An Integrated Approach to Climate Change and Design – City of Cambridge Case Study

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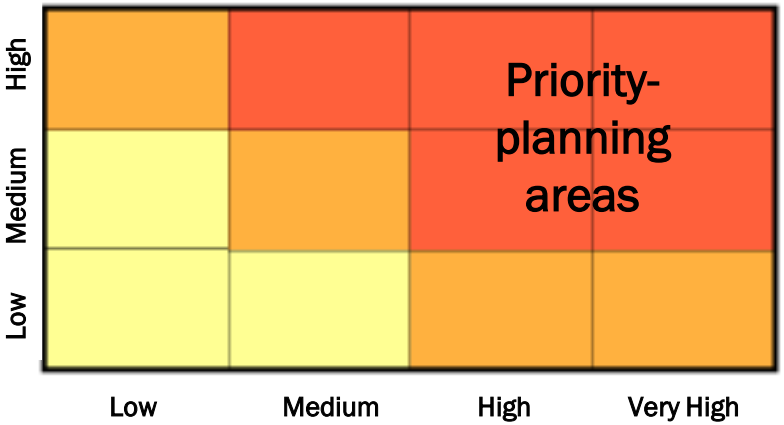
Project's Framework

Phase I: Vulnerability Assessment



Step 1

Climate Scenarios

Step 2

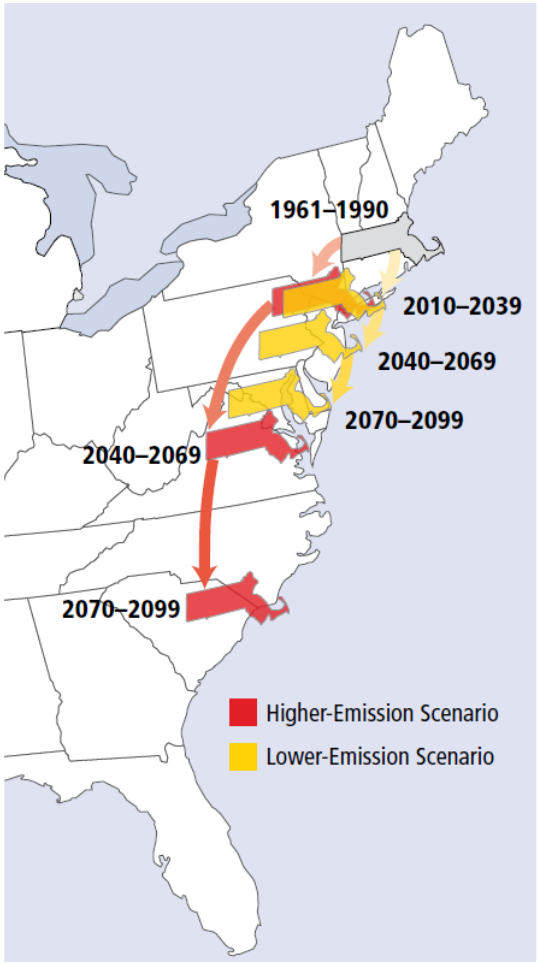
Vulnerability & Risk Assessment

Step 3

Preparedness Plan

Step 1: Climate Scenarios

Temperature

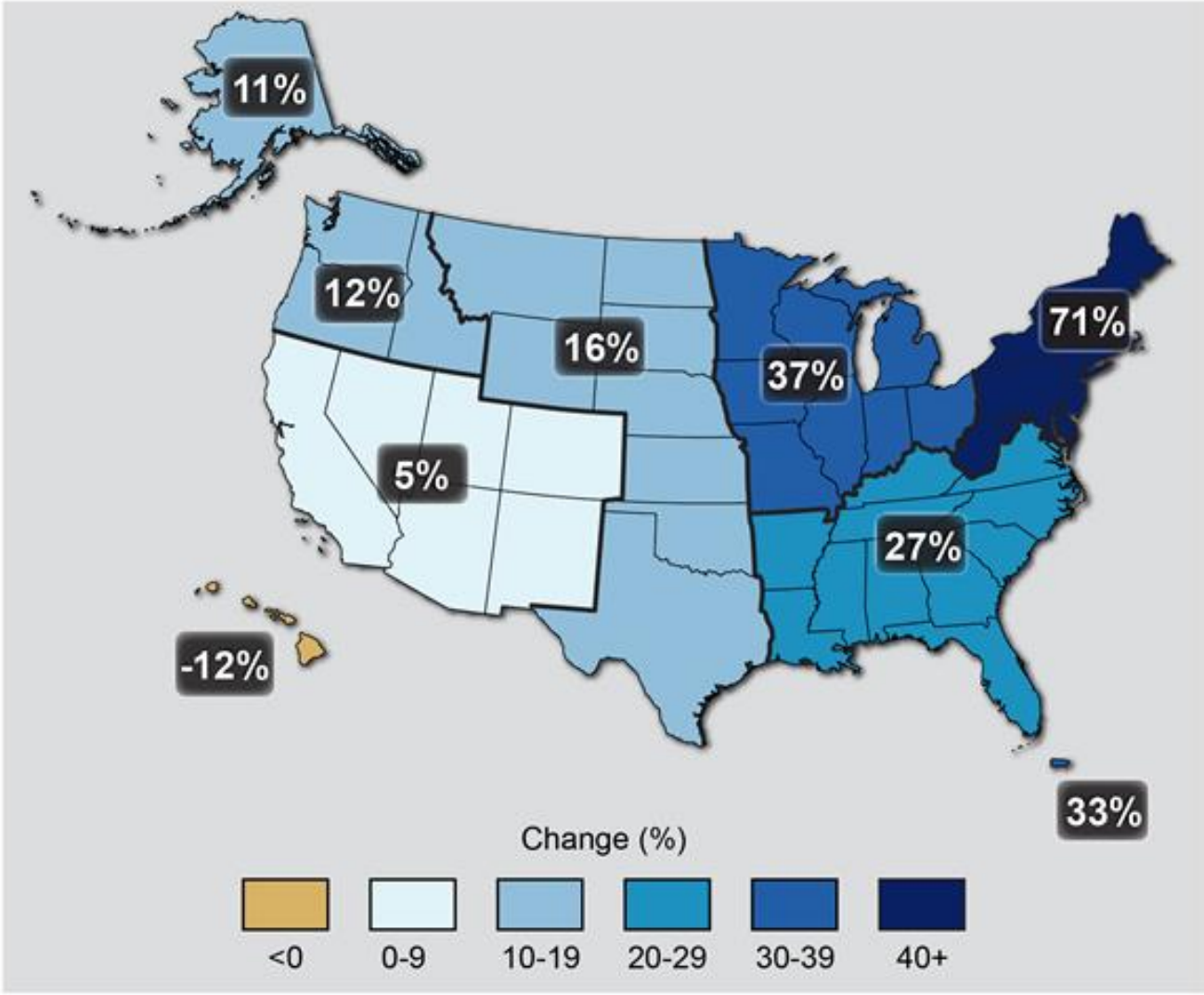


Precipitation

More extreme events

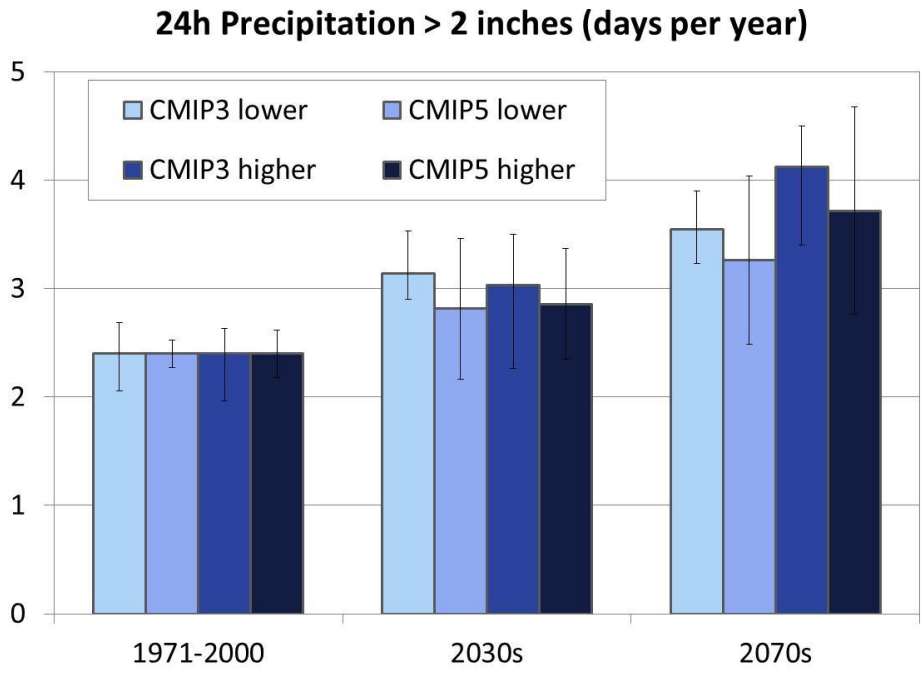
