



City of Baltimore  
Department of Public Works

Bureau of Water and Wastewater

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# City of Baltimore's Drinking Water System: *Security and Continuity*

February 25, 2009

# Baltimore City's Drinking Water System: *Security and Continuity Agenda*

- Water and Wastewater Bureau Overview
- Drinking Water System Overview
- Planning:
  - Define Emergencies, Continuity, Vulnerabilities and Threats
  - Comprehensive Water Emergency Preparedness Plan
- Response:
  - Existing Plans, Security of System, Emergency Response
- Case Studies
  - Fairfield (2007) – Water Main Break
  - Pikeville PS Power Outage (2008) – Facility Power Loss
  - Madison 30 (2009) – Water Main Break
- Lessons Learned

# Bureau of Water and Wastewater

## The Vision

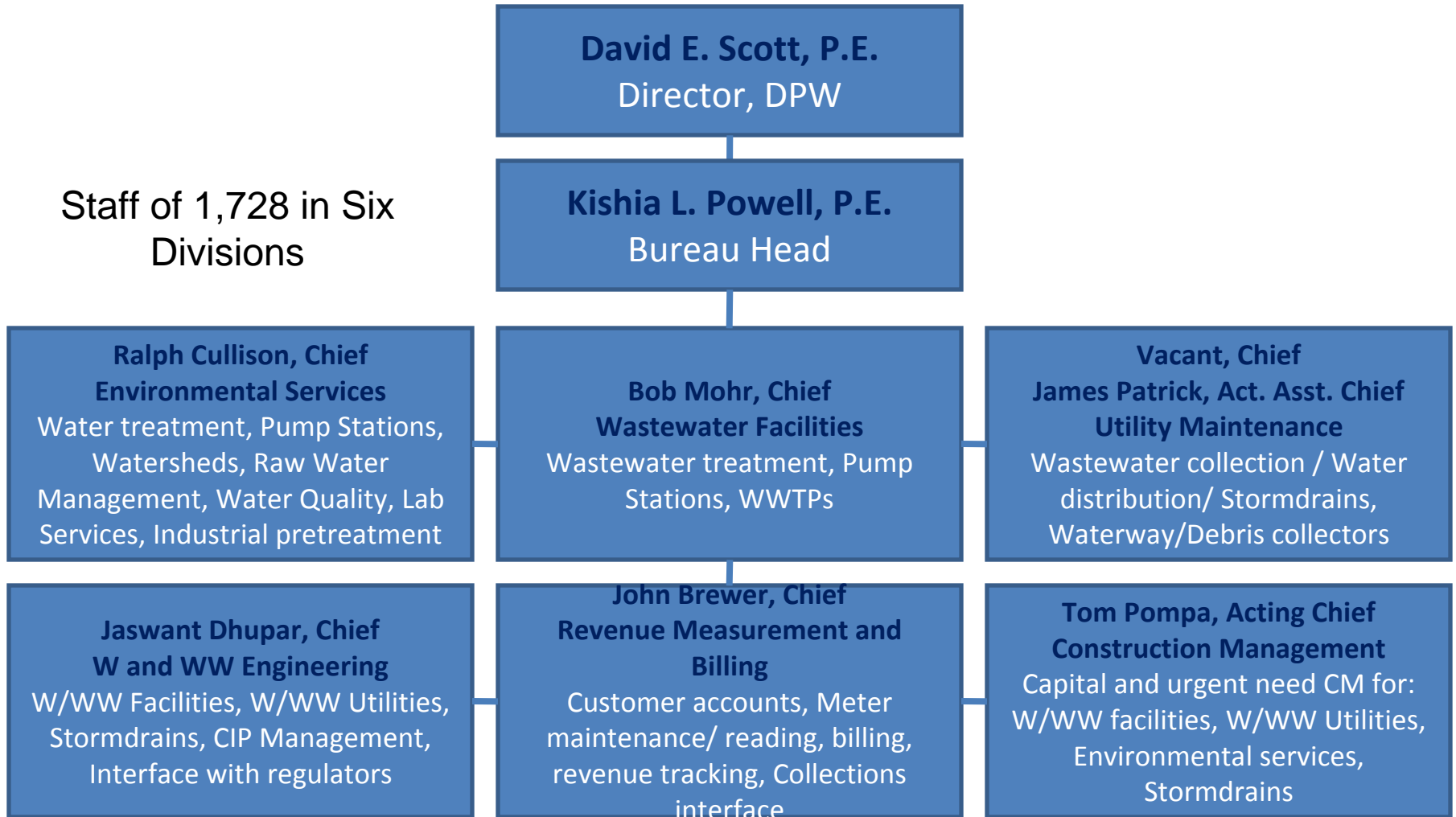
The Bureau of Water and Wastewater will be a world class utility: Marked by leadership and quality service.

