



The Mercer Island *E. coli* Event

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Office of Drinking Water

Washington State Department of Health

PUBLIC HEALTH
ALWAYS WORKING FOR A SAFER AND
HEALTHIER COMMUNITY



Office of Drinking Water's Mission

To protect the health
of the people of Washington
State
by ensuring safe
and reliable
drinking water.



Today's Talk

- Coliform water quality testing recap
- Coliform rule requirements
- Describe Mercer Island *E. coli* event
- Distribution System findings
- Lessons learned (Ah ha moments)

Coliform Bacteria Definition

- Coliform group several genera of bacteria belonging to the family Enterobacteriaceae.
- Historical definition based on detection method!
(Standard Methods 22nd Edition 2012, Section 9221 & 9222)
- **Fermentation** – facultative anaerobic, gram-negative, non-spore-forming, rod shaped bacteria, that ferment lactose with gas and acid formation w/in 48 hours at 35^o C.
- **Membrane filter** - facultative anaerobic, gram-negative, non-spore-forming, rod shaped bacteria that form distinctive colonies on specific media – usually w/in 24 hours at 35^o C.
- **Enzyme Based Methods** – Colilert-18 / Colisure

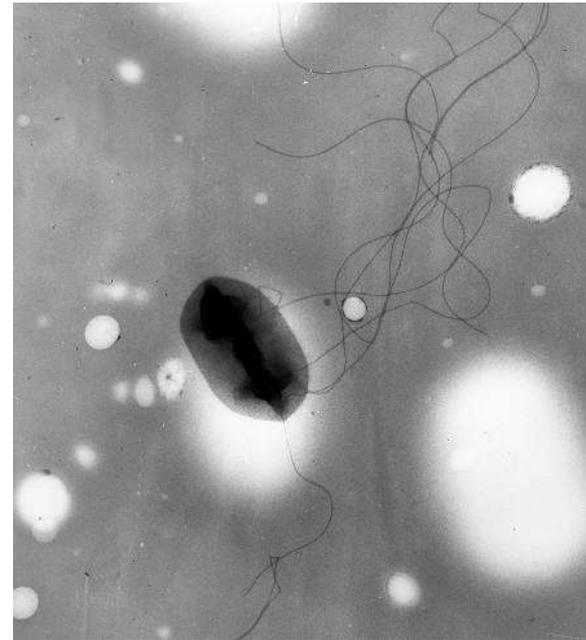
Thermotolerant Coliforms (*Fecal coliforms*)

- Total Coliform Bacteria That:
 - Ferment Lactose at an Elevated Temperature
When Using Standard (FC) Media
44.5 +/- 0.2 C (mimic body temperature)
- Short-Lived but Fecal Indicator
- *E. coli* Is a Fecal Coliform

Escherichia coli (*E. coli*)

(esh a rik e a)

- Hundreds of Strains Known
- Most Strains Are Harmless and Live in the Intestines of Healthy Humans and Animals
- Strain O157:H7
 - Produces a Powerful Toxin
 - Causes Bloody Diarrhea and Occasionally Leads to Kidney Failure



The Total Coliform Rule

Purpose:

- Determine the adequacy of water treatment.
- Determine the integrity of the distribution system and its impact upon water quality.

Rule uses Total Coliforms and *E. coli*

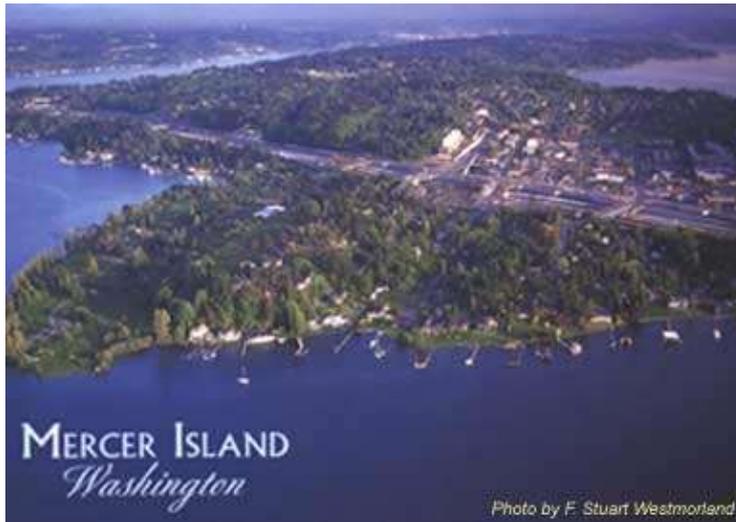
The Total Coliform Rule (cont.)

