Responding to Reoccurring Coliform Detects South Shore Water System South Kingstown, RI

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Outline

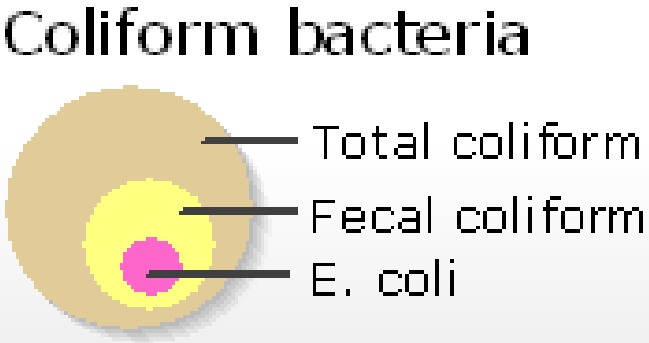
- Introduction
- South Shore System
- Hydraulic Model
- Evaluation Overview
- Summary

South Kingstown

Introduction

Total Coliforms

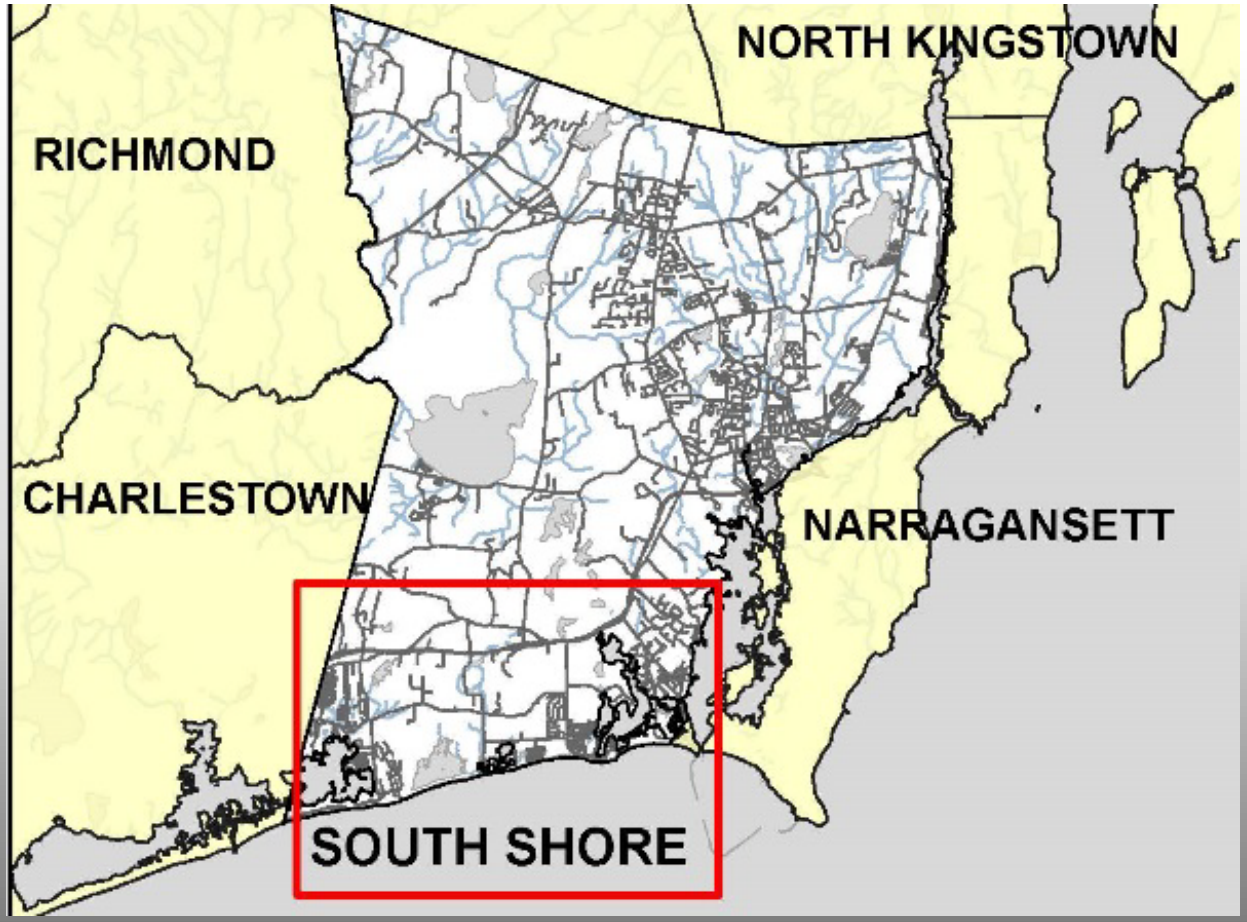
- Total Coliforms
  - Gram-negative, aerobic or facultative anaerobic, nonspore forming rods
  - Include both harmless bacteria and pathogenic bacteria (fecal coliform)
- Fecal Coliforms are a type of Total Coliform
- *E. coli* are a type of Fecal Coliform