## The Mission

- To provide high quality drinking water;
- To collect and treat wastewater to a high standard;
- To protect Surface Waters in Baltimore City;
- To provide efficient and responsive service to the Citizens of Baltimore and the region;
- To be proactive in the care of Baltimore's water, wastewater and stormwater infrastructure and facilities to promote longevity and dependable utility service.

# Bureau of Water and Wastewater

Staff of 1,728 in Six Divisions

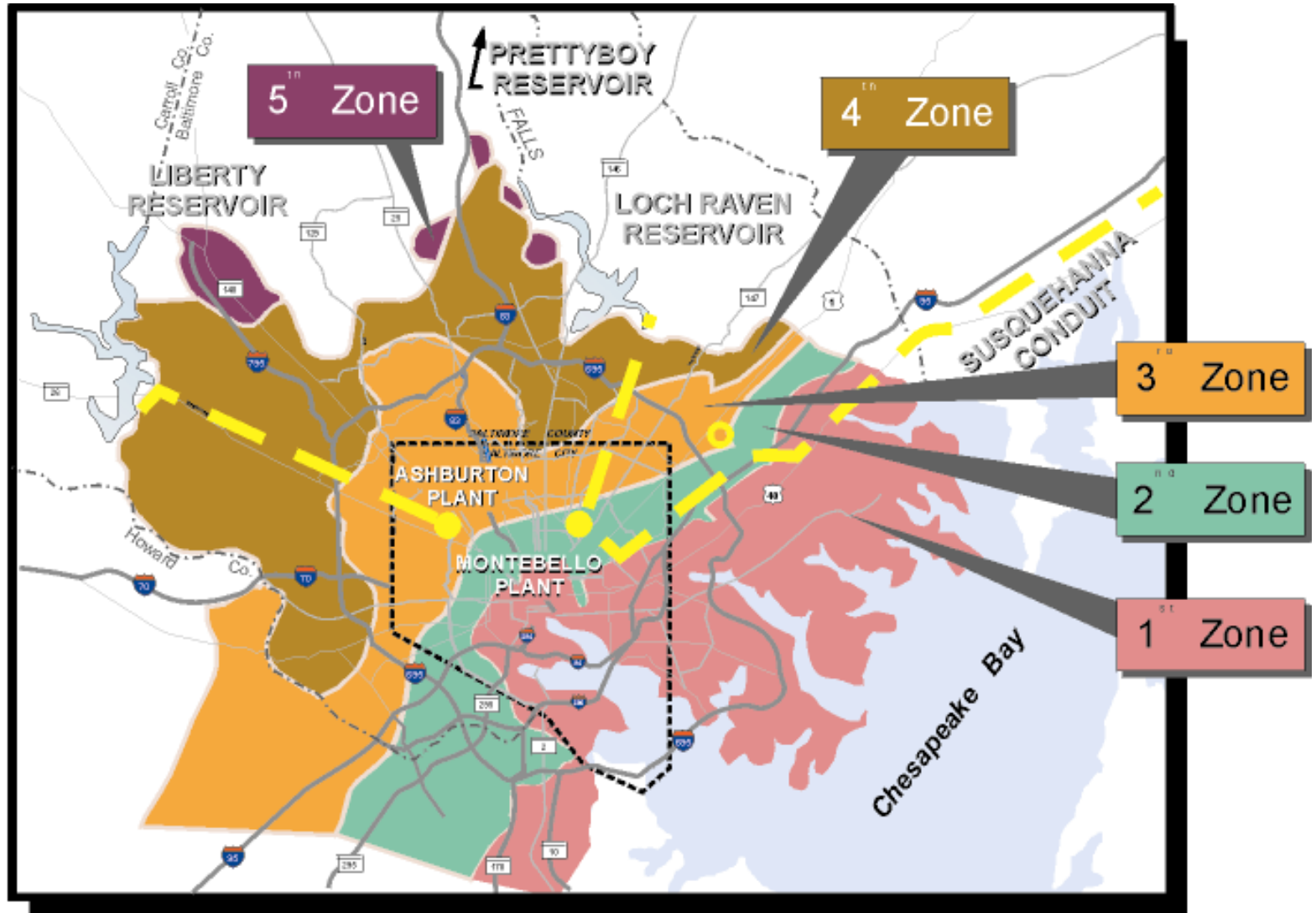


# Drinking Water System Overview

- Serves:
  - 1.8 M people in Baltimore City and Baltimore County
  - Parts of Anne Arundel and Howard Counties
  - Raw water supply to Carroll and Harford Counties
  - 5 Major water zones
- System components:
  - Three reservoirs: Loch Raven, Liberty and Pretty Boy (raw water source)
  - 3 Dams
  - 108" tunnel from Susquehanna River
  - 3 Water filtration plants – gravity fed
  - 7 Finished water reservoirs
  - 20 Filtered water pump stations
  - 22 Elevated storage tanks
  - 3,400 Miles of water main
  - 19,100 Fire hydrants



