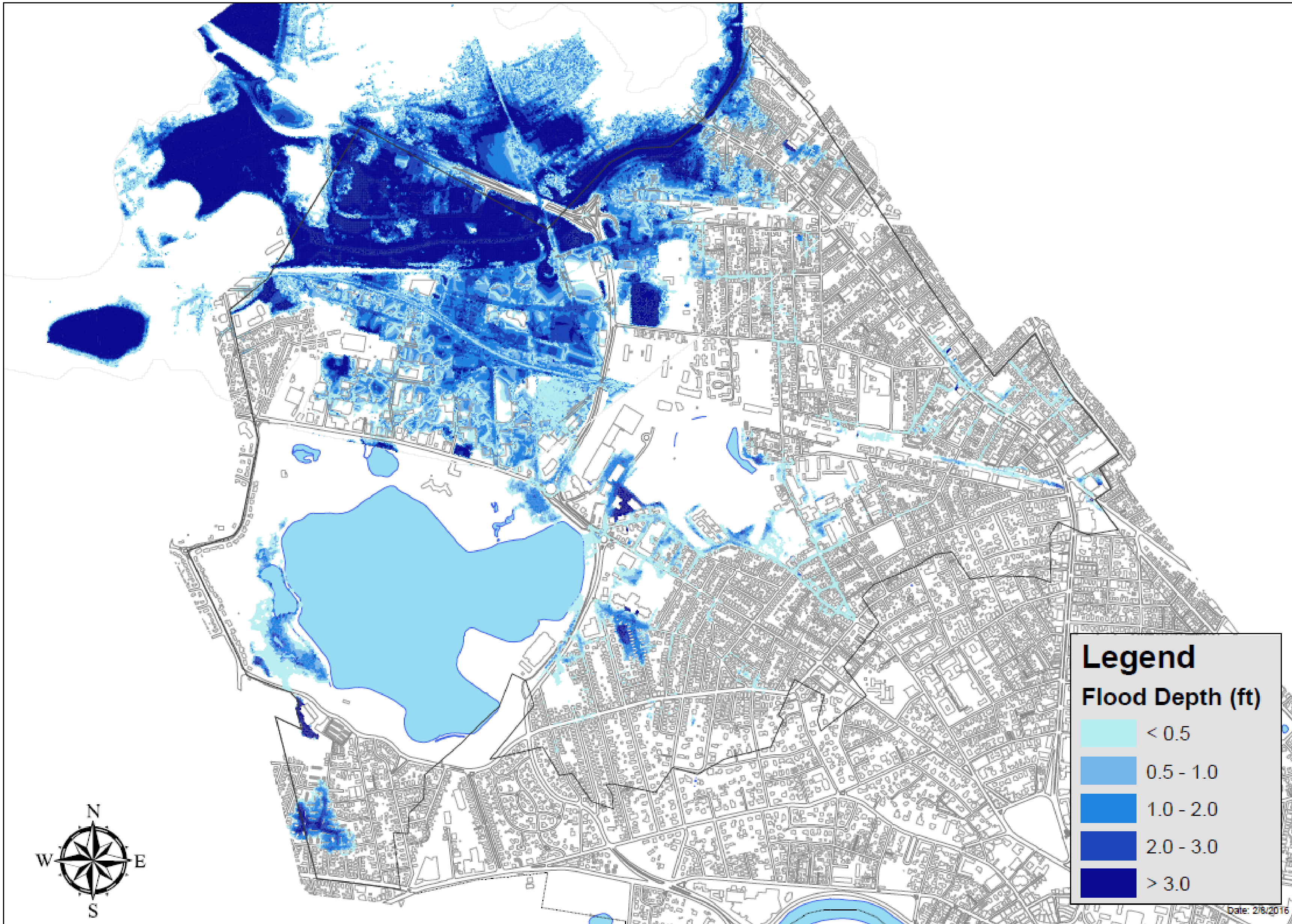
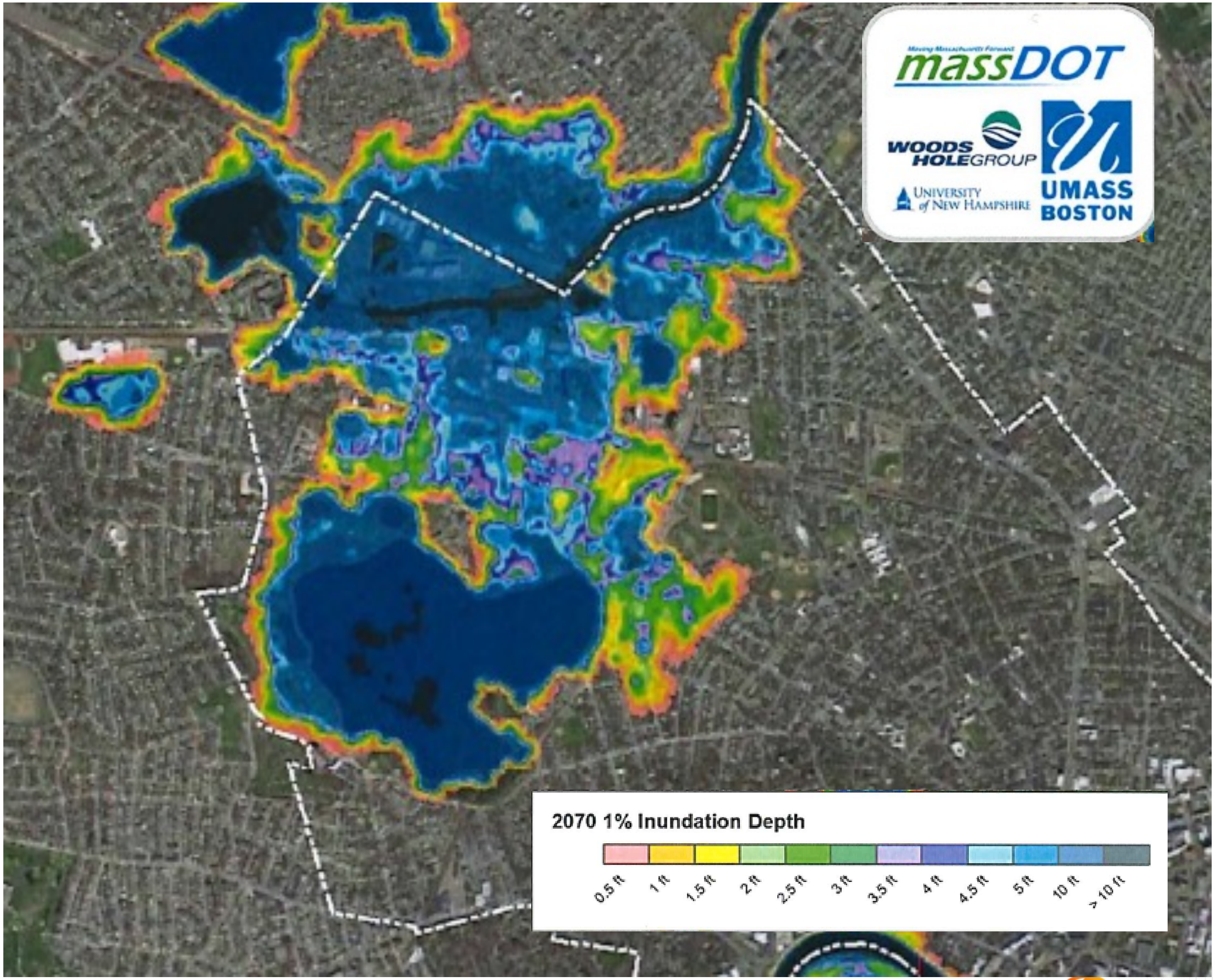
Riverine and Sewer System Flooding from Precipitation