- Collect routine total coliform (TC) samples from the distribution system every month.
- # of samples based on population served
- Samples must be analyzed by an accredited laboratory.
- TC positive samples must be analyzed for *E. coli*.
- Three repeat samples must be collected for every positive routine total coliform sample.
- An acute MCL violation is created if any of the repeat samples are positive and any sample contains *E. coli*.
- Public Notification is required asap in response to an acute MCL violation and no later than 24 hours.

European Union Microbiological Parameters

Parameter	Parametric Value
Escherichia coli (<i>E. coli</i>)	0 / 100 ml 0 / 250 ml (bottled)
Enterococci	0 / 100 ml 0 / 250 ml (bottled)
Total Coliform	0 / 100 ml 0 / 250 ml (bottled)
Colony count at 22° C	No abnormal change 100 / ml (bottled)
Clostridium perfringens (including spores)	0 / 100 ml

European Drinking Water Directive 1998 Annex 1, Part A & C



Mercer Island *E. coli* Event

Sept. 24, 2014

- Community description and population
- Water System Description
 - Miles of pipe, storage tanks - schematic
 - Source of water and treatment
 - Background water quality
- Event trigger – as determined with 20/20 hindsight
- Response / mitigation
- Lessons learned

~~Mercer Island *E. coli* Event~~ Just another fecal Friday

- 9am 'heads up' from lab - we have 6 TC+ / 1 *E. coli*+
Three systems: Mercer Island, System A, Seattle
 - What to do?
 - Collect repeats – any difference TC+ and *E. coli*+ repeats?
 - Who tell? Any Prep?
- Saturday 9am
 - 3 compliance repeats OK
 - 4 of 6 investigative *E. coli* + (not OK)
 - What to do? Who tell? What? Where?
 - What do others do? Food service, schools

