



Massachusetts Water Resources Authority

*Presentation to the*

**MWRA Board of Directors**

***Shaft 5A Pipe Break***

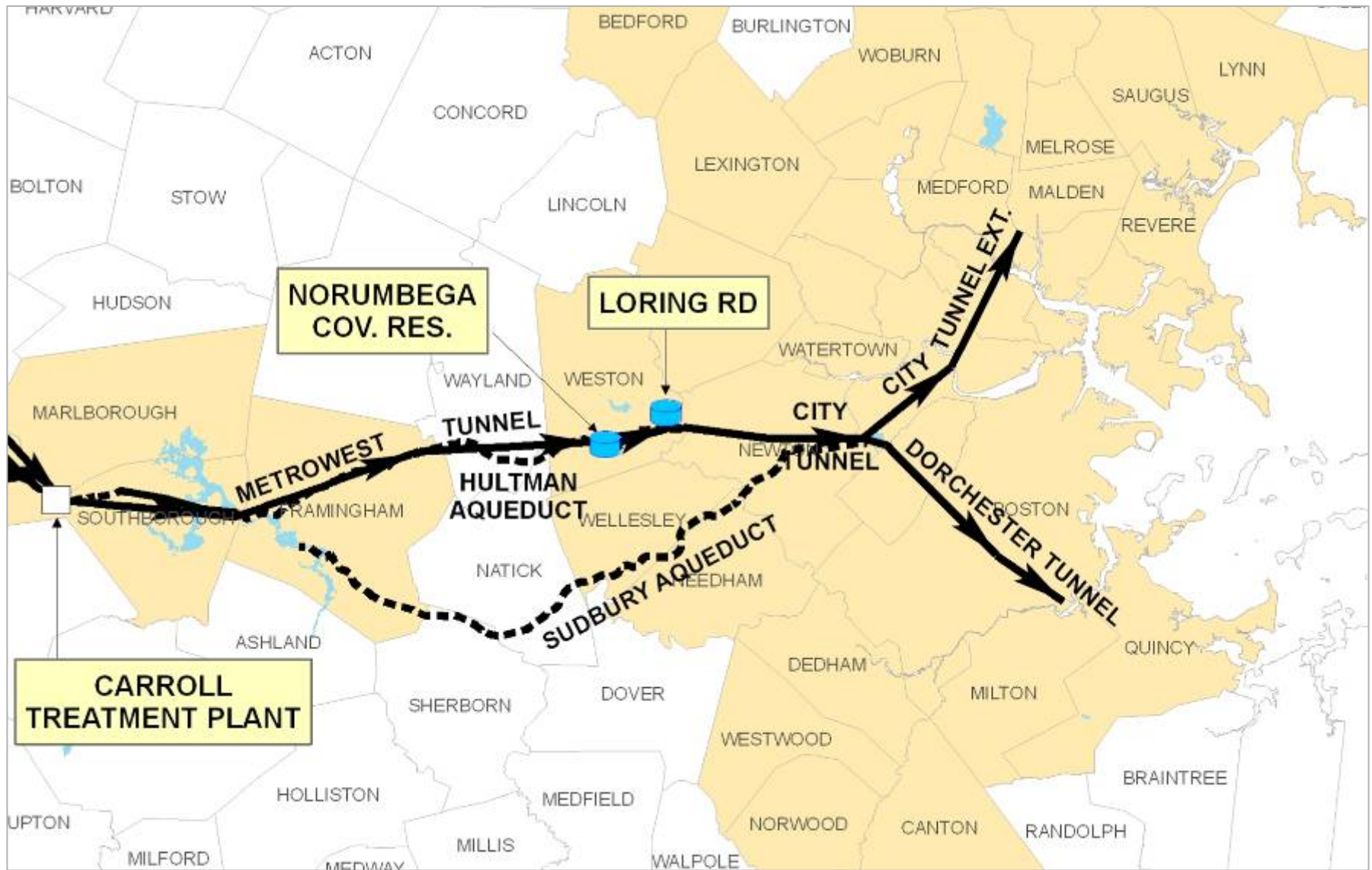
**May 6, 2010**



# **SYSTEM OVERVIEW**

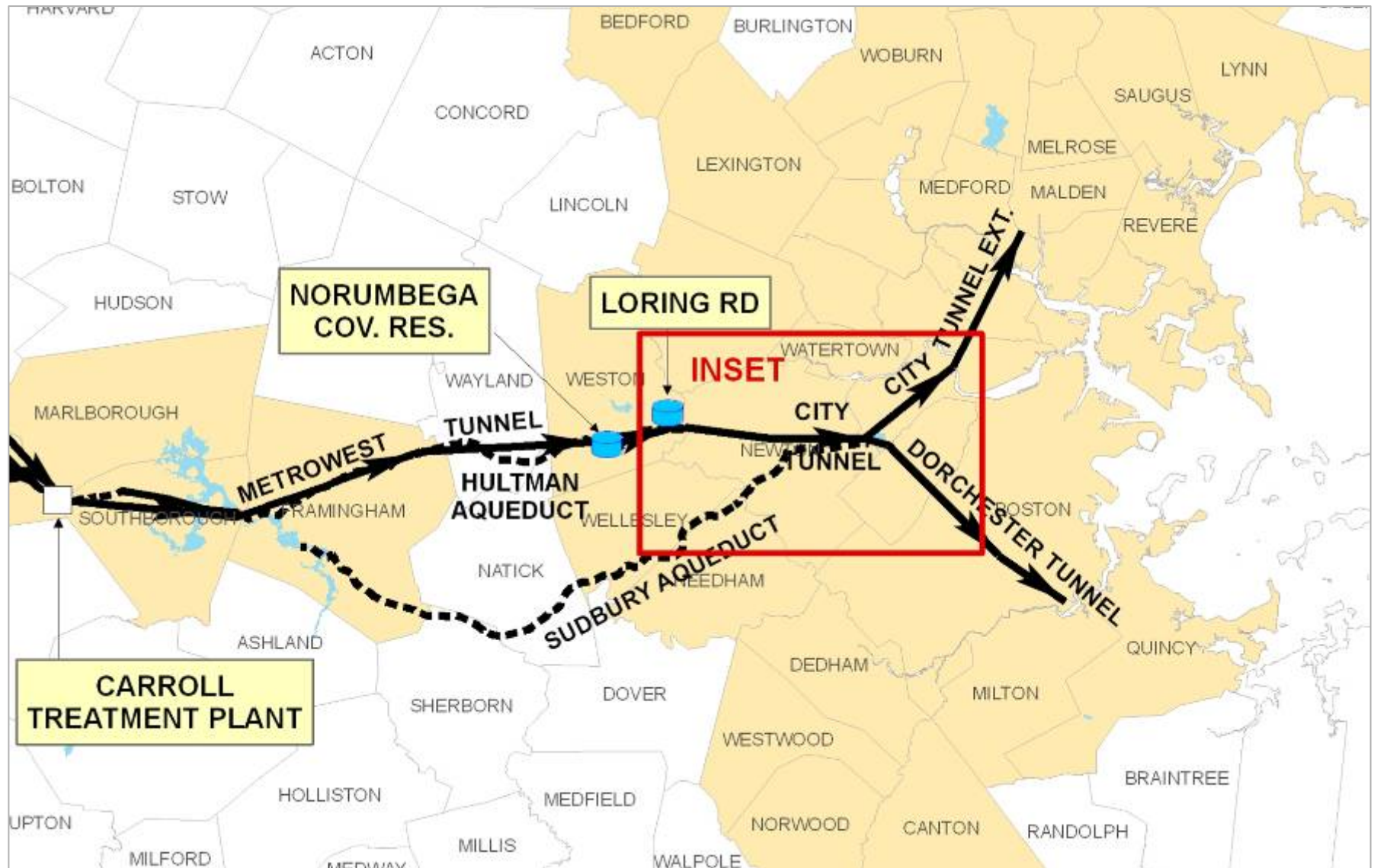


# Normal Flow



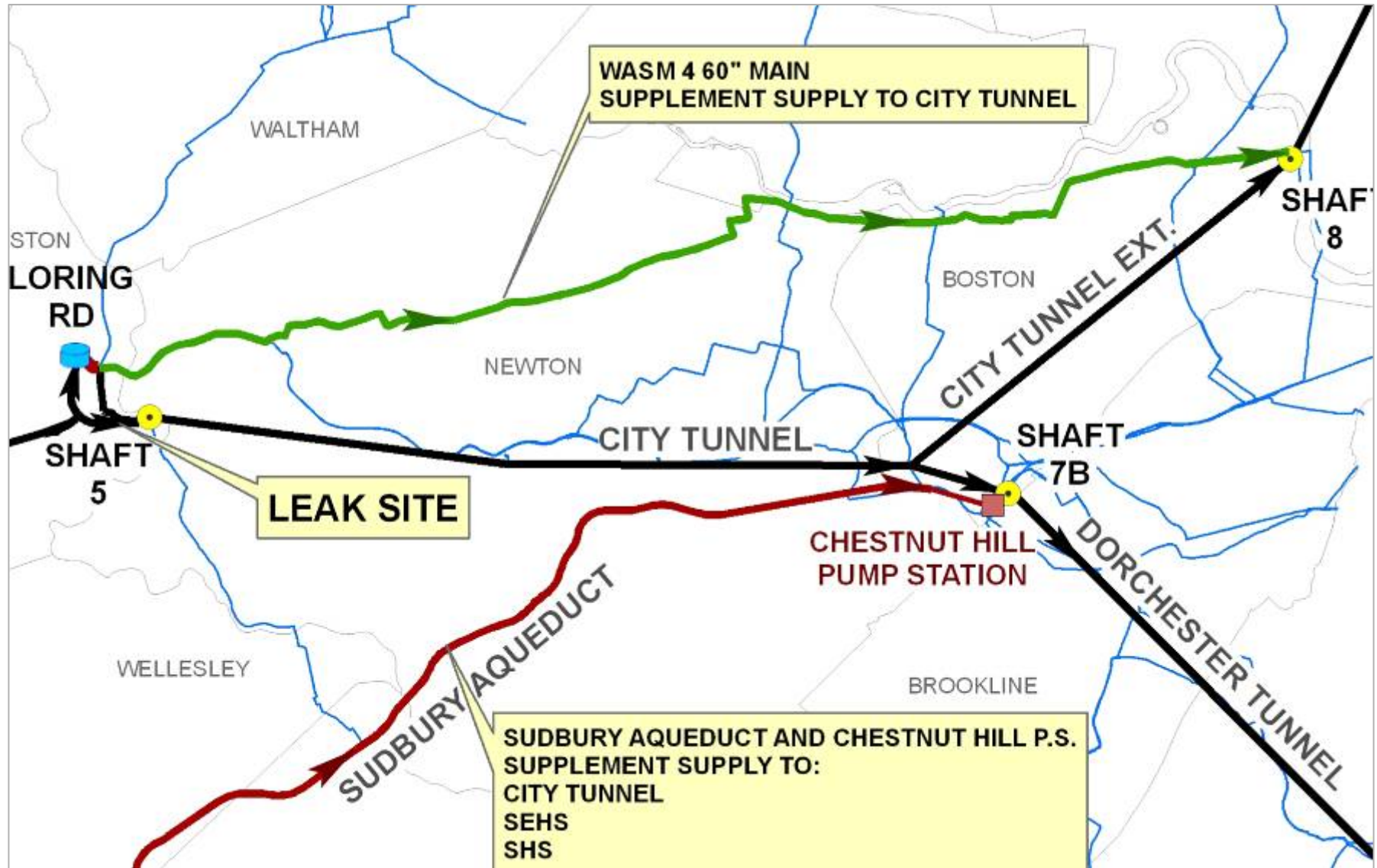


# Normal Flow



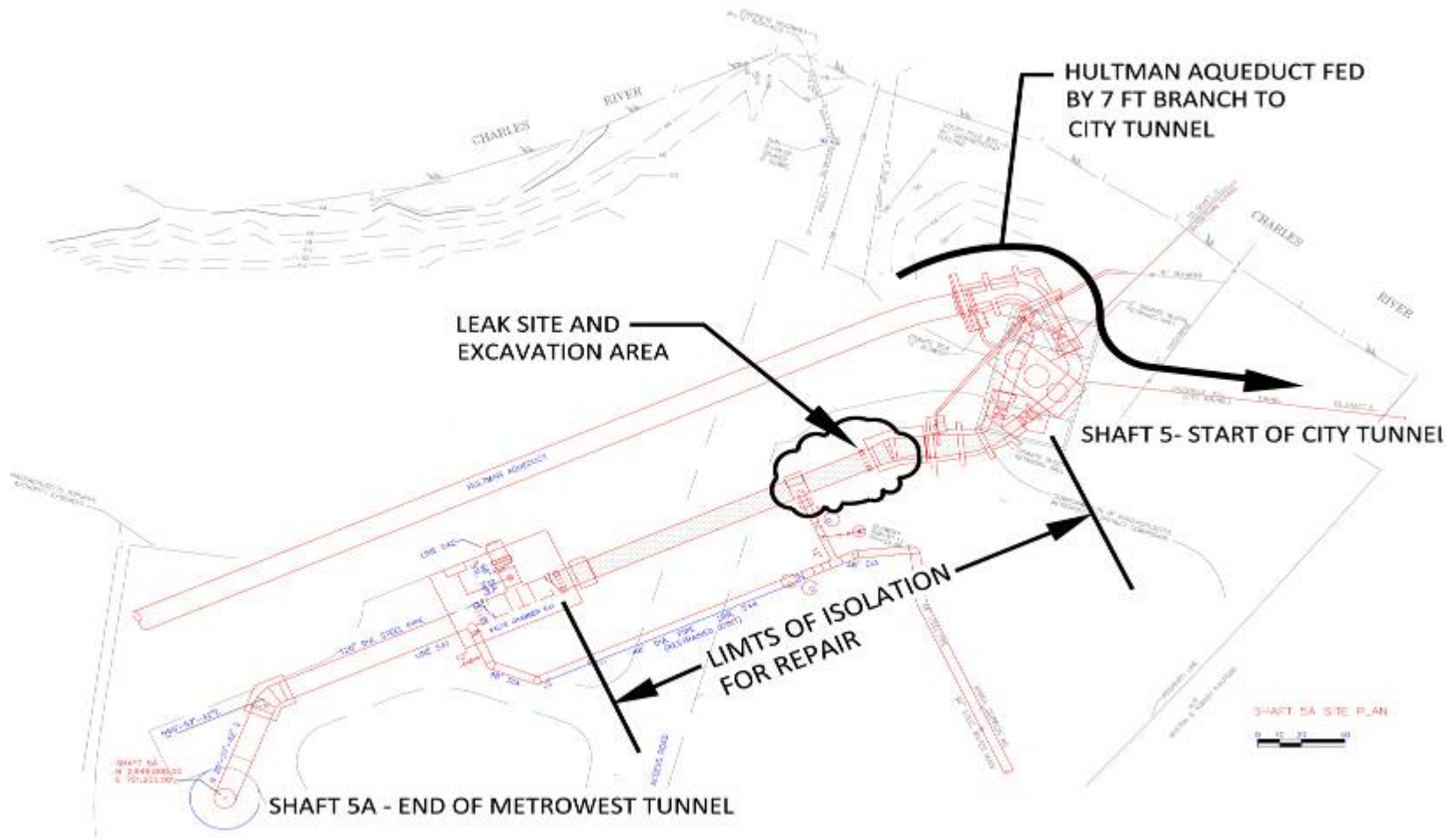


# Diverted Flow After Leak





# Shaft 5 Break Site





# **INCIDENT OVERVIEW**



## Surveillance Camera Captures Leak

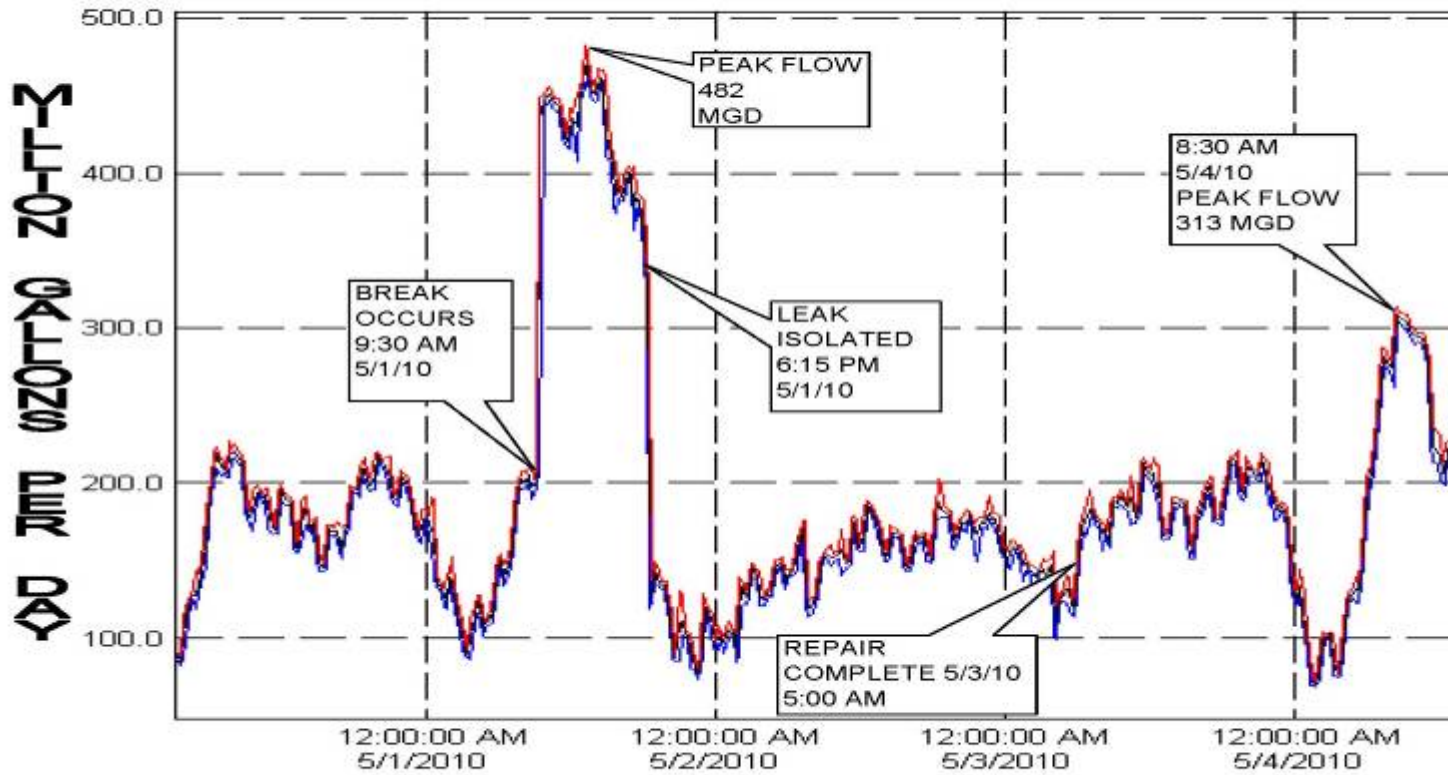






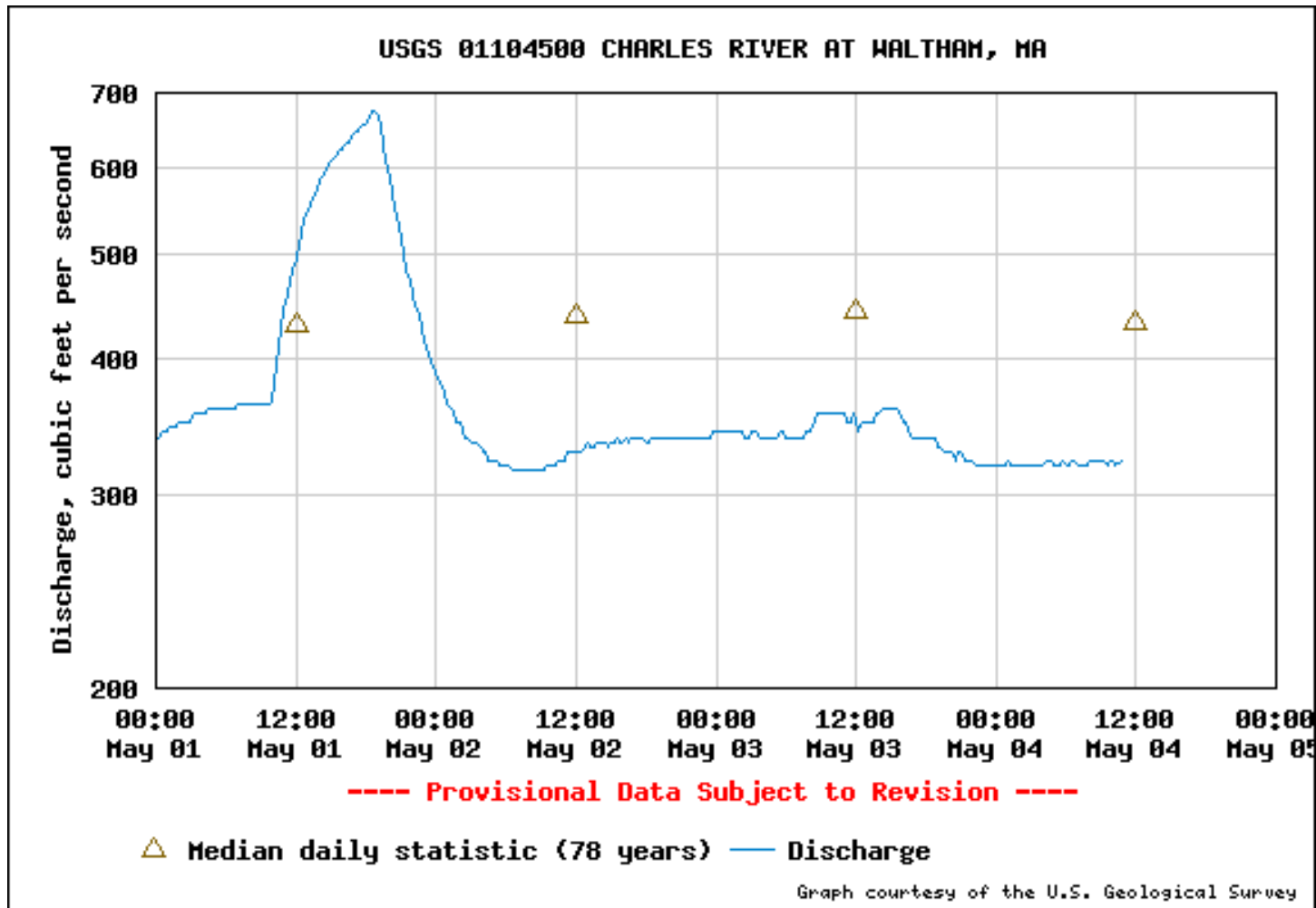