Riverine Flooding from SLR/SS



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Challenges of a non-integrated approach

- Different flood types occur at different times (local scale versus regional scale timing)
- Flooding is generated by factors of different scale
- High degree of inter-dependence between systems
- Hard to seamlessly assess impact of regional measures at the local scale and viceversa

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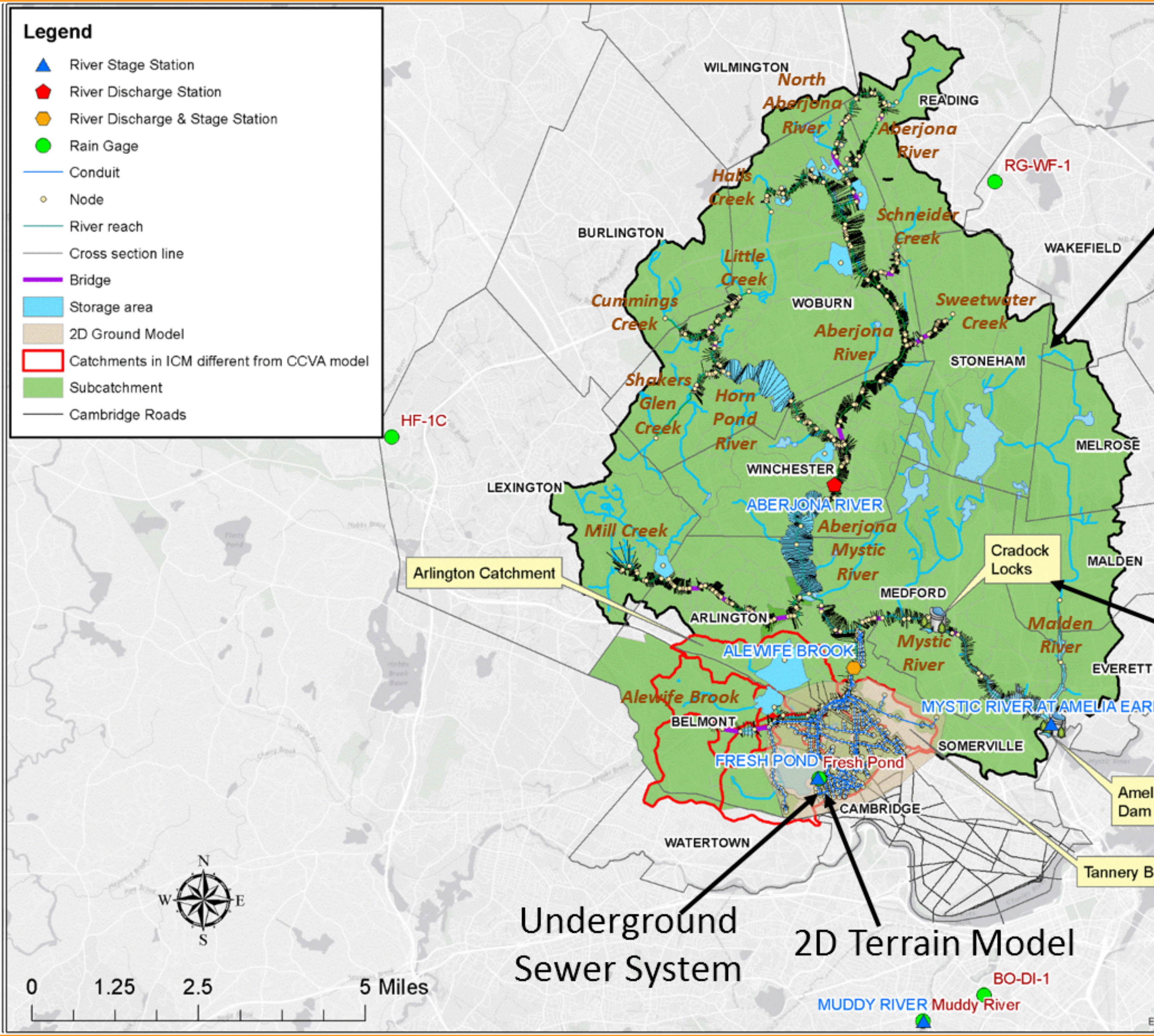
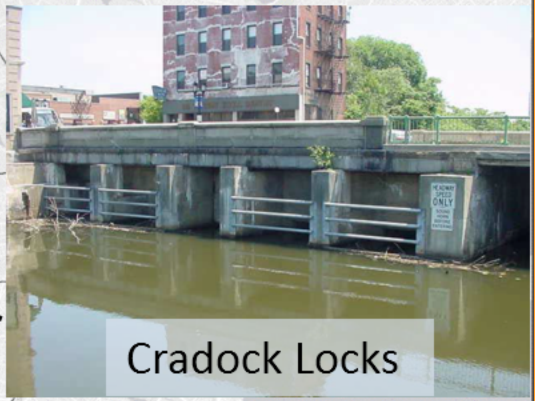
3. Mystic River Watershed Model Integration



Integrated ICM Sewer-Riverine Model Complexity

- 158 Bridges
~ 32 Miles of River
~ 430 Subcatchments
~ 69 Square Miles
~ 39 Sewer Miles
- 1 Pump Station at AED



