

Presentation to OTCO - Managing THMs in Disinfected Drinking Water

Transforming the Way We See and Treat Water

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Aqua Metrology Systems



Agenda

- Introduction to AMS
- The importance and challenges of monitoring THMs and THM Formation Potential
- The THM-100
- Data accuracy, precision and reliability
- SafeGuard H2O THM removal technology



Our History

- Global market leader in online THM analyzers (>100 in USA)
 - Only online THM analyzer for THM Formation Potential of treated water
 - Only online THM analyzer for THM Formation Potential of untreated water
- 2010: First THM-100 sale in in UK
- 2011: First THM-100 sale in USA
- 2015: Approved method for Regulatory Analysis by ISO 17025 Certified Laboratories (EU)
- 2019: Launched SafeGuard™ H2O Intelligent THM Aeration System
- 2021 Approved for THM monitoring by eSPAN (Malaysia Environmental Protection Agency)
- 2022 Approved for THM Monitoring in Greece
- US References: New York City, San Francisco, Birmingham, AL; El Paso, TX, Gilbert, AZ; Citizens, OK; Des Moines, IA; North Kentucky, KY, JEA, FL....



AMS Analytics Product Offering



Online Analyzers



THM



Trace Metal
(As, Ni, Pb, Cu, Cr, Fe, Mn, Se..)



Nitrite/nitrate/fluoride
ammonia/phosphate...



Trace Metal
(As, Ni, Pb, Cu, Cr, Fe, Mn Se..)

Bench-top Analyzers



THM



The Value of Real-time Water Quality Data

Characterization

Extensive data stream supports the design of cost-effective treatment processes

Demonstration

Provides rapid assessment of the impact from operational changes on water quality levels

Technology Validation

Provides fast feedback and validation of treatment process

Process Optimization

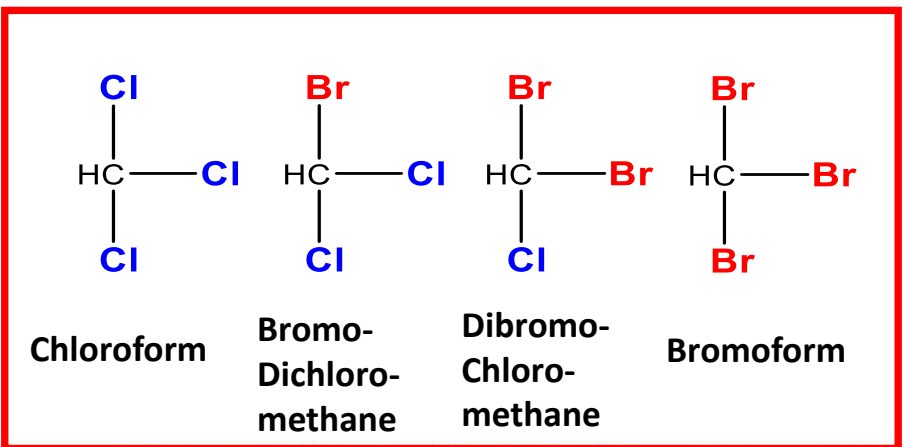
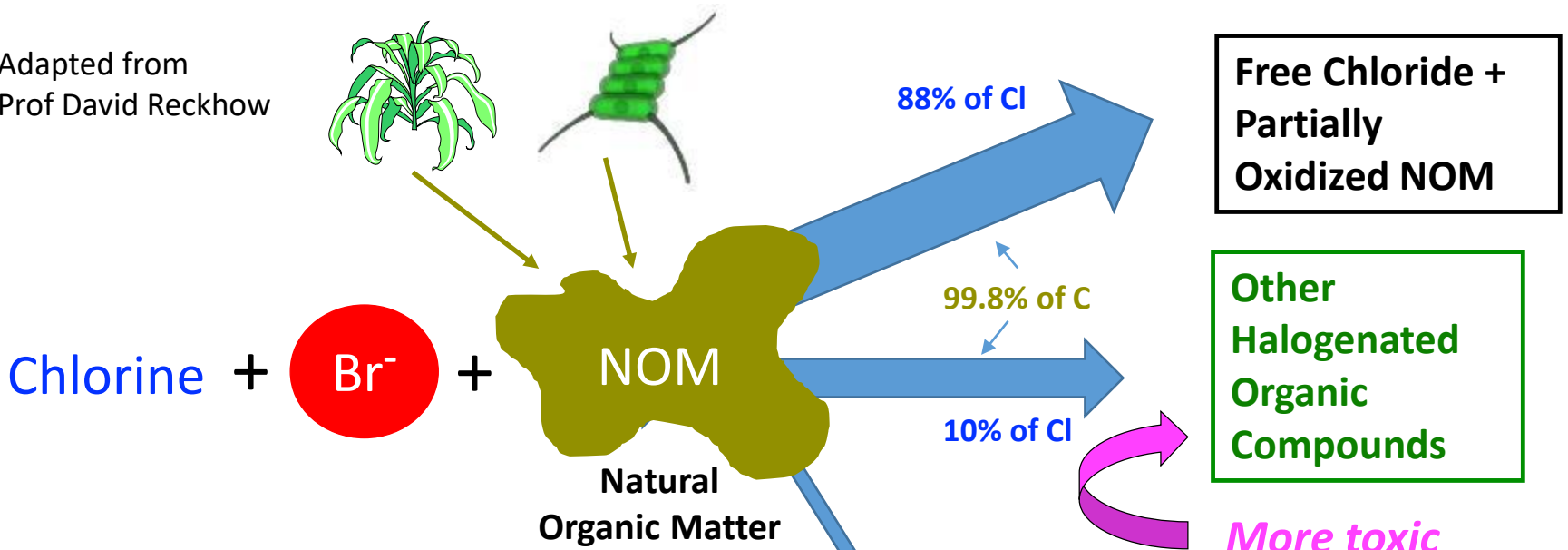
Captures and predicts changes in water quality levels ensuring timely and cost-effective treatment and **reduced GHG emissions**

Risk Management

Predicts non-compliance risk to enable timely action before non compliance occurs, ensures regulatory and contract compliance

The Formation of Disinfection By-Products (DPBs), including Trihalomethanes (THMs)

