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GEI Consultants

Hartford Flood Control System Overview and Status

Presentation to Mayor Bronin & the USACE

Riverfront Boathouse

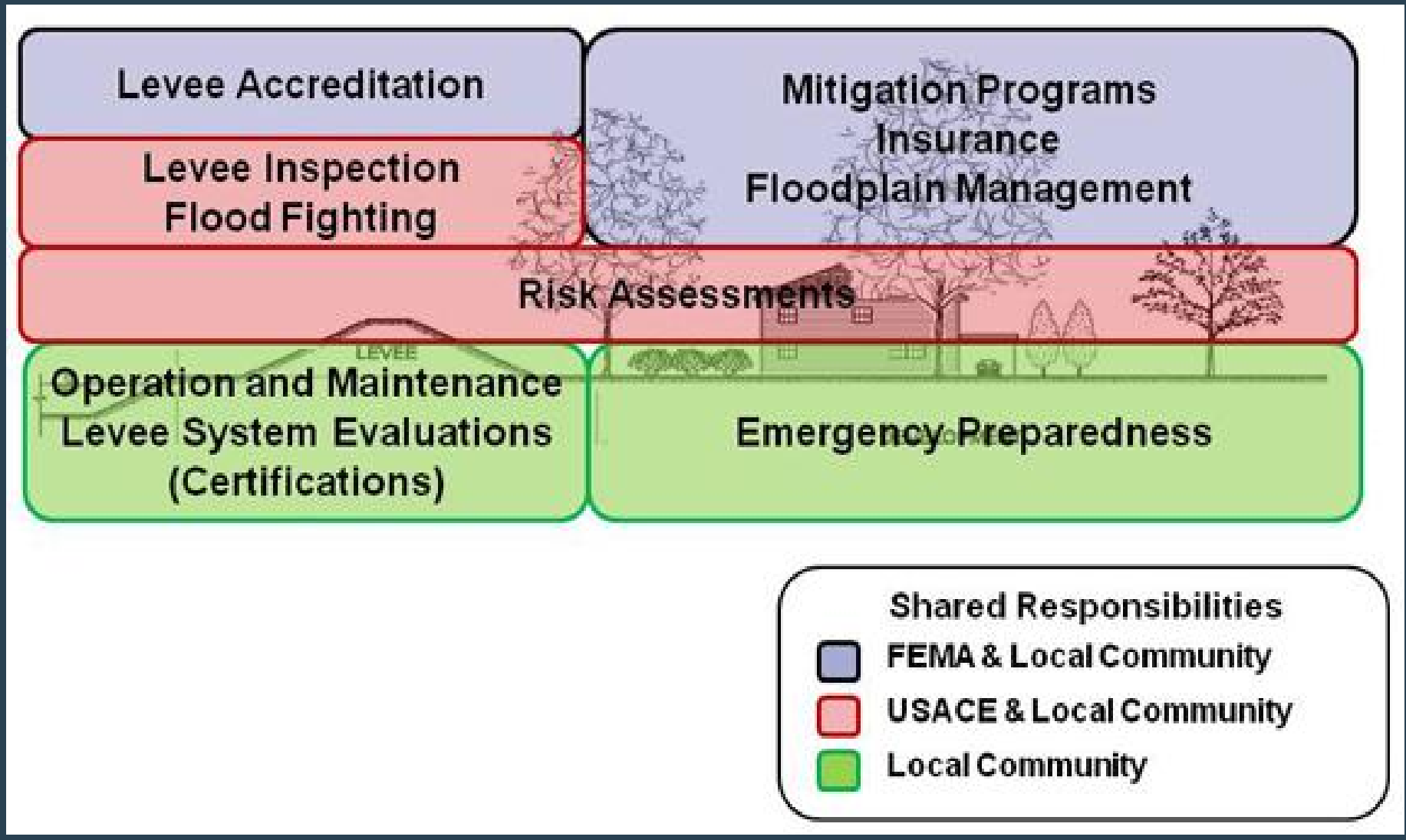
Hartford, Connecticut

March 15, 2016

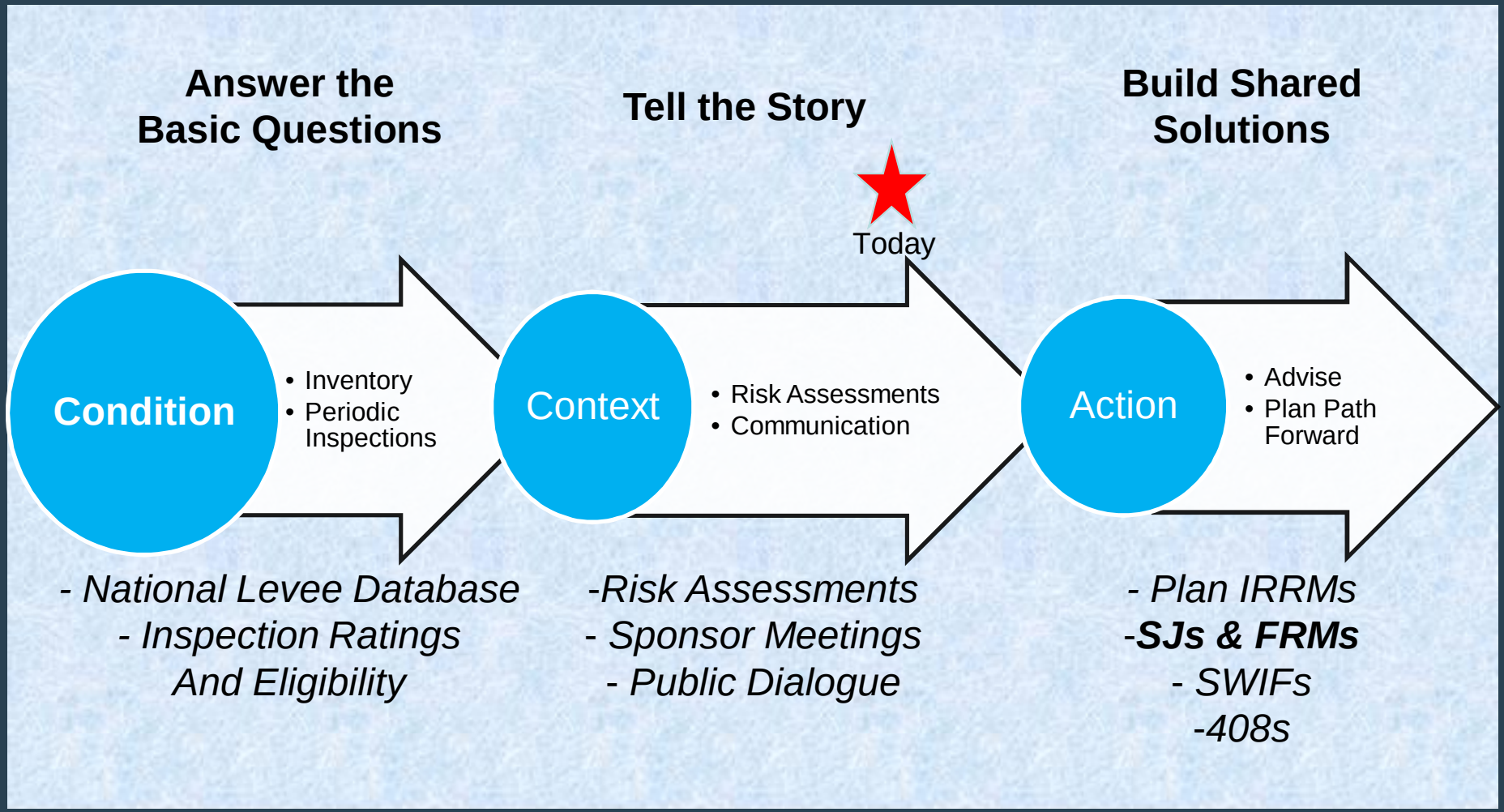
Introductions

- City of Hartford
- United States Army Corps of Engineers (USACE)
- Riverfront Recapture
- Others
  - Fuss & O'Neill, Inc.
  - GEI Consultants, Inc.

Shared Responsibility



Implementing the Risk Framework



Agenda

1. Background
2. Construction Work Performed
3. Maintenance & Monitoring
4. SWIF Program
5. Underseepage Concerns

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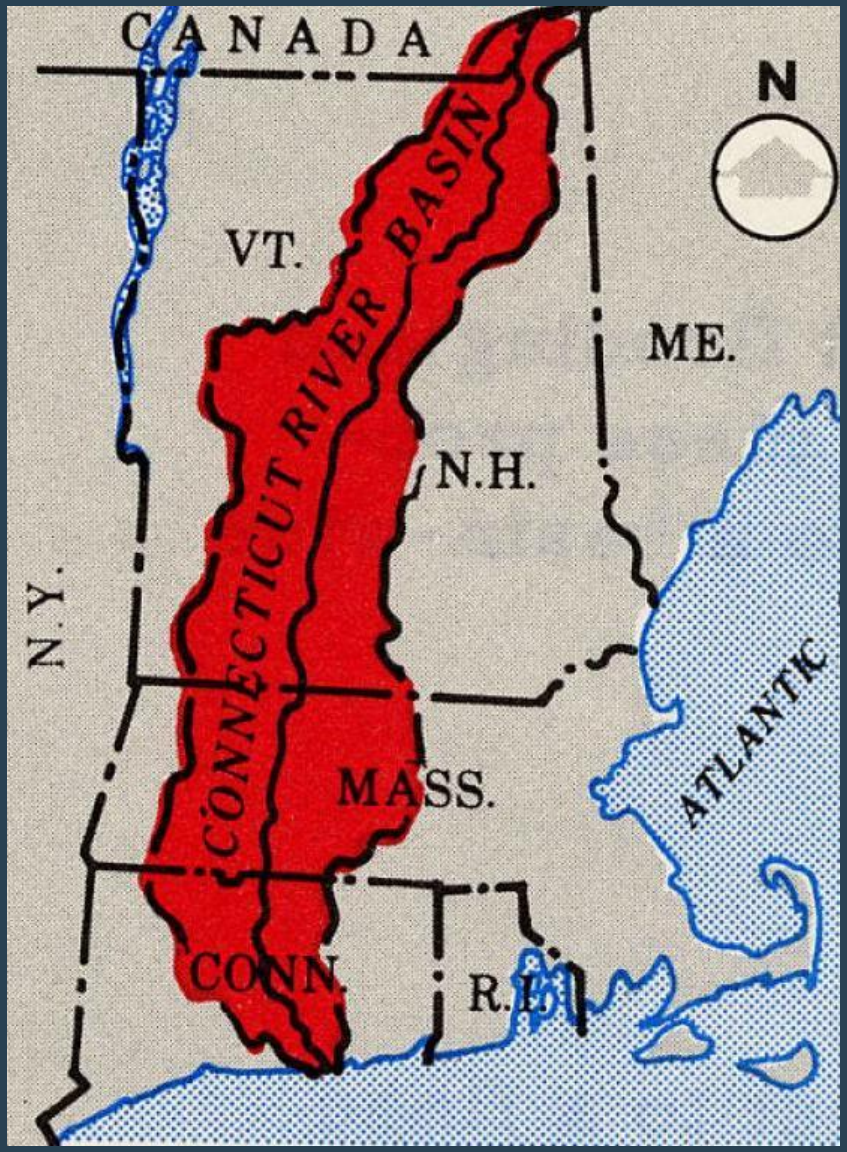
Background