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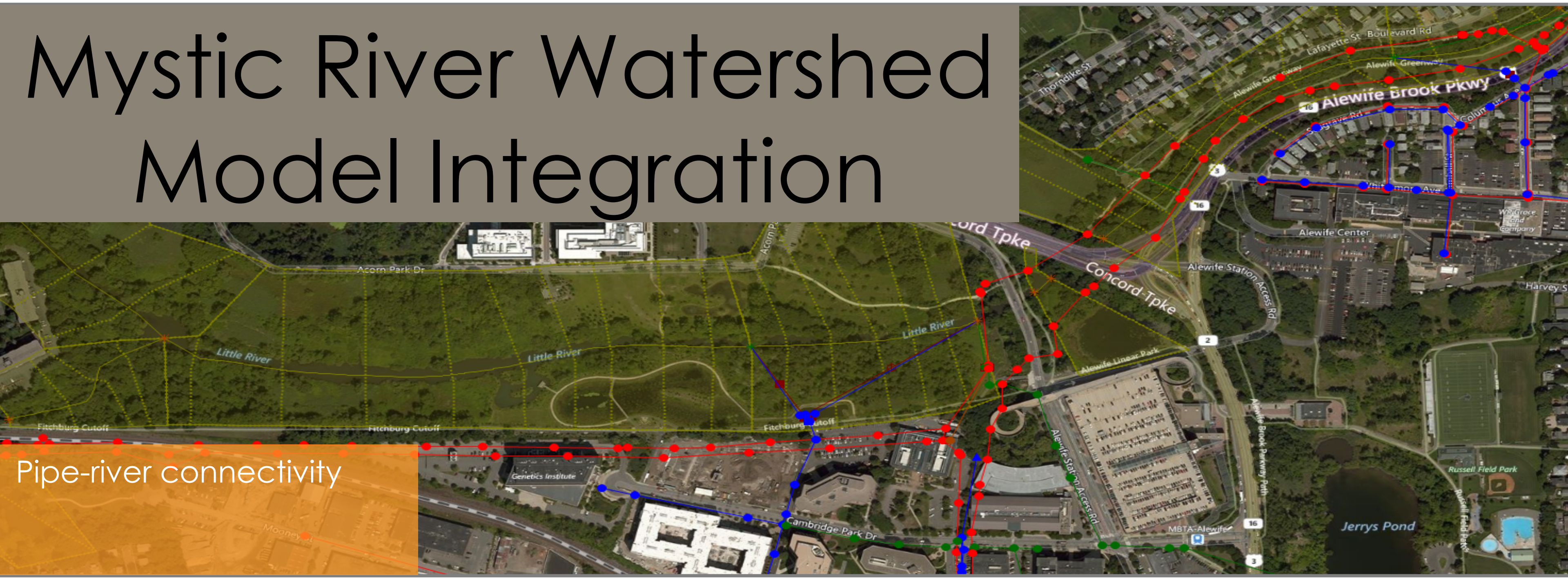
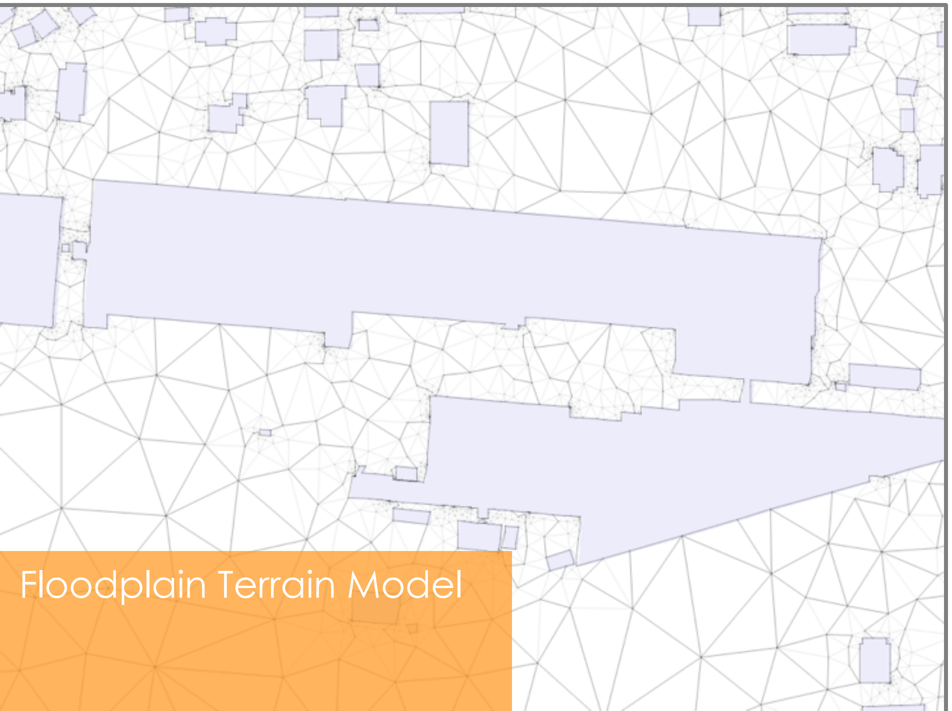
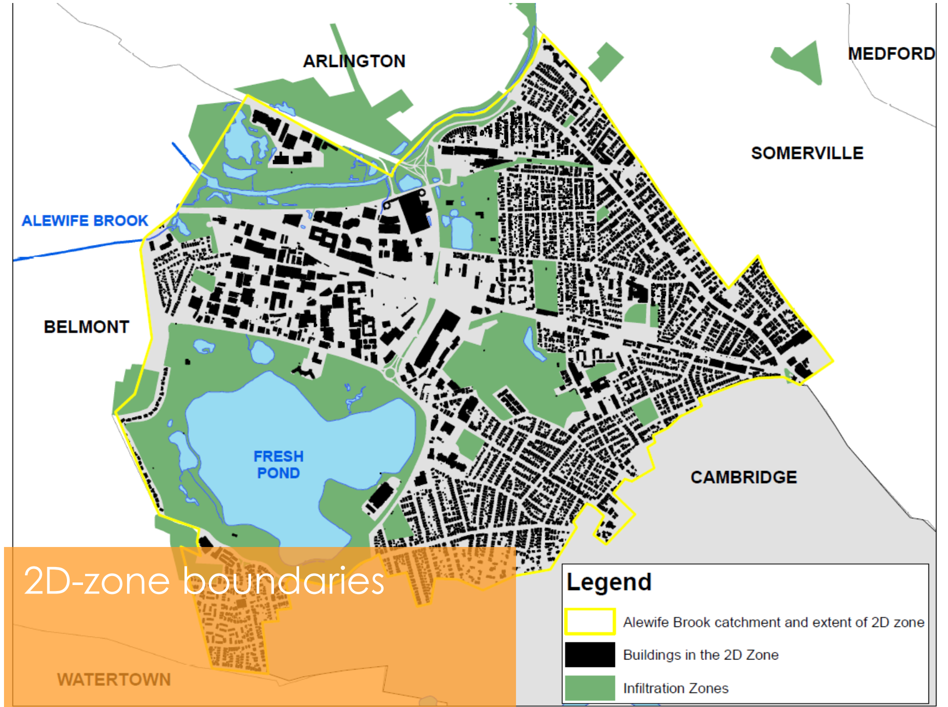
Mystic River Watershed Model Integration



