American Water®

Emerging Technologies for Water

NARUC Committee on Water

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RWE Group

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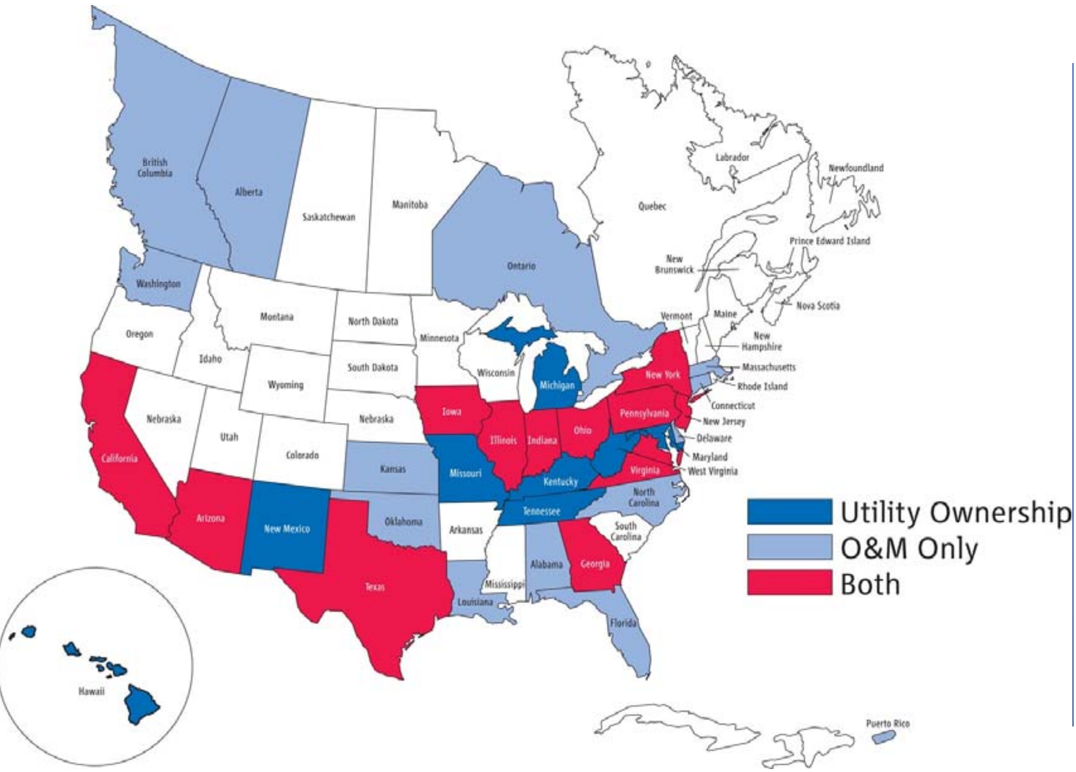

American Water is the largest water and wastewater services provider in North America, with $2.2 Billion in revenues; headquartered in Voorhees, NJ.

American Water serves over 18 million people in 29 states and 3 Canadian provinces, and employs over 7,000 water professionals.

American Water owns or operates over 870 water treatment plants & wells and 270 wastewater facilities.

The company conducts over one million water quality tests each year for over 100 regulated parameters, and up to 50 types of water-related tests each day.