Revised Total Coliform Rule

- Initial TCR, 1989, developed to set goals for presence of TC and limits for FC or *E. coli*
- TC - indicator for system integrity
- *E. coli* - indicator of fecal coliform - indicates contamination of water by warm-blooded animal
- RTCR, 2013, MCL for *E. coli* but not for TC
  - Level 1 Assessment
    - Required if more than 2 TC positives
  - Level 2 Assessment (by State or State approved party)
    - Second Level 1 trigger within rolling 12-month period or in 2 consecutive years

South Shore Water System



System Overview

- 2,479 accounts – primarily residential with light commercial
- 0.35 MGD Average Day; 0.9 MGD Max Day
- 47 miles water main 4” to 14” mainly AC pipe
- Two 400,000 gallon elevated water storage tanks on opposite ends of system
- Booster pumping station
- Source since about 2003: Interconnection with United Water Rhode Island (UWRI)

South Shore TC Detects

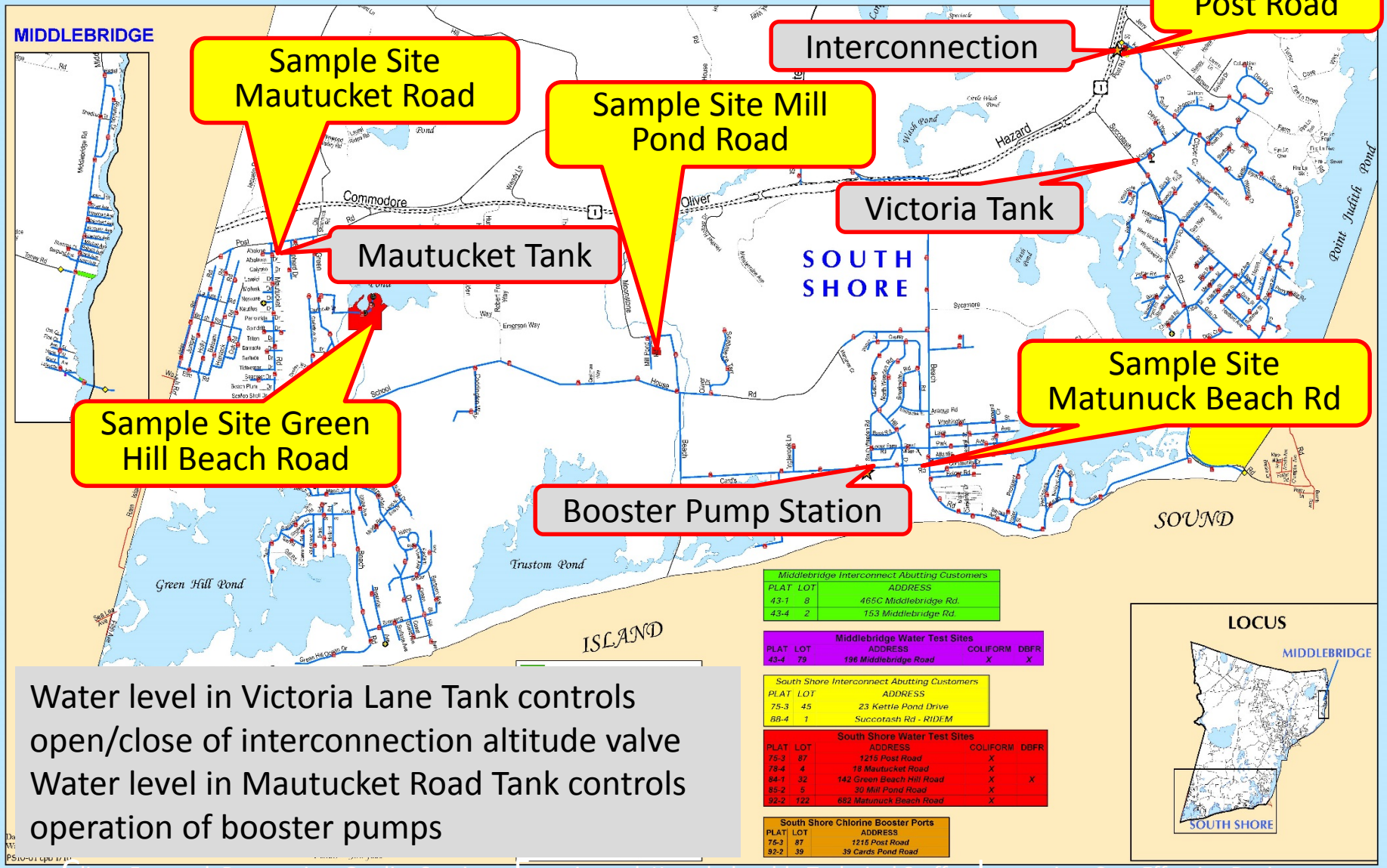
- 5 Regular Monitoring Sites in South Shore Water System
- Detections occurred at the Mautucket Road Tank regular sample site
  - October 2, 4 and 11, 2012
  - May 21 and 23, 2013
  - July 23 and 25, 2013
- Repeat samples taken in area of the tank were total coliform positive
- No *E. coli*

Town of South Kingstown

WATER SERVICE AREA

Department of Public Services

The features delineated within this map are shown solely for informational purposes. There is no warranty, either written or implied, as to the accuracy of these features.