Sea level rise

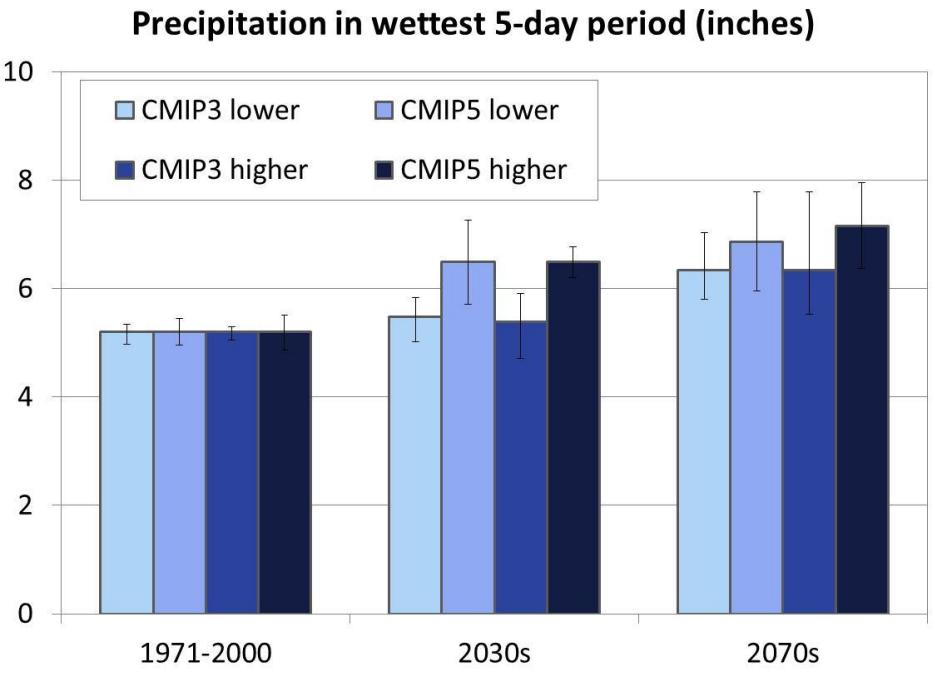
Precipitation Change



Observed change in very heavy precipitation events (defined as the heaviest 1% of all daily events) from 1958 to 2012. *Source: 2014 U.S. National Climate Assessment*

Traditional Indicators



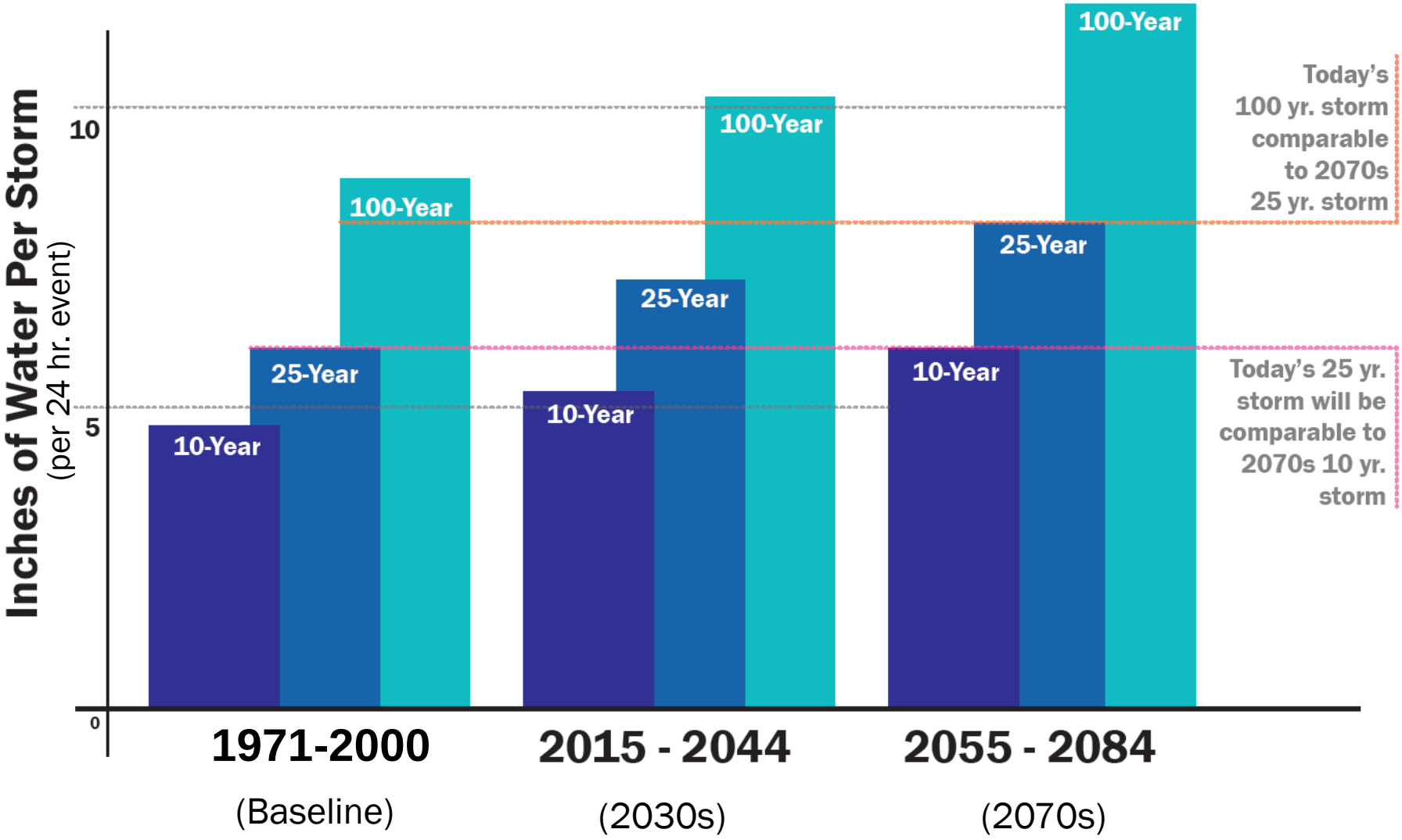


The Challenge

- Current design criteria based on past events
- Past is no longer a reliable indicator of present or future conditions

How do you translate uncertainty in climate models into usable design criteria?