Adapted from Prof David Reckhow



More toxic

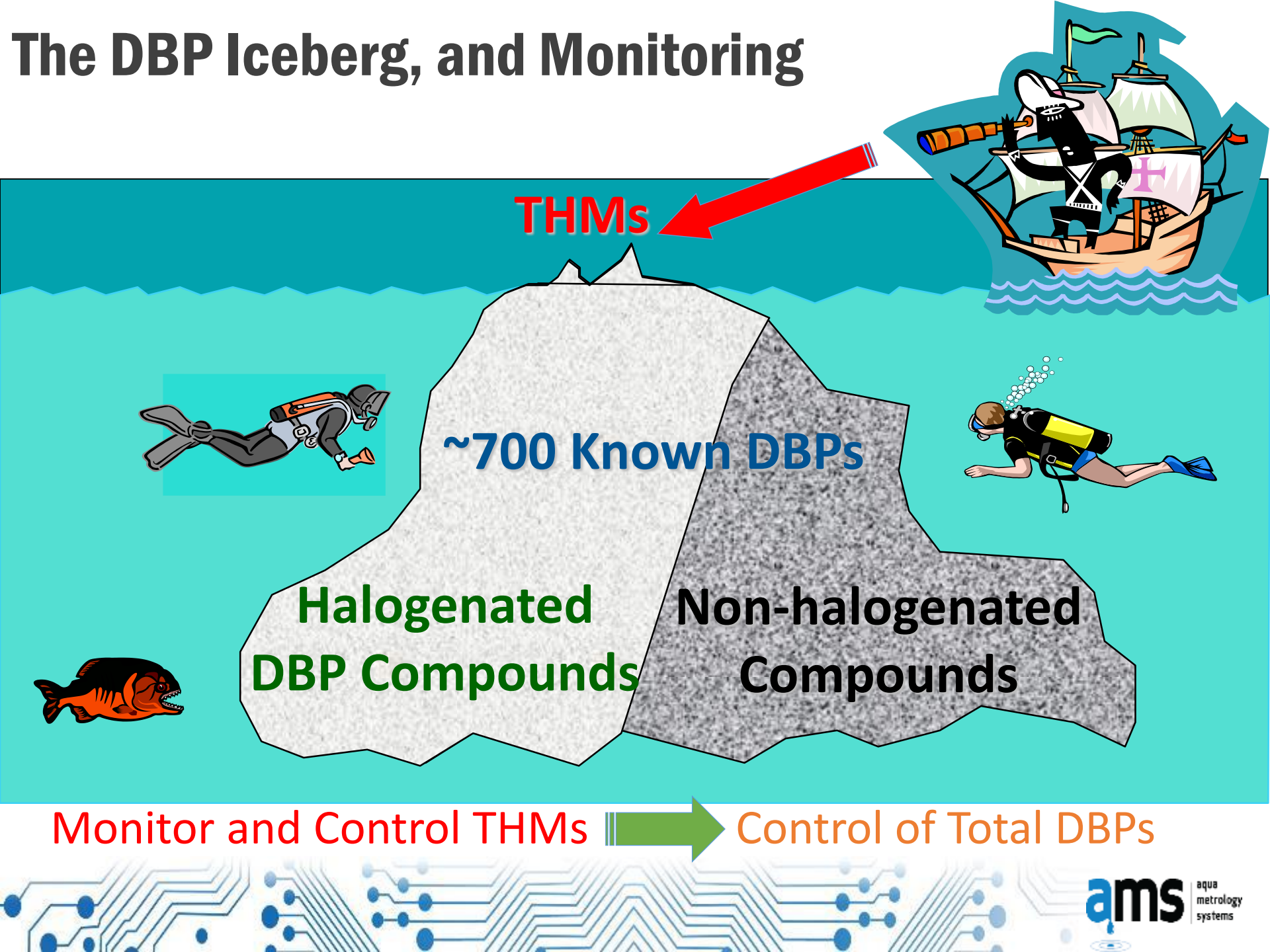
Easier to monitor

THMs
Trihalomethanes

Largest individual concentrations

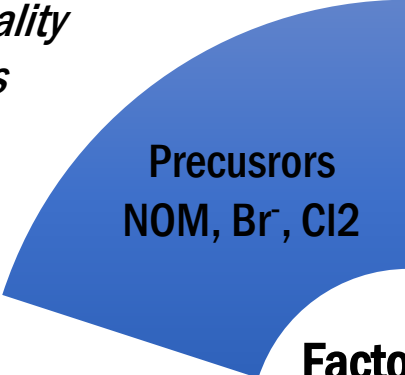
The Organic Disinfection Byproducts (DBPs)

The DBP Iceberg, and Monitoring

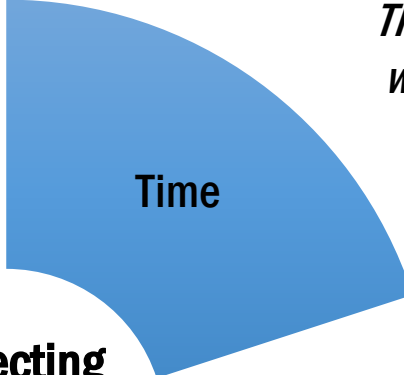


THMs Levels Fluctuate Unpredictably

Quantity & Quality of NOM affects DBP levels



THMs increase with age of water while the Cl₂/NOM reaction continues

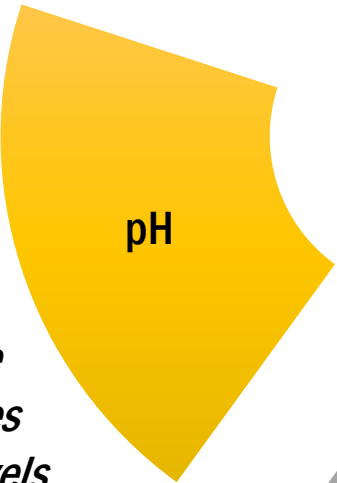


Factors Affecting THM Levels in Drinking and Waste Water

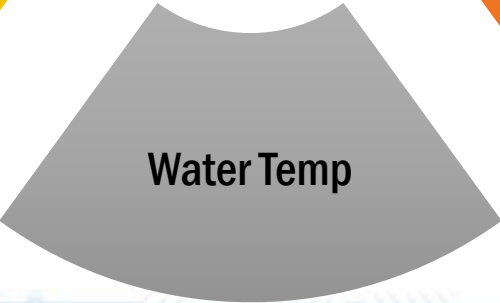
Removal of NOM and other activities reduce DBP and THM concentrations