Incident Timeline Phase 1

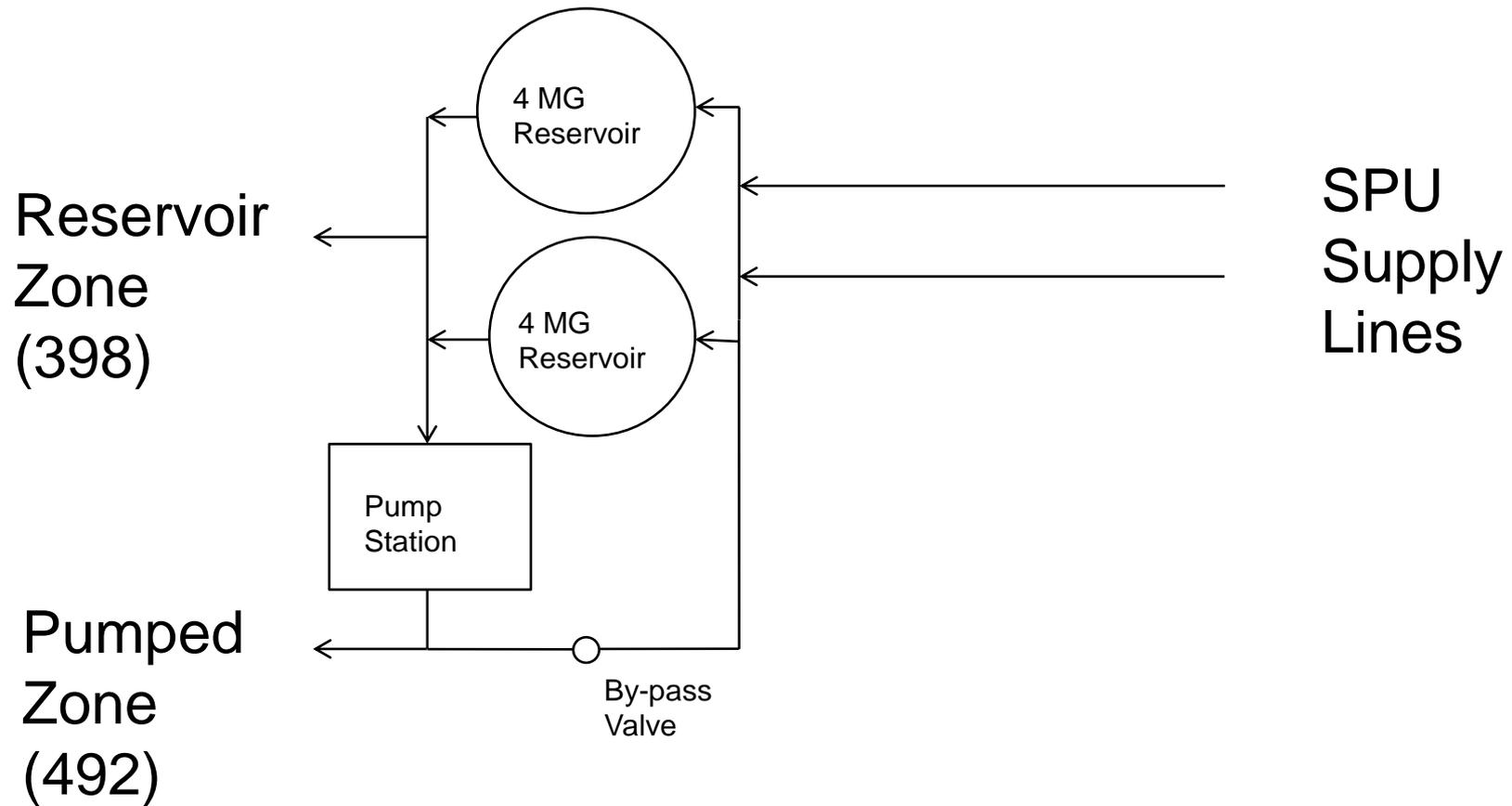
- Sept 27 4 MI investigative sites positive for *E. coli* and TC (with Cl₂ present)
(Compliance repeat sites showed no coliform, NO water quality violation under Total Coliform Rule)
With guidance from DOH, the City issues a Boil Water Advisory for all residents
9am / 11am / 4pm
Public Health-Seattle & King County closes food service venues
SPI conducted
- Sept 28 Of eight samples collected - all *E. coli* negative; one sample TC+
- Sept 29 Of eleven samples collected - all *E. coli* negative; one sample TC+
Boil Water Advisory lifted
- Sept 30 6 Samples - results all clear (6 more collected)
- Oct 1 6 Samples - results all clear (6 more collected)

Mercer Island Facts

- Population: 22,270 People
- Service Connections: 7,335 (62 Food Service Permits)
- Source: Seattle Public Utilities (SPU) wholesale customer
- Mainly Cedar River water; LAF designation; Closed watershed; Ozone, UV Disinfection, Chlorination; Low Organics



Mercer Island Supply Facilities



Mercer Island Water System

Storage: Two 4 MG Reservoirs

Distribution System:

- 121 Miles of Pipe
- Significant Amount of Unlined Cast Iron
- 86 PRV Vaults and stand alone Air-Vacuum Assemblies

Pump Stations:

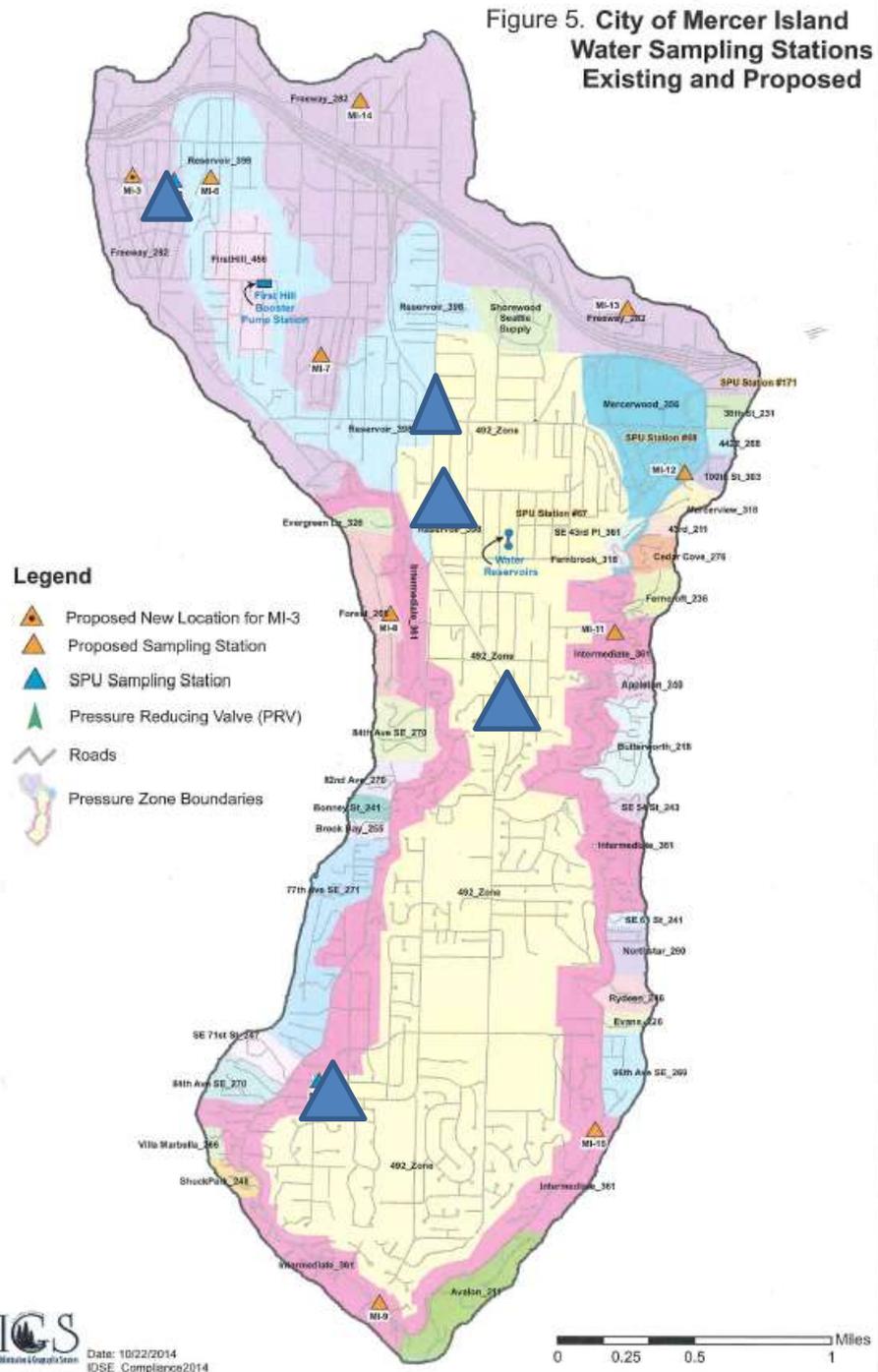
- Main PS (9,000 gpm to elevation 492)
- First Hill PS (1,150 gpm to elevation 456)

Pressure Zones:

- Reservoir Zone – 398 (31.4% of total demand)
- Pumped Zone – 492 (68.6% of total demand)
- First Hill Zone – 456 (2.2% of total demand)
- Many Smaller Zones Supplied Through PRVs
(range 215 – 285 ft. HGL)



Figure 5. City of Mercer Island Water Sampling Stations Existing and Proposed



Mercer Island Coliform Monitoring Sites & Pressure Zones

Mercer Island Coliform Monitoring Program

- Part of SPU Regional Coliform Monitoring Program
- SPU Collects all routine samples (> 880/month)
- SPU regional system monitoring (~330/month)
- On Mercer Island SPU collects 18 samples per month from five sample stations
- Mercer Island staff responsible for collecting Repeats and any Investigative Samples
- All samples are analyzed by SPU's Laboratory



Incident Timeline Phase 2

(Thermotolerant Thursday)

- Oct 2 One sample *E. coli* positive another sample TC+; **Boil Water Advisory reinstated**; Develop and begin **Initial Action Plan**
- Oct 3 Fifteen samples all clear; some foodservice venues reopen w/ limited menus
- Oct 4 Reservoir inspection
- Oct 5 Additional chlorine injected; flushing continues; *E. coli* case confirmed in child
- Oct 6 Samples increased to 18/day; flushing continues; inspect PRV vaults; explore backflow connections
- Oct 7 50% of restaurants back open; checklist of actions near-complete
- Oct 8 Boil Water Advisory lifted at noon (~ 100 coliform samples all negative)

Mercer Island Initial Action Plan

- Increase samples to 18 per day from throughout the island using standard collection protocols.
- Dive the reservoirs.
- Increase chlorine residual entering the tanks.
- Inspect all construction sites.
- Inspect all underground vaults.
- Identify and test all high hazard backflow assemblies that had not been tested within the last 12 months.
- Monitor chlorine and flush distribution system to displace the water.