Connecticut River Basin



(Source: USACE)

Flood of 1936

Looking North over Dutch Point Toward Bulkeley Bridge

(Source: Connecticut History Online)

Flood of 1936

Front Street Neighborhood with Bulkeley Bridge in the Distance

(Source: Connecticut History Online)

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Flood of 1936

Soldiers' and Sailors' Memorial Arch and Capitol Building

(Source: Connecticut Historical Society)

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Flood Control System Construction

- Authorized by the Emergency Relief Appropriations Acts of 1936, 1937, and 1938
- Constructed in several phases by the US Army Corps of Engineers from 1938 to 1981
- Construction of the dikes and floodwall, 3 pump stations, and Park River conduit began in 1938 and was completed in 1944
- The last portions (e.g., Folly Brook conduits, Park River conduit extension, 2 pumping stations, and the auxiliary conduit) were completed by 1981

Flood Control System Construction

Earthen levee construction south of Bulkeley Bridge (circa 1940)

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Flood Control System Construction

Floodwall construction south of Bulkeley Bridge (circa 1940)

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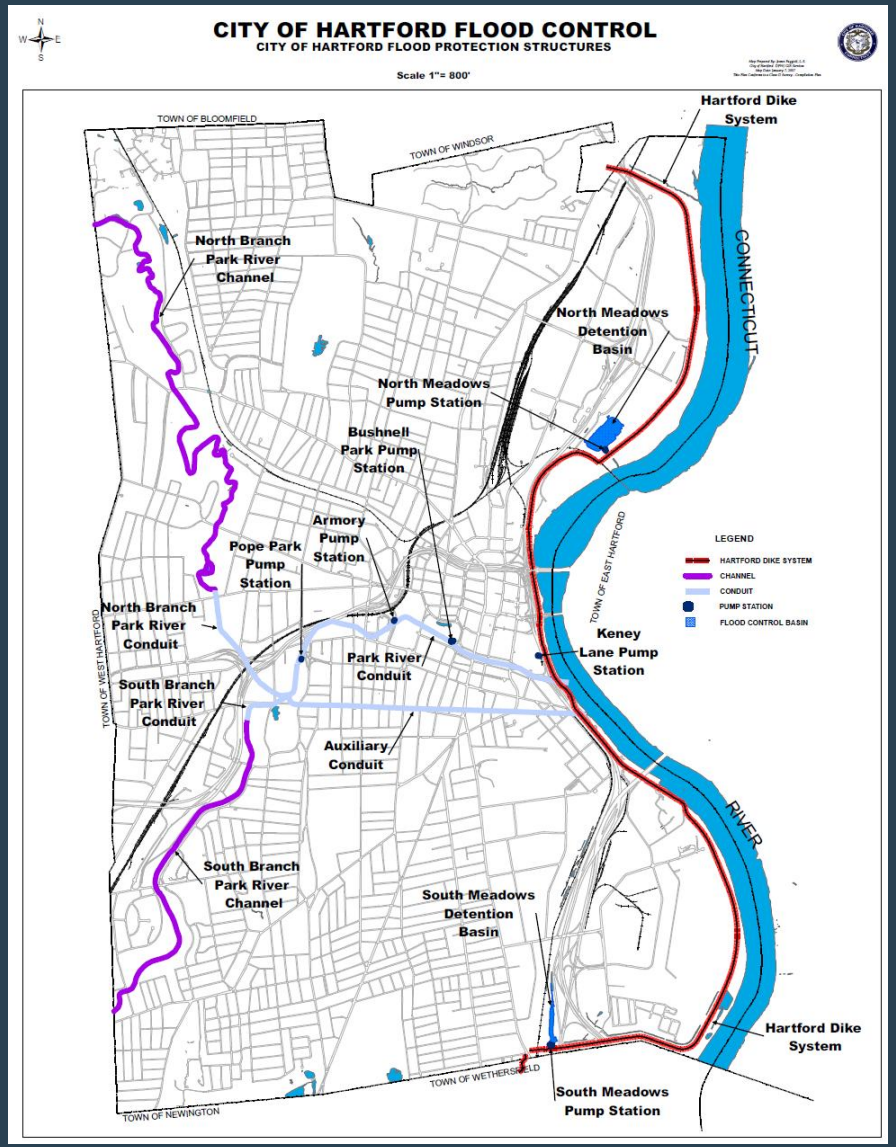
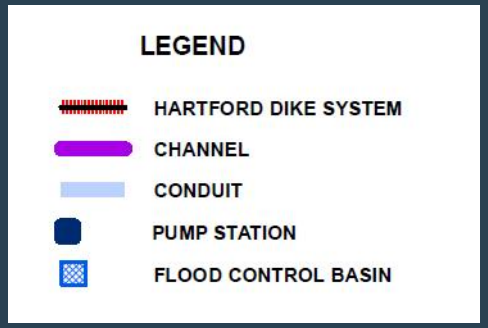
Hartford Flood Control System: Overview

- Provides protection against flooding for approximately 3,000 acres of developed urban area
- Main components of the system include:
  - 6.4 miles of earthen dikes
  - 0.8 miles of concrete floodwalls
  - Six pumping stations
  - Two drainage basins
  - Three pressure conduits
  - An auxiliary conduit

Hartford Flood Control System: Overview





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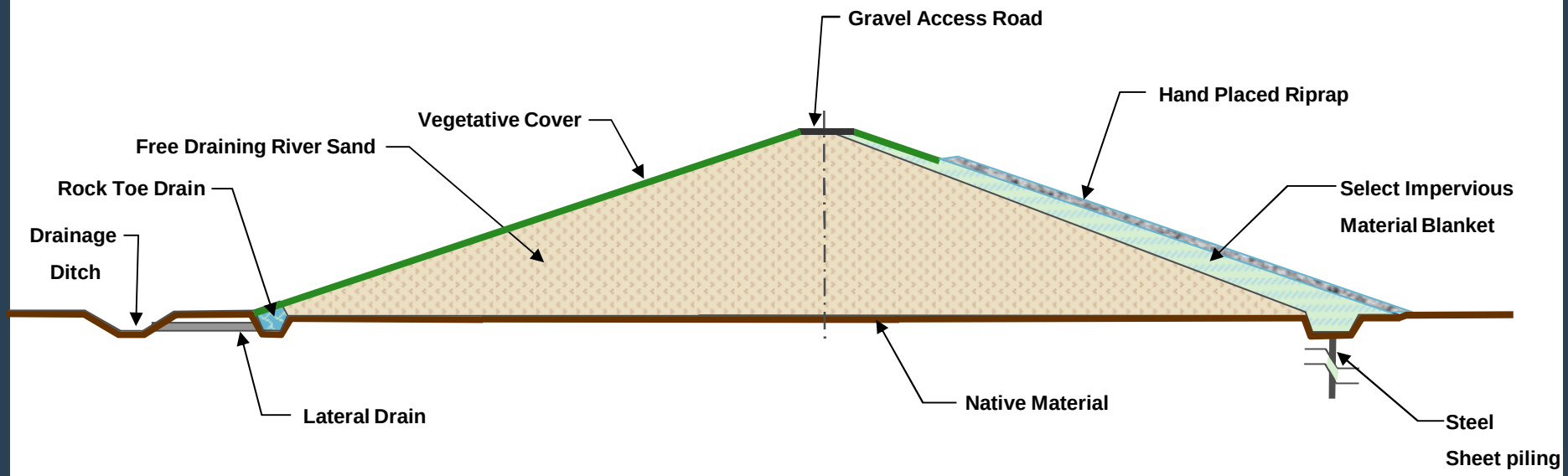
Typical Earthen Dike Cross-Section



