LONG-RANGE PLANNING FOR SMART-WATER NETWORK IN BØSTON

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AGENDA

- Background and System Characteristics
- In place systems and technologies
- Future Smart- Water network
- Challenges

MWRA IS A REGIONAL WATER AND WASTEWATER WHOLESALER

- MWRA provides wholesale water and wastewater services to over 2.5 million customers in 61 communities
- On average, MWRA delivers an average of 200 million gallons per day to its water customers, with a peak demand of 350 million gallons
- MWRA collects and treats an average of 350 million gallons of wastewater per day, with a peak capacity of 1.2 billion gallons



MWRA Water System Overview

MWRA Quick Facts:

- 150 miles of tunnel and 300 miles of pipe
- 11 storage tanks and 10 pump stations
- 890,000 households and 5500 businesses
- 63 local storage tanks
- No Retail Connections



CURRENT WATER SUPPLY TO BOSTON



BOSTON TODAY



BOSTON'S WATER DISTRIBUTION SYSTEM

- Five pressure zones 60 psi -112 psi
- Supplied from 29 metered locations
- 1011 miles of pipe from 4 inch to 48 inch
- Approximately 18214 valves
- 13,618 hydrants
- 90,000 Accounts

Pressure Zone	Feet	Miles
High Pressure Fire System	87,870	17
Northern High	25,478	5
Northern Low	470,427	89
Southern Extra High	425,248	81
Southern High	2,956,110	560
Southern Low	1,371,429	260



Source: Boston Water & Sewer Commission

Age of Boston Water Mains Total: 1,021 miles



Water Main Breaks 1992 - 2014 by Year of Break Number of Breaks Year of Break

Boston's Water Consumption Trend 1977 - 2014



Years

Boston Water Use 1900-2014



CURRENT WATER MANAGEMENT

- Active Asset Management of Physical Plant
- MWRA Water Quality Monitoring (Supply)
- Master Metering and Alarms
- AMI
- Leak detection

MWRA Monitoring System



Monitoring and Event Detection

Monitoring Only

FINISHED

RAW

Under Installation

MWRA Water Communities

Baseline Characterization - Source Water

- Quabbin Reservoir
 - Swift River
 - 412 billion gallons
- Wachusett Reservoir
 - Nashua River
 - Quinapoxet River
 - Stillwater River
 - 65 billion gallons



Baseline Characterization -Treatment

- John J. Carroll Water Treatment Plant Marlborough, MA
- Serving Metro West and Metro Boston Communities
- Treatment
 - Ozone
 - Sodium Bisulfite
 - UV
 - Sodium Hypochlorite
 - Hydrofluorosilicic Acid
 - Sodium Carbonate
 - Aqueous Ammonia
 - Carbon Dioxide



- Infrastructure Concerns for the Monitoring Space
 - Environmental Controls
 - Heating and Cooling
 - Utilities
 - Power
 - Communication
 - Test Stream
 - Proximity to feed source
 - Feed and return lines
 - Drain



MWRA Monitoring System

- Parameters monitored:
 - pH
 - Temperature
 - Conductivity
 - Turbidity
 - Dissolved Organic Carbon
 - Total Organic Carbon
 - Nitrate-N
 - UV 254
 - Oxidation-Reduction Potential
 - Monochloramine
 - Free Chlorine
 - Total Dissolved Solids



Alarming Strategy

Collect Alarm Data

2014 Actionable Alarms By Cause

Turbidity Related
 Service Required - Pump Failure
 Service Required - Routine Maintenance
 Service Required - Auto Brush Failure
 Service Required - Software Related
 Hydraulic Event

- Criteria
 - Location/Type
 - Duration
 - Cause
 Grouping
- Sensitivity
- Condition limits
- Duration of condition



MASTER METER MONITORING





AUTOMATED METERING READING SYSTEM

- System operating successfully for over 12 years
- 90,000 residential/commercial meters
- Four reads per day for each meter 99% accuracy
- Updating system to obtain hourly readings
- Transmits over a secured FCC licensed frequency
- Reduced calls to Customer Service



PROACTIVE CUSTOMER SERVICE

- Collected data used to support analyses for:
 - Daily Consumption Review High/Low usage
 - Consumption Analysis Trends/Patterns Failing Meters
 - Anomalies Theft/Broken Meters
 - Leak Detection
 - Customer Service Web



Data Collection Units (DCU) Locations

- 62 DCUs
- Boston School Department
- Non-School Locations
 - EDIC
 - 1 Ashburton Place
 - Boston University



ACCOUNT INFORMATION ON WEB

- Enable customers
- Consumption data by area

198233

OCT 12

2721

2105

APR 1

2098

2277



Current Upgrade

- More accurate data From 4 reads to 24 reads/day
- Two-way communication
- Switch from cellular to WiFi protocol
- Improved analysis of data
- More robust reporting Better customer service

LEAK SURVEILLANCE



IDENTIFY SOURCES OF LOST REVENUES

- Leaks
- Under-registering meters
- Theft
- Non-metered accounts
- Non-metered construction flushing
- Construction bypass
- Un-permitted street sweepers
- Other unaccounted-for water



LEAK DETECTION EFFORTS

- 6 full time personnel
- 3 additional as needed
- Required to survey entire system every 2 years

BWSC Engineering Services			
Lea	an Detection Totals	Dy real	
YEAR	Number of Leaks Detected	Miles of Main Surveyed	
2004	273	683	
2005	180	815	
2006	197	985	
2007	194	809	
2008	167	672	
2009	231	841	
2010	252	994	
2011	187	776	
2012	274	753	
Total:	1,955	7,328	



- Permanent
- Pinpoints location
- Drive-by reading
- Scalable to fixed radio





SMARTER LEAK DETECTION METHODS NEEDED





WHAT PROBLEMS ARE WE SOLVING? (AND AT WHAT COST?)

- Low Water Main Break Frequency
- Unaccounted for water 8%
- No pumping costs
- No tanks
- No Pressure problems
- Minimum water quality complaints

WHAT NEXT ?

- Install water quality monitoring system within Distribution system
- Simple, noise limited
- Install distribution leak monitors; integrate with master meters, DMA meters, Customer meter data
- Challenge Cost Effective, Avoid Data Overload, Useful, Sustainable

The three pillars of Smart Water Networks:

- Information: making full use of all data produced by a water utility
- Integration: utilizing current IT systems to maximize previous investments
- Innovation: having the flexibility to meet future challenges

Goals for smart Water Grid

Achive the water of intelligent information service and solve the temporal water supply imbalances by applying a low-power highly reliable wired and wireless communication technologies to address reginal water management facility, AMI system and Water Information Management S/W.



GOAL

"Everything should be made as simple as possible. But not simpler."

Albert Einstein

Wicked Smart City