Water level in Victoria Lane Tank controls open/close of interconnection altitude valve
Water level in Mautucket Road Tank controls operation of booster pumps

Middlebridge Interconnect Abutting Customers

PLAT	LOT	ADDRESS
43-1	8	465C Middlebridge Rd.
43-4	2	153 Middlebridge Rd.

Middlebridge Water Test Sites

PLAT	LOT	ADDRESS	COLIFORM	DBFR
43-4	79	196 Middlebridge Road	X	X

South Shore Interconnect Abutting Customers

PLAT	LOT	ADDRESS
75-3	45	23 Kettle Pond Drive
88-4	1	Succotash Rd - RIDEM

South Shore Water Test Sites

PLAT	LOT	ADDRESS	COLIFORM	DBFR
75-3	87	1215 Post Road	X	
78-4	4	18 Mautucket Road	X	
84-1	32	142 Green Beach Hill Road	X	X
85-2	5	30 Mill Pond Road	X	
92-2	122	682 Matunuck Beach Road	X	

South Shore Chlorine Booster Ports

PLAT	LOT	ADDRESS
75-3	87	1215 Post Road
92-2	39	39 Cards Pond Road

LOCUS

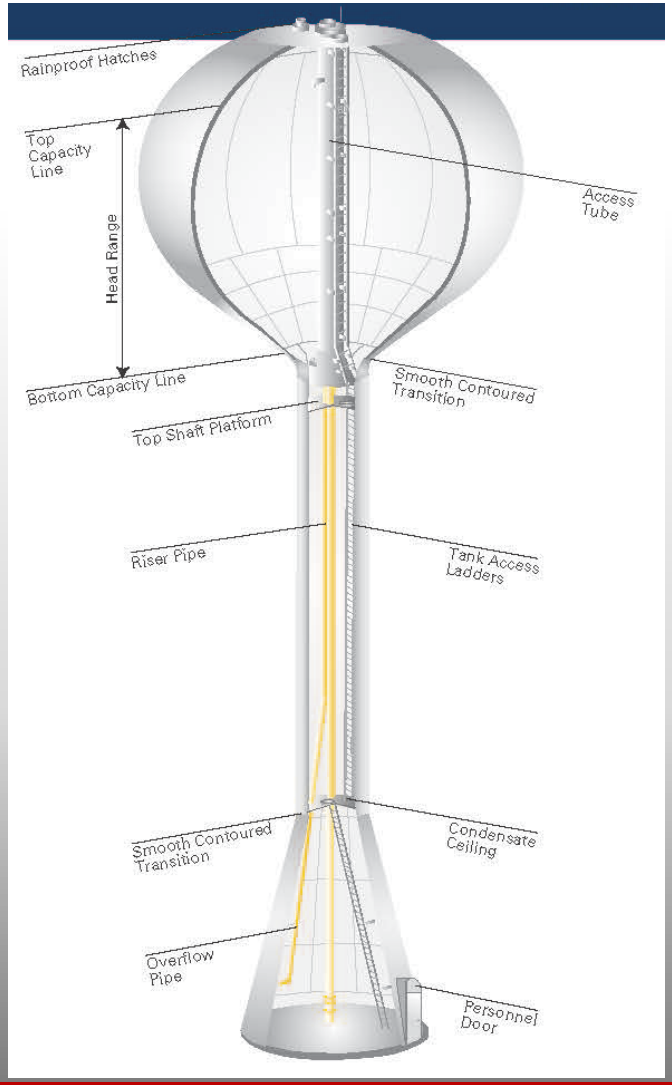
UWRI – South Kingstown

- Gravel packed wells (Tuckertown Road) about 2 miles from interconnection (Fe < 0.05 mg/L, Mn < 0.02 mg/L)
- Treatment at one of two facilities, both have:
  - Aeration for CO_2 removal,
  - Lime - pH adjustment (8-14 mg/L),
  - Zinc orthophosphate - corrosion control (2.5-3 mg/L)
  - Sodium hypochlorite – disinfection (0.6-0.7 mg/L)
- Finished water pH is about 7.5
- Groundwater temperature 53°F winter to 58°F summer
- Total coliform positive detections have occurred (as recently as Nov 2013) repeat sampling TC absent.