Composition Overview

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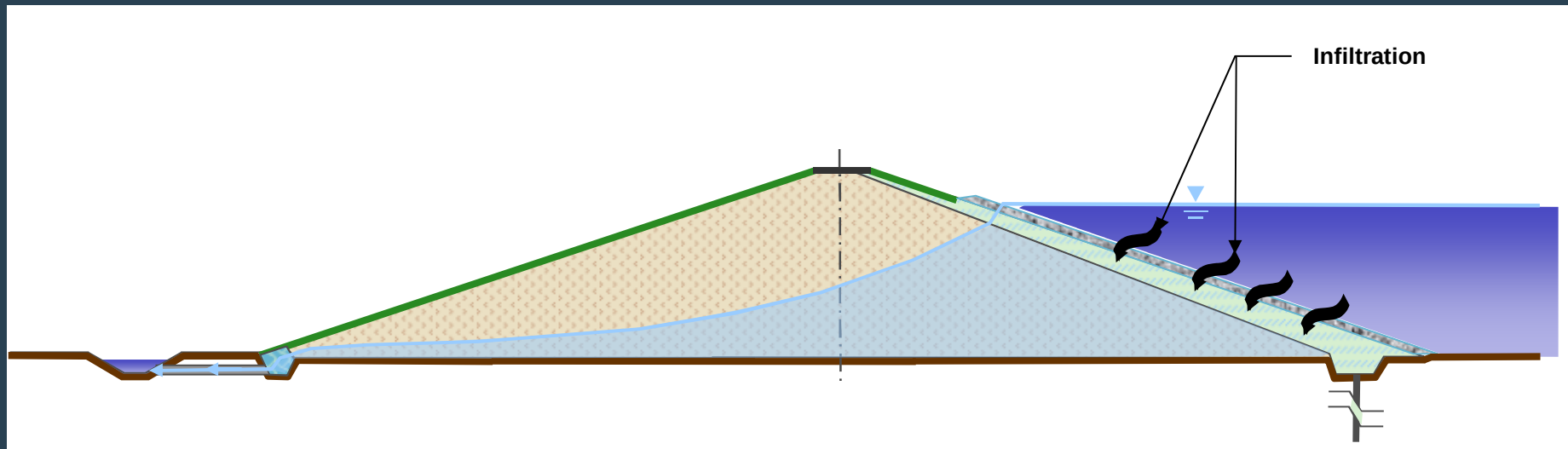
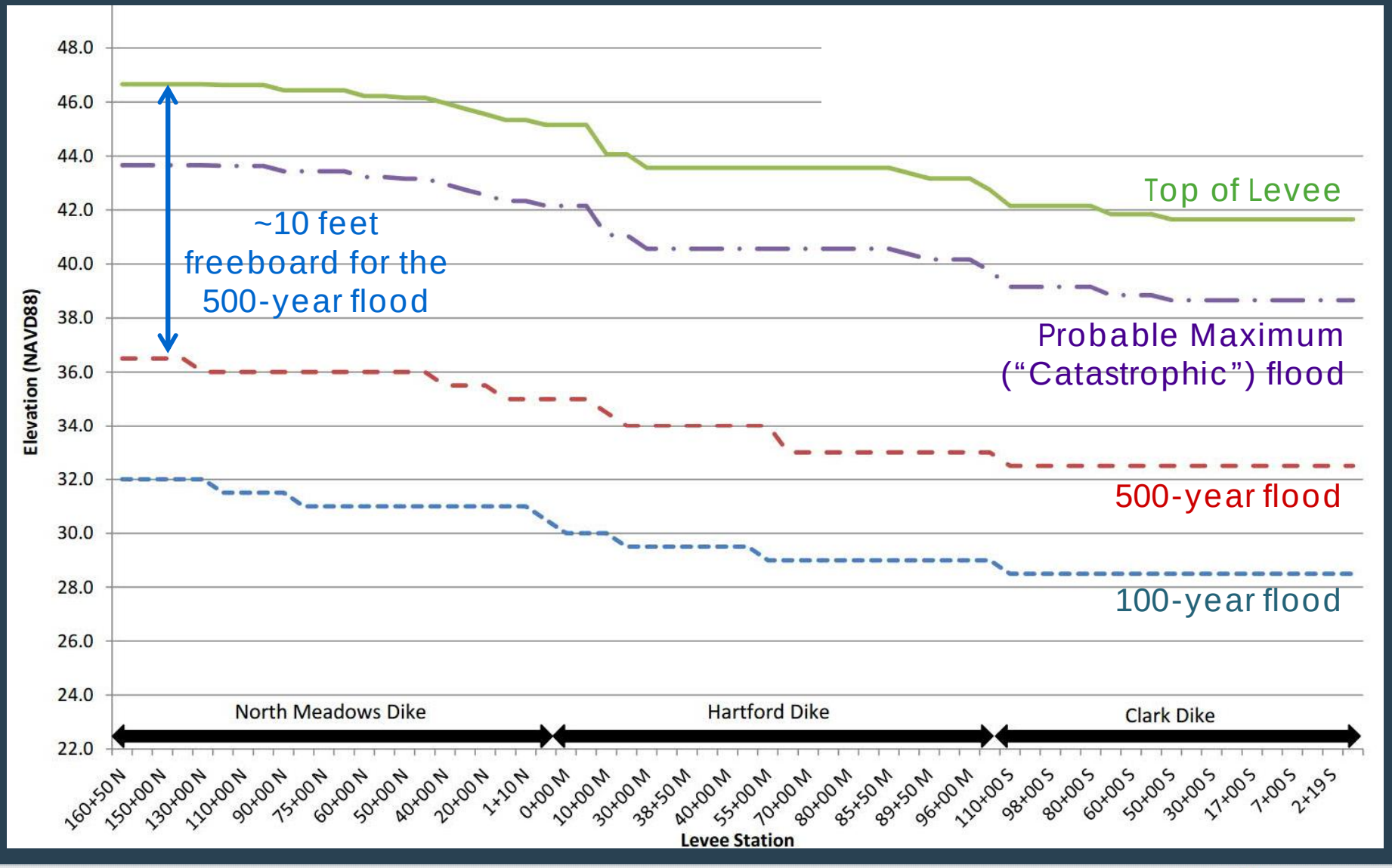
Typical Earthen Dike Cross-Section



Drainage Overview

Levee and Flood Elevation Comparison



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Flood of 1984

View looking north of South Meadows Dike and Brainard Airport

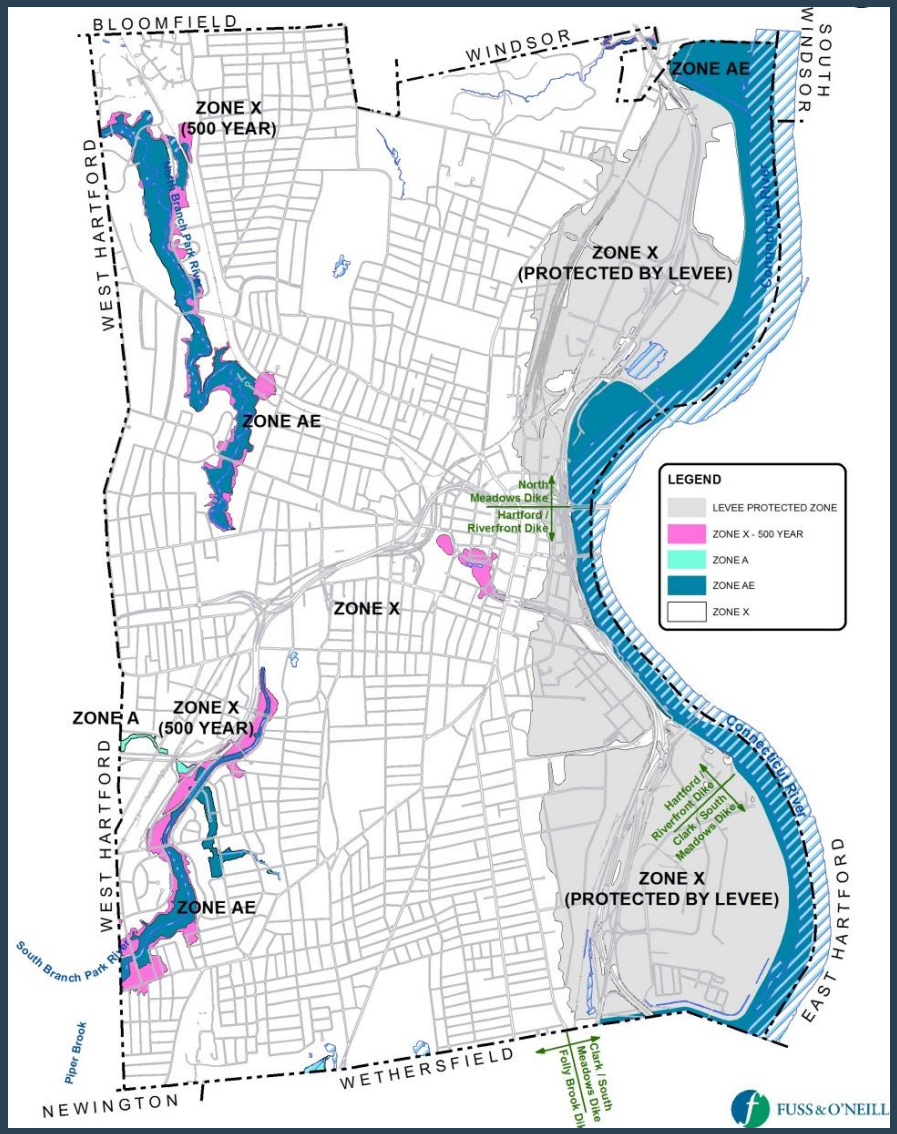
Recent Flood Events

Riverfront Plaza

Recent Flood Events

Riverfront Boat House

FEMA Flood Map

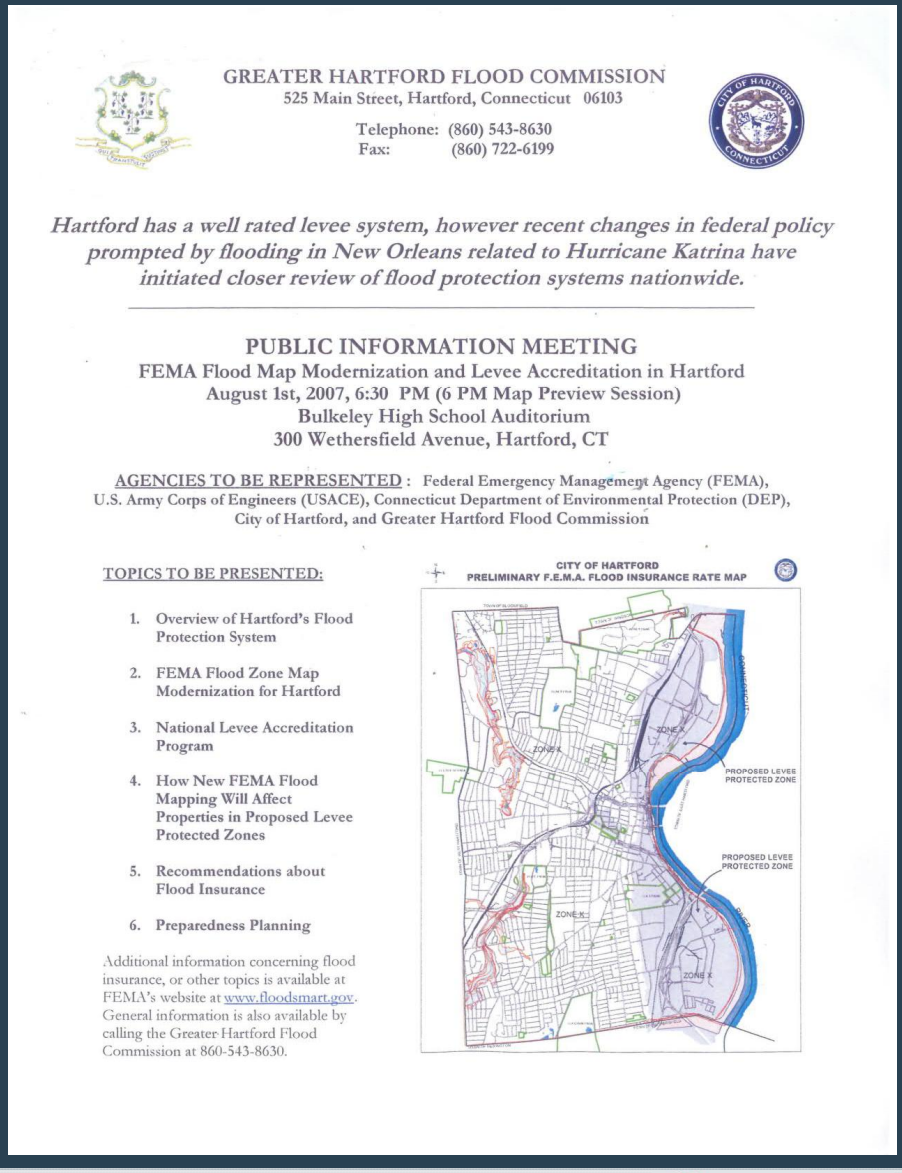


FEMA Accreditation

- Completed in July 2009 and in effect for 10 years
- Prevents owners within the levee protected area from having to obtain mandatory flood insurance

FEMA Accreditation Public Outreach

- As part of the FEMA Accreditation process:
  - Sent mailers to affected property owners
  - Conducted a Public Information Meeting (televised on public access)
- Note: Minimal response from the public



GREATER HARTFORD FLOOD COMMISSION
525 Main Street, Hartford, Connecticut 06103
Telephone: (860) 543-8630
Fax: (860) 722-6199

Hartford has a well rated levee system, however recent changes in federal policy prompted by flooding in New Orleans related to Hurricane Katrina have initiated closer review of flood protection systems nationwide.