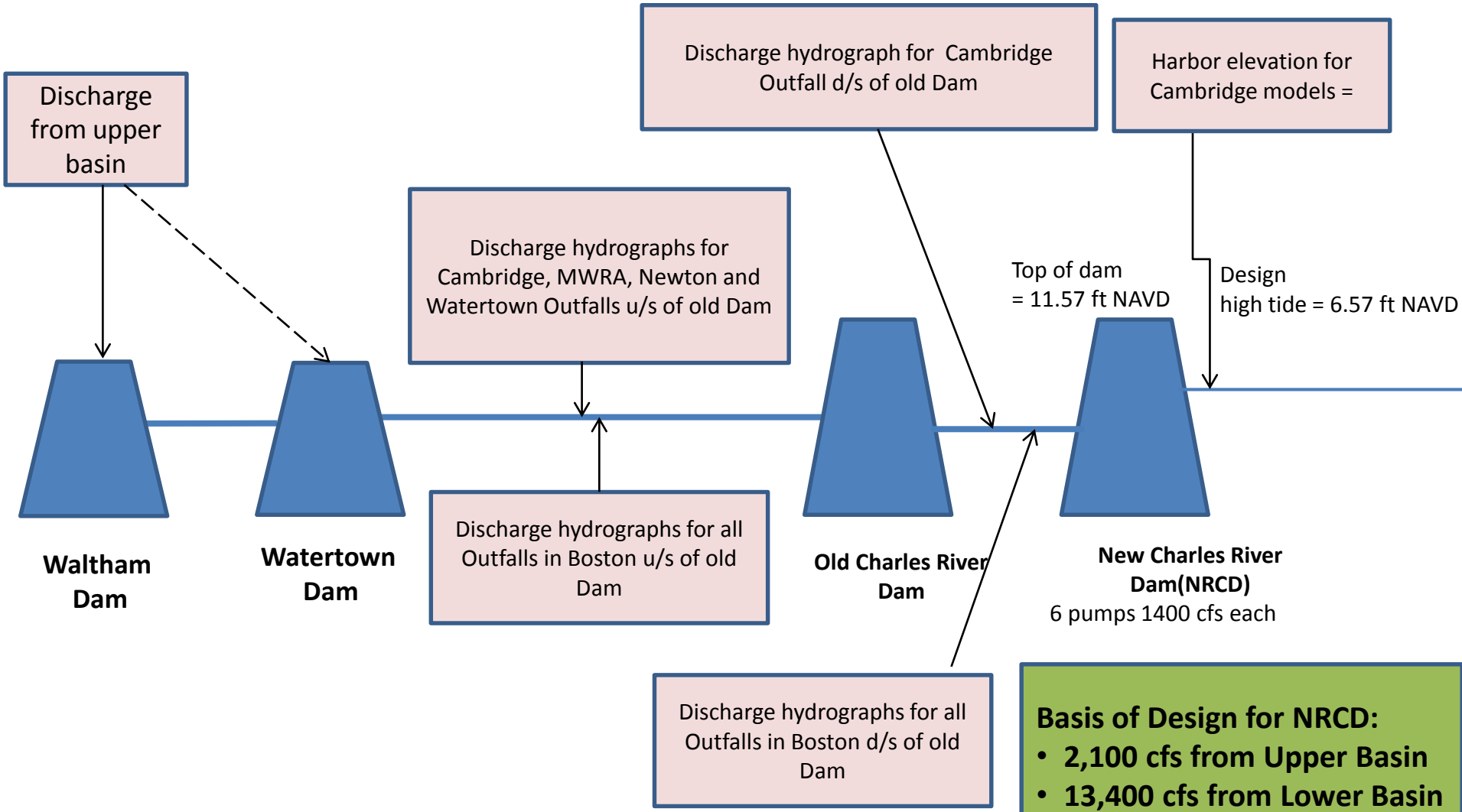
Precipitation Projections



Comprehensive Water Model

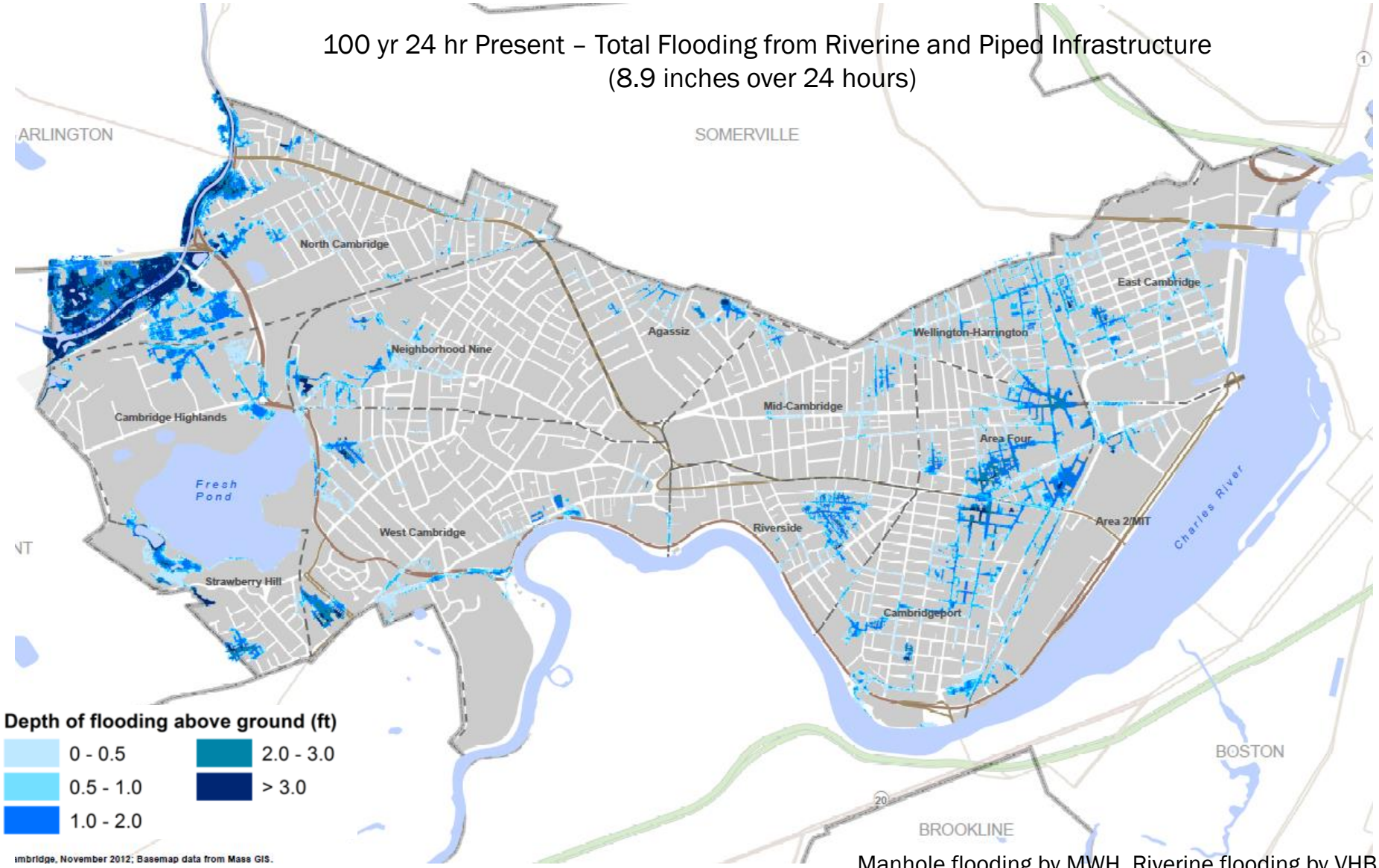
Linking Surface Water, SLR & Piped Infrastructure

Model Inputs



Inland Flooding – Present
High Scenario

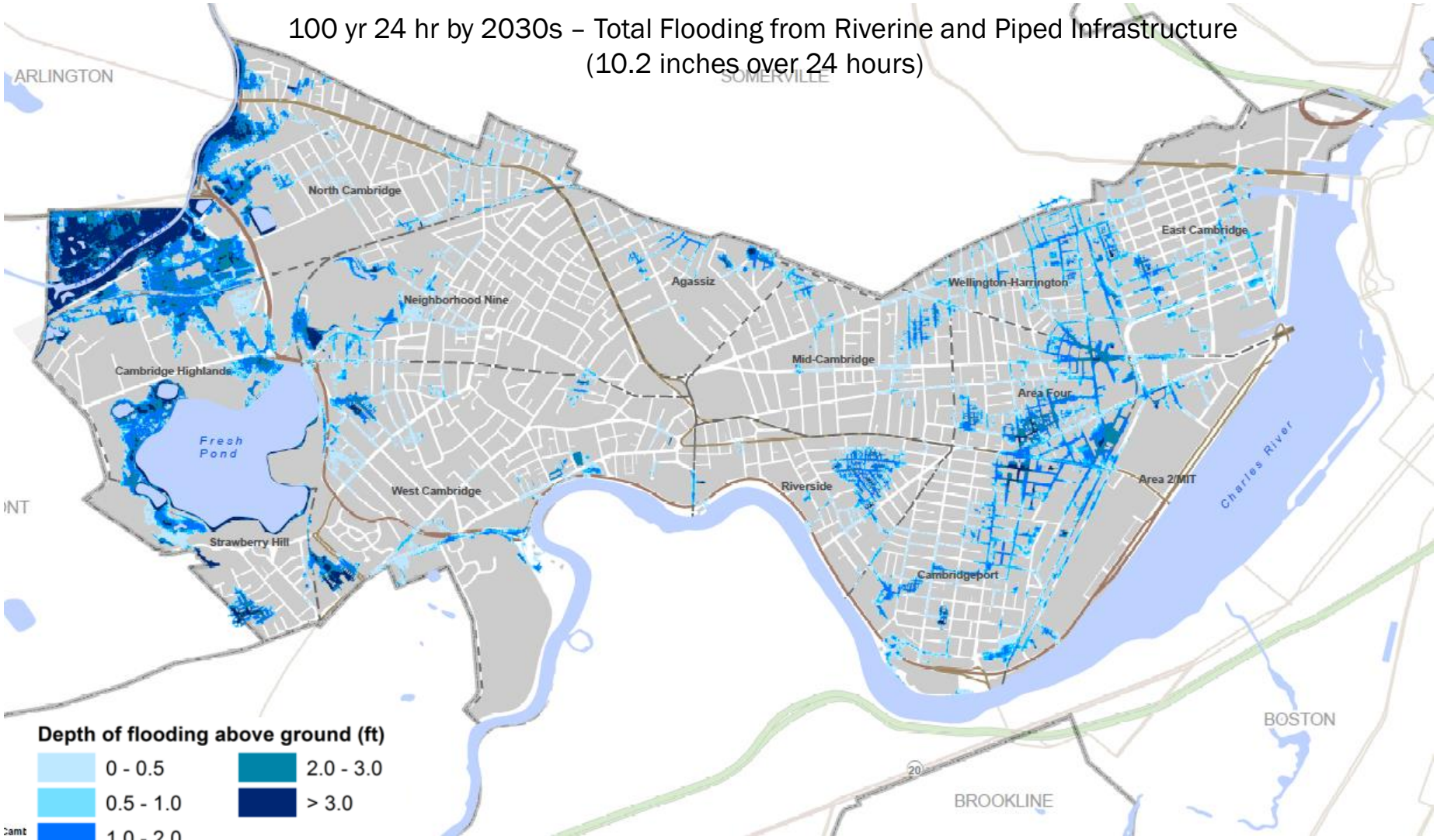
100 yr 24 hr Present – Total Flooding from Riverine and Piped Infrastructure
(8.9 inches over 24 hours)