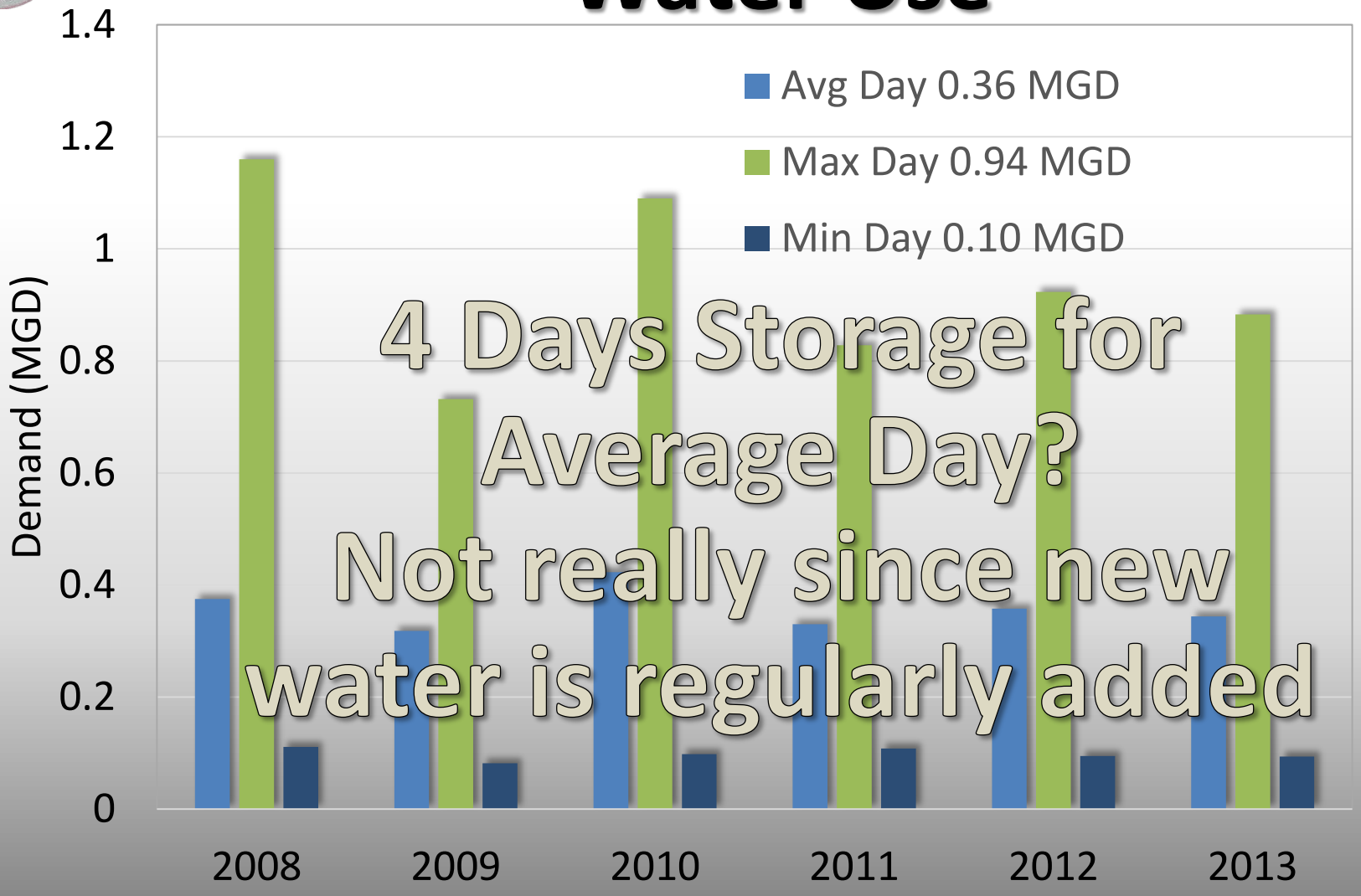
South Shore - Distribution

- Victoria Lane Tank (East Zone) 400,000 gal
- Mautucket Road Tank (West Zone) 400,000 gal
- Water main 4” – 14” total 755,000 gallons, primarily AC pipe, DI used for new pipes