Coliform Sample Collection

- Positive results occurred with different samplers
- Positive results from different locations
- Review of sample collection techniques reviewed and approved on Oct 2 by SPU and DOH
- Laboratory controls reviewed and found acceptable
- Sample stands are designed for continuous flow
- Use of alcohol wipes on first investigative samples – no SOPs
- Standard sampling protocol established on Oct 2



Source and Treatment Evaluation

- Raw water sampling results—Typical.
- Source treatment includes ozonation, filtration or UV radiation, and chlorination.
- No treatment problems identified by SPU.
- No other systems had *E. coli*.
- Six TC+ samples from three systems on one day.
- Average four/year in 2011-12.
- Fourteen TC+ samples (including 2 EC+) since August 1.

Distribution System Evaluation

- Storage facilities—no problems inside or out.
- 18 untested assemblies on high hazard cross-connections.
- By-pass valve with standing water containing *E. coli* — *no* leaks.
- By-pass valve and pump stations are designed to prevent pressure transients.
- New construction—no problems identified.
- Water main repairs and leakage—one recent Type 1 break and 9 % leakage.
- Fire hydrant and valve maintenance—no program.
- No pressure issues identified.
- No credible threats identified.

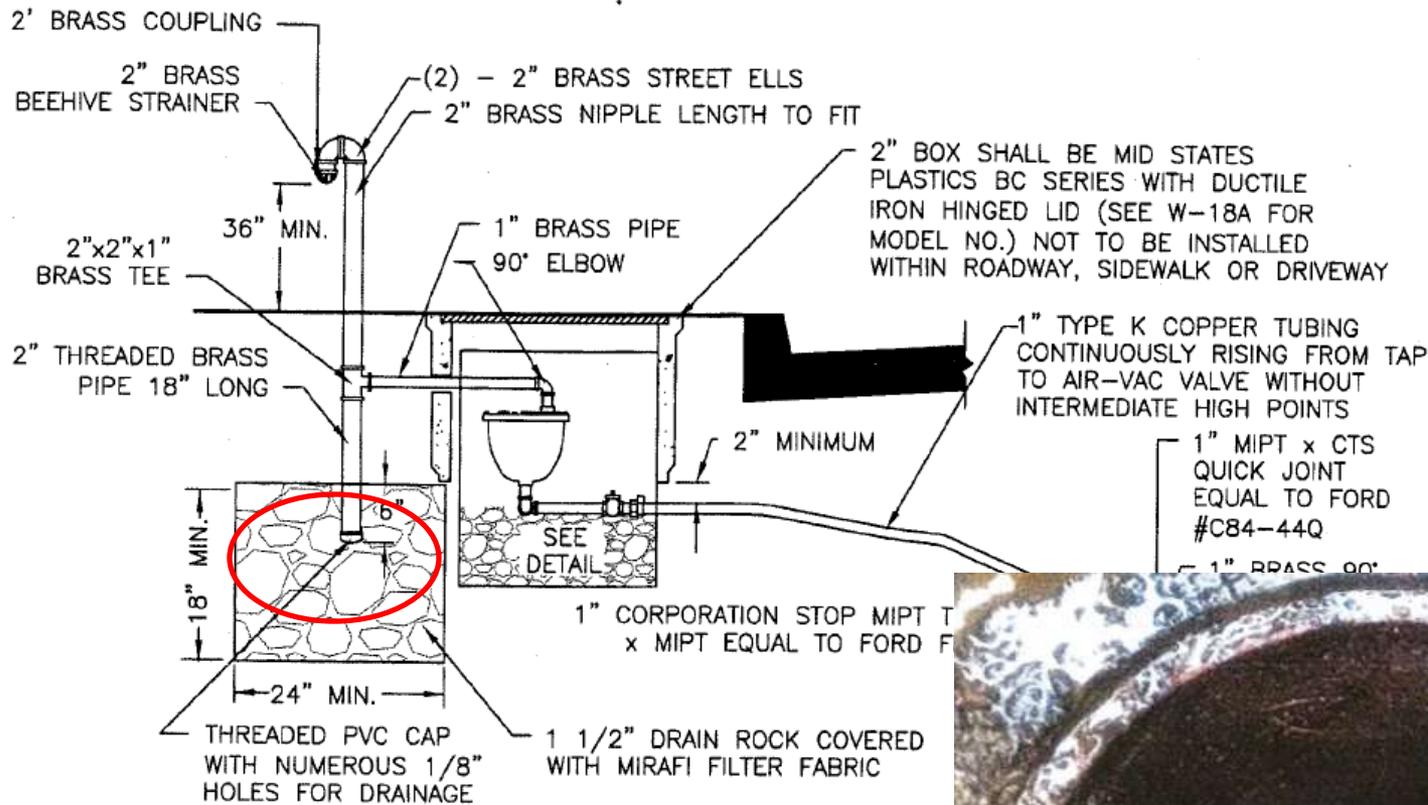


Distribution System Evaluation

- Pipe conditions
 - High proportion of unlined cast iron
 - Flow restricted due to tuberculation
 - Replacement rate 0.4 percent a year
- Flushing program
 - System flushed every two years
 - Unable to achieve scouring velocities
- Disinfection residuals
 - Limited monitoring
 - Flushing required to maintain residual
- Air-vac valve assemblies without proper venting.