# Drinking Water System Overview

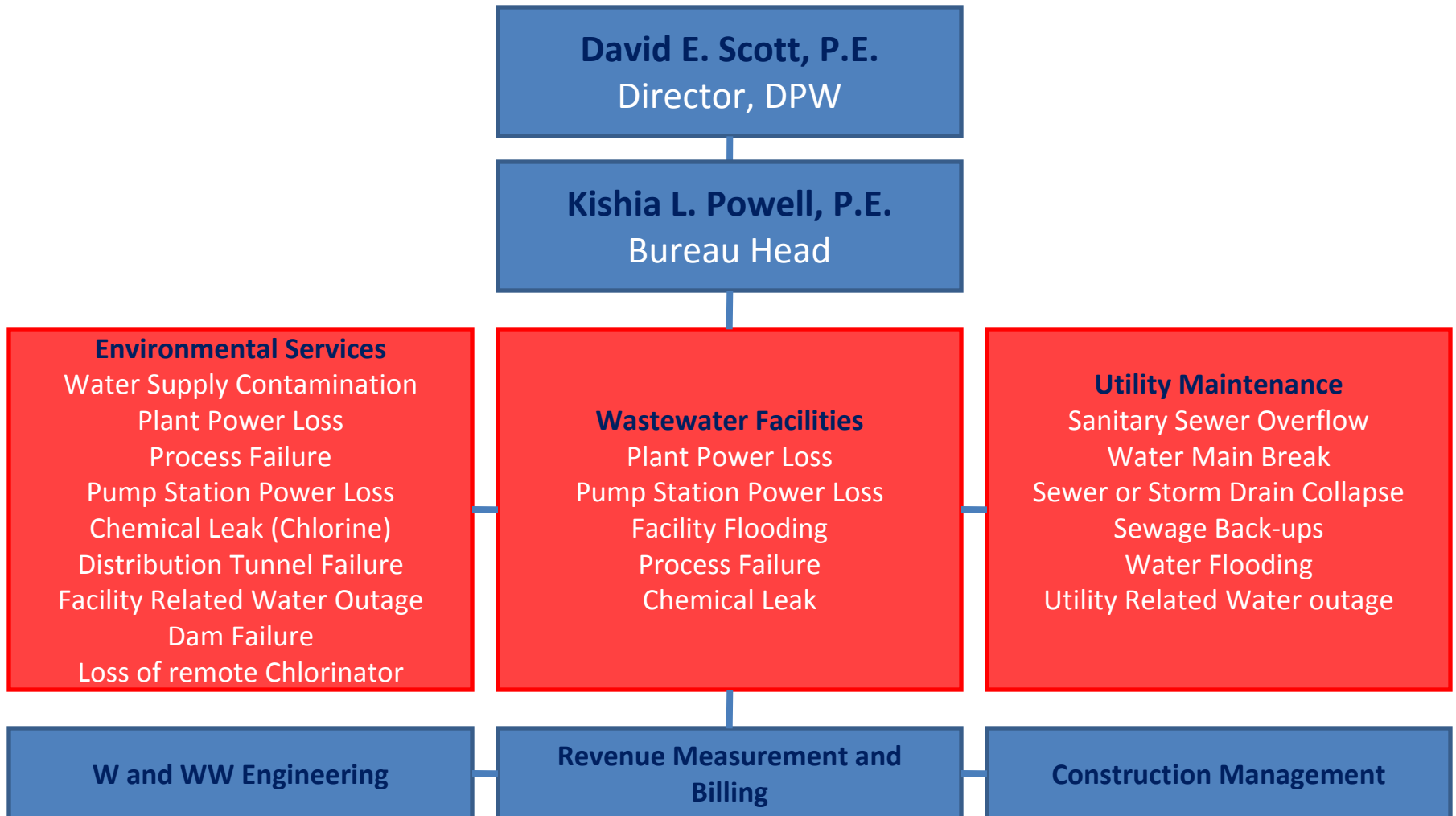


# Drinking Water System Overview

*Mayor and City Council of Baltimore began efforts to construct water system in 1804*

- Water mains were installed beginning 1858
- Water system audit shows 23% unaccounted water vs. 12-14% industry standard
- Water mains range in size from 4 to 144 inches
- Cast iron, steel and reinforced concrete main
- 3 Major water distribution tunnels
- Treatment includes disinfection, coagulation, sedimentation, filtration, pH control and fluoridation