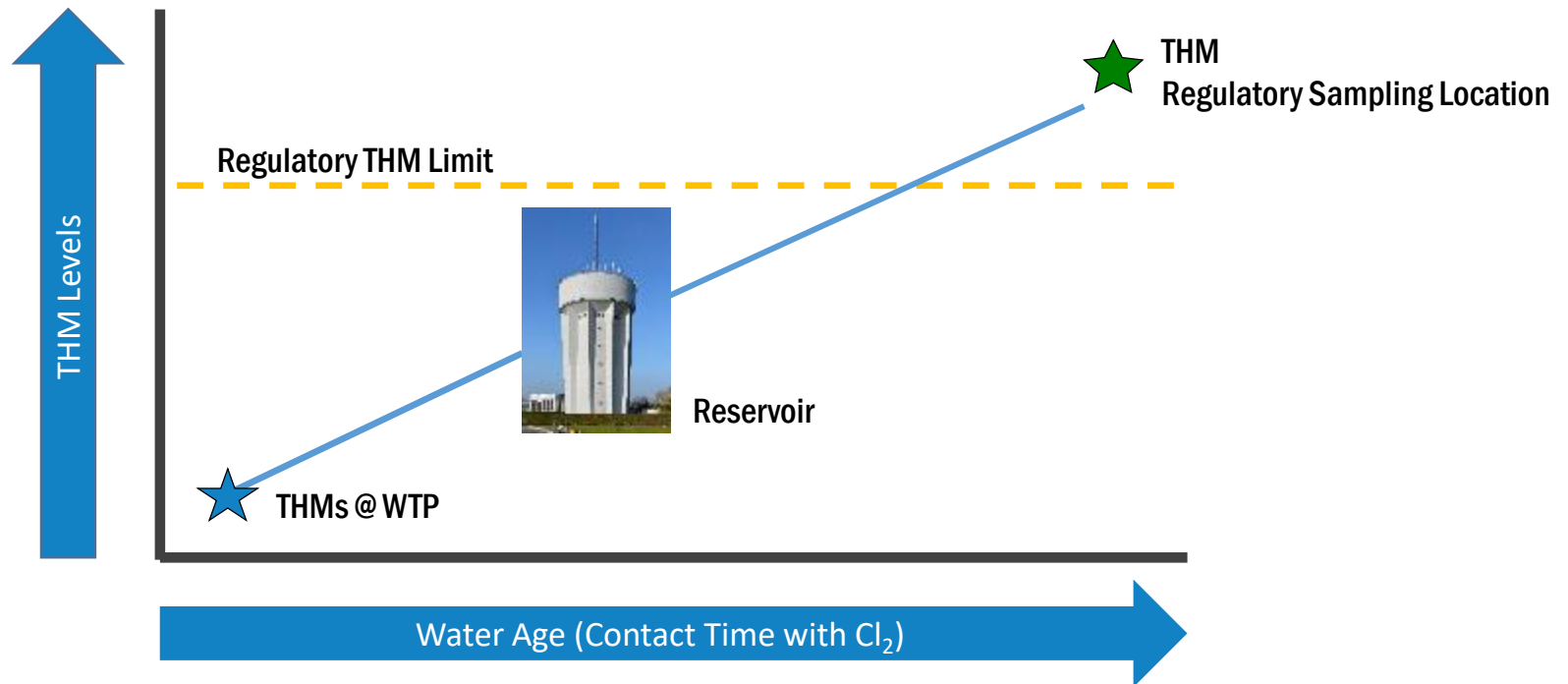
An increase in pH raises THM levels



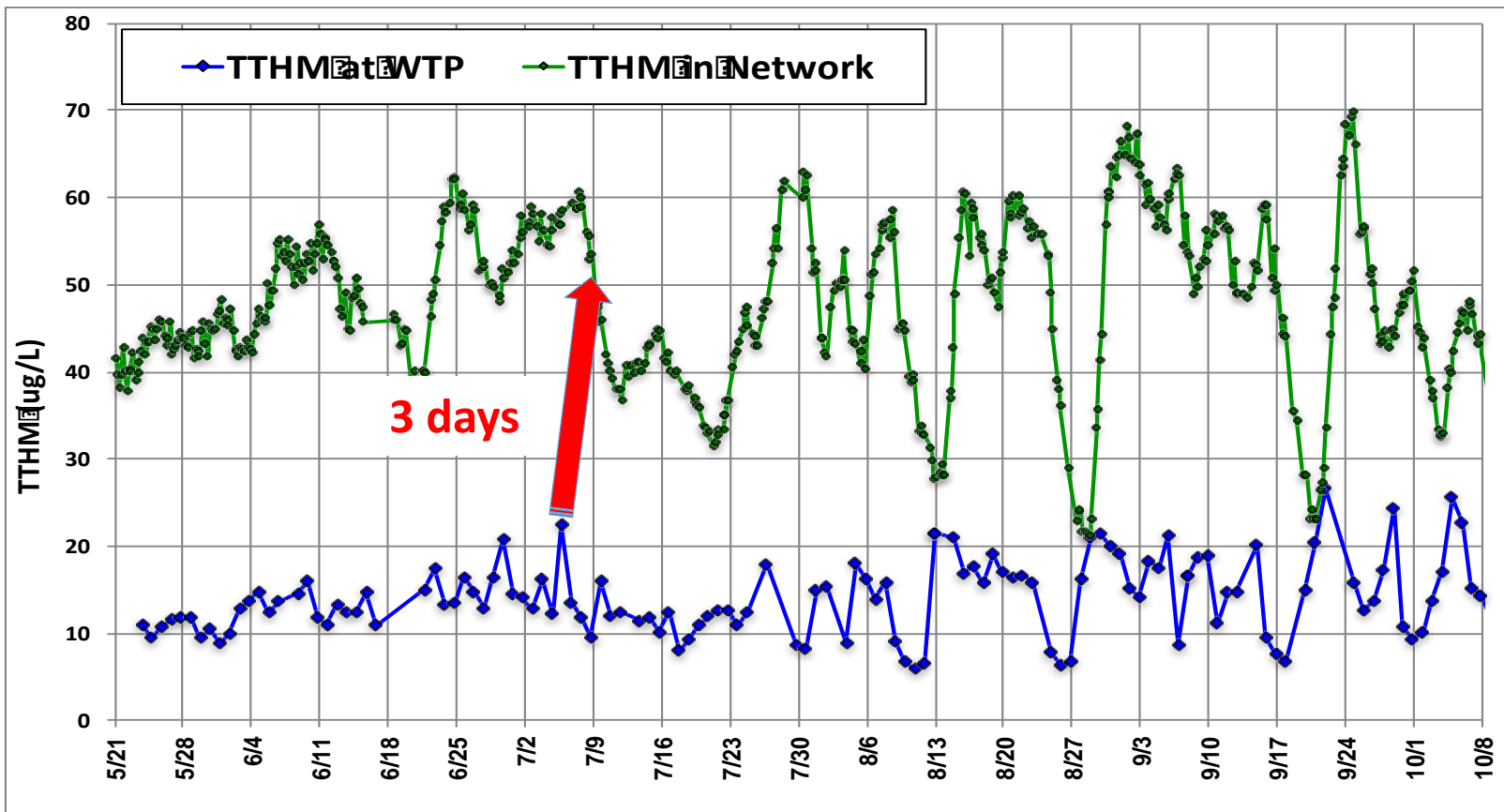
THM formation increase with rise in water temperature