www.amwater.com

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A New Look At Technology

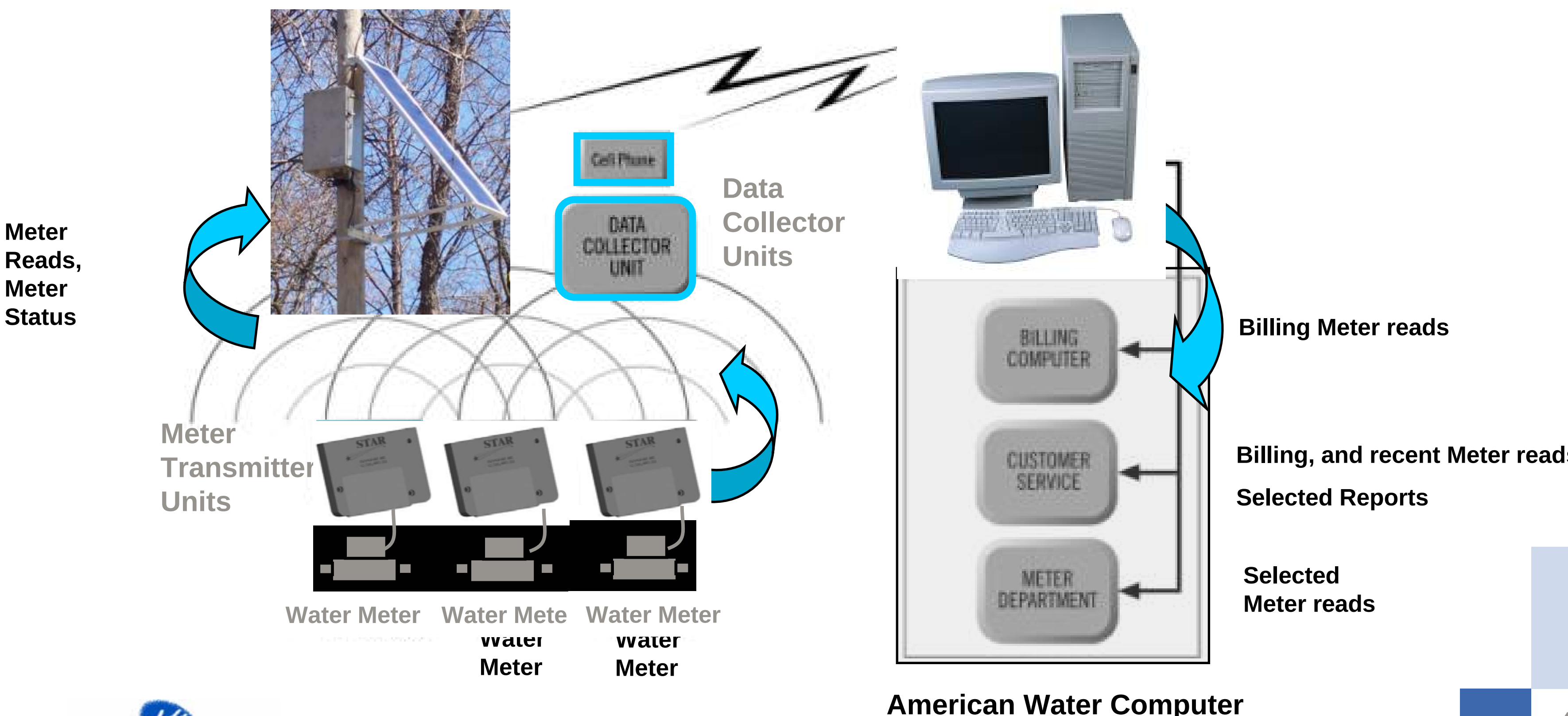
- New technologies must be multifunctional and be able to address multiple issues. They must integrate into larger more functional systems

- “Old” technologies are taking on new roles – looking at old technology in a new way