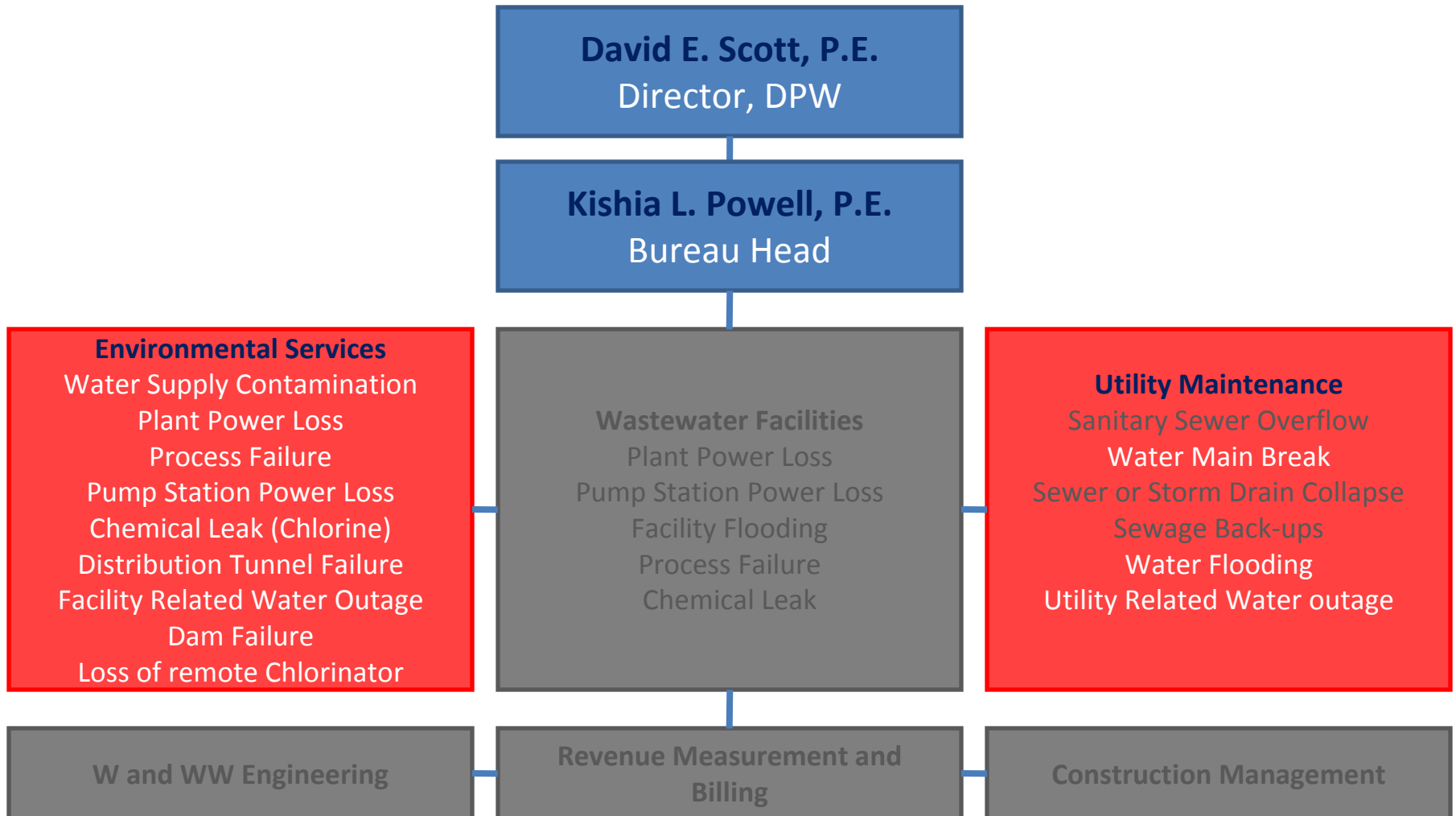
# Defining Water Emergencies





# Bureau of Water and Wastewater

## W/WW Emergencies & Threats



# System Continuity

- Points of failure
  - Power at pump stations
  - SCADA controlled distribution system
  - Aged Water distribution system
  - Gravity based system
- Systems zones
  - 5 major pressure zones based on elevation above sea level.
  - Zones 1 and 2 largely gravity fed from filtration plants
  - Zones 3-5 receive excess water from Zones 1 & 2 through pumping stations
  - Local storage in each zone (reservoirs and elevated storage tanks)
  - Valves separate zones



# System Continuity

- Redundancy
  - Filtration plants have redundant chemical feeders
  - Sufficient sedimentation and filtration capacity with redundant support equipment (filter wash pumps)
  - Filtration plant electrical systems “double-ended” with redundant electrical routing capabilities
  - Some PS have “double-ended” systems
  - Mobile emergency generators assigned to filtration plants 480VAC pumping stations.
- Drought Provisions
  - Filtration plants have “low lift” pumping stations to provide for sufficient raw water flow if reservoir levels drop below sufficient gravity flow levels
  - Susquehanna River is available to supplement Gunpowder supply through the Deer Creek Pumping Station located in northeastern Harford County
  - Susquehanna may not always be available in undiminished quantities due to withdrawal restrictions imposed by the Susquehanna River Basin Commission or because of poor water quality in the river.