The Challenge of Controlling THMs



THM Levels Increase & Fluctuate in the Network

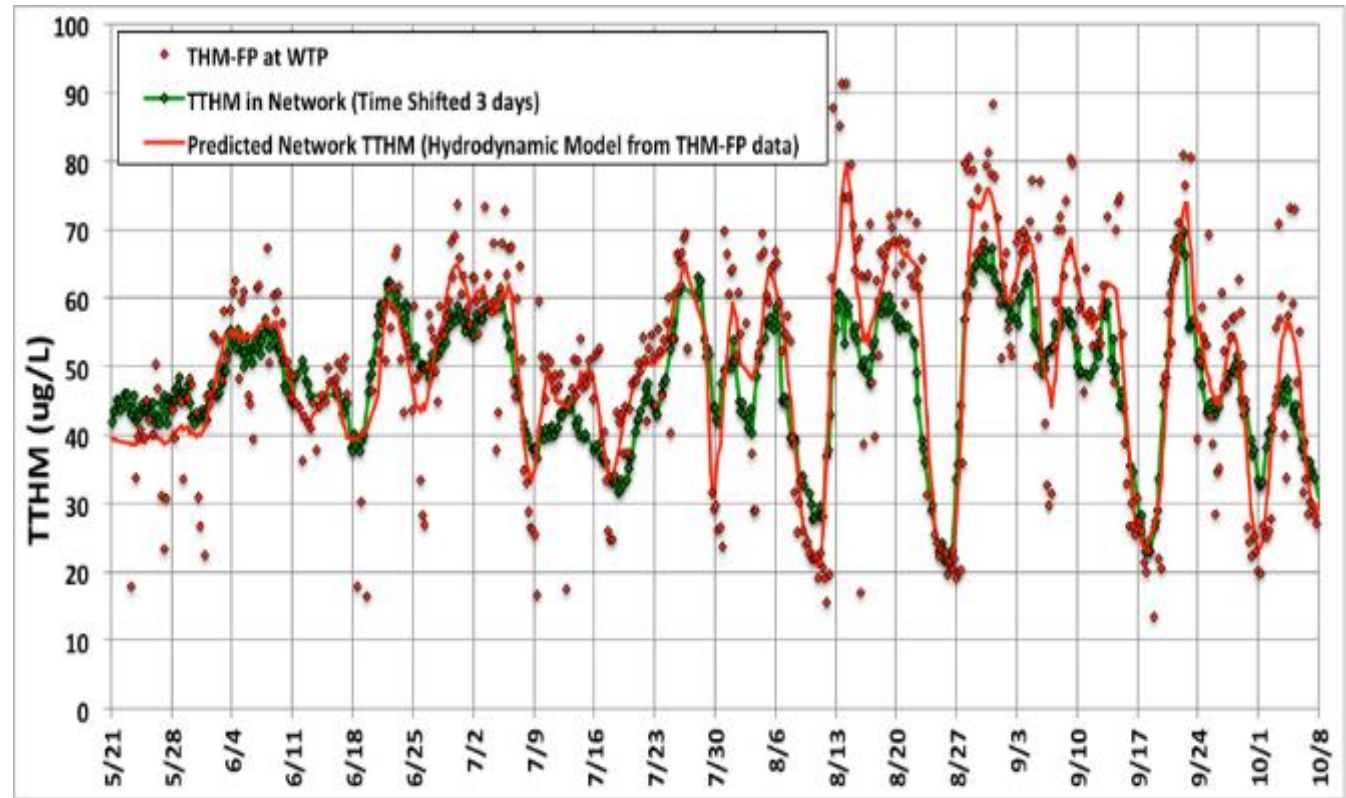


THM levels in the network are considerably higher than at the exit of the water treatment plant, and can change dramatically within a few days.

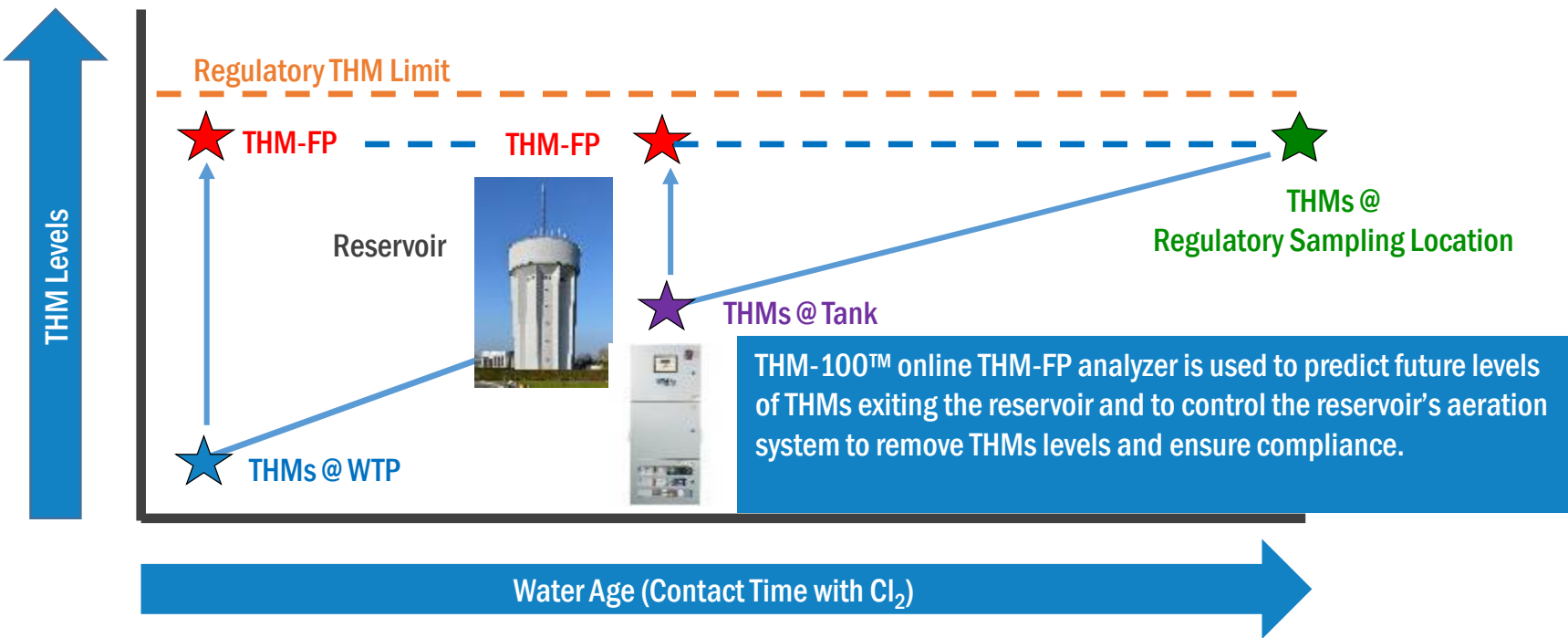


Online THM-Predicted Network Values Compared with 'Actual' THM Levels

Online THM-FP monitoring of the WTP effluent and a mathematical model of distribution flow allowed for a method that predicted THM levels three days in advance at a remote network location.