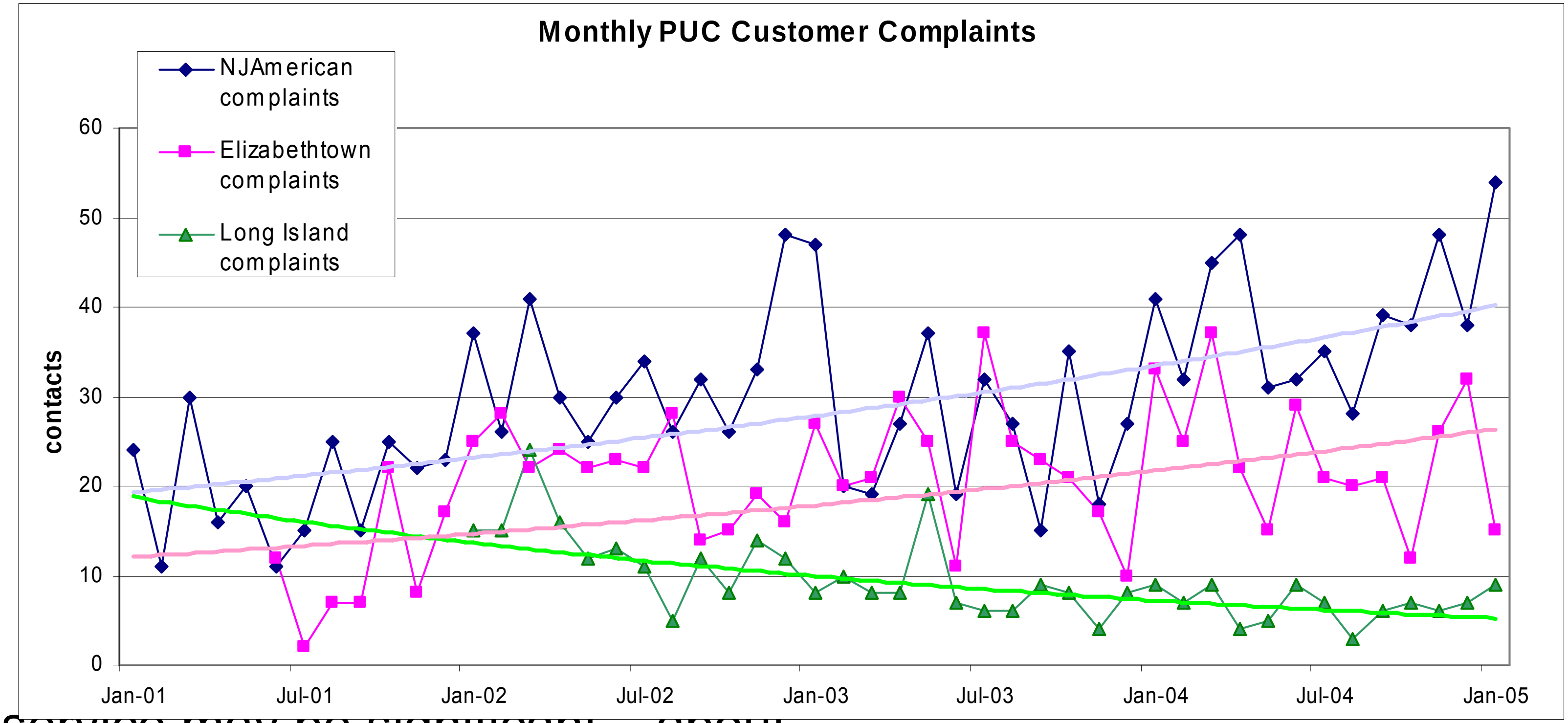
- The cost of the new technology can be justified through improved water quality, increased efficiency, better customer service, or compliance with new regulations

Automatic Meter Reading

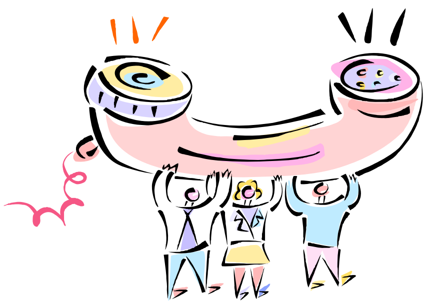
- Efficient collection of meter data



Customer Service



service may be significant – about 30-40% of customer calls and regulatory complaints relate to meter reads and high bills.



Example: Cross Connection Research

- Working with the AWWA Research Foundation, American Water is examining the occurrence of backflow with surge events.
- As part of the study, we are working with Neptune Meter on a prototype system where the meter detects backflow and an AMR system would transmit immediate notification of the incident to the utility.