PUBLIC INFORMATION MEETING
FEMA Flood Map Modernization and Levee Accreditation in Hartford
August 1st, 2007, 6:30 PM (6 PM Map Preview Session)
Bulkeley High School Auditorium
300 Wethersfield Avenue, Hartford, CT

AGENCIES TO BE REPRESENTED : Federal Emergency Management Agency (FEMA), U.S. Army Corps of Engineers (USACE), Connecticut Department of Environmental Protection (DEP), City of Hartford, and Greater Hartford Flood Commission

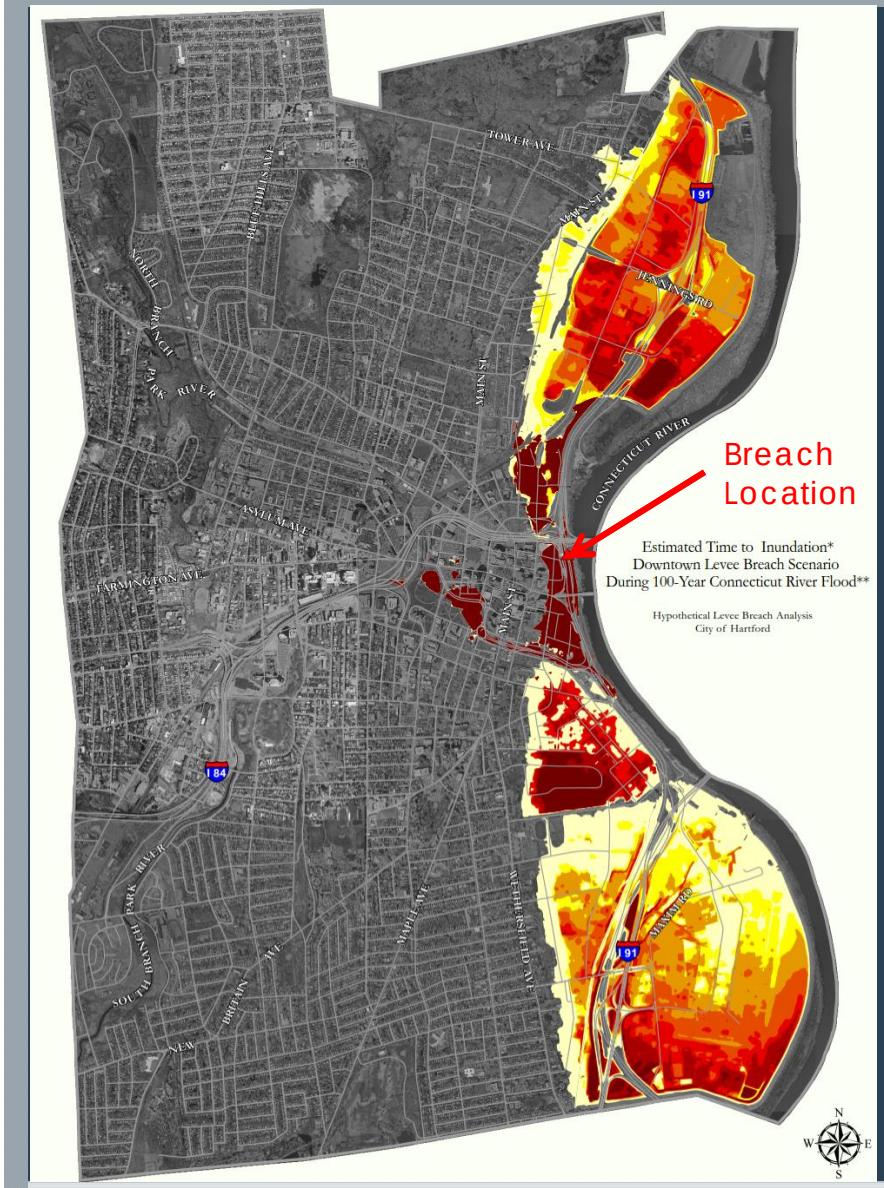
TOPICS TO BE PRESENTED:

1. Overview of Hartford's Flood Protection System
2. FEMA Flood Zone Map Modernization for Hartford
3. National Levee Accreditation Program
4. How New FEMA Flood Mapping Will Affect Properties in Proposed Levee Protected Zones
5. Recommendations about Flood Insurance
6. Preparedness Planning

Additional information concerning flood insurance, or other topics is available at FEMA's website at www.floodsmart.gov. General information is also available by calling the Greater Hartford Flood Commission at 860-543-8630.

CITY OF HARTFORD
PRELIMINARY F.E.M.A. FLOOD INSURANCE RATE MAP

Levee Breach Analysis



Used computer tools (ArcGIS & HEC-GeoRAS) to simulate a levee breach during a FEMA 100-year flood in each of four neighborhoods and developed maps showing possible timing and extents of flooding

Estimated Time to Innundation (hours)

- 0 - 1 Hours
- 1 - 3 Hours
- 3 - 6 Hours
- 6 - 12 Hours
- 12 - 24 Hours
- 24 - 48 Hours
- 48 Hours - Max flood

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Emergency Operations Plan Annex

- Worked with Hartford Emergency Operations Center (EOC) to prepare a Flood Evacuation Plan
- Incorporated maps from levee breach analysis
- Hartford EOC receive input from various other city agencies

Regulatory Outreach

- Worked with FEMA and the USACE during the 2009 Accreditation process
- Received cost sharing assistance from the State of Connecticut to fund previous projects
  - Projects performed under CT DEEP oversight
- Developed outstanding working relationships with these agencies

Political Outreach & Grant Funding

- Assisted Representative John Larsen and his staff during a March 2013 Levee tour and press event in an attempt to receive federal funding for Flood Control System improvements
- Pursuing all available funding opportunities
  - FEMA – No eligible projects this cycle
  - Connecticut Institute for Resilience and Climate Adaptation (CIRCA)
  - Water Resources Development Act (WRDA)

Construction Work Performed

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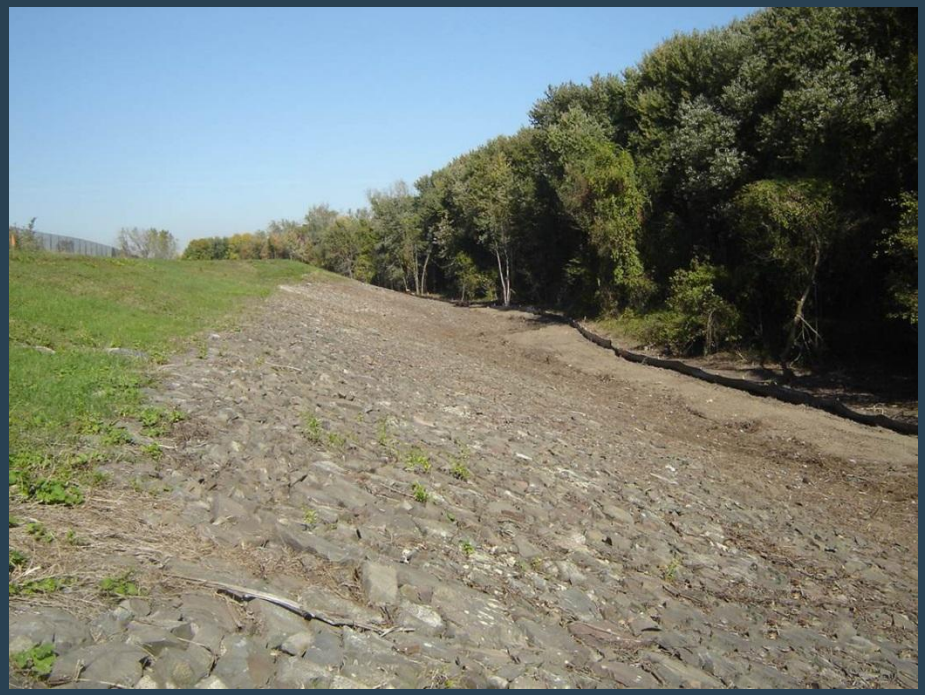
Vegetation Clearing

Before



After

North Meadows Dike Near Police Firing Range

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Animal Burrow Repair

A portion of North Meadows Dike under repair
(stakes show burrow locations)