- ... did I mention the rain? +1.5 inches Sep 24-25



Air Vacuum Valve Vaults



 CITY OF MERCER ISLAND STANDARD DETAILS WATER		
1" AIR & VACUUM VALVE ASSEMBLY		
10-16-2013	NO SCALE	W-25
		APPROVED

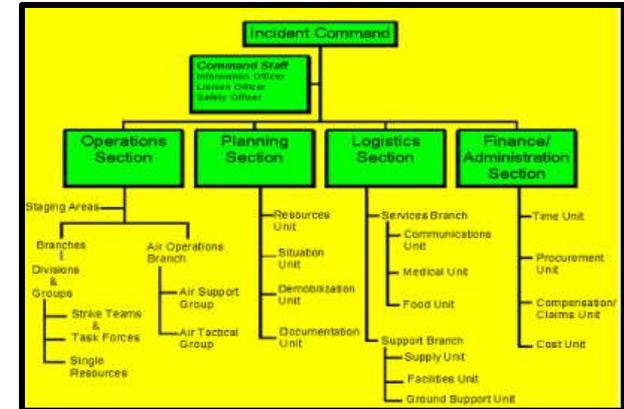
Lessons Learned & re-learned

- Boundary – key issue – who is impacted?
- Multi-media world. Perfect message vs. Time!
 - Social Media is faster than a speeding bullet
 - Reverse 911, Website, Twitter, Reader boards.
 - Be in the room if you want to be heard.
- Media face – quandary – know subject matter?
 - Toledo Idea?
- Coordinating – Food, hospitals, schools.



Lessons Learned & re-learned

- Incident Command Structure – integration of utility capability into larger structure ICS
- Staffing requirements – IT, utility, (reticent to ask for help)
- Response time – utility staff, et.al.
- Budget implications NOW.



Lessons Learned & re-learned

- A large chlorinated system—lack of operational flexibility.
- Implementation of best management practices (BMPs) reduces uncertainty
- Documentation – SOPs, BMPs - culture.
 - Data driven decisions / answers for media
- Health Advisory Response Plan
 - *E. coli*
 - Water Main Breaks
 - Pressure Loss

Questions

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State Health's Role

- Regulator.
- Technical specialist.
- Educator.
- Risk communications.
- Public health partner.
- We want to be in the room with the decision-makers.

Public Health – Seattle & King County Role

- Emergency response.
- Permit food service establishments.
- Technical specialist.
- Educator.
- Should be in the room with the decision-makers.

Utility Partners

- City or county general purpose government.
- Schools and school districts.
- Medical community.
- Business community.
- Adjacent utilities.
- Volunteers.