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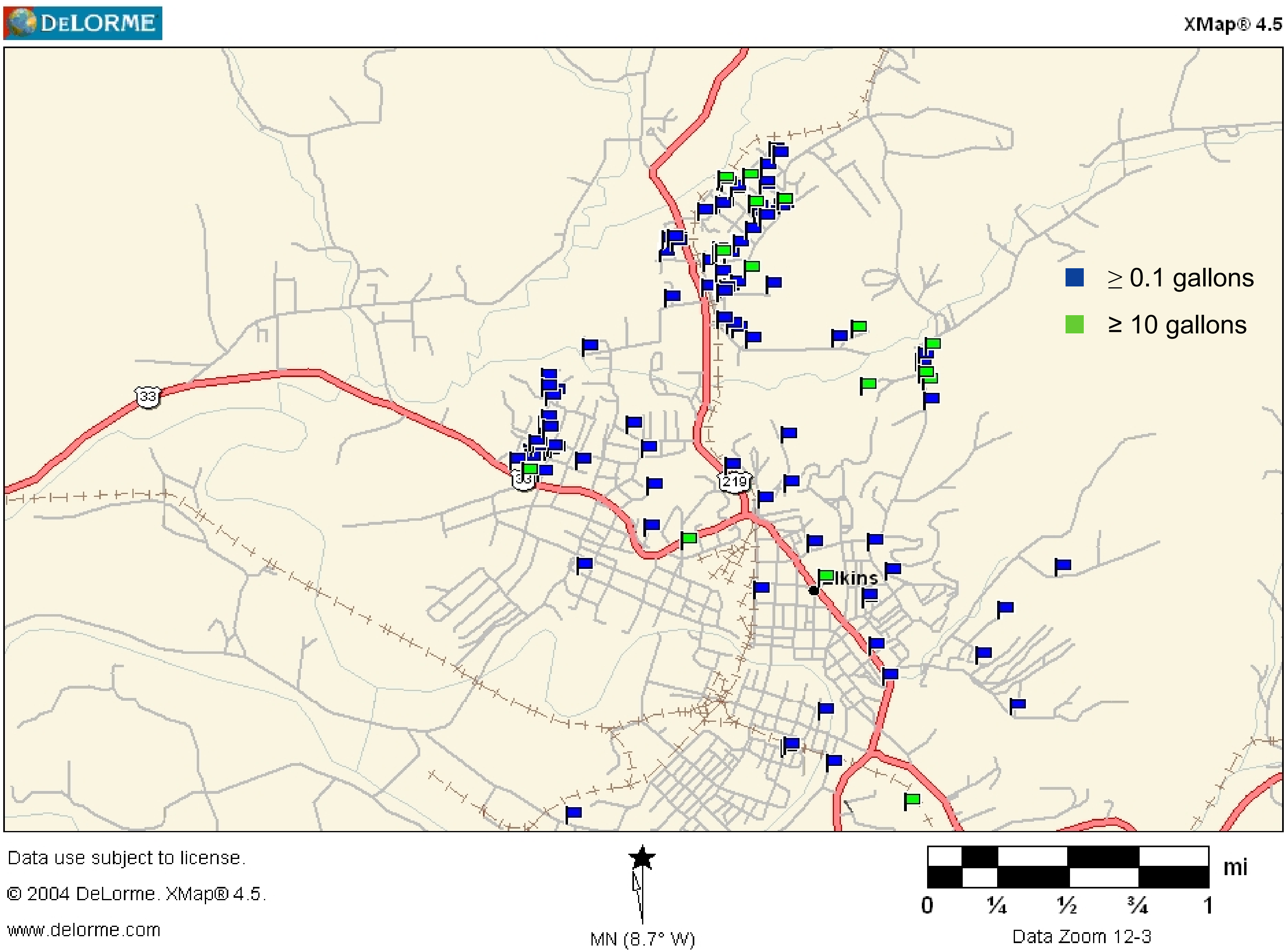
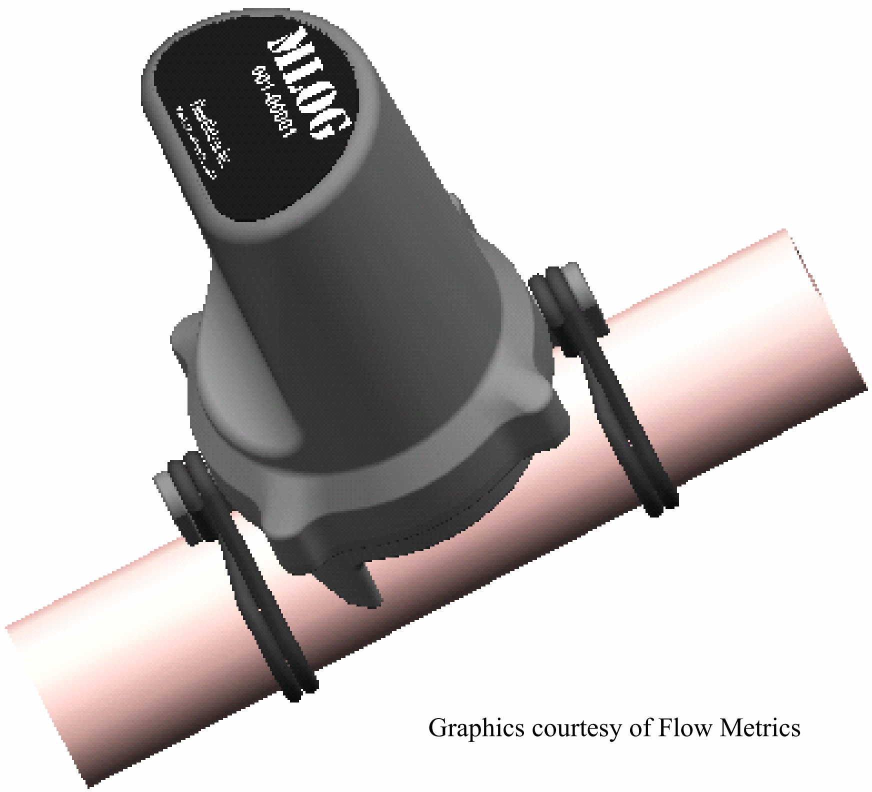
Evidence of Backflow – West Virginia