Manhole flooding by MWH, Riverine flooding by VHB

Inland Flooding – 2030s

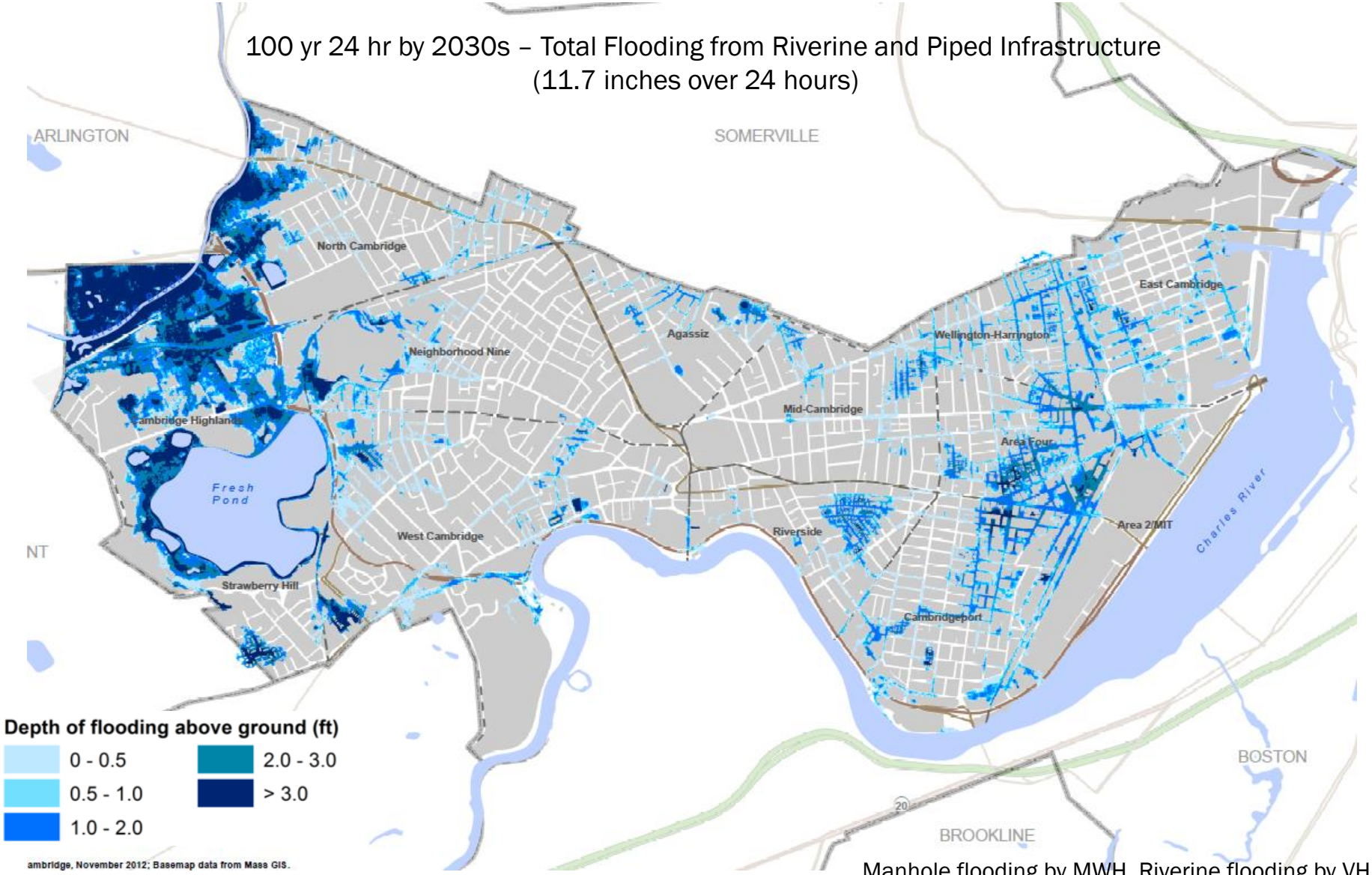
100 yr 24 hr by 2030s – Total Flooding from Riverine and Piped Infrastructure
(10.2 inches over 24 hours)



Manhole flooding by MWH, Riverine flooding by VHB

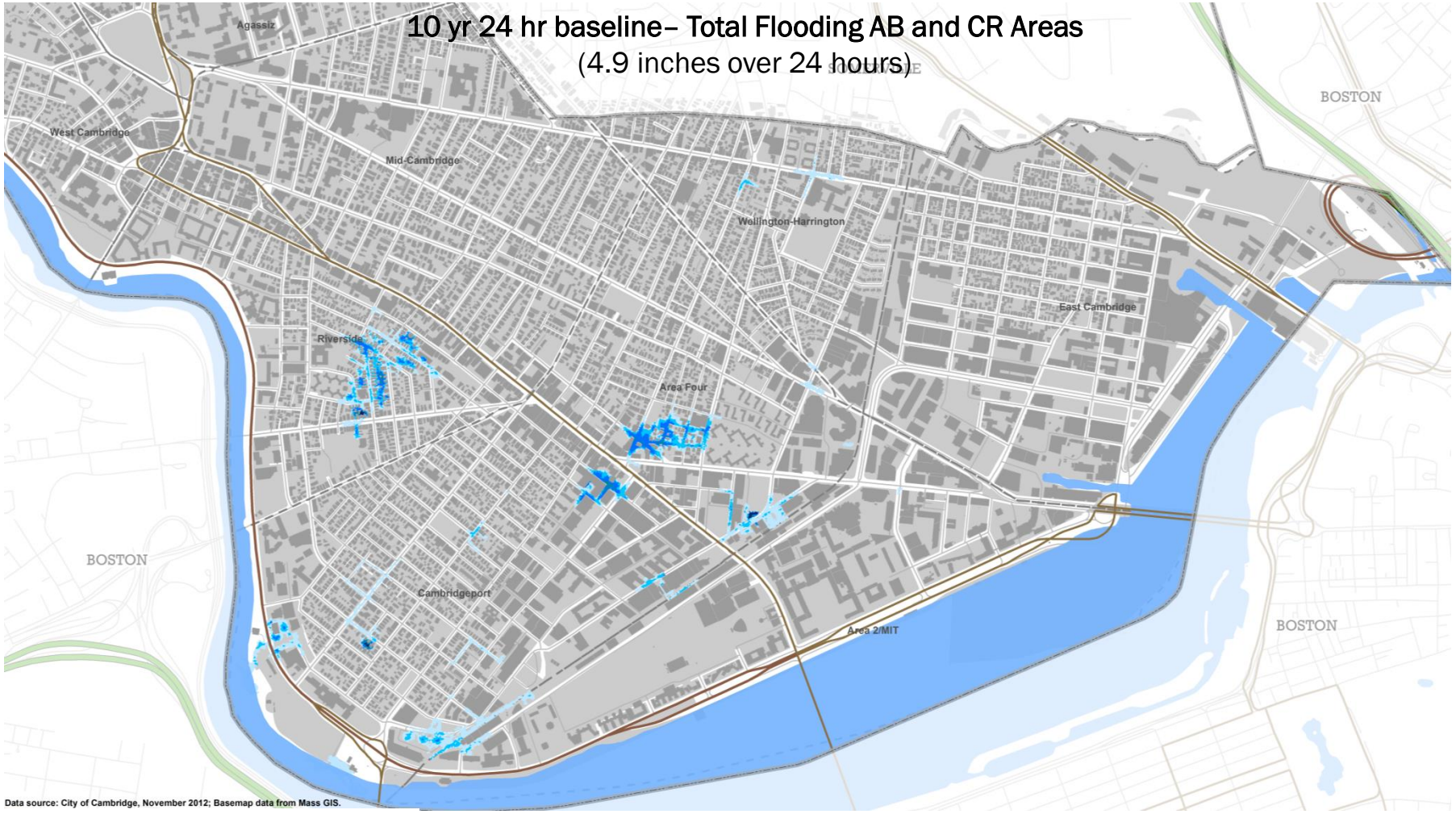
Inland Flooding – 2070s

100 yr 24 hr by 2030s – Total Flooding from Riverine and Piped Infrastructure
(11.7 inches over 24 hours)