Pipe-river connectivity



Floodplain Terrain Model



2D-zone boundaries

4 Hydraulic Model Calibration and Validation

Photos courtesy of Cambridge DPW

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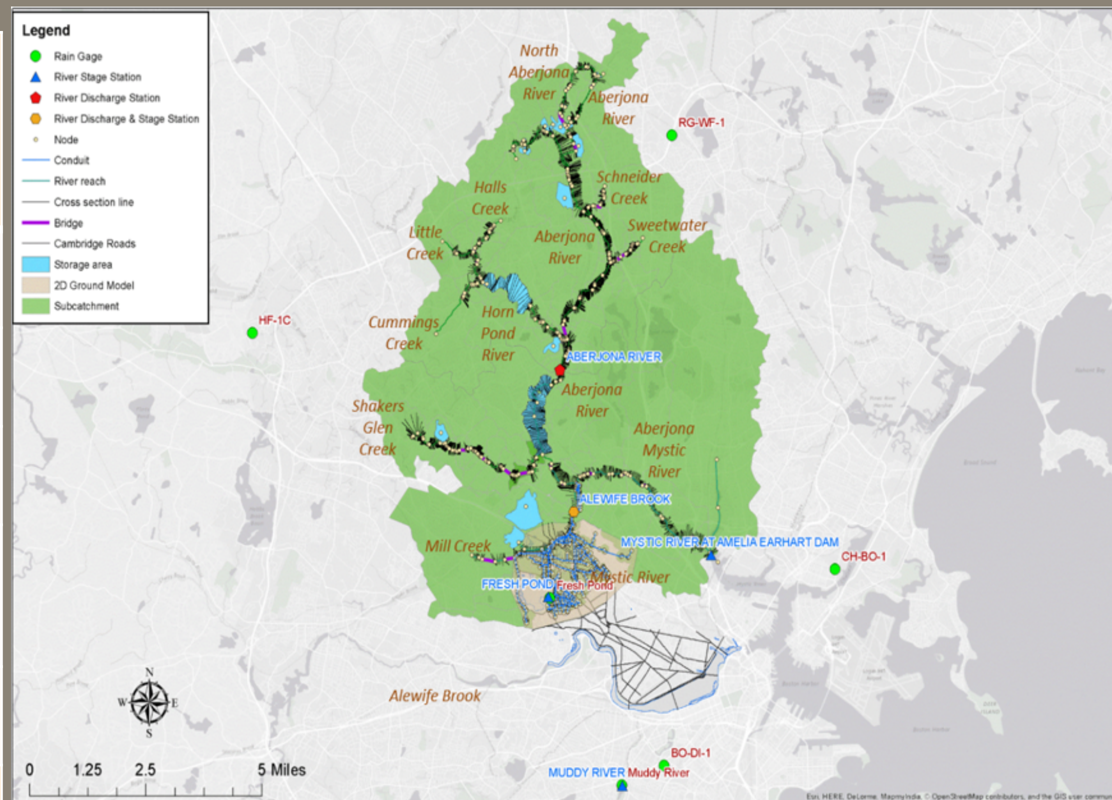
Hydraulic Model Calibration and Validation- Selected Storms

	March 2010	May 2006
Start Date/Time	13/8:00	12/17:30
End Date/Time	15/21:00	16/18:30
Total Rainfall (in)	9.59*	7.42*
Peak Intensity (in/hour)	1.32	0.60
Return Period**	>50-yr	~>25-yr

*At Muddy River in Brookline RG

**Based on NOAA Atlas 14 Estimates at Logan Airport



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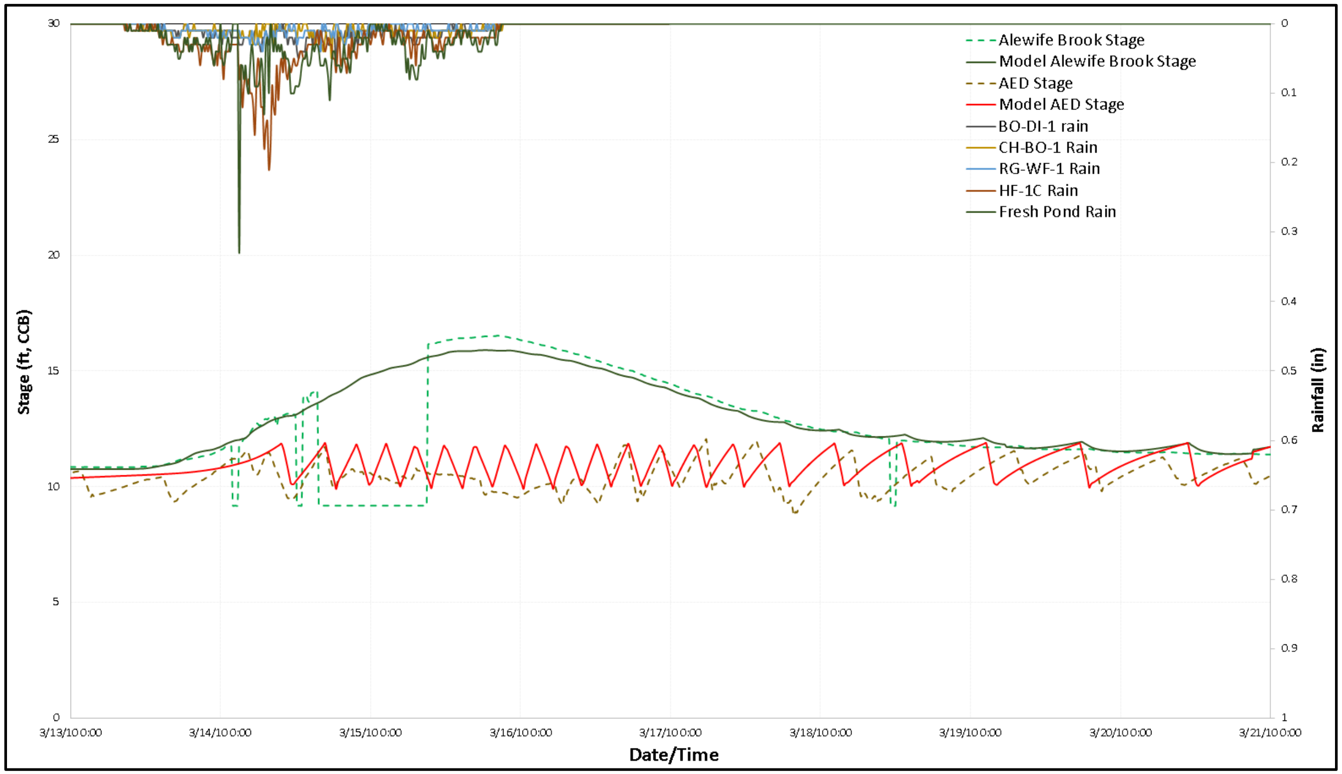
Hydraulic Model Calibration -March 2010 River Gages