Riprap Repair

Removal of disturbed riprap

Drainage Ditch Restoration

Before

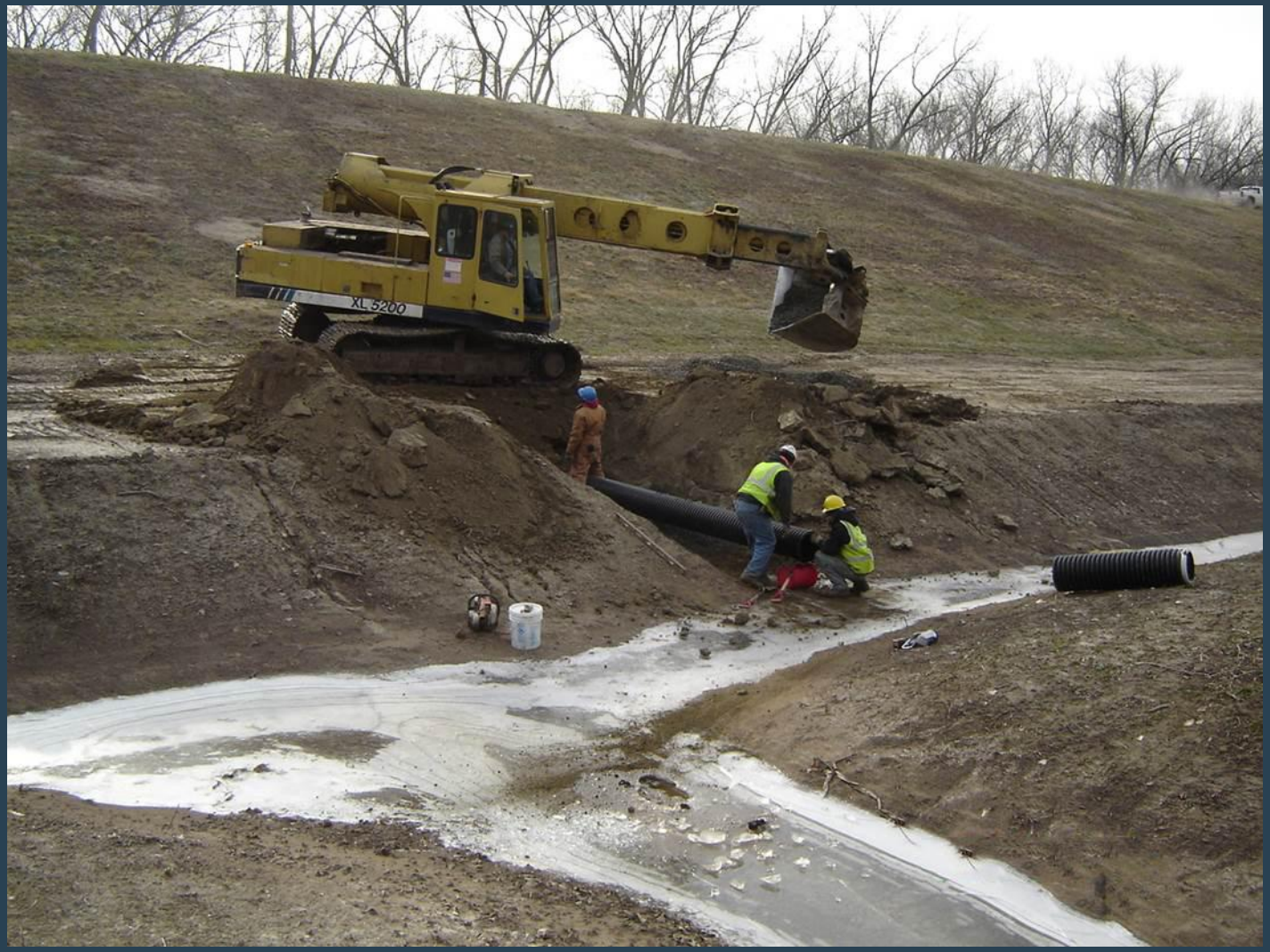
After

Drainage ditch North of Hartford Landfill

Toe Drain Repair

Toe drain clogged with sediment being cleaned

Lateral Drain Pipe Repair



Lateral drain being repaired with HDPE sleeve

Concrete Floodwall Repair

Repaired floodwall keyway near MIRA Powerplant

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Auxiliary Conduit Sediment Removal

North & South Meadows Pond Dredging

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North & South Meadows Pond Dredging

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South Meadows Pumping Station Rehab

Upper Level

Lower Level

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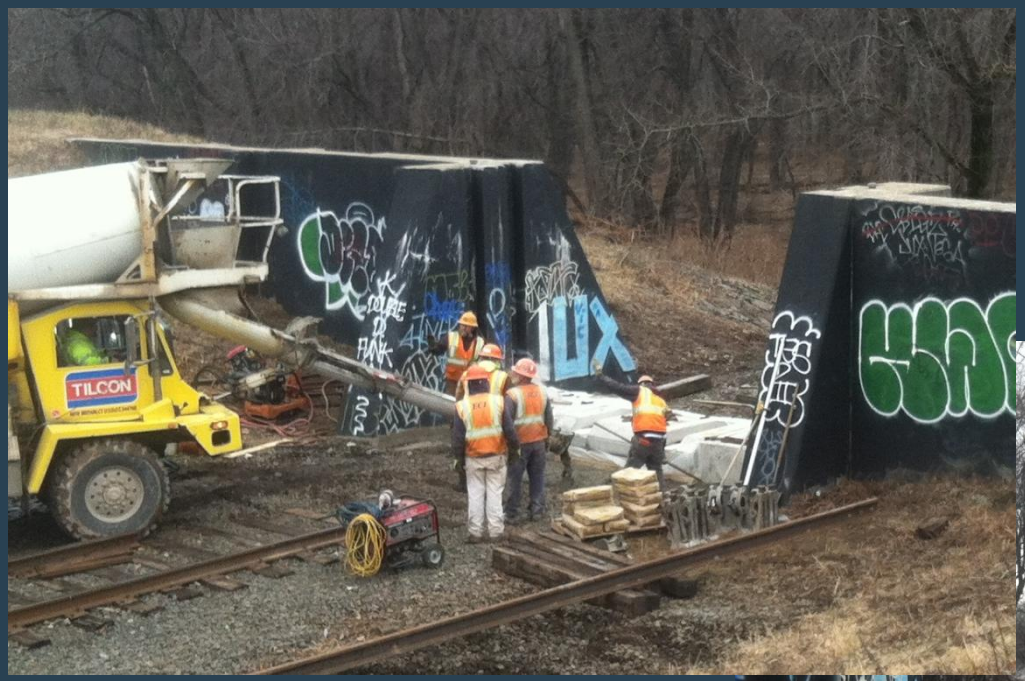
South Meadows Pumping Station Rehab

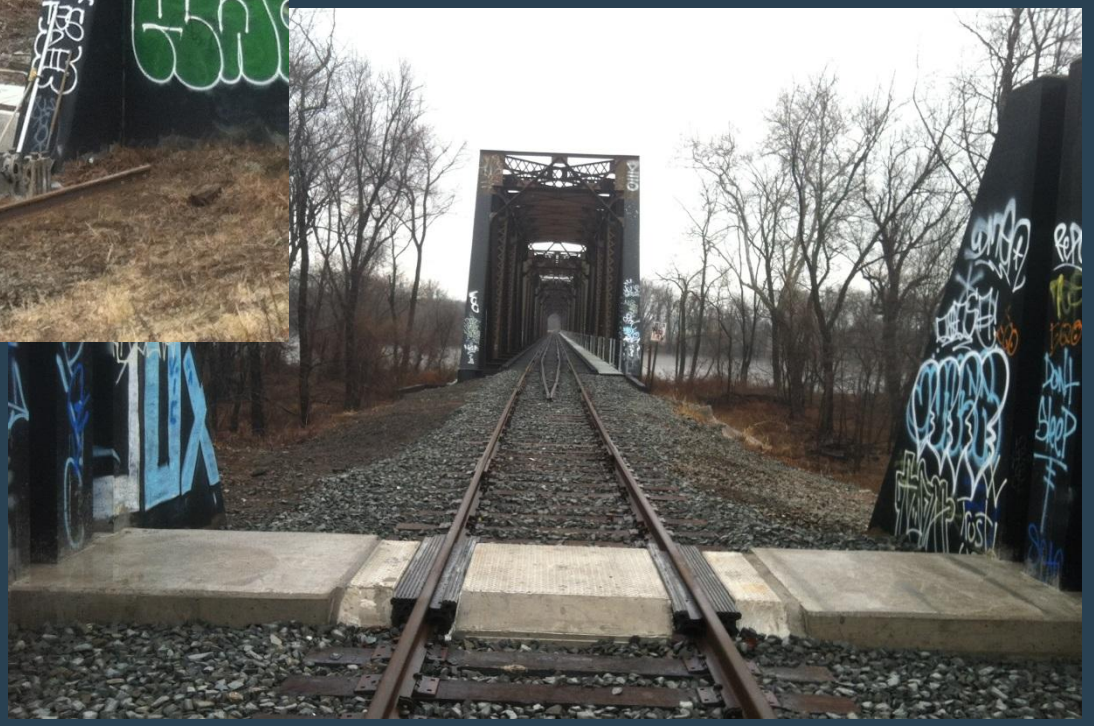
BEFORE

AFTER

Propellers

Stop Log Structure Repair





Sill Installation at Closure 2 near North Meadows Pumping Station

Maintenance & Monitoring

Maintenance & Preparedness

- Earthen Levees
  - Mowing of levees
  - Ditch clearing
  - Herbicide of riprap
  - Animal burrow repairs
  - Flood event cleanup
- Closure Structures
  - Trial erections
- Pump Station
  - Equipment testing
  - Routine maintenance

Flood Event Monitoring

- City Performs Monitoring Prescribed in:
  - Operation & Maintenance Manual
  - Emergency Operation Plan (Annex N)

LEVEE BREACH (>31.2 FT OR BREACH POTENTIAL) DPW & City officials work together to inform residents
PHASE II FLOOD MONITORING (>24 FT) Establish Emergency Ops Center @ Public Safety Complex Patrol Levee every 8 hours Contact media if warranted
PHASE IB MONITORING (>16 FEET) Patrol Levee System Daily
PHASE IA MONITORING (>12 FEET) Ensure availability of Staff and Materials

SWIF Program

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System-wide Improvement Framework (SWIF) Program

- Late 2014: “Unacceptable” rating by USACE based on USACE Routine Inspection June 2013
- System temporarily placed on “Inactive” status – not eligible for federal funding if system is damaged
- August 2015: “Active” status is restored to the system while under the SWIF Program

System-wide Improvement Framework (SWIF) Program

- City must develop a SWIF Plan that:
  - Outlines the cost and schedule to address system deficiencies
  - Is completed by August 2017
- In the Interim, the City must also:
  - Implement risk reduction measures until repairs are made
  - Implement a public outreach program (e.g., mailers, website)
  - Continue to perform flood event inspections

System Deficiencies

- 37 Items in all deemed "Unacceptable" by USACE
  - Any one of the "Eligibility Criteria" deficiencies below places the entire system in "Inactive Status"