1.6 MG Storage in Distribution System



Water Use



4 Days Storage for Average Day?
Not really since new water is regularly added

Residual Chlorine

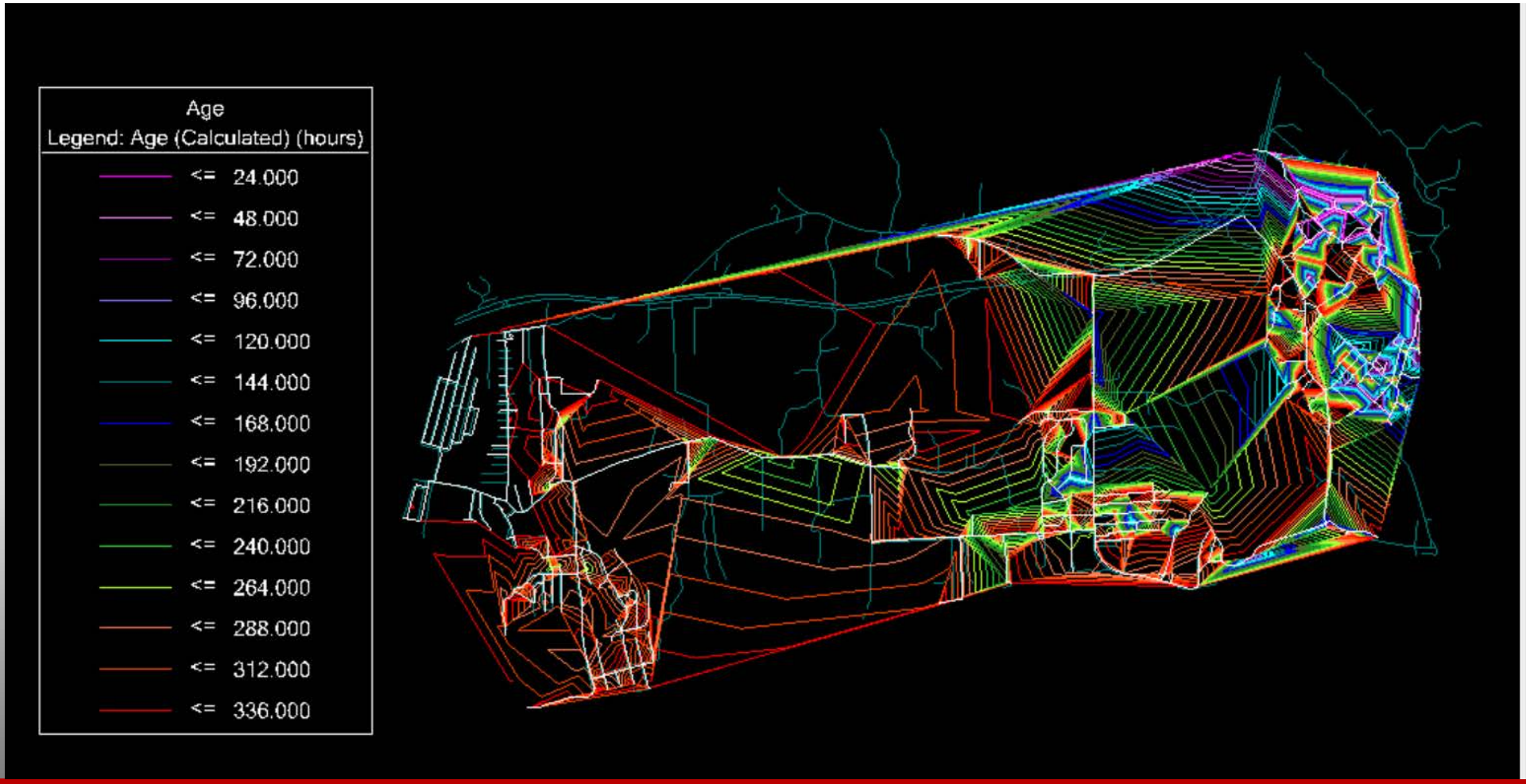
- Chlorinated water supplied by UWRI
- Town monitors twice monthly at several locations
- Level at interconnection typically 0.3-0.5 mg/L, but can be < 0.1 mg/L
- Levels at TC sampling sites typically trace amounts
- Levels at Mautucket Road Tank site 0.0 to 0.05 mg/L – Essentially Non-Detect