# Changes in Flow

**MGD vs. Time**





# Charles River Flow Impacts





## Immediate Response

- 10:01 AM - Loss of communication alarm from Shaft 5 received at Carroll Water Treatment Plant (CWTP)
- 10:05 AM - Chelsea Security calls CWTP to report that water discharge was observed on the camera at Shaft 5
- 10:05 & following initial notifications to and mobilization of MWRA management, operations, engineering, construction and support staff. Flow at Shaft 5 reported to have immediately gone from 200 mgd to 450 mgd



## Communications

- These parties were quickly provided by phone or e-mail with a preliminary assessment of the incident and the potential impacts:
  - MWRA Staff
  - Board of Directors
  - Governors Office
  - Department of Public Health
  - Department of Environmental Protection
  - Fire Marshalls
  - MEMA
  - Service Area Communities



## Immediate Operational Response

- Increase plant flows (match flow to demand) to mitigate loss of storage in the Norumbega Reservoir
- Shut down Cosgrove Turbine to avoid potential impacts
- Metropolitan system operation stable and decision to continue flow through the break site
- Contact partial user communities and request use of local sources (Bedford, Woburn, Wakefield, Wellesley, Needham, Peabody, Wilmington, Stoughton)
- Coordinate/control tank fillings to regulate flow (Blue Hills, Loring Road, etc.)



## Sudbury System/Chestnut Hill Emergency Pump Station

- Hydraulic grade lines below targets – fire protection
- Fear of catastrophic failure at break site
- Fear of loss of backpressure necessary to start Chestnut Hill Pumps Station and air intrusion in system
- Imminent loss of power at Shaft 5 resulting in significant delay if shut down



## Sudbury System/Chestnut Hill Emergency Pump Station

- May 1
  - Operated for 7 hours
- May 2
  - Operated for 8 hours
- Sudbury Aqueduct
  - Activated May 1, shut down May 4, 9:30 AM
  - Transferred approximately 90 million gallons