Predictive Analytics Ensure THM Compliance



Online *vs.* Lab Monitoring of THMs



Online Monitoring

- Automated
- 2-hr time-to-result
- High frequency
(every 2-4 hours)
- Self-calibrating
- High accuracy
- Unattended: ideal for remote locations
- Enables process optimisation

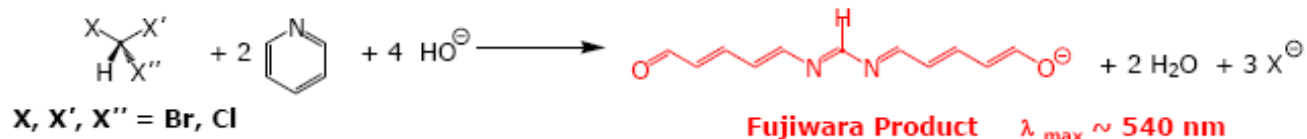
Traditional Sampling & Lab Method

- Manual collection
- Delayed results
(up to 10 days)
- Infrequent sampling
- Prone to manual errors
- **CANNOT be used for optimisation of water treatment operations**

Analytical Method

THM Online Method	THM-FP Online Method
Acquire Online Sample	
	Heat Sample (~60 min, ~70 °C) to accelerate formation of THMs
Add Dechlorinator	Add Dechlorinator (Optional)
Purge & Trap THMs	
Desorb THMs into Reaction Mixture	
Heated Fujiwara Reaction	
Absorbance Measurements (at two or three reaction time intervals)	
Calculation of THM Concentrations	

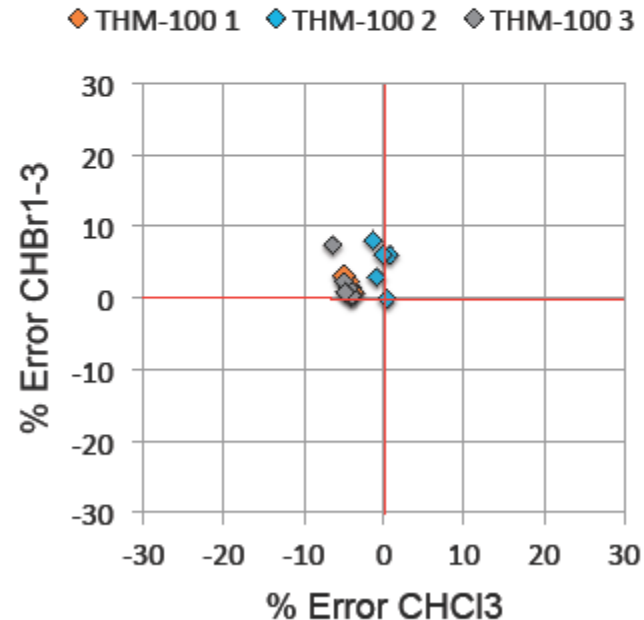
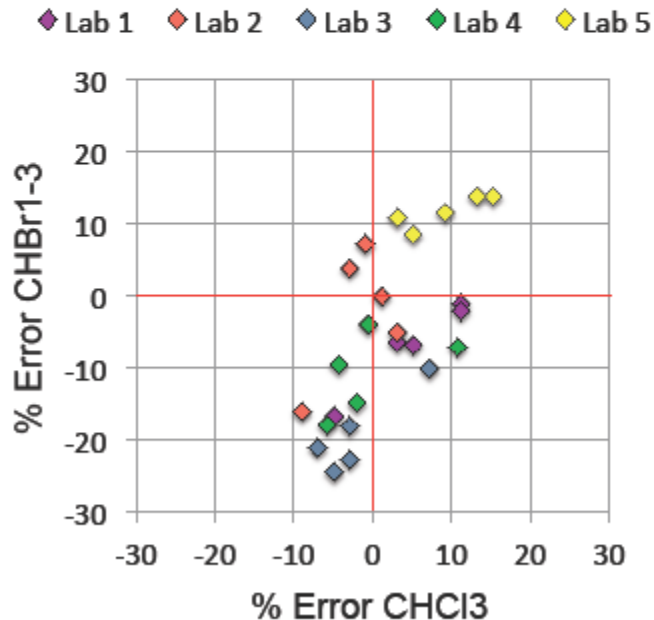
- All four THMs are converted to the same product when treated with a pyridine derivative in an aqueous base:



Online Monitoring Provides More Accurate than Labs

Data Reliability: Labs vs. Online (Spiked Samples)

- 5 US-EPA Accredited Labs & 3 THM-100 Monitors
- Sample Water Spiked at TTHM 79.5 ug/L (60% CHCl_3)



Ensuring Data Availability (24/7/365)