USGS Station		Model	Meter	Difference (ft)
Alewife Brook	Peak Stage (ft)	16.52	15.90	-0.62
Amelia Earhart Dam	Peak Stage (ft)	12.05	11.90	-0.15



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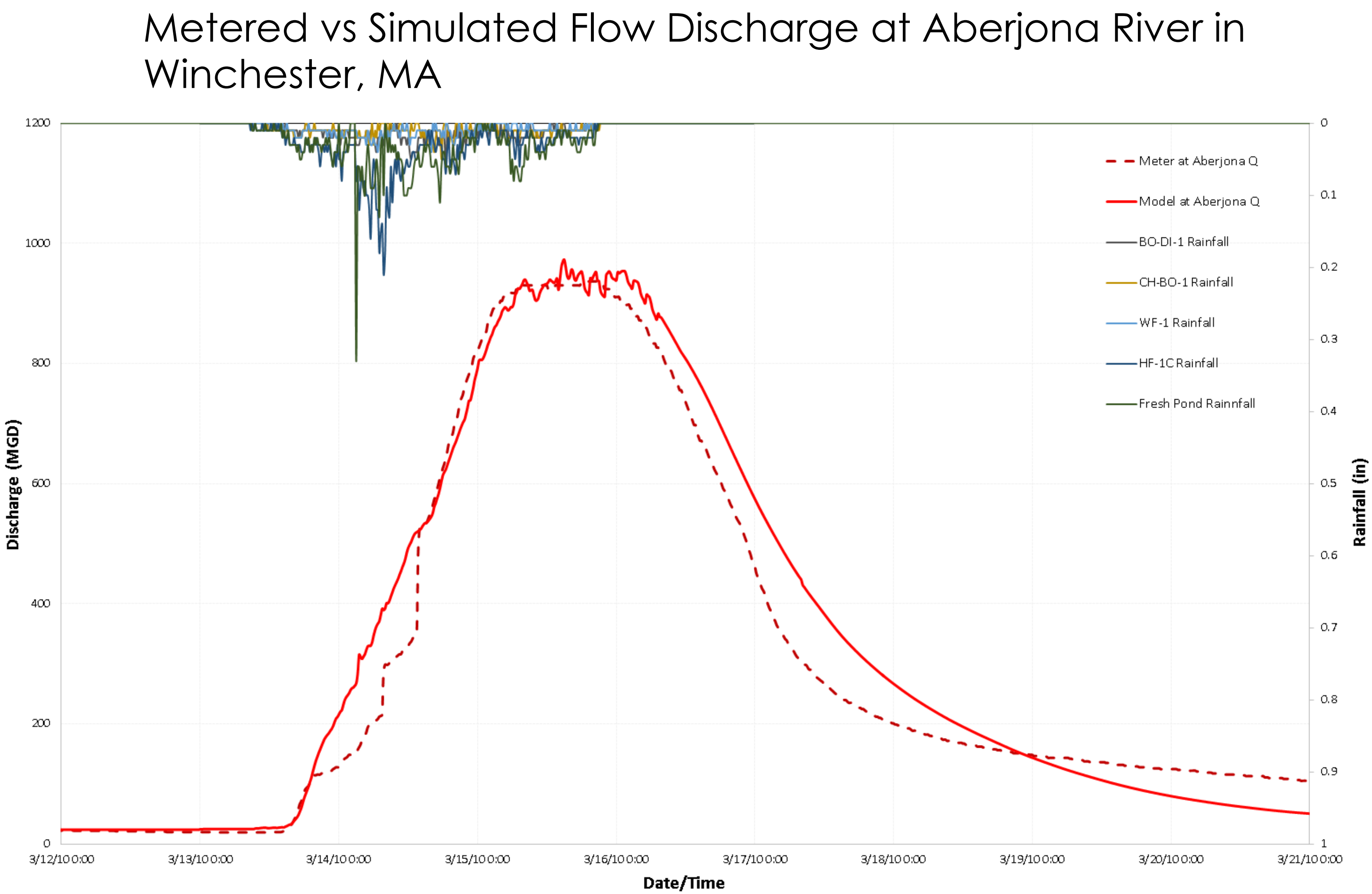
Hydraulic Model Calibration -March 2010 River Gages



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Hydraulic Model Calibration -March 2010 Photographic Evidence

Photographs Courtesy of Cambridge DPW

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Hydraulic Model Calibration -March 2010 Photographic Evidence

Photographs Courtesy of Cambridge DPW

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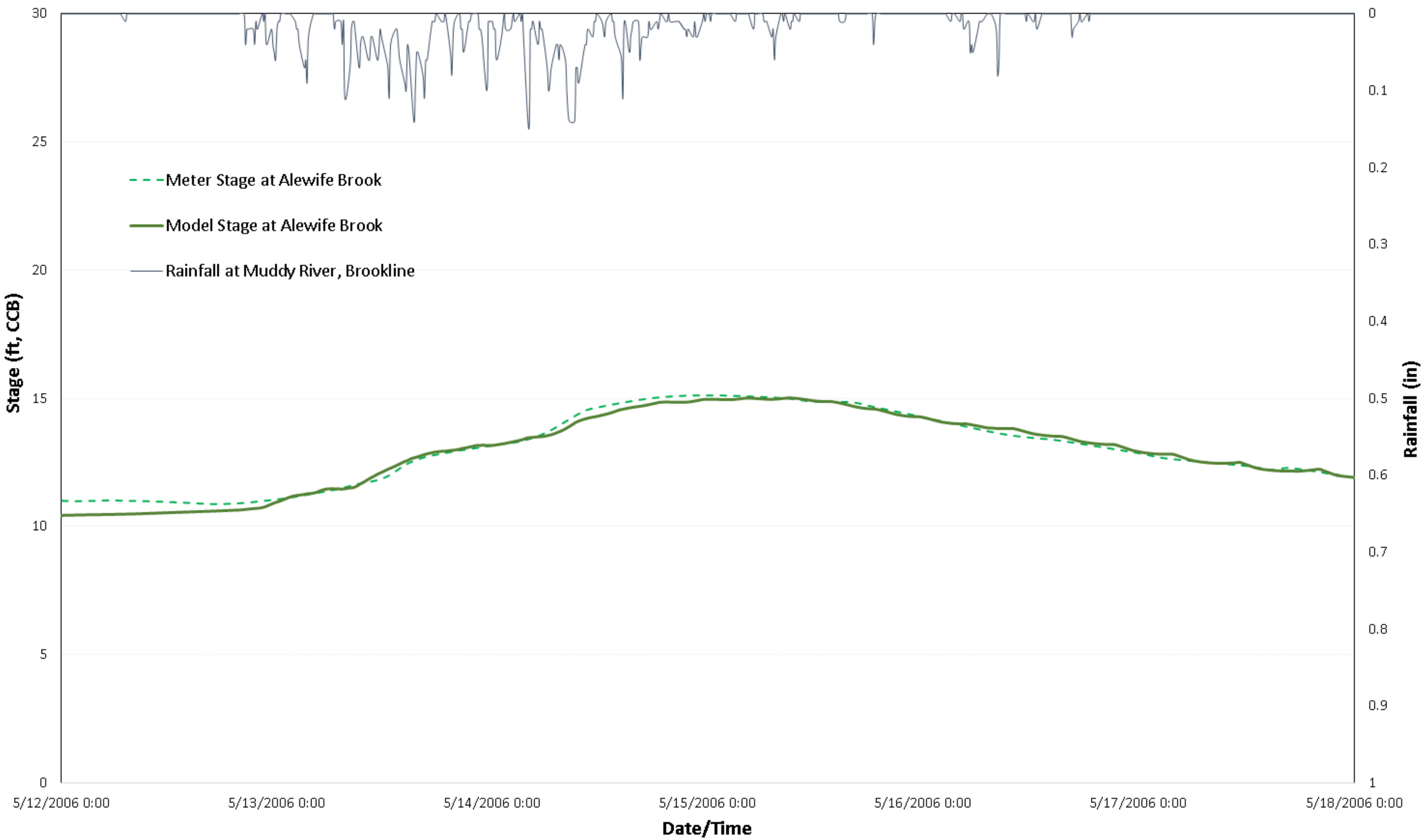
Hydraulic Model Validation -May 2006