# Sudbury System







## Chestnut Hill





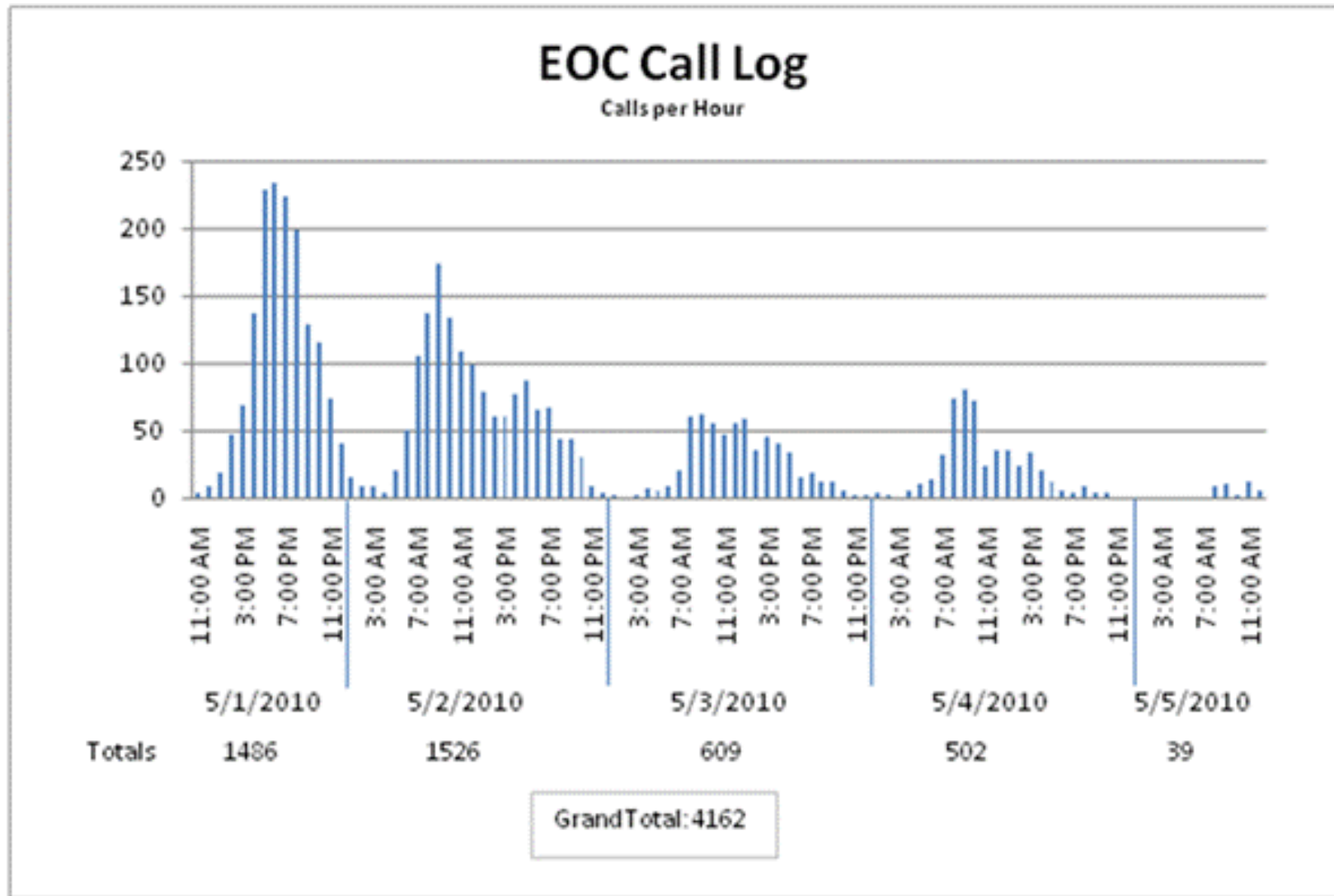
## Spot Pond

- Staffed, all valving reset and chlorine delivered May 1
- Could have provided another 30-40 million gallons per day





# Emergency Operations Center Received 4,162 Calls

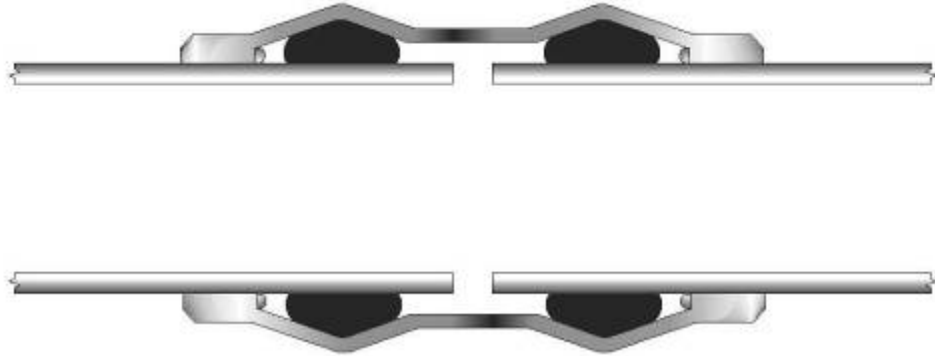




# **PIPE BREAK AND REPAIR**



# Coupling





## Pipe Repair Timeline

EVENT	DATE/TIME
Leak Detected on Security Cameras	May 1/10:00 am
Total Line Shut Down	May 1/6:40 pm
Dewatering of Flooded Area Complete	May 1/10:00 pm
Pipe and Repair Collar Preparation for welding begins	May 1/10:00 pm
Pipe and Collar Preparation Completed	May 2/9:15 am
Welding of Collar on Bottom Half of Pipe Begins	May 2/10:00 am
Welding of Collar on Bottom Half of Pipe Complete	May 2/10:00 pm
Chlorine Addition Complete	May 2/11:00 pm
Welding of Collar on Top Half of Pipe Begins	May 2/11:00 pm
Concrete Cradle Pour Begins	May 2/Midnight
Concrete Cradle Pour Complete	May 3/12:45 am
Welding of Collar on Top Half of Pipe Complete	May 3/ 4:00 am
Filling of Pipe Begins	May 3/ 4:00 am
Filling of Pipe Complete	May 3/ 4:30 am
Pipe Pressure Test Begins	May 3/ 4:30 am
Pipe Placed into Service	May 3/ 5:30 am
Flow Fully Restored	May 3/ 6:15 am