Hydraulic Model

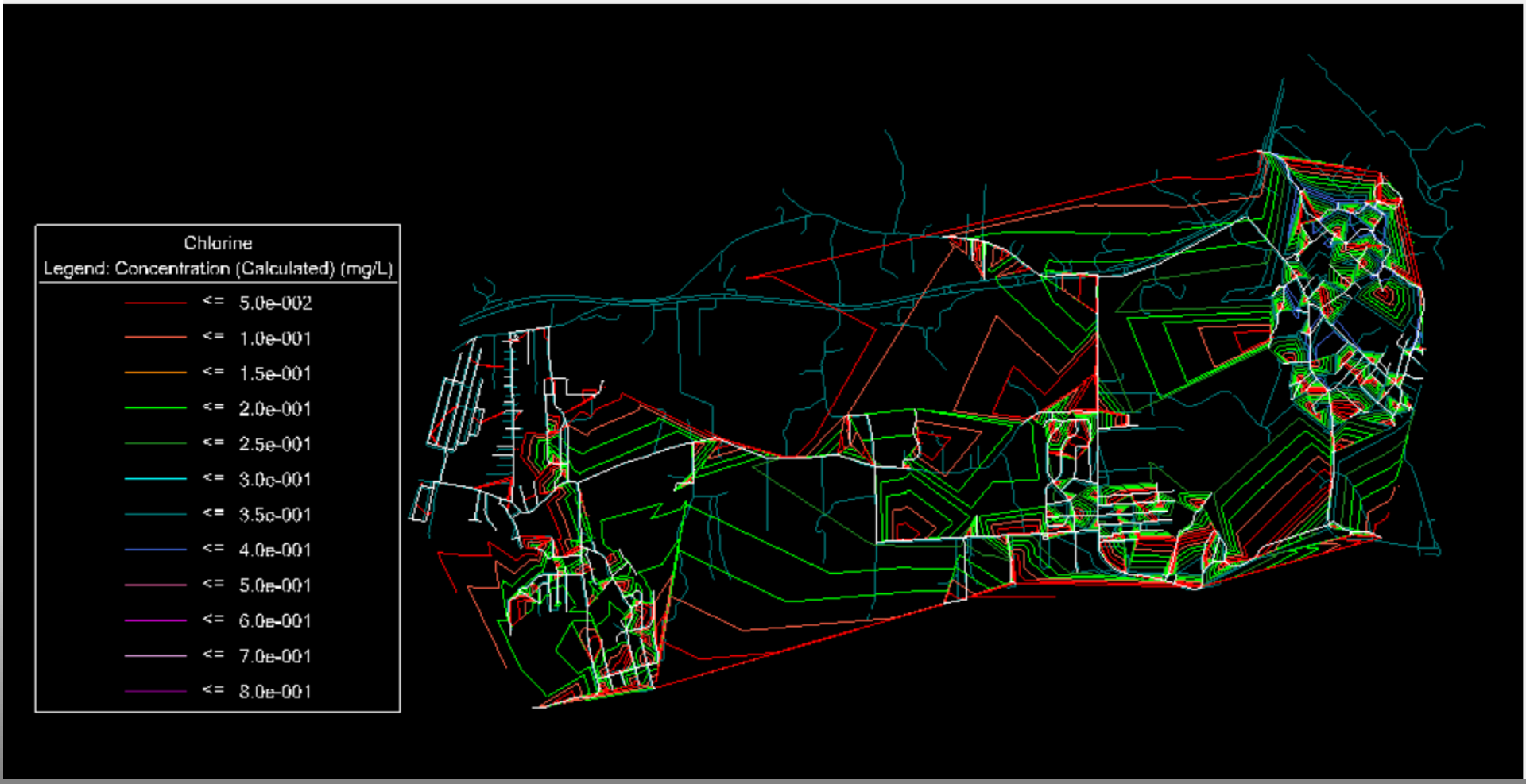
Model

- Developed using WaterCAD/GEMS
- Tanks with Operating Levels
- Interconnection with altitude valve controls and meter
- Booster Pumps
- Demands – Average Day and Max Day
- Extended runs – Diurnal Curve
- Water Age
- Residual Chlorine

Existing Conditions/Operations
Water Age – Average Day



Existing Conditions/Operations
Residual Chlorine



Chlorine Added at Booster PS

- Hourly Changing Average Day Demand
- Assumes 0.4 mg/L residual chlorine provided at interconnection and another 0.4 mg/L added at Booster Pump Station
- Over the two weeks modeled no improvement over the existing conditions.
- Areas near the Booster Pump Station experience levels up to 0.7 mg/L, which may cause complaints
- Validated by historical observations by Water Department staff when chlorine was added at Booster Pump Station in the past.