ams Health Monitor cdoughert

dashboard gauges filters chart map gmap reports

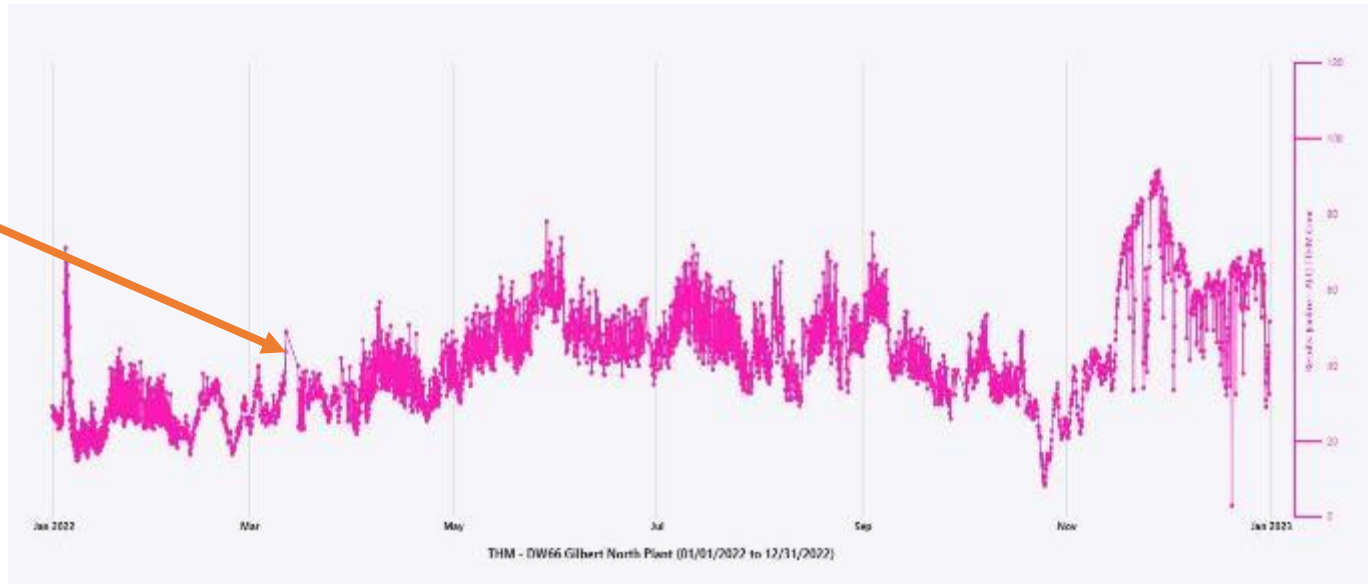
THMs Metals SGH2O

	DataLog: Hourly Records	Results: Hourly Records	Except Events	Dark Count (online) All	Temp (online) w/ ETS TTHM: Start	Δ Temp (online) w/ ETS TTHM: Start	RH: Purge: Start w/ Comp	BOTTLE Sample Ran	Integ-ration Time by StdDev	Integ-ration Time by Ranges	Main#: TTHM: Start	PV Fill Time BOTTLE	PV Fill Time ONLINE	PV Empty: Empty Time	PV Temp Sens All	PTD Eff	Trap# Bake
HM (Field-Deployed)																	
DW6 Palleja	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW8 Phoenix	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW9 Sant Climent I	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW10 Valividera	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW11 Stockton	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW12 Rancho Santa Fe	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW13 Sant Climent I	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW16 Roquetes	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW18 Old Bridge	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW19 Abrera	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW23 Orinda	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW25 Independence	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW26 Bilbao	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW27 Birmingham	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW30 Salado	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW33 Santa Cruz	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW36 Brunswick	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW37 Mashantucket	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW39 Scottsdale CAP	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW40 Cardedeu	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW42 Pima	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW43 San Jose	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW44 Alicante	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW45 Goleta	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW46 Irvington	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW50 Birmingham IT	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW51 Phoenix	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DW52 Scottsdale	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●



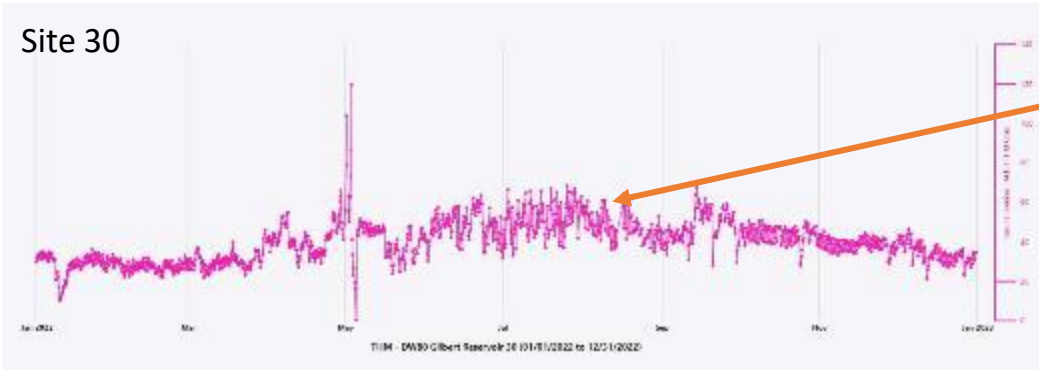
Remote Health Monitoring

3/11-3/15 Syringe failure
(Identified by AMS
Friday-fixed Tuesday)



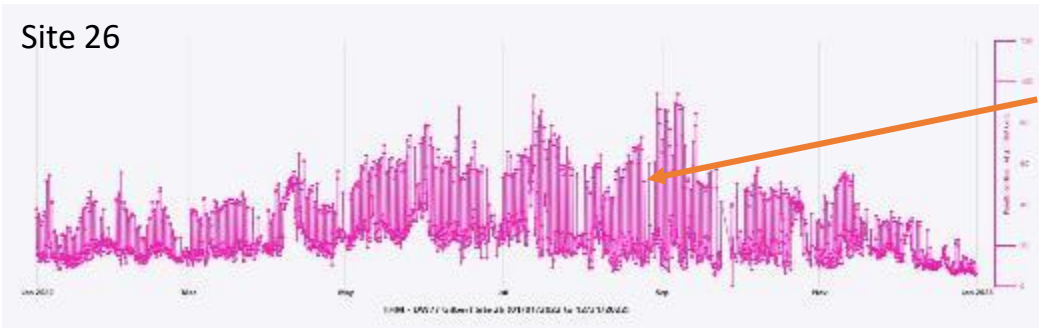
Remote Health Monitoring

Site 30



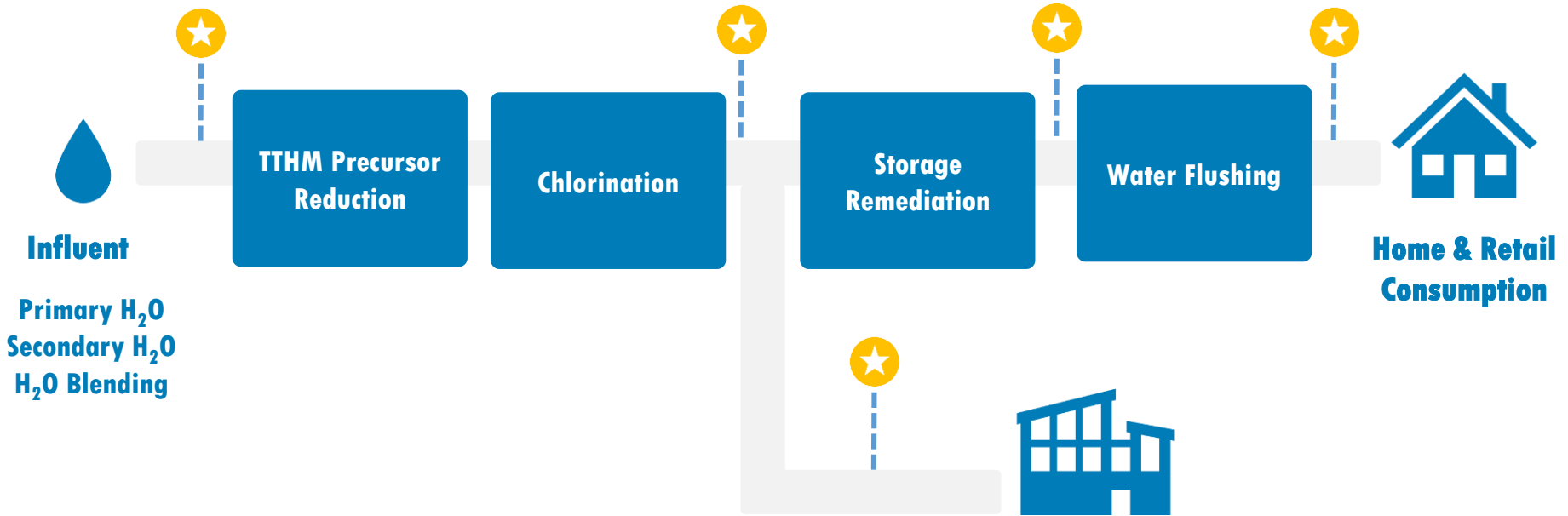
8/14-8/16 Loss of air pressure (notified by AMS on 8/16)
(Monday-Wednesday)