# Dewatering





## Top of Pipe







## Rubber Gasket





## Pipe Joint



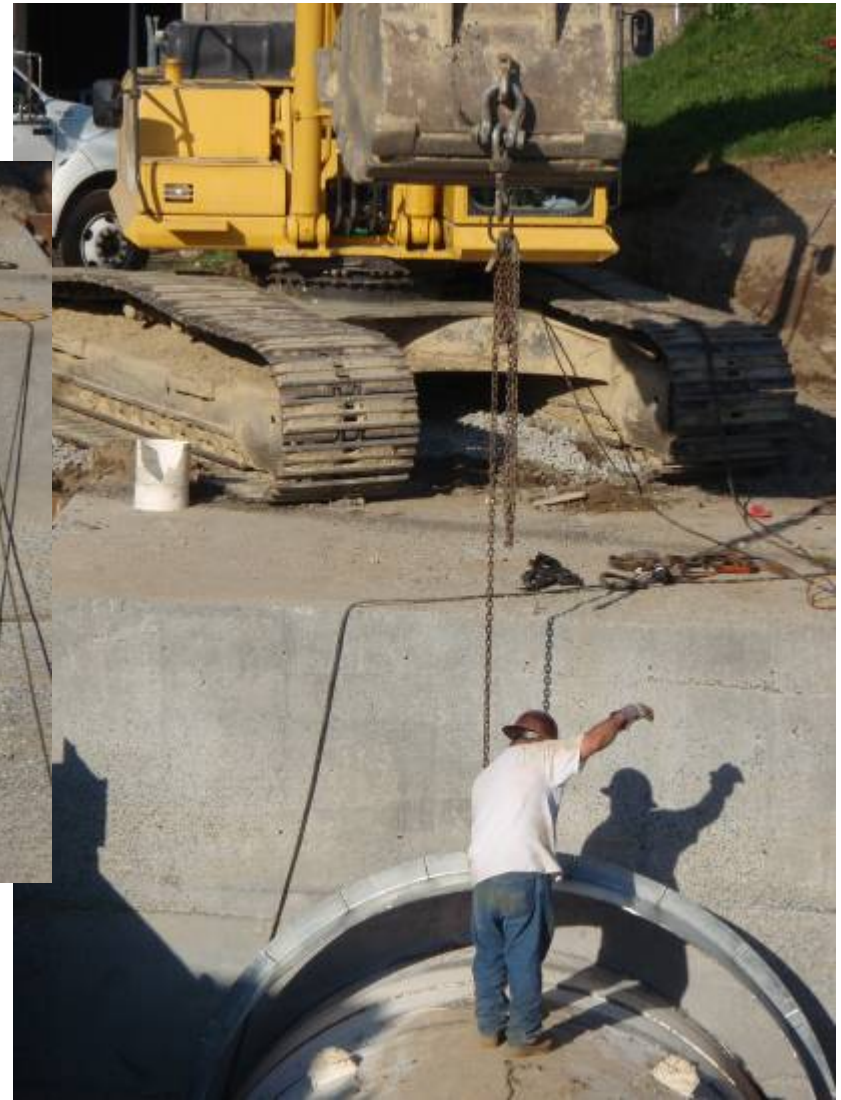


# Probing





## Installing New Strap





## Welding Strap in Place





## Welding Strap in Place





## New Strap Installation Completed





## Concrete Cradle Poured







# **WATER QUALITY**



## Activation of Chestnut Hill Pump Station – Water Quality

- Prior to activation, tested raw water at gatehouse for E. coli, VOC, SOC, metals
- Results available 24 hours later – all within health standards
- Chlorine tank truck delivered to site and treatment system prepared
- Hourly monitoring of chlorine residual near first meter/first customer

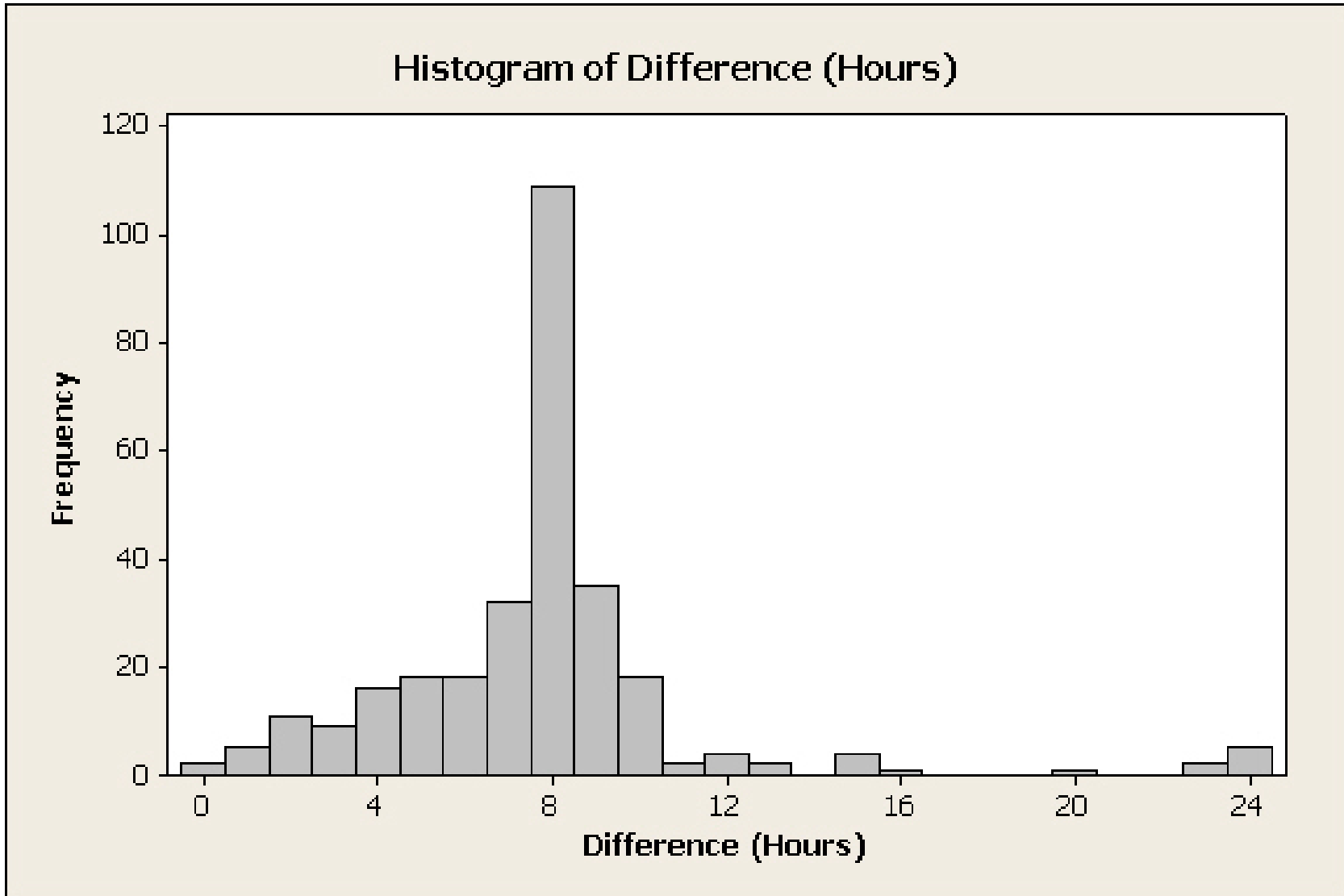


## Next Steps

- Worked with DEP to determine criteria for lifting the boil order
  - Agreed to conducting two rounds of coliform sampling each Sunday and Monday (continuing as needed)
  - About 400 samples per round - Each round represents a normal week of sampling
- Test results include total coliform, E. coli, and chlorine residual
- Agreed with DEP that two rounds of samples about 8 hours apart would allow boil order to be lifted
- Communities contacted Sunday morning to collect two rounds of samples