# Water System Vulnerabilities

- No system-wide comprehensive evaluation has been performed
- Major distribution system tunnels NEVER inspected since put in service
- Pipes near or at end of service life
- Main breaks increased from avg. of 5 to 14 per day
- Open finished water reservoirs
- Microbial contamination
  - *Giardia lamblia* and *Cryptosporidium*



# Common Threats

- Water Quality Contamination
  - Antifreeze or other readily available substances
  - Raw Sewage
  - Biological Attack – Land of the unknown
- Physical/malicious destruction of property/major distribution system components
- Tunnel collapse
- Cyber-attack to SCADA system
- Chlorine Leak



# Water Emergency Preparedness Plan

- 5 Components
  - Water and wastewater utility, water and Wastewater facility and Storm/Flooding
- Review vulnerabilities and threats
- Incorporate existing risk management plans and Emergency Response SOPs
- Update threat/emergency incident levels
- Solidify response protocols
- Strengthen public information protocols and communications plan; Water Emergency Notification
- Coordination with Health Department and OEM
- Identify System critical components and mains

# Water Emergency Preparedness Plan

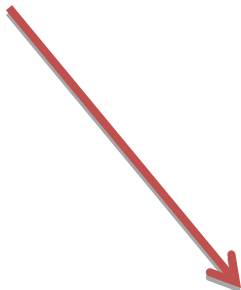
- Document required internal resources, equipment and material
- Consider required urgent need contracts or other outside resources
- Critical drawings; records on hand
- Regularly update emergency contact lists



# Water Emergency Preparedness Plan

Ties to DPW Response Plan and OEM Protocols

**OEM's Lead Agency Matrix**



HAZARD	LEAD AGENCY						
	OEM	BCFD	BCHD	BPD	DOT	DPW	MOIT
Tropical Cyclone	L						
Power Outage	L						
Chemical		L					
Radiological/Nuclear		L					
Fire/Explosion		L					
Collapse/Rescue		L					
Flash Flooding		L					
Earthquake		L					
Biological			L				
Extreme Heat			L				
Extreme Cold			L				
Active Shooter/Hostage				L			
Bomb Threat				L			
Civil Disturbance				L			
Blizzard					L		
Water Outage/Contamination/Drought						L	
Cyberterrorism							L

Lead agency assigns an Incident Commander and establishes command



# Existing Plans

- COB Emergency Operations Plan
  - DPW Emergency Response Plan
  - Water and Wastewater - Water
    - Water Quality Security Plan; daily monitoring
    - Security Plans for Threats
    - HAZMAT Plan; Environmental Services has an internal HAZMAT team
    - Emergency Response SOPs
    - Utility Maintenance Emergency Maintenance SOPs

# Emergency Response

## Proper Planning Prevents Poor Performance

1. Identify the problem; mark the time and determine how much time we have to work with
  - Potential contamination – *every second counts*
  - Power loss – *time for system to drain*
  - Water main break – *24 hours from no water; immediate shut-off if doing damage*
  - Dam failure, etc. – *every second counts*
2. Establish proper incident command (Physical and hierarchal)
  - No matter how small an event; problems can compound quickly
3. Take control; get the situation under control
4. Employ proper resources ; interagency coordination, external coordination
5. Enact proper response protocols and SOPs
6. Communicate effectively; one message (PIO)
  - Internal communication (DPW, Safety, Mayor's Office, Health Dept., OEM, DOT, etc)
  - Communicate to Critical facilities, major businesses, immediately affected OR Mass Communication (get the word out quickly; in the case of contamination)
  - Press release; Media communications
7. Follow-up/Recovery

# Case Studies – Fairfield (2007)

## 1. Problem:

- Water loss in the Locust Point Area first and we thought it was related to cleaning and lining
- Thought location was on Fort Avenue and learned that the problem was on the other side of the harbor; Tony Bressi left the Locust Point side to investigate other side
- PIO drove to location where brake was expected and saw no WWW personnel on site

## 2. Establish proper incident command:

- PIO ran into BCFD personnel and they became incident command

## 3. Take control; get the situation under control

- Valves were being turned to re-route water around the harbor
- The BCFD began to set up an Emergency Operations Center because we were losing water in the Curtis Bay tank

## 4. Employ proper resources ; interagency coordination, external coordination

- Pumper trucks were called in from AA and Baltimore Counties as backup if needed since this area in Fairfield/Wagners Point was high risk

## 5. Enact proper response protocols and SOPs

- PIO corresponded with WWW personnel by phone

## 6. Communicate effectively; one message (PIO)

- Public was updated ; told to conserve water with an outline of communities affected.