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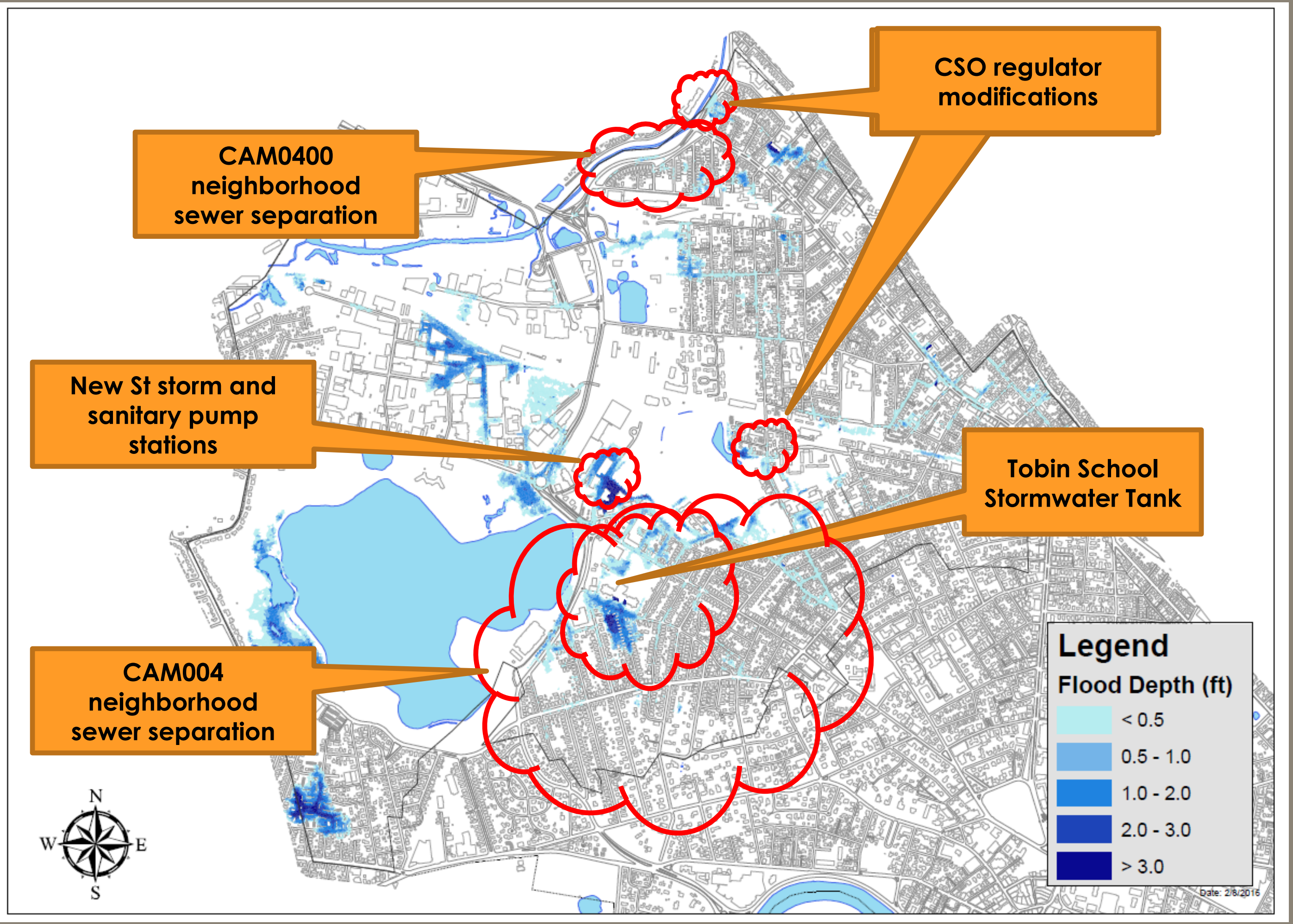
5. Model Uses – Local Scale Project Assessment



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Model Uses – Local Scale Project Assessment

Existing Conditions

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Model Uses – Local Scale Project Assessment

Example Project: Surface Berm

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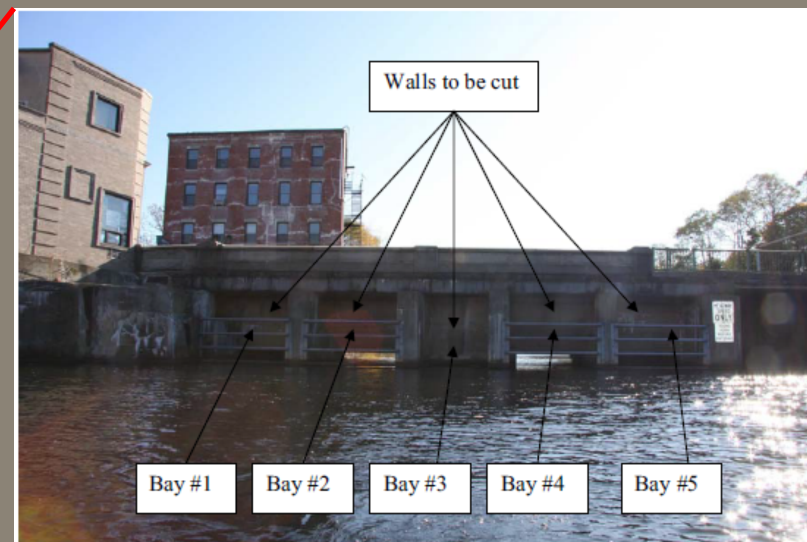
Model Uses – Evaluate Impact of Downstream Modifications