Manhole flooding by MWH, Riverine flooding by VHB

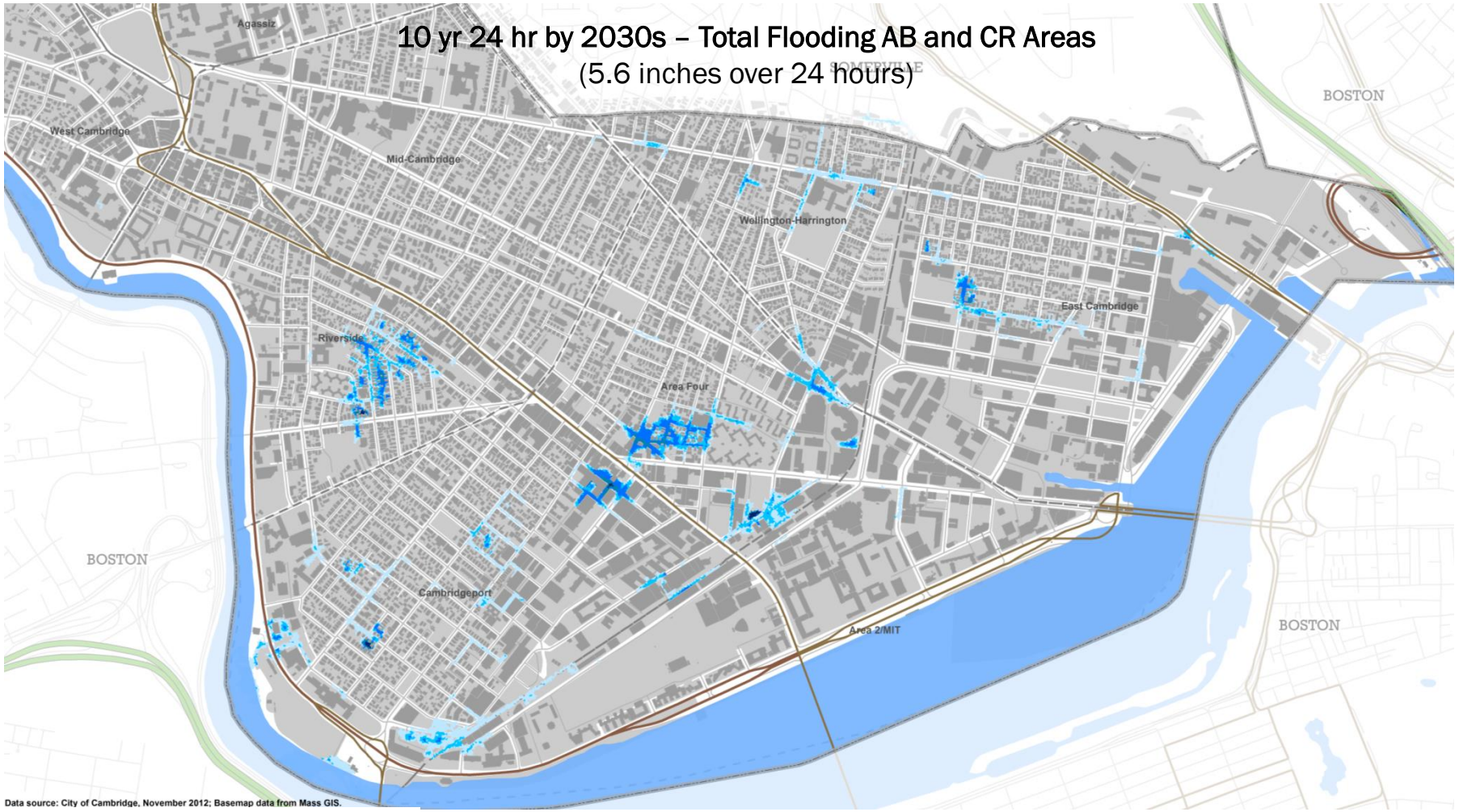
Inland Flooding /Eastern Cambridge – Present Low Scenario