	Deficiency	Status
CT River	Encroachment: Soil pile with heavy vegetation along landside toe	Completed
	Closure Structures (General): Remove vegetation, Repair cracking, and perform trial closures	City to perform trials 2016; New aluminum panels installed for several crossings; Working with railroad for last crossing which required tracks to be cut for trials
	MDC Sewer Crossing: video inspection required	Planned for 2016 Inspections, may have follow-up repairs
	Toe Drainage Systems: visually or video inspect	Planned for 2016 Inspections, Expected to require toe drain replacement
	Closure Structures - Corroded bulkhead door @ MIRA	Completed - CS Removed
	Establish a floodwall tilting monitor program	Proposed for 2016
	Visually or video inspect all culverts and discharge pipes	Planned for 2016 Inspections, may have follow-up repairs
Park River	Visual or video inspection of the Folly Brook Conduit, Gully Brook Conduit, Park River Conduit, and lateral sub drains	Planned for 2016 Inspections, may have follow-up repairs
	Pope Park PS: Corrosion on the intake/discharge pipe flanged connections. Sand and repaint connections. Repair cracked flanges.	Pope Park Pumping Station requires replacement of all suction and discharge piping

System Deficiencies

- The majority of deficiencies that lead to the system being placed on inactive status were related to not performing the required inspections
- However, based on past work the need for additional repairs to the system are anticipated
- Therefore, the overall SWIF Program will include a comprehensive assessment of known and potential improvements to the entire flood control system

Capital Improvement Projects

Project	Priority	Total Est. Cost
EMBANKMENTS/FLOODWALLS		
1. Bulkeley Bridge Underseepage Mitigation	High	$12,500,000
2. North and South Meadows Dike Toe Drain Installation	High	$650,000
3. South Meadows Dike Underseepage and Impervious Blanket	Medium	$5,500,000
4. Floodwall Inspection and Tilting Portion Monitoring	Medium	$10,000
5. Closure Structure Upgrades	High	$1,369,000
6. Concrete Flood Wall Upgrades (Joint Repairs)	Low	$500,000
7. Utility Penetration Abandonment & Modification	Low	$500,000
PUMPING STATIONS		
8. Pump Station Inspections	High	$130,000
9. North and South Meadows Pump Station Trash Rack Replacement	High	$2,000,000
10. Repairs to intake and discharge pipelines at Pope Park, Bushnell Pump, and Armory Pump Stations	High	$6,000,000
11. South Meadows Pumping Station Valve Improvements	High	$3,870,000
12. North Meadows Pumping Station Improvements	High	$4,200,000
13. Bushnell Park Pumping Station Improvements	High	$2,800,000
14. Keney Lane Pumping Station Improvements	Medium	$2,800,000
15. Pumping Station Training Program	Medium	$74,900
16. South Meadows Pumping Station Additional Improvements	Low	$400,000
17. Armory Pumping Station Improvements	Low	$2,800,000
18. Pope Park Pumping Station Improvements	Low	$2,900,000
19. Pumping Station Automation Improvements	Low	$3,750,000
INTERIOR DRAINAGE & CONDUITS		
20. Weston Street Drainage (Phase 1B)	High	$300,000
21. North Branch Park River Channel Improvements	Low	$3,500,000
22. Park River Conduit Upgrades	Low	$10,000,000
23. Folly Brook Conduit Replacement	Low	$8,000,000
24. Cemetery Brook Conduit Upgrades	Low	$1,000,000
TOTAL		$42,200,000

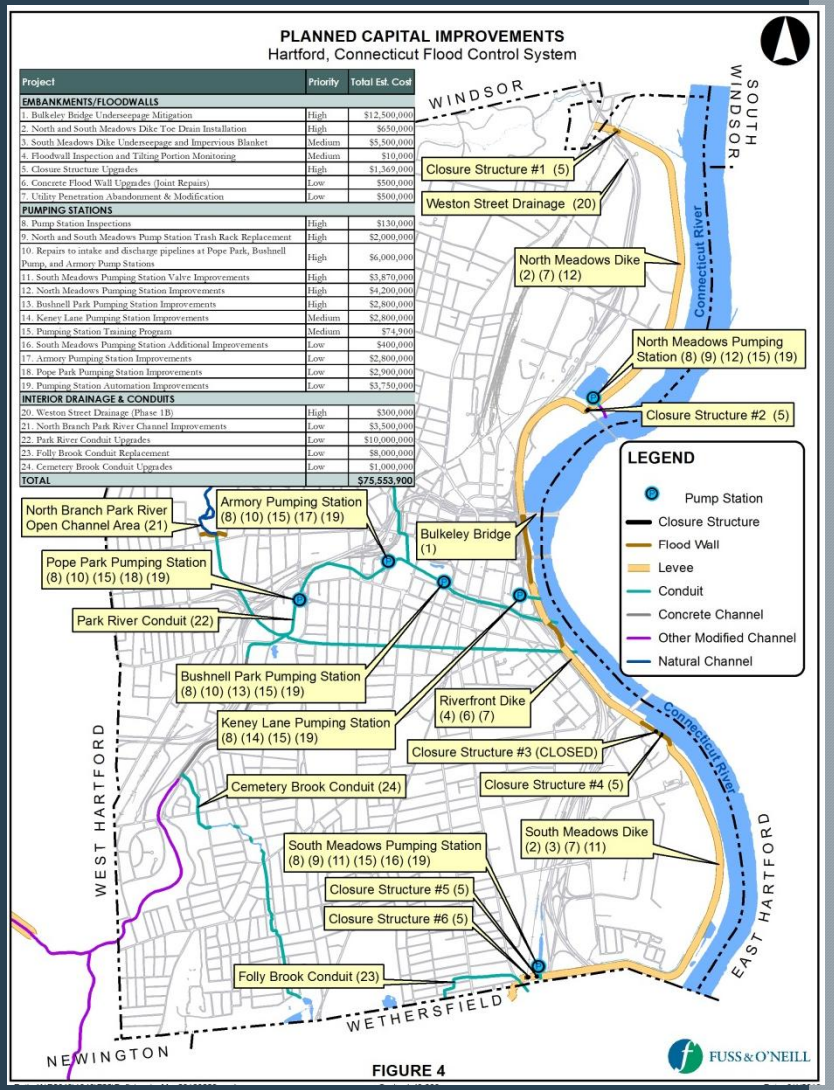

FIGURE 4

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CIP Plan

DESIGN/PERMITTING Phase in Red

CONSTRUCTION/CA Phase in Green

Project	ALREADY FUNDED	FY17	FY18	FY19	FY20	FY21	BEYOND 5 YEAR CIP
EMBANKMENTS/FLOODWALLS							
1. Bulkeley Bridge Underseepage Mitigation							
2. North and South Meadows Dike Toe Drain Installation							
3. South Meadows Dike Underseepage and Impervious Blanket							
4. Floodwall Inspection and Tilting Portion Monitoring							
5. Closure Structure Upgrades							
6. Concrete Flood Wall Upgrades (Joint Repairs)							
7. Utility Penetration Abandonment & Modification							
PUMPING STATIONS							
8. Pump Station Inspections							
9. North Meadow and South Meadows Pump Station Trash Rack Replacement							
10. Repairs pipelines at Pope, Bushnell, and Armory Pump Stations							
11. South Meadows Pumping Station Valve Improvements							
12. North Meadows Pumping Station Improvements							
13. Bushnell Park Pumping Station Improvements							
14. Keney Lane Pumping Station Improvements							
15. Pumping Station Training Program							
16. South Meadows Pumping Station Additional Improvements							
17. Armory Pumping Station Improvements							
18. Pope Park Pumping Station Improvements							
19. Pumping Station Automation Improvements							
INTERIOR DRAINAGE & CONDUITS							
20. Weston Street Drainage (Phase 1B)							
21. North Branch of the Park River Channel Improvements							
22. Park River Conduit Upgrades							
23. Folly Brook Conduit Replacement							
24. Cemetery Brook Conduit Upgrades							
SYSTEM-WIDE MAINTENANCE							
25. Perform Routine Inspections							
27. Levee System Operations							
TOTAL	$8.0 M	$2.0 M	$10.9 M	$9.9 M	$10.7 M	$12.3 M	$25.4 M
CIP Allocation	$20.0 M	-	$0.9 M	$9.9 M	$10.7 M	$12.3 M	$25.4 M

Amount Bonded = $10M

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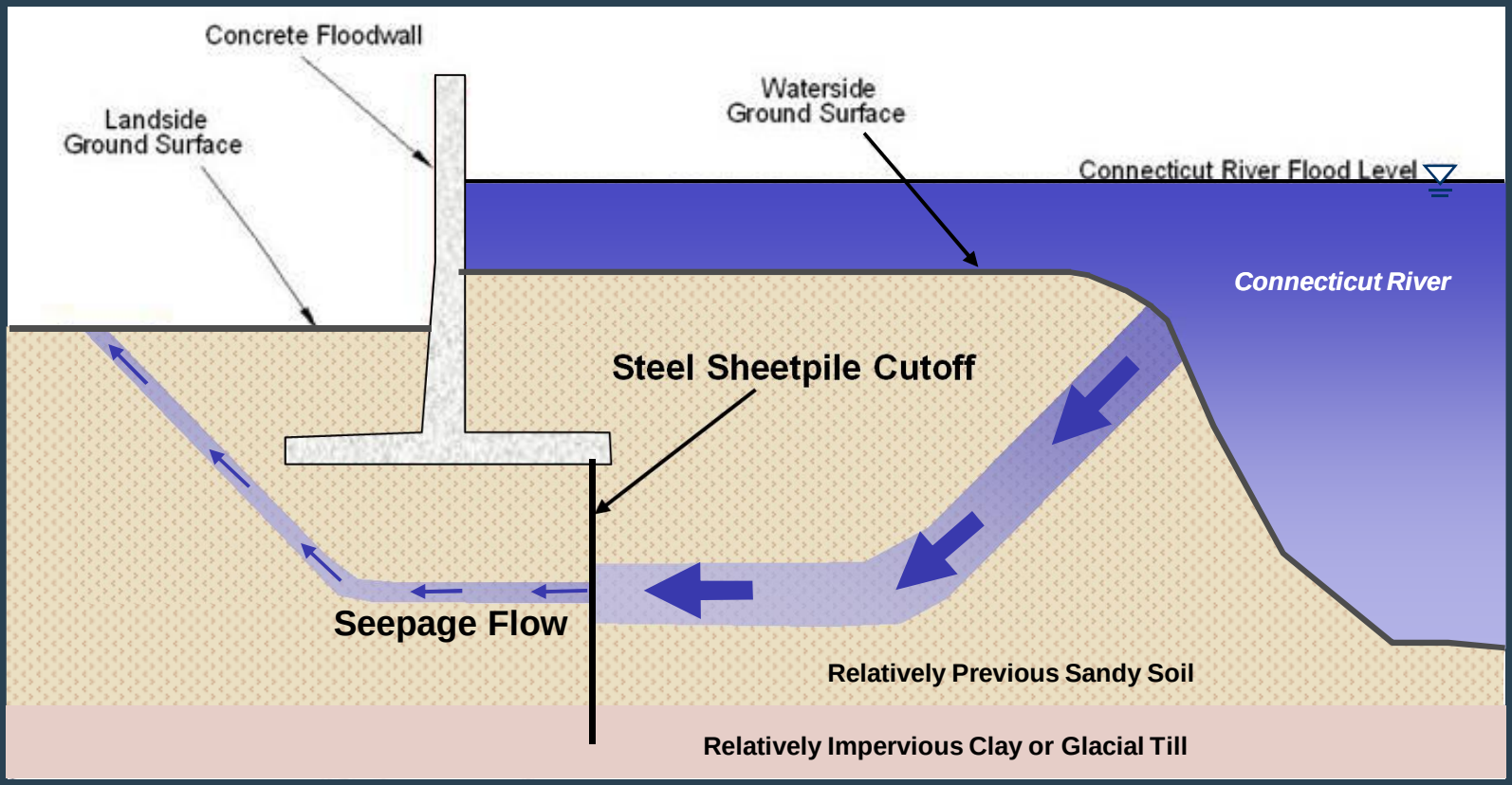
Underseepage Concerns