Source: AECOM evaluation report of the Cradock Dam removal, 2015

Model Uses – Evaluate Impact of Downstream Modifications

Model Uses – Evaluate Impact of Downstream Modifications

	New Cradock Locks		Old Cradock Locks
Horizon	3 pumps	4 pumps	3 pumps
100y, 24h			
Present	16.89	16.89	16.90
2030	17.49	17.35	17.46
2070	18.88	18.67	18.85
25y, 24h			
Present	15.73	15.73	15.73
2030	16.19	16.19	16.19
2070	16.62	16.62	16.62
10y, 24h			
Present	15.09	15.09	15.09
2030	15.44	15.44	15.44
2070	15.82	15.81	15.81

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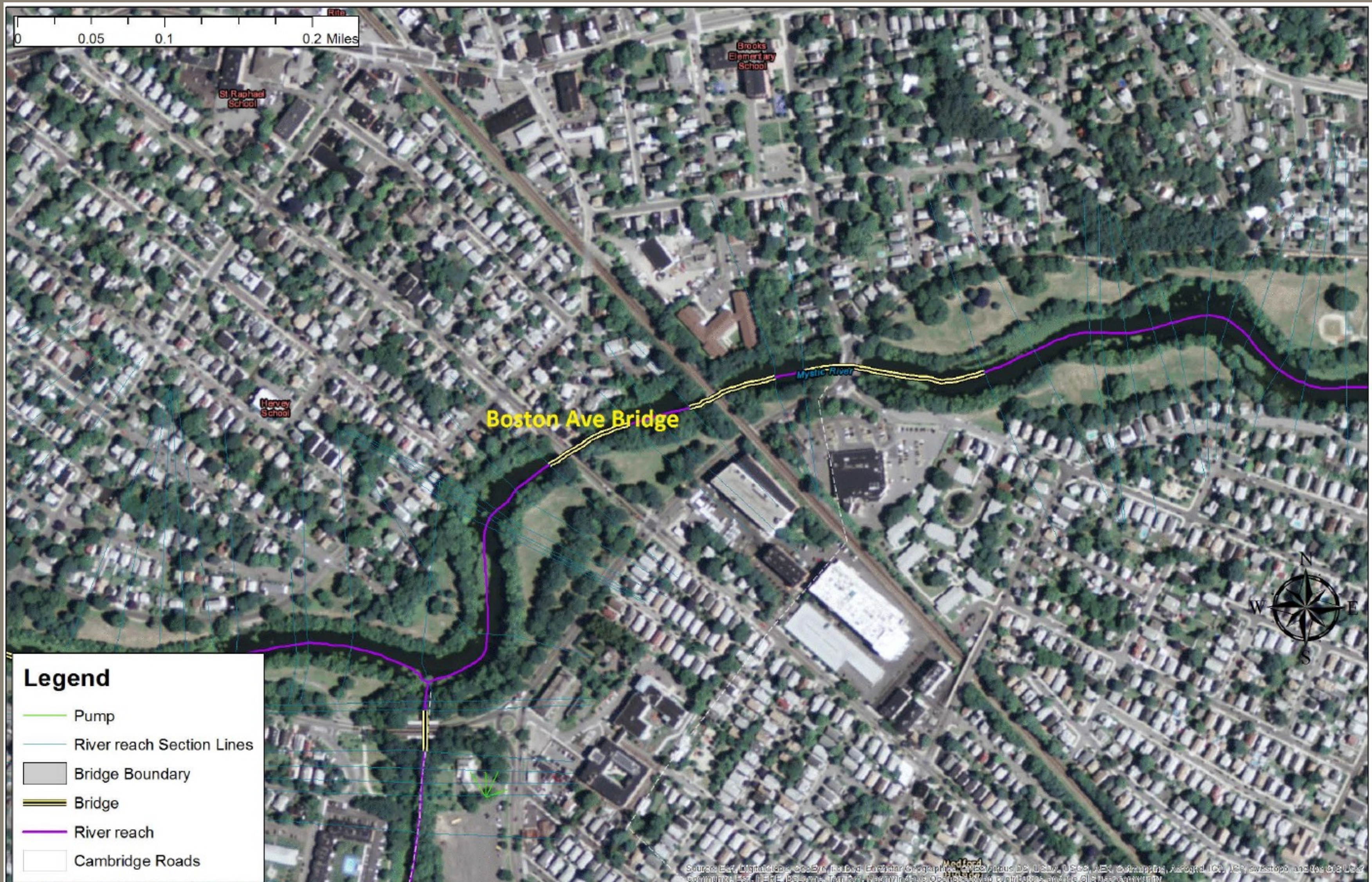
Model Uses – Understand Root Causes of Watershed Issues