## Sample Collections Averaged 8 hours Between First and Second Rounds



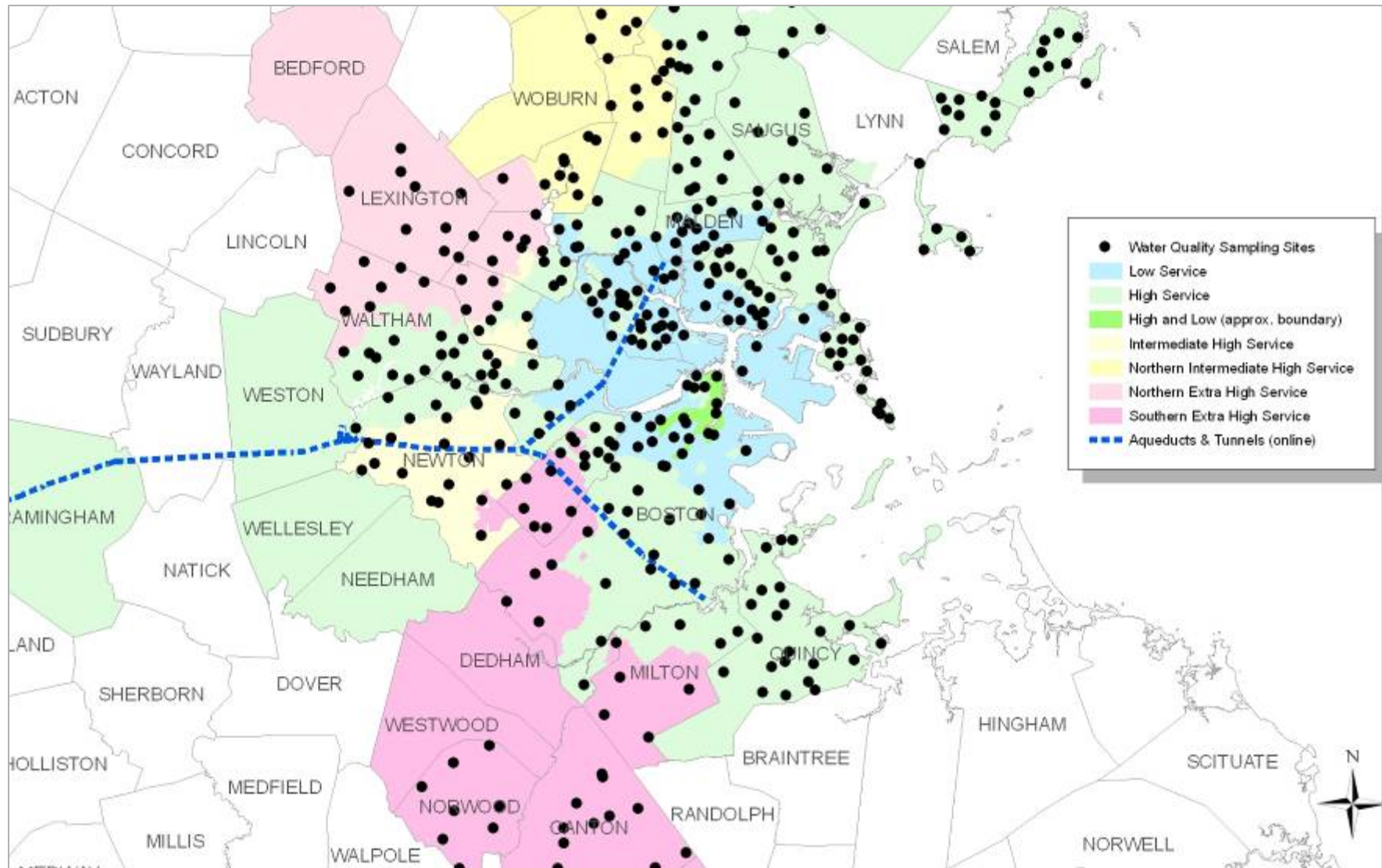


## Boil Order Lifted

- Last of Sunday sample results were available at approximately 1 am Tuesday
- DEP set up emergency operations at the Chelsea facility to monitor results
- Two remaining community results (from Monday first round) available at 2:37 am and 6:30 am
- Boil order lifted at approximately 3 am Tuesday for 29 communities
- Boil order for all 30 communities lifted at about 7 am Tuesday



# Sampling Locations





# **EMERGENCY RESPONSE PREPARATION**



## Emergency Planning

- The MWRA has developed and maintains contingency or emergency plans for a wide range of events, including:
  - 140 Individual Emergency Action Plans for each of the MWRA's facilities and events
  - Emergency Service Unit plans for responding to water contamination
  - Specific plans for reactivating backup facilities
  - Continuity of Operations Plan
  - Emergency Plans for all MWRA Dams
  - Integrated Contingency Plans for Deer Island and the Carroll Water Treatment Plant
  - Spill Control Plans





## Training and Drills



- MWRA staff regularly participate in drills and training exercises
- These have included a 2006 exercise that specifically involved damage to Shaft 5 and the resulting need to activate the Sudbury Aqueduct
- Other training and exercises include:
  - Major yearly exercises
  - Monthly Emergency Service Unit drills
  - Boom Deployment drills using boats and other equipment
  - Mobile Disinfection Unit drills and deployments
  - Notification Drills



# Emergency Equipment





# **PRELIMINARY INVESTIGATION**



## Forensics to Date and On Going

- As soon as the site (hole) was dewatered, MWRA Staff and Consultants and Contractor started:
  - Visual Inspection
  - Excavation below Pipe
    - People under pipe doing inspection
    - Vactor removal of loose material under pipe
    - Probing into soil under pipe by geotechnical consultant
  - State Police divers in Charles River looking for old collar
  - Ground penetrating radar and electromagnetic detectors to try locate old collar
  - Soil removal from River, with stockpiling on adjacent land to inspect for old collar or other information
  - Magnetic Metal Detectors
  - Metallurgical tests on any metal found























## Consultants and Sub-Consultants

- **DESIGN CONSULTANT, MWRA Contract No. 5044**
- Prime consultant:
  - Sverdrup Corporation/Sverdrup Civil, Inc.
- Sub-consultants:
  - Boston Affiliates
  - Delon Hampton & Associates
  - Fay, Spofford & Thorndike, Inc
  - Goldberg Zoino & Associates
  - Jacobs Engineering
  - Lenz Engineering
  - Judith Nitsch Engineering, Inc
  - GPR (sub-sub to Goldberg Zoino)
  - Offset Prep
  - GZA Geo Environmental, Inc.



## Consultants and Sub-Consultants

- **CONSTRUCTION MANAGEMENT & RESIDENT ENGINEERING CONSULTANT, MWRA Contract No. 5284**
- Prime consultant:
  - Stone & Webster Civil and Transportation Services, Inc. (assigned to Stone & Webster Massachusetts, Inc. and The Shaw Group)
- Sub-consultants:
  - Stone & Webster Construction Company, Inc.
  - Parsons Brinckerhoff Construction Services, Inc.
  - DMC Engineering, Inc.
  - H2O Engineering Consulting Associates, Inc.
  - Judith Nitsch Engineering, Inc.
  - Regina Villa Associates, Inc.
  - Toxikon
  - Hager GeoScience
  - Revet Laboratories



## Contractors and Sub-Contractors

- **CONSTRUCTION CONTRACTOR, MWRA Contract No. 6374**
- Prime Contractor:
  - Shea-Traylor-Healy, Joint Venture
- Sub-contractors:
  - Barletta Engineering/Daniel O’Connell’s Sons
  - Harding & Smith
  - E.J. Smith Construction Corporation
  - E.T. & L. Construction Corporation
  - Determining if others