Cutoff Embedded into Underlying Clay



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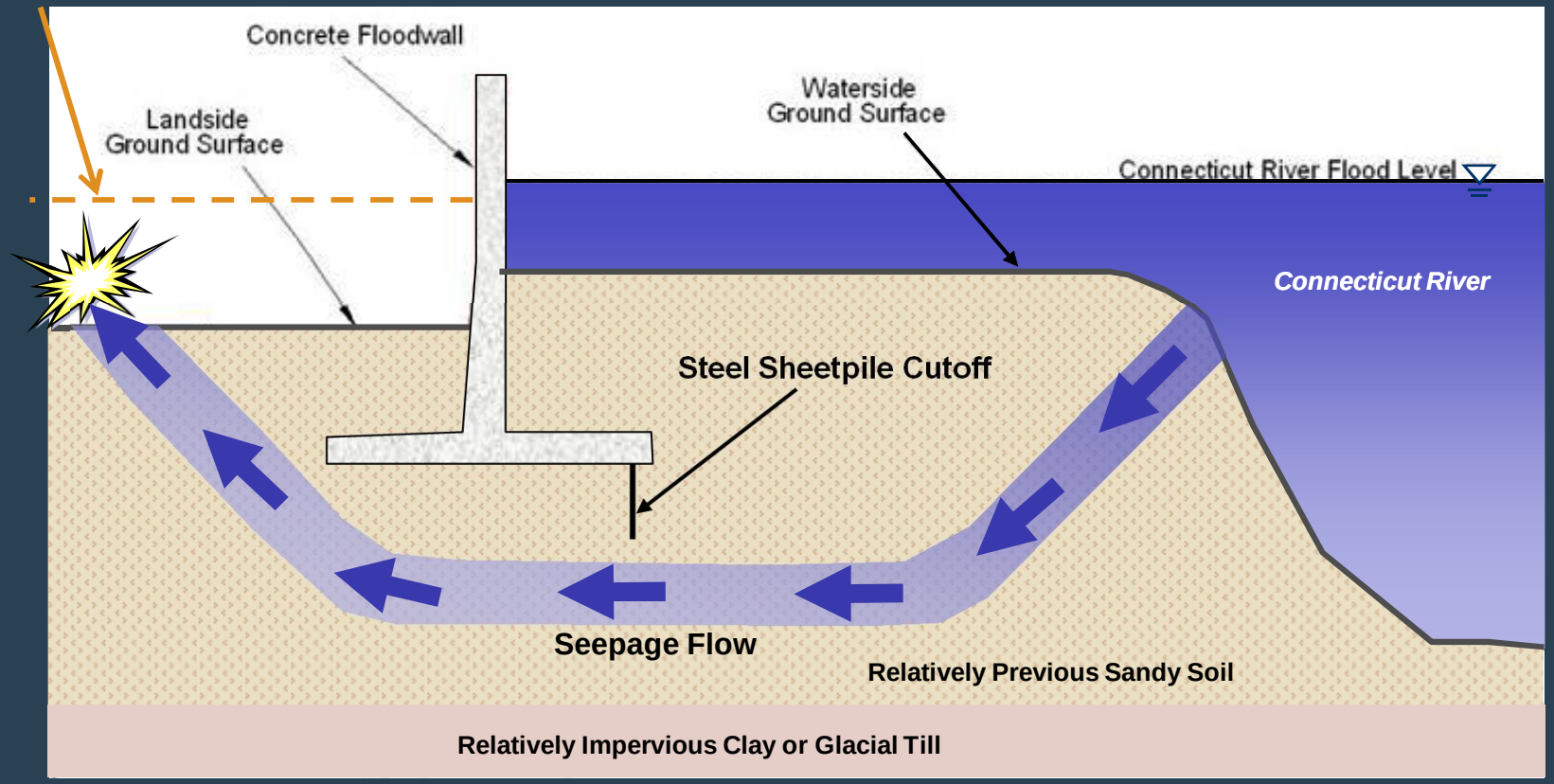
Short Cut-off Wall

Ground Surface
Before I-84/I-91
CTDOT Upgrades



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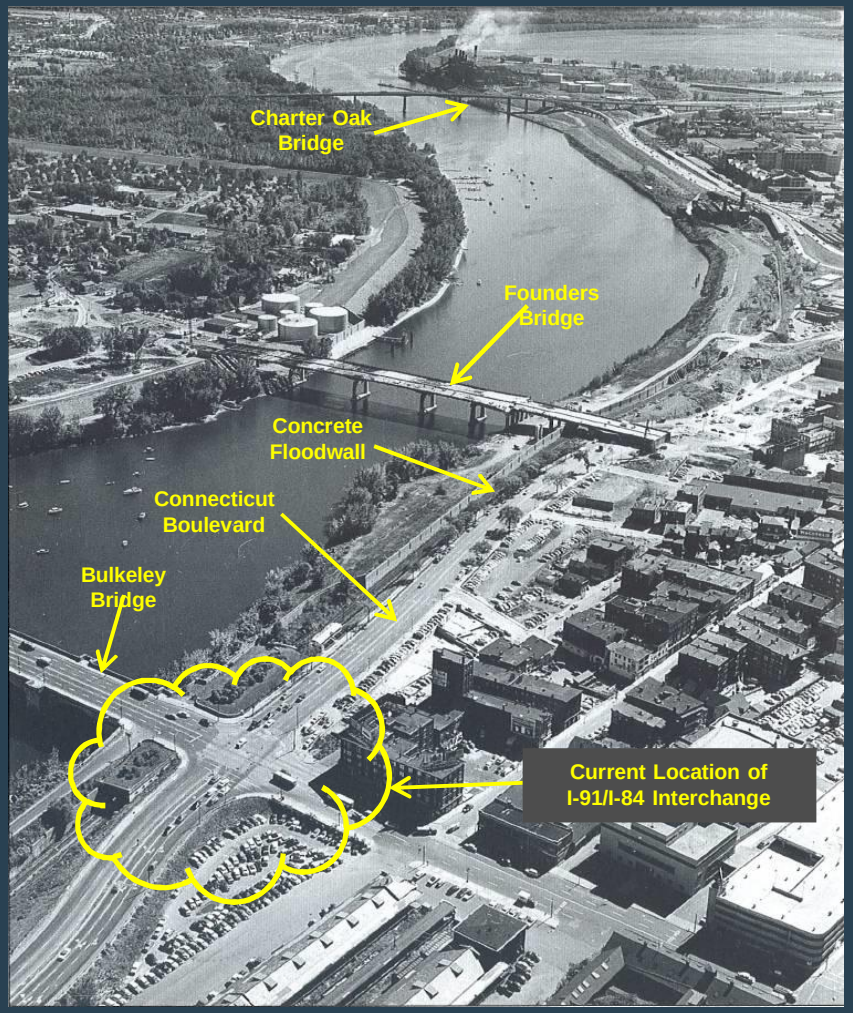
Overview of Area of Concern

- Following the construction of the levee system in the early 1940s, the area was largely unchanged until the construction of the I-91 & I-84 Interchange
- Connecticut Boulevard (future I-91) shown here to ramp up gradually to meet the grade of Morgan Street and the Bulkeley Bridge

Detail of Area of Future Interchange



View of Bulkeley, Founders, and Charter Oak Bridges, 1957

(Source: Larned, Larry. (2002) Images of America: Route 15, the Road to Hartford. Arcadia Publishing, Inc)