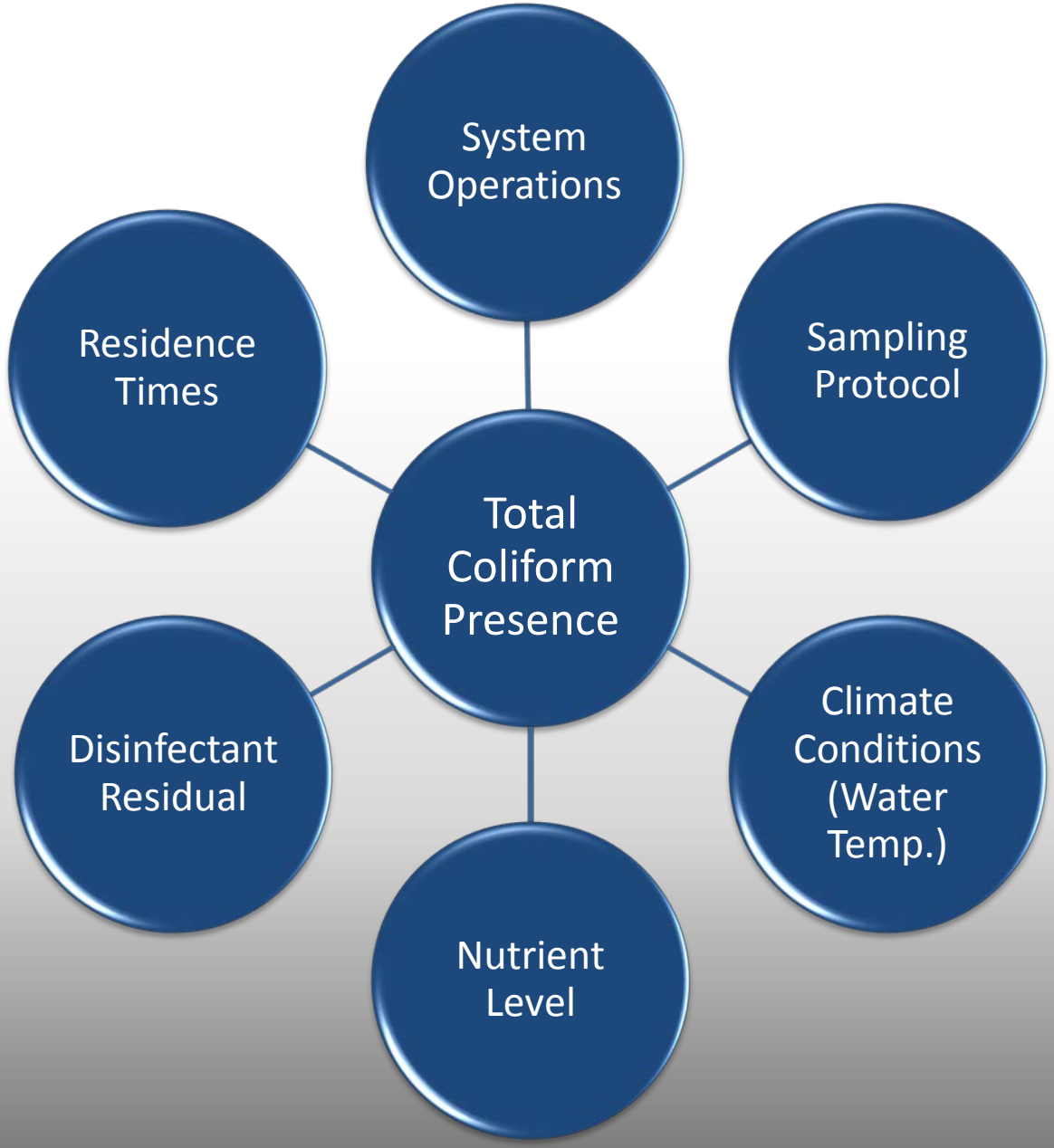
Chlorine Added at Mautucket Road Tank

- Hourly Changing Average Day Demand
- Assumes 0.4 mg/L residual chlorine provided at interconnection and another 0.4 mg/L added as water flows out of Mautucket Road Tank
- Over two weeks shown, residual chlorine remains close to 0.4 mg/L in the areas around Mautucket Road Tank. This is an improvement over existing conditions.
- No areas of the system are greater than 0.4 mg/L chlorine