## Reviewing Other Projects

- Reviewed 28 Projects to date including other MetroWest Water Supply projects. The failed coupling is the only coupling of its type on the entire MWWST project and the ongoing Hultman Aqueduct Interconnections project
- 8 Projects used similar couplings under varying conditions
  - Many existing locations have been retrofitted or included internal joint seals
  - Many of the projects included low pressure lines
  - Projects where couplings have been used will be evaluated for risk of failure depending on the findings related to the recent event
- Staff will continue to review additional projects since Depend-O-Lok couplings became available



# **HULTMAN REHABILITATION**

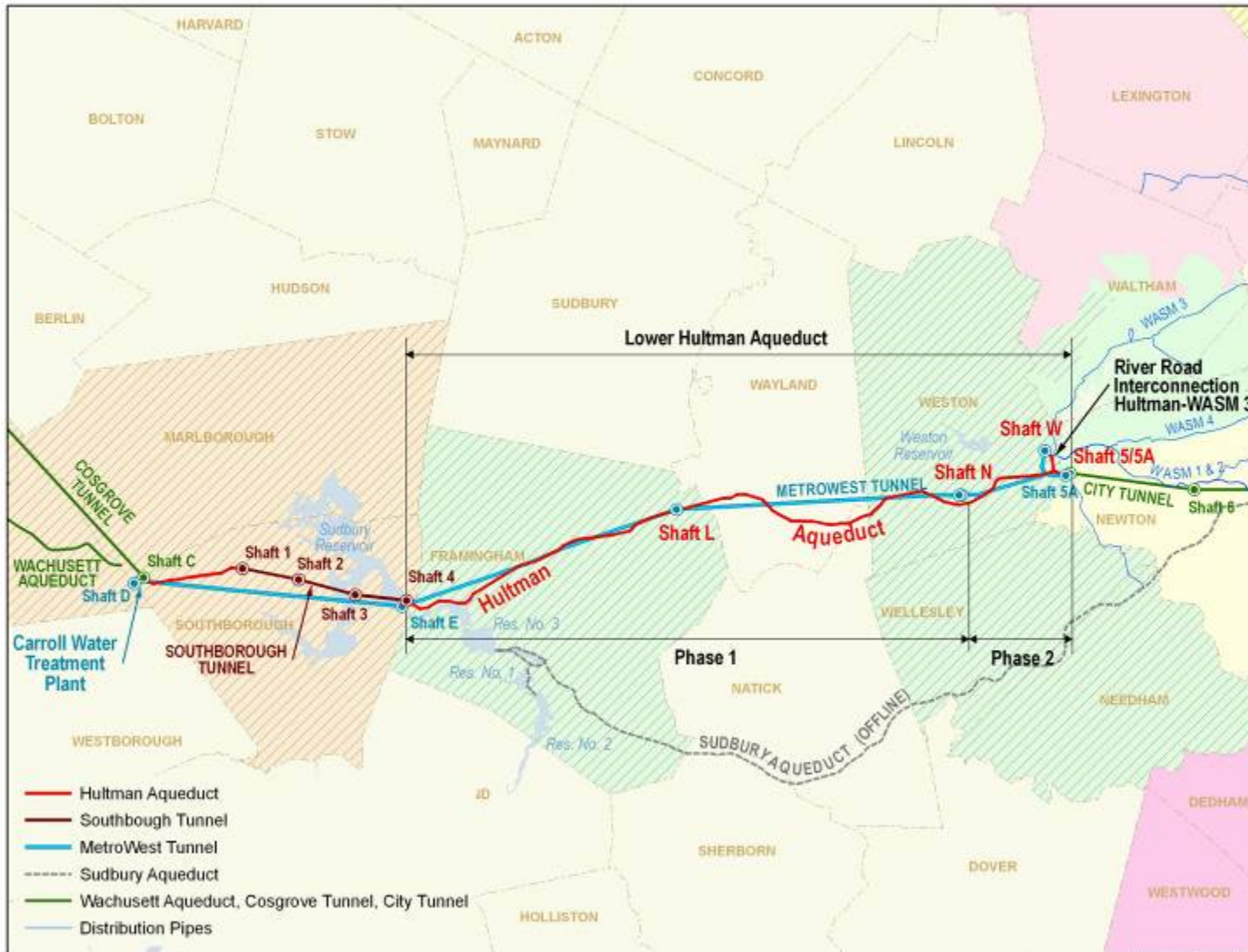


## Hultman Aqueduct Rehabilitation and Interconnections

- Two construction contracts
  - CP-6A Lower Hultman – under construction
    - Phase 1: Shaft 4 to Norumbega Covered Storage (9/2009-9/2011)
    - Phase 2: Norumbega Covered Storage to Shafts 5/5A and W (10/2011-9/2014)
  - CP-6B Upper Hultman – to be designed
    - Rehab Hultman from Shaft C to Shaft 4
    - Rehab Shaft 4 Top of Shaft Structure
    - (5/2012-5/2014)



# CP-6A Hultman Aqueduct Rehabilitation and Interconnections with MetroWest Tunnel





## CP-6A Project Scope and Schedule

- Inspect and rehabilitate 13.5 miles of Hultman Aqueduct and appurtenances
- 4 new interconnections between the Hultman Aqueduct and the MWWST
- 6 new valves on Hultman Branch at River Road in Weston
- Current Project Schedule: September 2009 – September 2014



## CP-6B Project Scope and Schedule

- Rehabilitate Hultman Aqueduct and appurtenances from Shaft C to Shaft 4
- Rehabilitate Shaft 4 Top of Shaft Structure
- Current Project Schedule: May 2012 – May 2014



## CP-6A Current Sequence of Work

- Designed to minimize number of sections that are unavailable at any given time.
- Maintain uninterrupted service to customers during normal operation.
  - Valves need to be added at the interconnection between the Hultman 84-in Branch and WASM 3 at River Road in Weston prior to working on Hultman east of Norumbega.
  - Valve work at River Road in Weston must be completed during low demand winter months
  - Improvements must be made to the Waltham water distribution system to allow WASM 3 to be shut down during the River Road valve work



## Reassessment of Project Schedules for CP-6A & CP-6B

- A comprehensive reassessment of the sequence of work for CP-6A and CP-6B has begun with contractor, designer and MWRA staff. Factors being analyzed:
  - Valve manufacturing lead time
  - Working additional shifts on weekends
  - Contractor resources
  - Reevaluating seasonal flow constraints
  - Coordination with other ongoing MWRA projects
  - Acceleration of CP-6B contract award
  - Risk of additional sections out of service for rehabilitation





# **REDUNDANCY INITIATIVES**



# Water Redundancy Spending

Water Redundancy Spending thru FY09 and Projected to FY20 and Beyond  
(\$ in Millions)