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Overview of Area of Concern

View of Bulkeley Bridge, looking North

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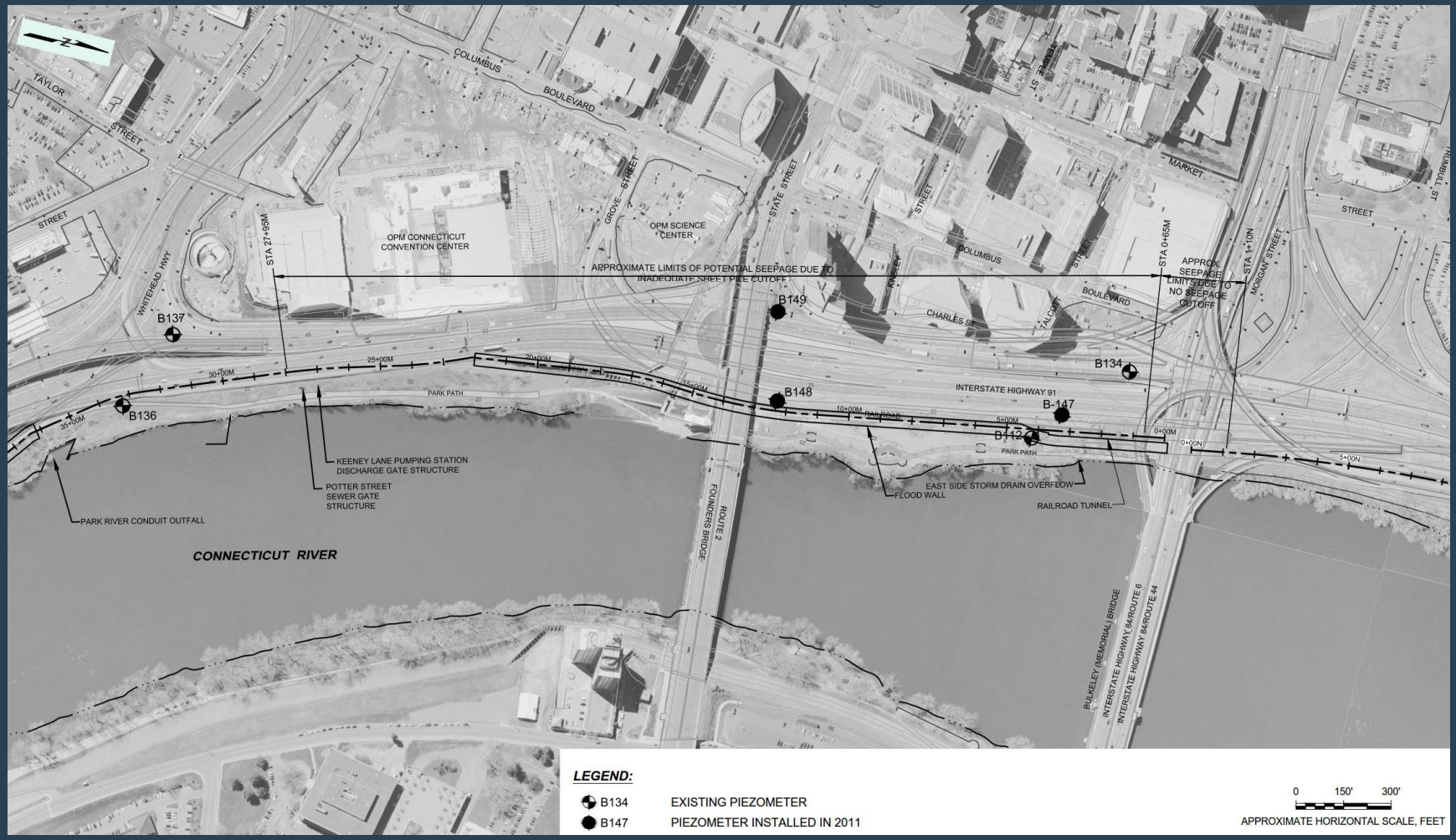
Overview of Area of Concern

View of Grove Street On Ramp, looking North

Seepage Monitoring



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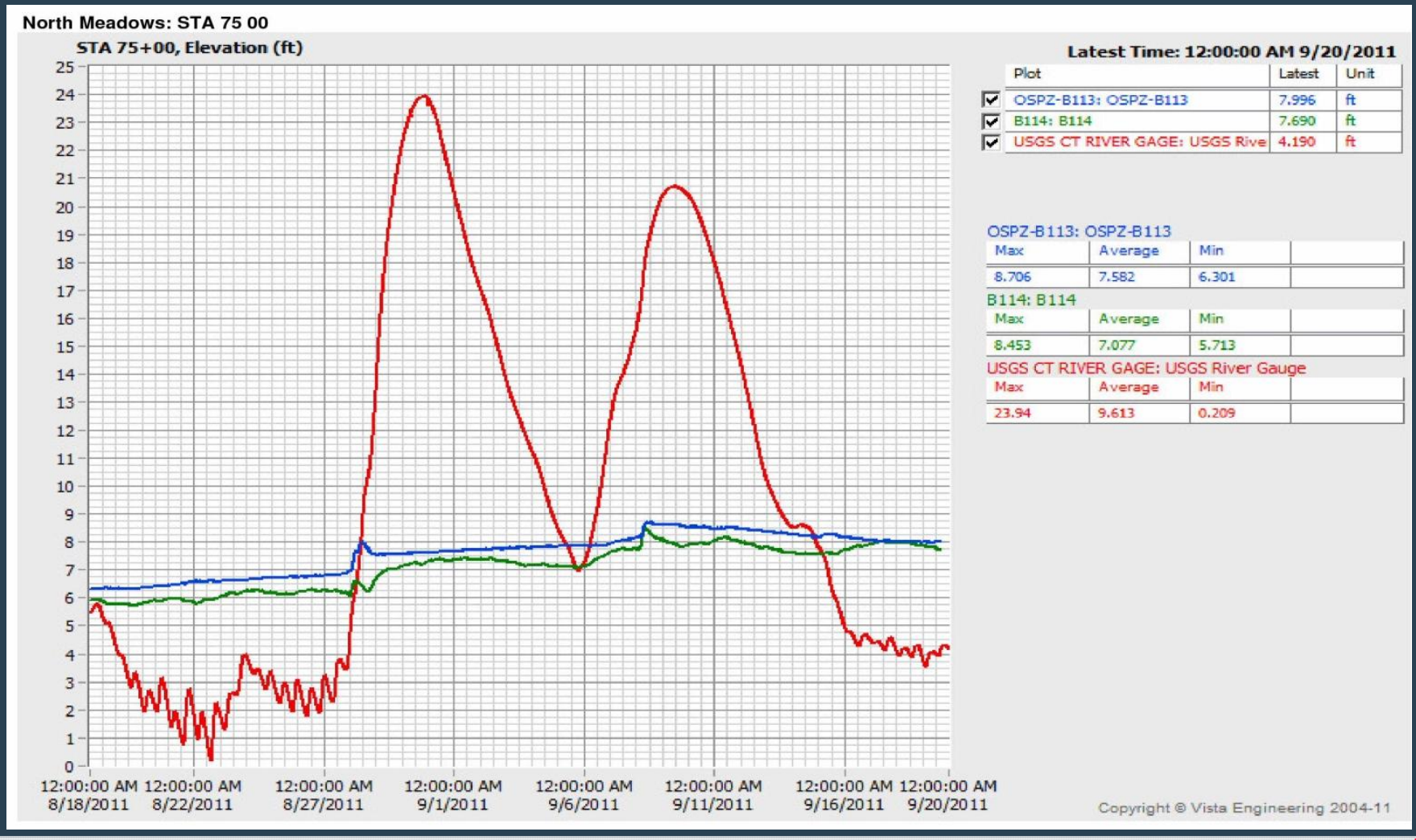
Seepage Monitoring

- Conditions w/ Sheet Piles (North Meadows Dike)



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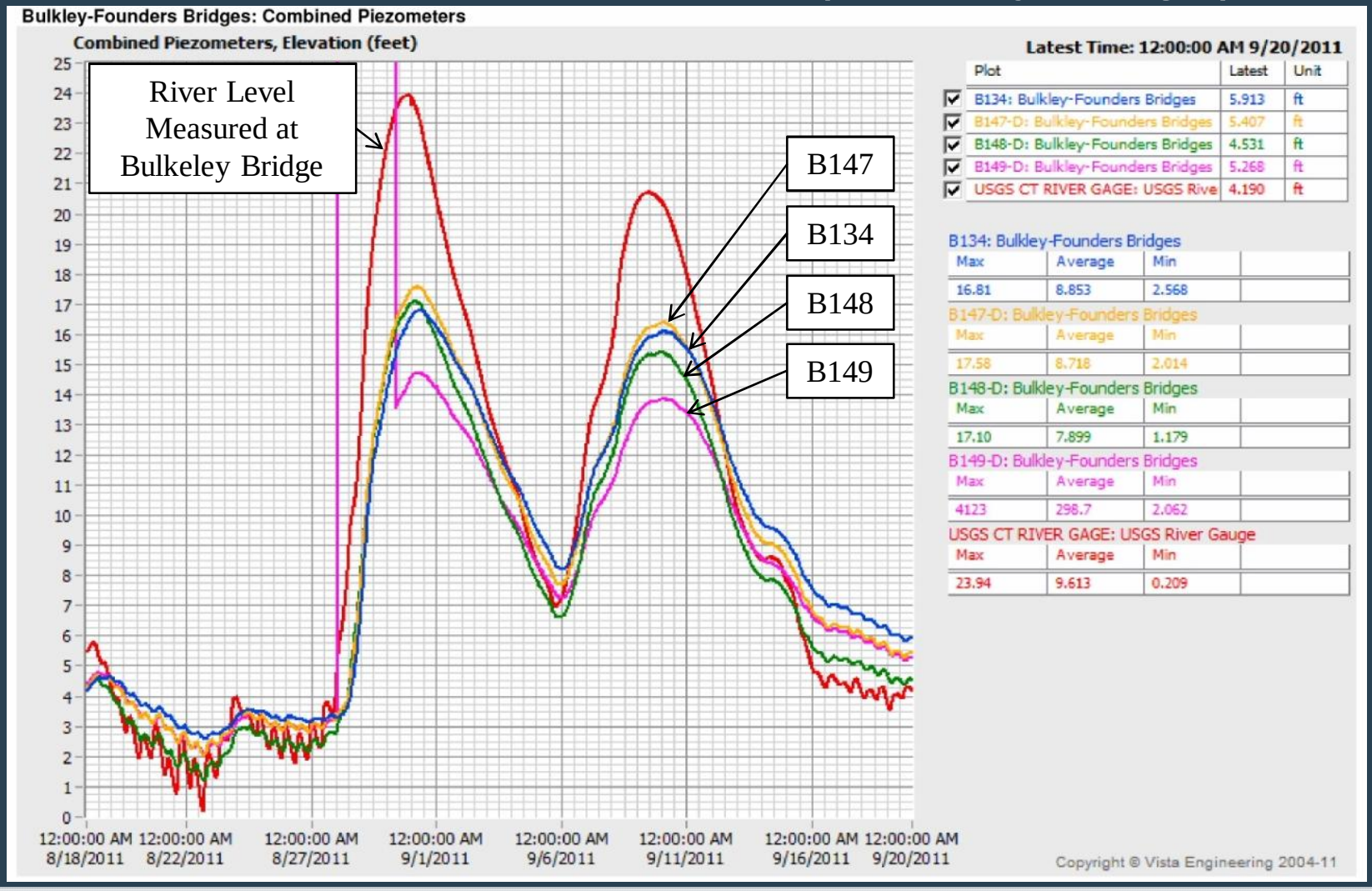
Seepage Monitoring

- Conditions without Sheet Piles (Bulkeley Bridge)



Conclusions

1. Flood Control System is FEMA-Accredited to the 100-year flood elevation
2. Flood Control System is currently “Active” per the USACE and the City is eligible for Federal funding if damage occurs to the system
3. SWIF Plan deadline is August 2017; Risk Reduction Measures and Public Outreach must be conducted in the interim
4. The City’s CIP outlines the strategy to address expected repairs and upgrades to the system
5. DPW staff is capable of maintaining and inspecting the system moving forward

Questions?