Manhole flooding by MWH, Riverine flooding by VHB

Inland Flooding/ Eastern Cambridge – 2030s

Low Scenario

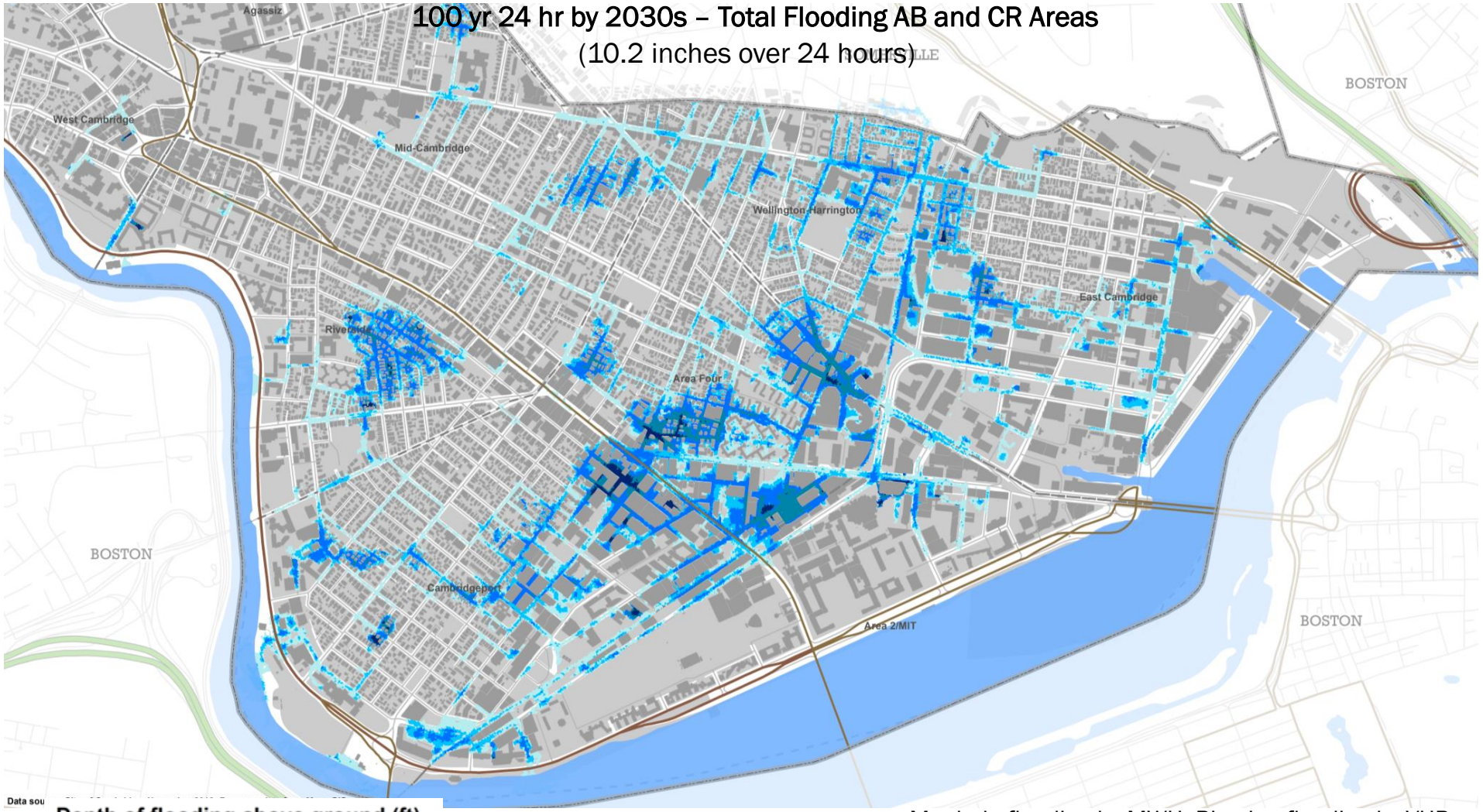


Manhole flooding by MWH, Riverine flooding by VHB

Inland Flooding /Eastern Cambridge – 2030s

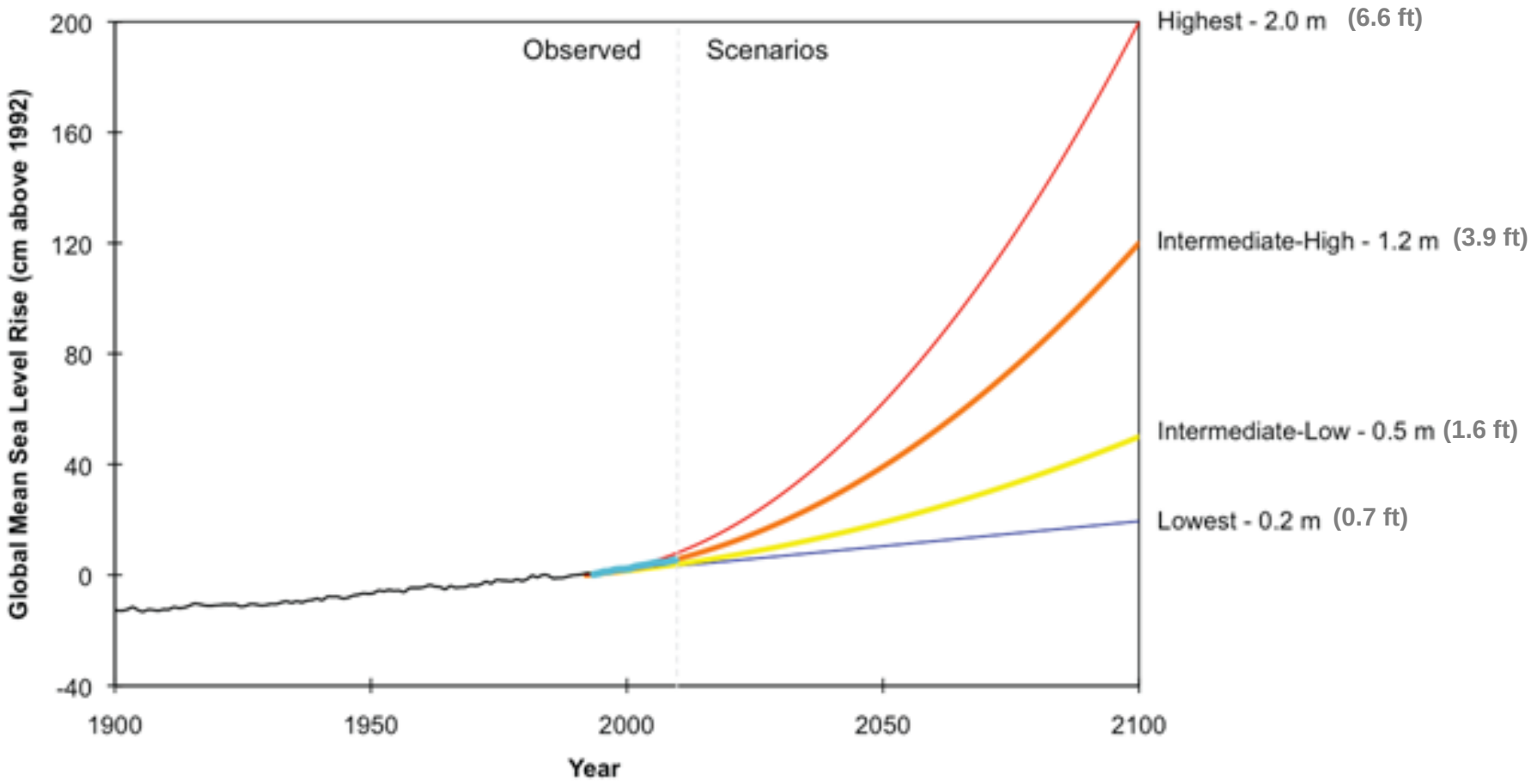
High Scenario

100 yr 24 hr by 2030s – Total Flooding AB and CR Areas
(10.2 inches over 24 hours)



Manhole flooding by MWH, Riverine flooding by VHB

Sea Level Rise Projections



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

Scenarios	2020	2030	2040	2050	2060	2070	2080	2090	2100
"Highest" Global SLR (from 2013-2020) (feet)	0.21	0.61	1.10	1.70	2.40	3.21	4.11	5.12	6.23
Land subsidence (feet) @ 0.04 in./yr	0.02	0.06	0.09	0.12	0.15	0.19	0.22	0.25	0.29
"Highest" Relative SLR (from 2013-2020) - (feet)	**0.24**	**0.66**	**1.19**	**1.82**	**2.56**	**3.39**	**4.33**	**5.37**	**6.52**

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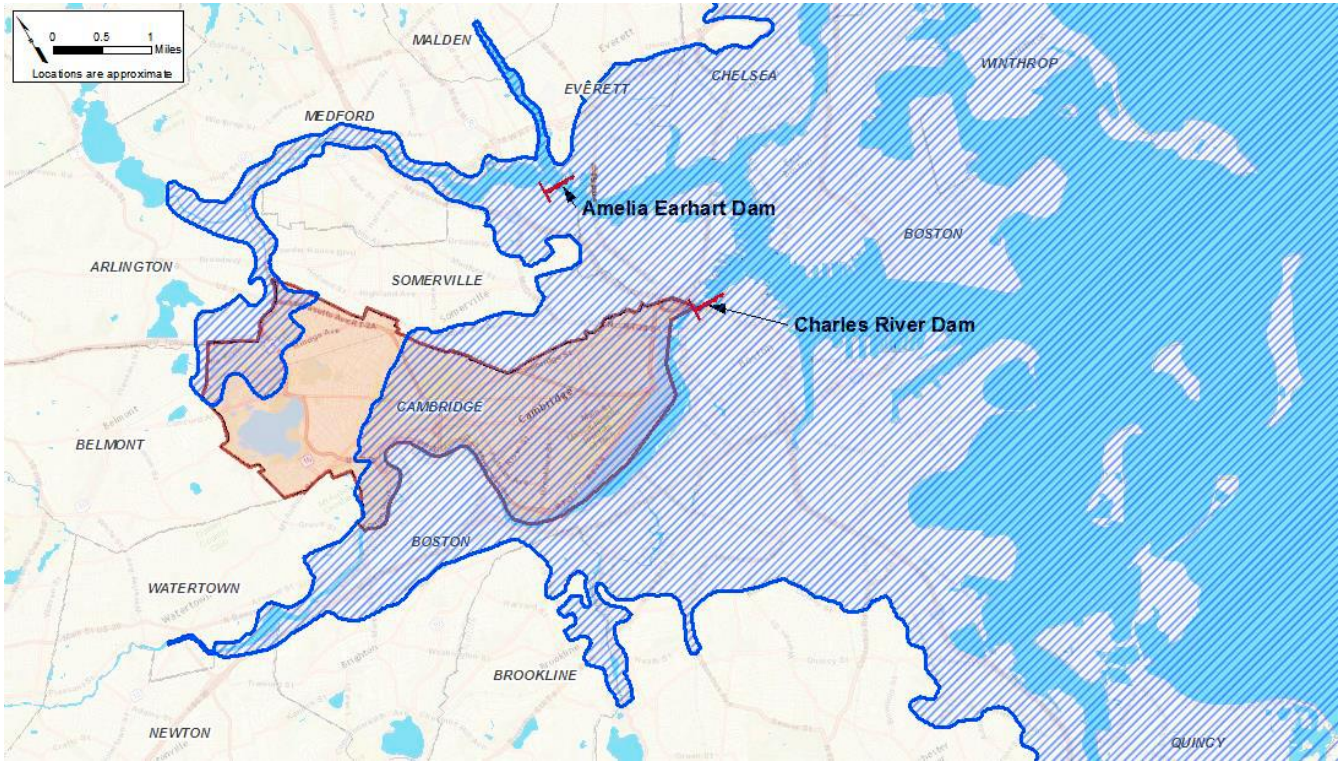
Update on Sea Level Rise / Storm Surge

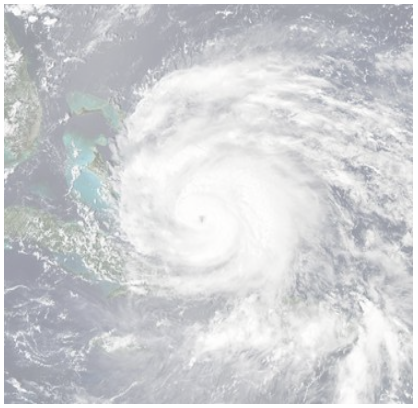
Preliminary findings:

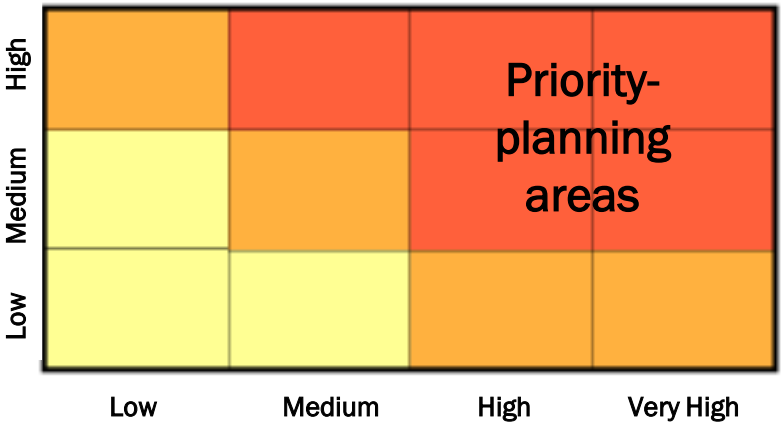
- 2030s: Charles River Dam unlikely to be overtopped, unlikely impact on Cambridge
- 2050-2070: Charles River Dam becoming more likely to be overtopped, likely impact on Cambridge
- Preliminary findings: Modeling being finalized for 2070s



Boundaries of MassDOT study: Shaded area in blue indicates the extent and location of project area boundaries that were included in the analysis.
(Source: MassDOT, Woods Hole Group, UMass Boston. March 2015)

Step 2: Vulnerability and Risk Assessment





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Climate Scenarios

Step 2

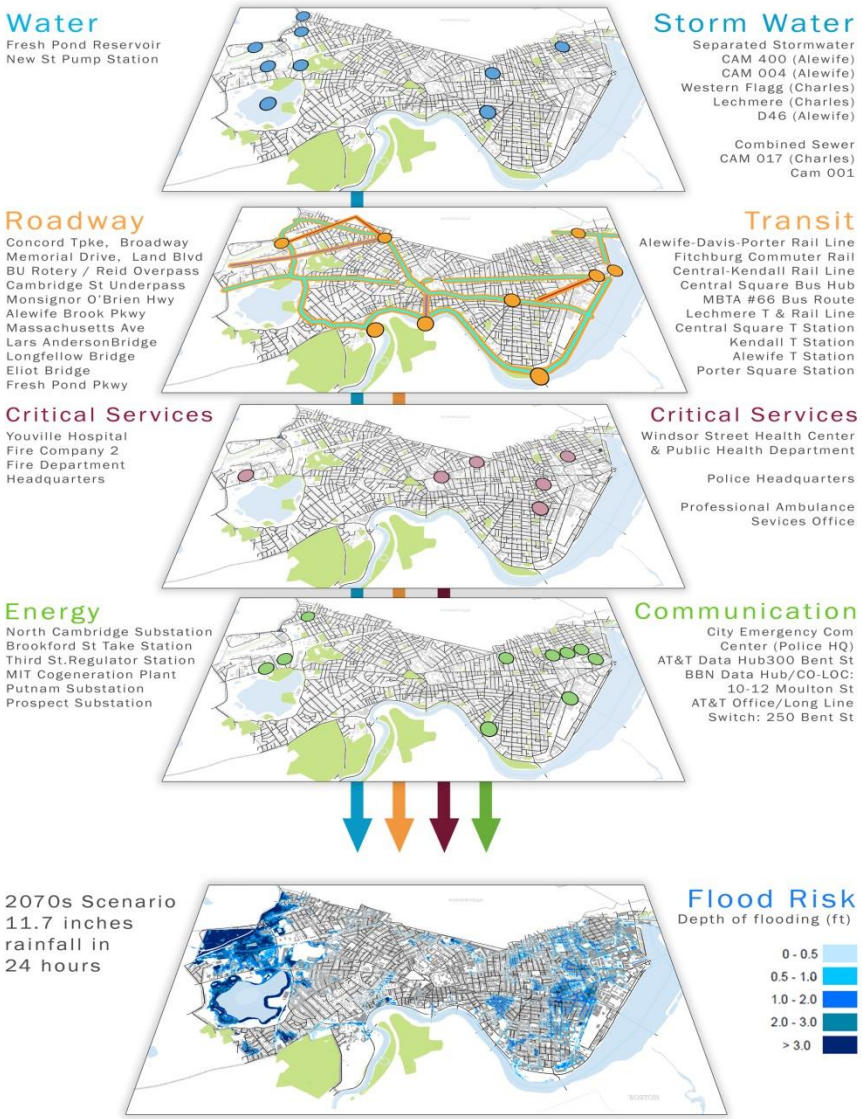
Vulnerability & Risk Assessment

Step 3

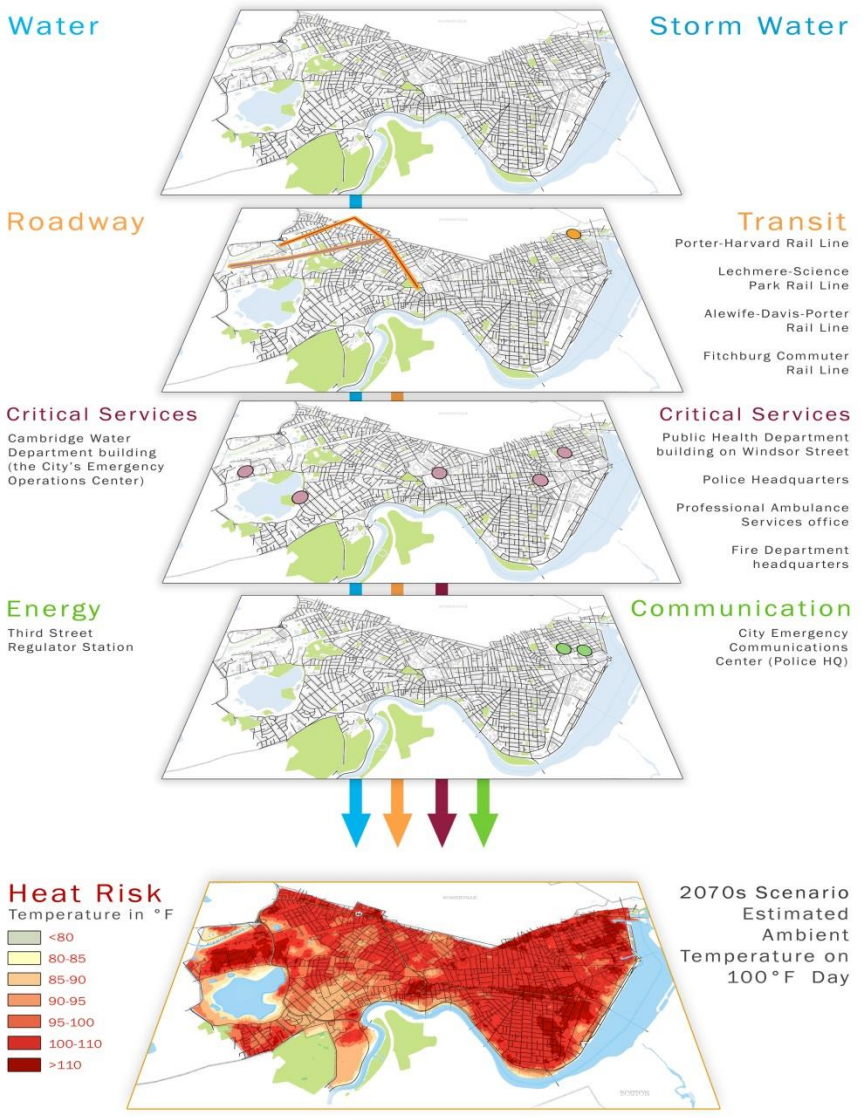
Preparedness Plan

Urban Infrastructure & Services

Flooding stress test



Heat stress test



Vulnerability and Risk Assessment – Water/WW Infrastructure

(V5 – Most Vulnerable, V0 – Least Vulnerable; R4 – Highest Risk, R1 – Lowest Risk)