Site 26



9/24-9/28 Loss of air pressure (notified by AMS on 9/25)
(Saturday-Wednesday)

THM-100™ Provides Real-Time THM Data Throughout the Drinking Water Treatment Process



The online THM-100™ monitor can be installed at multiple locations in the drinking water treatment process.

Consecutive Systems
Contract Compliance

Optimizing Raw Water Source Selection to Reduce THM Formation

New York, Department of Environmental Protection

- 4 Remote reservoirs 120 miles from point of chlorination
- THM formation from these raw water sources change unpredictably

Benefit

- Minimize DBP production at the WTP by optimizing the blend of raw water sources according to their respective THM-FP levels

Validation of Online Monitoring of THM-FP of Raw/Untreated Sources

- University of Massachusetts, Amherst, with Prof. D. Reckhow
- Funded by Massachusetts Center for Energy Efficiency



 Potential locations in the NYC watershed for the THM-100-FP-RAW instrumentation.

 Disinfection with Chlorine

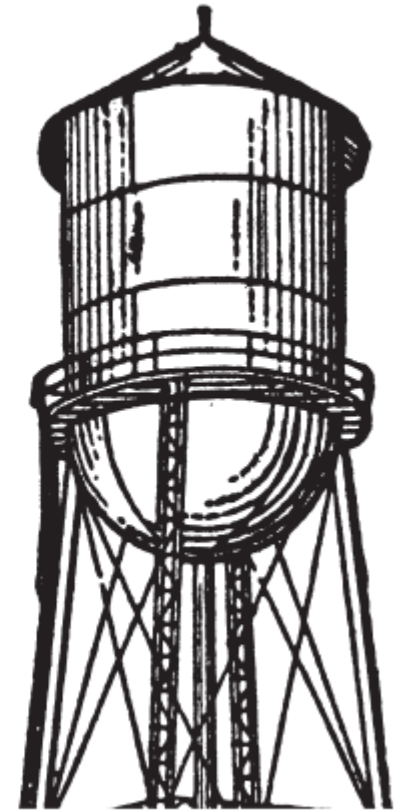
Criteria for Evaluating On-line Analyzers

Criterion	Feature	Benefits
Accuracy and Precision	Sensitivity sensor technology Sensor recovery Sample preparation technology	Limit of detection Sensor reliability Eliminate matrix interference (chemical and physical)
	Self-calibration and validation	Accuracy and repeatability Unattended operation
Reliability (mean-time-to failure, mean-time-to-repair)	Remote health, performance monitoring and diagnostics	Reliability (uptime >99%) Unattended operation for 90 days
Relevance of data	Predictive analytics (lead, THM) Grab-sample analysis	Ensuring water at the consumes tap is safe BEFORE they drink it Multi-location analysis
Lifetime cost control	Warranty	Peace of mind!



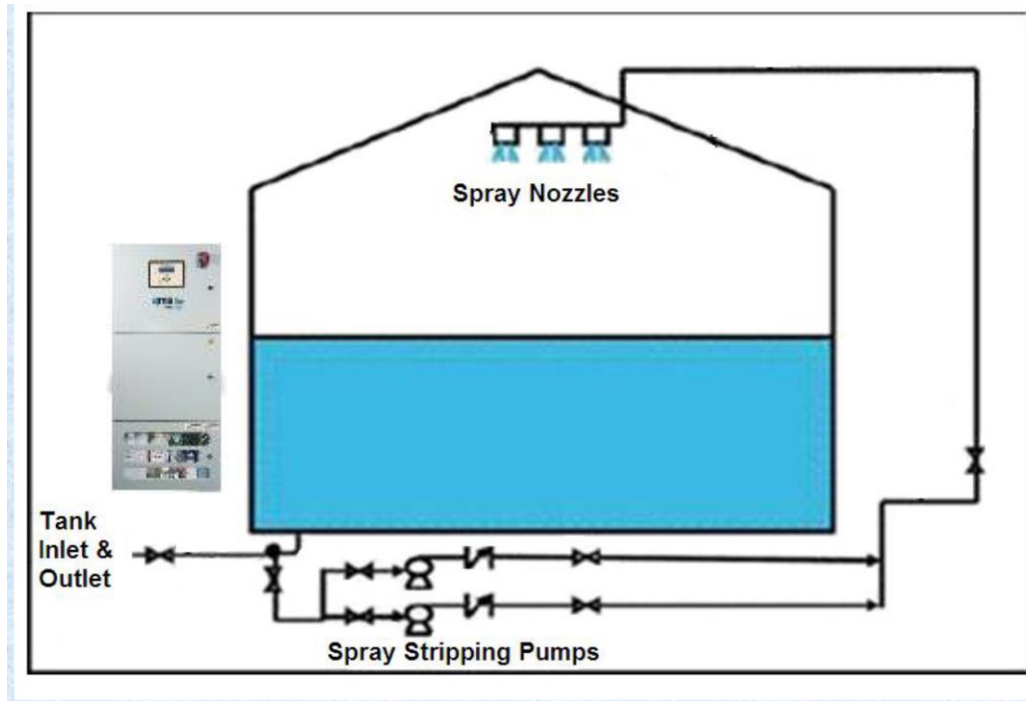
THM Removal: Hidden Value in Reservoir Systems

- Reservoirs are an asset to be used to achieve THM compliance at the point of consumption
- In-reservoir aeration can offset unexpectedly high levels of THMs leaving the WTP
- Real-time THM FP Data on treated water ensures maximum advantage is taken of aeration systems to deliver compliant water to the consumer
- WTP is alerted immediately there is a compliance risk before consumer impacted