Chlorine Addition at Mautucket Road Tank

Evaluation Overview

Factors Impacting Total Coliform Detects



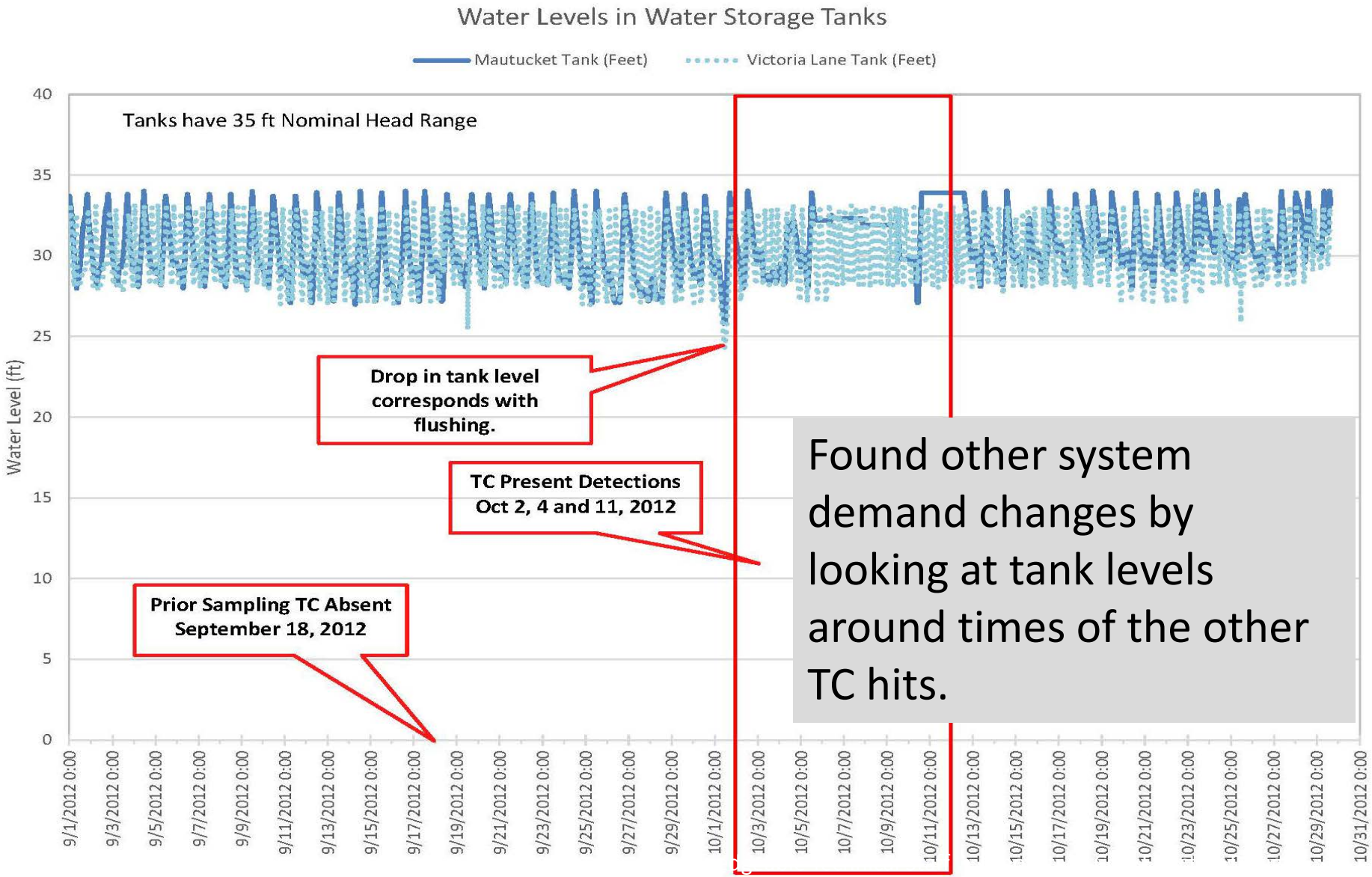
Sampling Protocol

- Samples taken by Water Department Staff
- Samples taken at each sample location in the same manner
  - If present, aerators are removed
  - Sample tap is disinfected
  - Sample tap flushed for several minutes
  - Sample taken, covered and stored for transport to lab
- Since detects reoccur in the same location (Mautucket Tank) and not at other sites the sampling protocol is not a likely cause of coliform detections

System Operations

- System operations that can cause disruptions
  - Main breaks
  - Main construction
  - Power losses
  - Pressure losses
  - Source water changes
  - Flushing and Changes in flow patterns
    - Flushing and/or tank level change did occur prior to detects

Tank Levels: Sep – Oct 2012



Found other system demand changes by looking at tank levels around times of the other TC hits.

Flushing

- Flushing at lower velocities can exacerbate problems by disturbing/sloughing and mobilizing biofilms and sediment but not removing them
- Velocity
  - Conventional approach 2.5 fps minimum
    - 12-inch dia. main, 2.5 fps is about 900 gpm
  - More recent research shows the minimum velocity needed to remove sediment 5 fps
    - 12-inch dia. main, 5 fps is about 1800 gpm
- Helps explain why some systems see higher levels of coliforms after flushing

Evaluation Summary

- Sampling protocol – Not likely factor
- System operations – Likely contributing factor
- Climate conditions – Warming air temperatures contribute to warming water temperature (precipitation not likely factor)
- Residence times – Likely contributing factor
- Residual chlorine levels - Likely contributing factor
- Nutrients – Organics not a likely factor for this system however, materials of construction could contribute

Coliform Source

- Potential Sources of Coliform
  - Soil and Water Surrounding Pipes – Possible source during main repair and construction
  - Biofilms – Likely source
    - Difficult to pin point
    - Random sampling of pipe surfaces may not detect
  - Sediment in both pipes and tanks – Likely source since velocities in mains are low
  - Corrosion tubercles – Not likely since mostly AC pipe
  - Materials in Use – Possible, materials could have been contaminated during installation
  - Customer Connections – Possible, no current cross connection survey

Susceptible Locations/Times

- Dead-ends where residence times and water temperatures are highest
- Areas that are difficult to flush at high enough velocities
- Spring to Fall – Higher water temperature
- Sudden velocity or flow direction changes
  - Flushing
  - Higher than normal demands and fire fighting
  - Valve exercising
  - Tank level change

Next Steps for South Kingstown

- Chlorination station to be constructed at Mautucket Road Tank
  - Design currently under review by RI Dept. of Health
  - Generally consists of precast concrete building, metering pump, day tank, chlorine analyzer, flow meter and SCADA upgrades
- Considering tank mixing system

Summary

- TC hits can be persistent
- Document and save as much data/information occurring before and during the time of the hit for further analysis
- Utilize tools available including SCADA and hydraulic model
- Every system is unique – need to carefully review all components to develop a plan

Questions?

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