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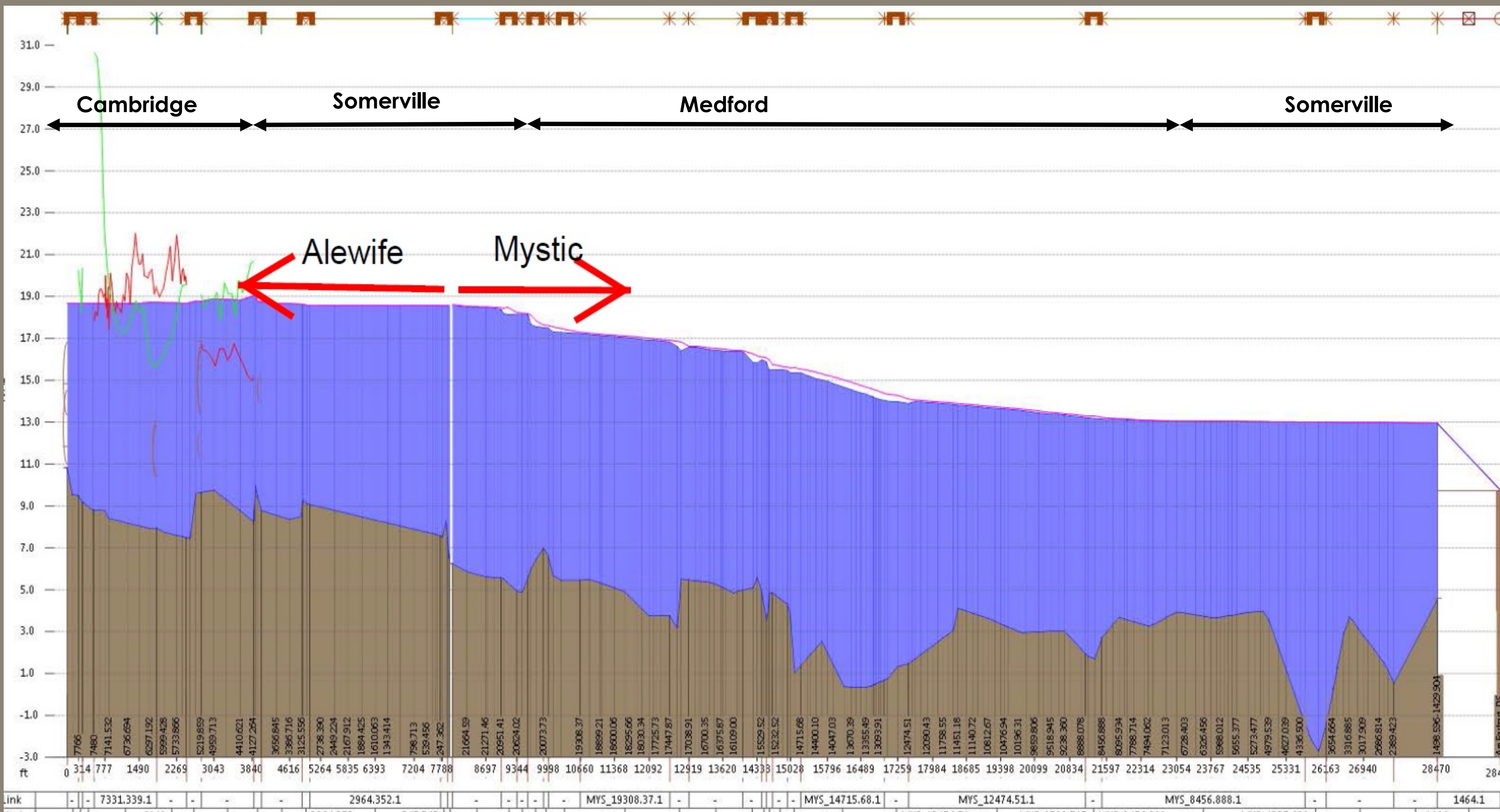
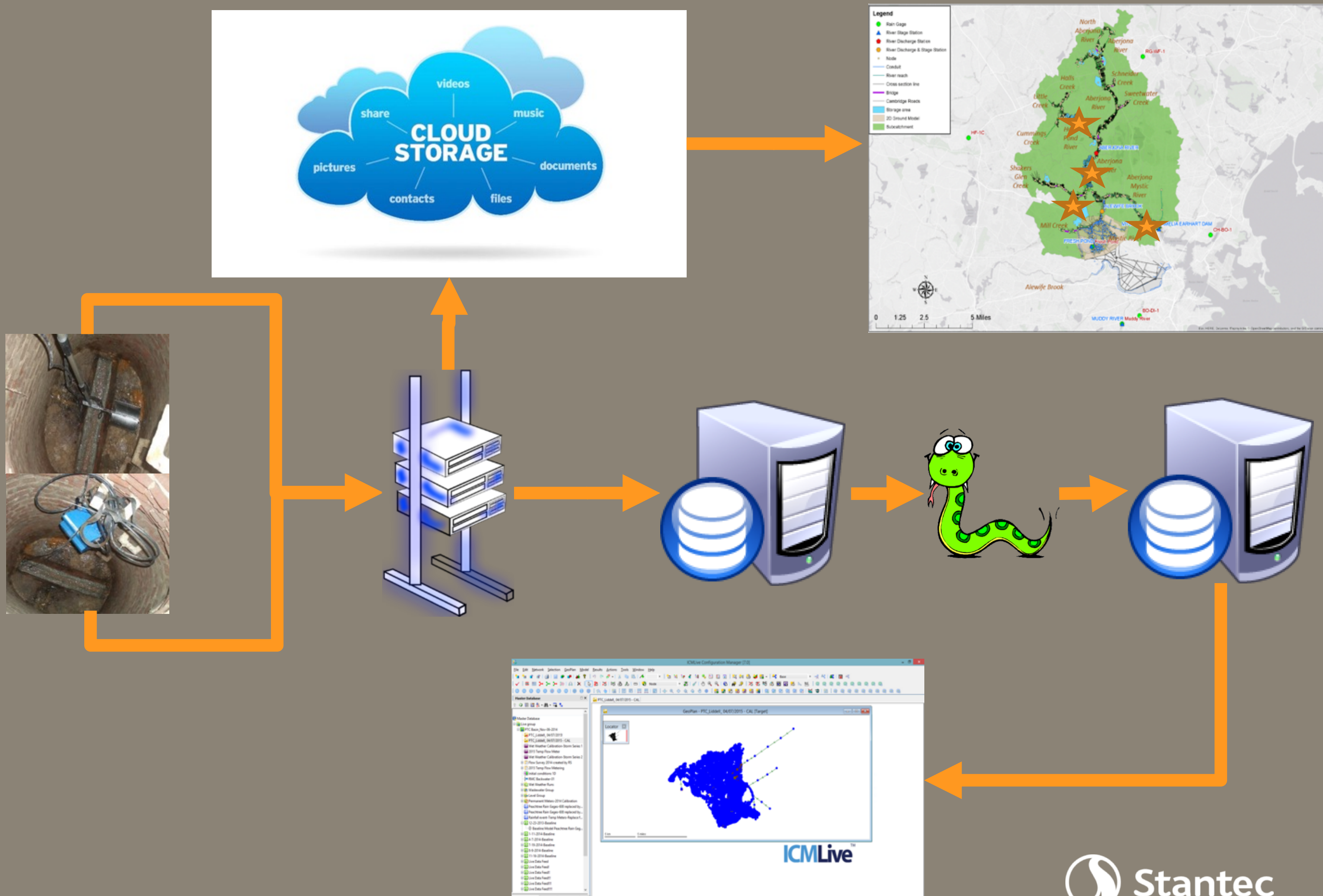
Model Uses – Understand Root Causes of Large Scale Flooding

2 pumps



Model Uses – Real-Time Watershed Management



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Model Uses – Evaluation of Impacts and Emergency Management

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Conclusions

- The Mystic River model has been successfully integrated, calibrated, and validated
- The model is being used by Cambridge to evaluate mitigation options at different scales
- Somerville is also fully integrated and using it for its flood risk assessment
- The watershed integrated model is ready to be used to assess regional or watershed-wide mitigation actions (e.g. reduction in DCIA or main channel conveyance improvements)
- It can be used for watershed and regional decision making and to evaluate phasing and effectiveness of those decisions
- Model detail can be added as it becomes available

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Thank you!!
Questions?

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