SafeGuard™ H2O: Intelligent THM Aeration System

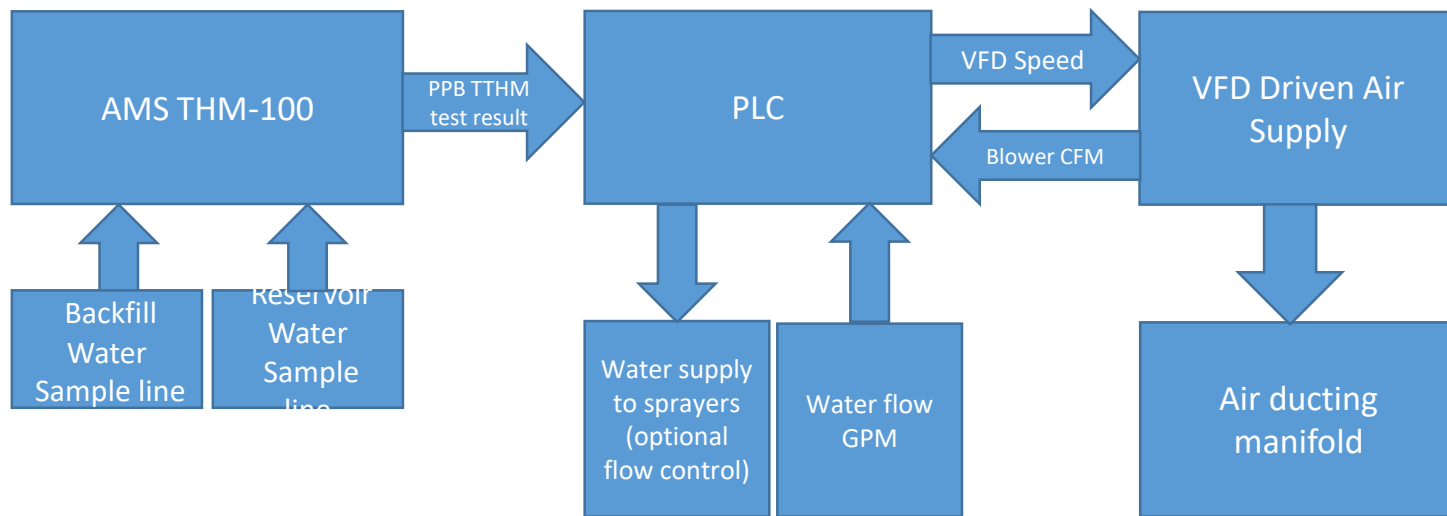
Control THMs using predictive analytics with online THM-100™ analyzer and an intelligent spray aeration system



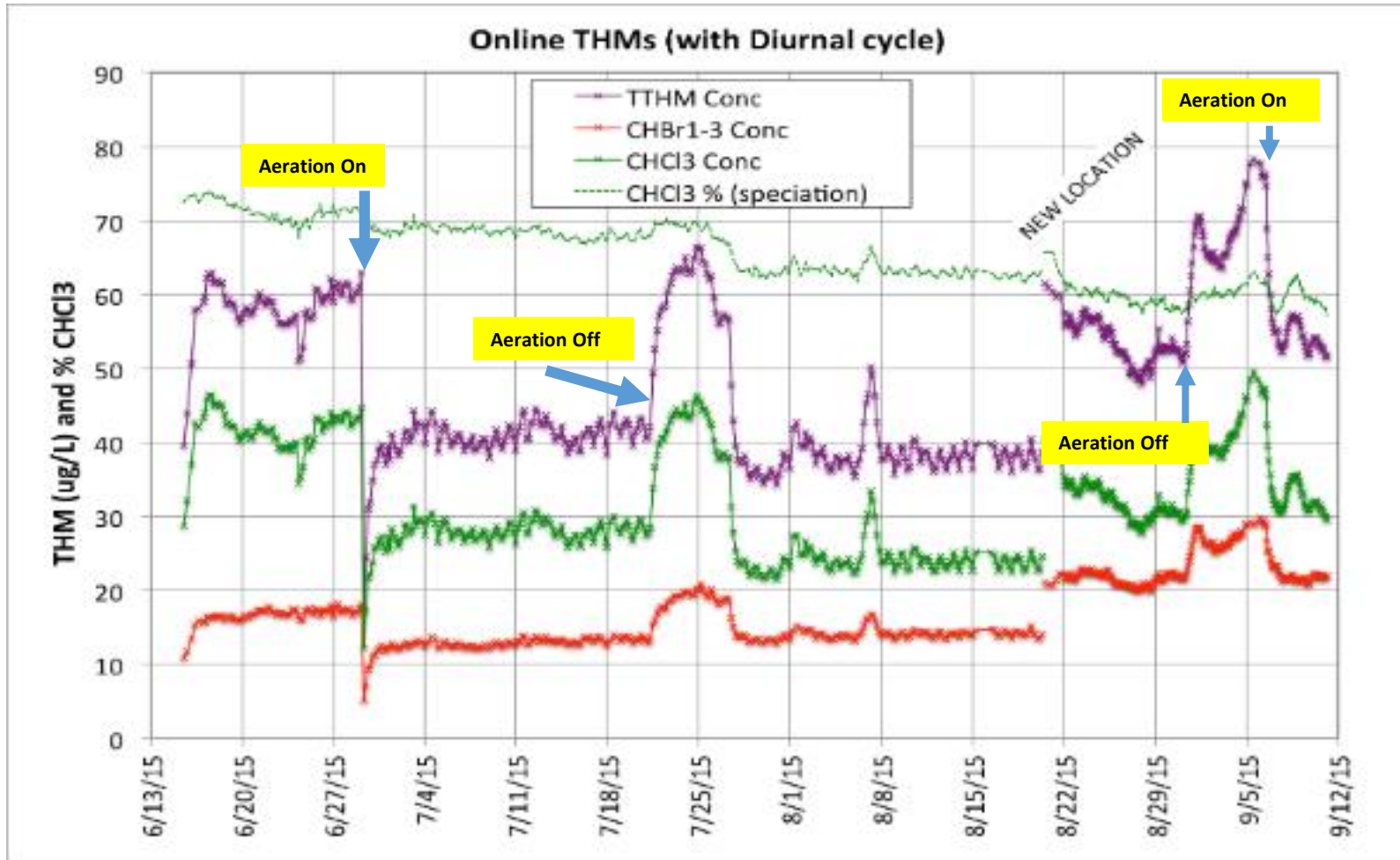
Easy to maintain THM removal aeration system

Process Diagram

- PLC adjust air and water supply flow based on AMS THM test results.



Controlling Aeration Performance



SafeGuard™ H2O: Intelligent THM Aeration Treatment System

Integrated with predictive analytics with online THM-100 Formation Potential Analyzer to ensure safe drinking water at consumer's tap by controlling THM removal system

- Continuous, and self-automated THM monitoring
- Highly efficient THM removal aeration system, operational costs minimized with online real-time THM data
- Unlike other aeration systems that require complicated installation, the SafeGuard H2O THM Removal System is easy to retrofit in a reservoir
- 24 / 7 / 365 system control



Thank you!

Transforming the Way We See and Treat Water

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