Critical Assets		Flooding - 2030			
		10 yr 24-hr (5.6 in.)		100 yr 24-hr (10.2 in.)	
Type	Name	Vulnerability	Risk	Vulnerability	Risk
Surface Water Bodies	Charles River	V1		V1	
	Alewife Brook	V1		V3	
Dams	New Charles River Dam	V1		V1	
	Amelia Earhart Dam	V1		V2	
Drinking Water System	Fresh Pond Reservoir	V0		V4	R3
	Walter J. Sullivan Water Purification Facility	V0		V1	
Stormwater Pump Stations	New Street Pump Station	V5	R3	V5	R2
	Cambridge St Underpass pump station	V2		V2	
Combined Sewer/Sanitary Pump Stations	Sewer pump station: Prison Point	V2		V2	
	Sewer pump station: Cottage Farm	V2		V3	
Separated Stormwater Catchment Areas and Associated Conveyance Systems	CAM 400 (Alewife)	V3		V5	R3
	D46 (Alewife)	V5	R2	V5	R2
	CAM 004 (Alewife)	V3		V5	R3
	May Street Golf Course (Alewife)	V3		V5	R1
	Sparks St (Charles)	V3		V3	
	Harvard Sq (Charles)	V3		V3	
	Area 13 (Charles)	V3		V4	R2
	Coperthaite (Charles)	V3		V4	R2
	Dewolfe (Charles)	V2		V3	
	Western Flagg (Charles)	V4	R4	V5	R3
	Cambridgeport (Charles)	V3		V4	R2
	North Point (Charles)	V3		V3	
	Lechmere (Charles)	V3		V4	R3

Critical Assets		Flooding - 2030			
		10 yr 24-hr (5.6 in.)		100 yr 24-hr (10.2 in.)	
Type	Name	Vulnerability	Risk	Vulnerability	Risk
	Ames Wadsworth (Charles)	V3		V3	
	Wetland Area (Charles)	V2		V3	
Combined Sewer/Sanitary Catchment Areas and Associated Conveyance Systems	CAM 001 (Alewife)	V3		V5	R2
	CAM 002 (+ CAM 002a for manhole flooding) (Alewife)	V3		V3	
	401 A/B (Alewife)	V3		V4	R2
	CAM 005 (Charles)	V3		V4	R2
	CAM 017 (Charles)	V3		V5	R3

Vulnerability and Risk Assessment – Water/WW Infrastructure

(R4 – Highest Risk, R1 – Lowest Risk)

Consequence	Probability: Low	Probability: High

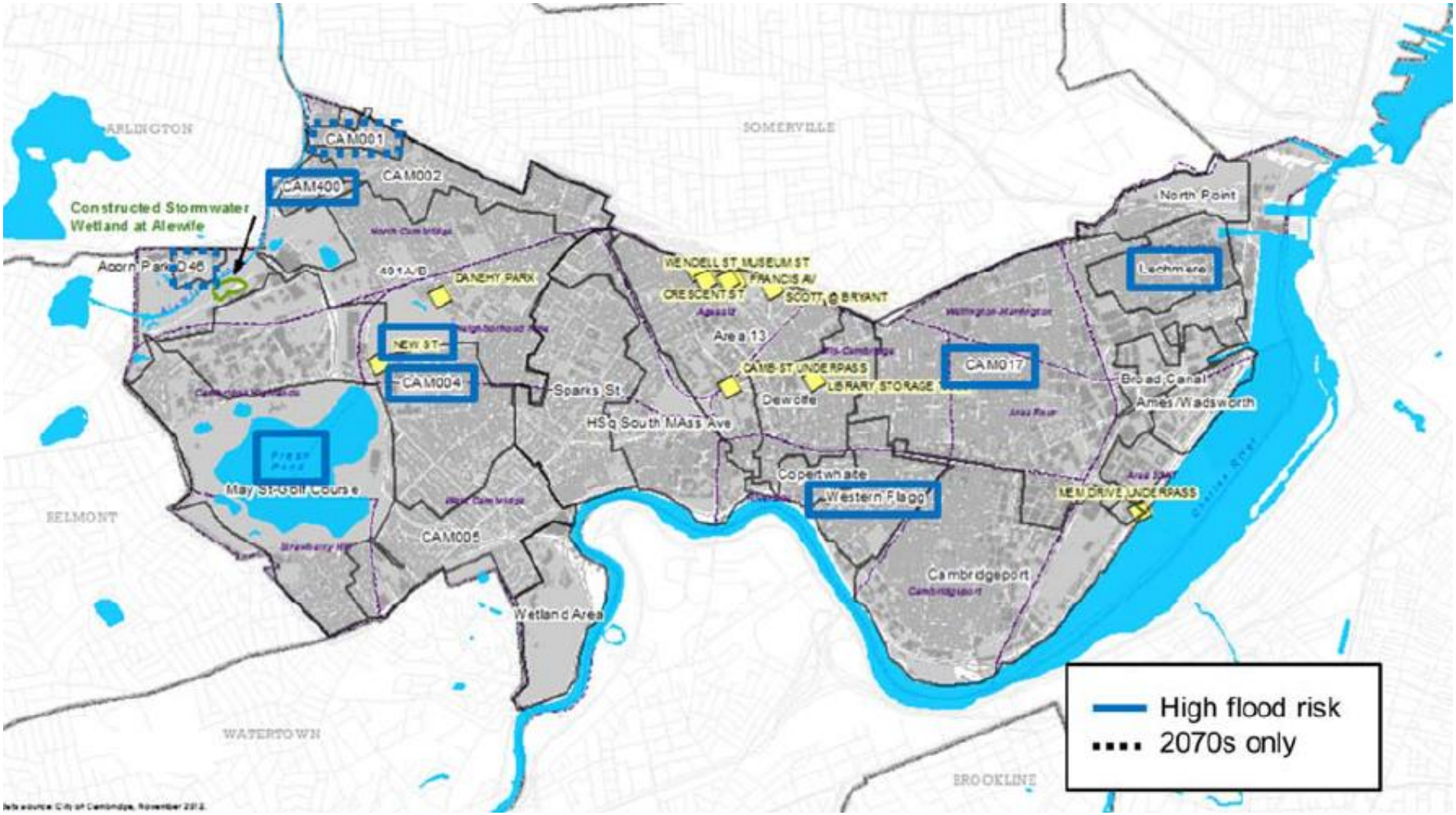
High	**Score R3**
	• Fresh Pond Reservoir
	• Separated Catchment Areas and Conveyance:
	  • CAM 400 (Alewife)
	  • CAM 004 (Alewife)
	  • Western Flagg (Charles)
	  • Lechmere (Charles)
	• Combined Sewer/Sanitary Catchment Areas and Conveyance:
	  • CAM 017 (Charles)
		Score R4
		• Separated Catchment Area and Conveyance:
		  • Western Flagg (Charles)

Medium	**Score R2**
	• New St Pump Station
	• Separated Catchment Areas and Conveyance:
	  • D46 (Alewife)
	  • Area 13 (Charles)
	  • Coperthaite (Charles)
	  • Cambridgeport (Charles)
	• Combined Sewer/Sanitary Catchment Areas and Conveyance:
	  • CAM 001 (Alewife)
	  • 401 A/B (Alewife)
	  • CAM 005 (Charles)
	  • CAM 002/a (Alewife) (2070)
		Score R3
		• New St Pump Station
		• Separated Catchment Area and Conveyance:
		  • D46 (Alewife) (2070)
		• Combined Sewer/Sanitary Catchment Areas and Conveyance:
		  • CAM 001 (Alewife) (2070)

Low	**Score R1**
	• Separated Catchment Area and Conveyance:
	  • May Street Golf Course (Alewife)
	  • Sparks St (Charles) (2070)
		Score R2
		• Separated Catchment Area and Conveyance:
		  • D46 (Alewife)

*(2070) indicates that an asset is highly vulnerable in the 2070s scenarios, but not in the 2030s scenarios.

Priority Planning Areas for Water/WW Infrastructure



Climate Change Priority Planning Areas

Preliminary Key Findings

- Cambridge is unlikely to be impacted by **sea level rise or storm surges** by 2030, due to flood protection from both the Charles River and Amelia Earhart dams.
- **Heat vulnerability** and **inland flooding** are more imminent.
- **Key infrastructure assets** are vulnerable in the near-term.
- **Economic losses** from a flood event or an area-wide power loss would be significant.
  - Disruption of **economic** activity could be greater than property damage.
- **Social vulnerability** is not evenly distributed among the neighborhoods.
  - Heat waves and indoor air quality are the most challenging public health implications in the near future
- **Adaptation** will require regional coordination and cooperation, such as the Metro Mayors climate resilience initiative

Next Steps

- Complete the vulnerability assessment based on coastal storm surge & sea level rise scenarios
- Conduct additional technical analyses before starting plan, e.g., modeling other storm events
- City is embarking on the Preparedness Plan a two year effort – and program early actions
- Evaluate resiliency best practices world-wide
- Develop Strategies, Policies and Concrete Measures
- Implementation, Reporting and Monitoring

Thank You for your attention!

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Link to Project information on City of Cambridge website
http://www.cambridgema.gov/CDD/Projects/Climate/climatechangeresilianceandadaptation.aspx