## 7. Follow-Up/Recovery

- Not made clear

# Case Studies – Pikesville PS (2008)

## 1. Problem:

- High winds took out both feeds to the MCC at the PS; lost power
- Determined there was a two hour window before the system drained leading to no water
- Identified location of generator supply and need to transport it from Back River
- New Year's Eve Holiday; staff on vacation; BGE Liaison was on vacation

## 2. Establish proper incident command:

- It was established the Pumping Ops supervisor would handle
- He took necessary action to set response protocols in play

## 3. Take control; get the situation under control

- Determined the area affected by possible outage
- Followed up with BGE for power restoration

## 4. Employ proper resources ; interagency coordination, external coordination

- BGE PS liaison was called; Other WWW Divisions and Transportation contacted to move the generator with no success

## 5. Enact proper response protocols and SOPs

- PS Personnel acted by Emergency Response Protocols for PS Power Outage

## 6. Communicate effectively; one message (PIO)

- Director, BH, Safety, PIO were notified early
- Public was notified ; told to conserve water with an outline of communities affected.

## 7. Recovery/Follow-up

- Power restored outside 2 hour window; however, generator able to run pumps
- System was monitored for recharge



# Case Studies – Madison 30 (2009)

## 1. Problem:

- Major 30" water main break 3:30 AM; major roadway; heavy flow causing damage
- Road at considerable slope; Macadam floating up and down street; debris wash out of hole
- Water flooding in a church, SHA and several residences as well as garage
- Valve adjacent to break is inoperable
- BGE major utility infrastructure in the same location

## 2. Establish proper incident command:

- Superintendent was on-site however when BH arrived site was not controlled; BH took over incident command
- Due to BGE perceived hazard, incident command was turned over to BCFD

## 3. Take control; get the situation under control

- Shut-off was in progress using a contractor and City resources
- Mercy hospital water pressure dropped; Hospital was back fed and monitored until pressure restored

## 4. Employ proper resources ; interagency coordination, external coordination

- OEM got proper resources out to control scene; DOT, BCPD, BCFD , Mayor's Office, DPW

# Case Studies – Madison 30 (2009)

## 5. Enact proper response protocols and SOPs

- BGE Emergency response, main break and no water response protocols put into play simultaneously with BGE work occurring first
- Once BGE cleared excavation, the incident was handled as any other main break

## 6. Communicate effectively; one message (PIO)

- PIO on scene early, communicated with Mayor's Press Secretary, DPW and the major businesses affected; Health Department, OEM, BCFD, BCPD and DOT
- Press release sent; however, there was a problem with DOT piece

## 7. Recovery/Follow-up

- Hospital pressure was restored within an hour of drop
- Main section replaced; Citizens out of water 1.5 days; however, Citizens provided water
- Basement pumping, cleaning debris; restoration of roadway in 2 days from start of incident



# Lessons Learned

- Fairfield:
  - *No Operations Personnel /WWW staff on-site at incident command*
  - *No drawings on site*
  - *Water quality testing resources should always be in place to give firm direction to Public*
- Pikesville PS Power Loss:
  - *Need emergency resources in place at all times; know what resources you have before the incident*
  - *Additional resources may be required*
  - *BGE learned that they need to make sure designee is clearly identified in an absence*
- Madison 30:
  - *Proper command brings situation under control in a short period; know what resources you have before the incident*
  - *Original notification sent by email instead of phone calls during sleep hours*
  - *All tools, materials and equipment must be on-site and at the ready; cuts time*
  - *Shutoff diagrams allow you to maintain control*

# Lessons Learned

- Prepare for emergencies: review prior briefs and after action reports; table-top exercise; training, resources in place; pre-established roles
- Over-communicate if you have to, but get the right resources in place as quickly as possible
- Flash brief: understand all the issues, the effects, the time frame ASAP
- Establish command based on the threat; L&L means BCFD
- Have a Plan B



Are We Ready?

**YES**