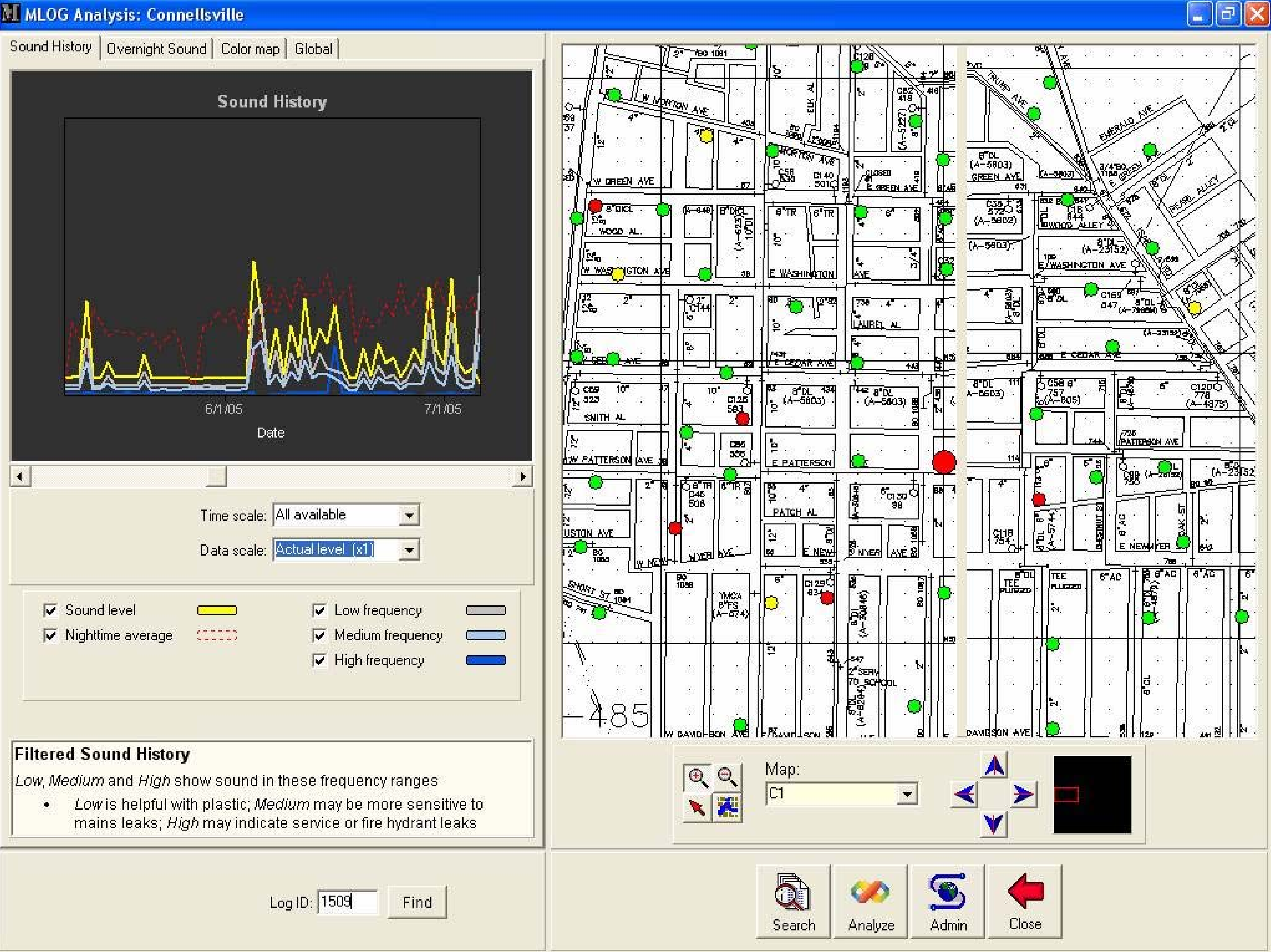


COST MODEL AND PILOTING
Acoustic Monitoring



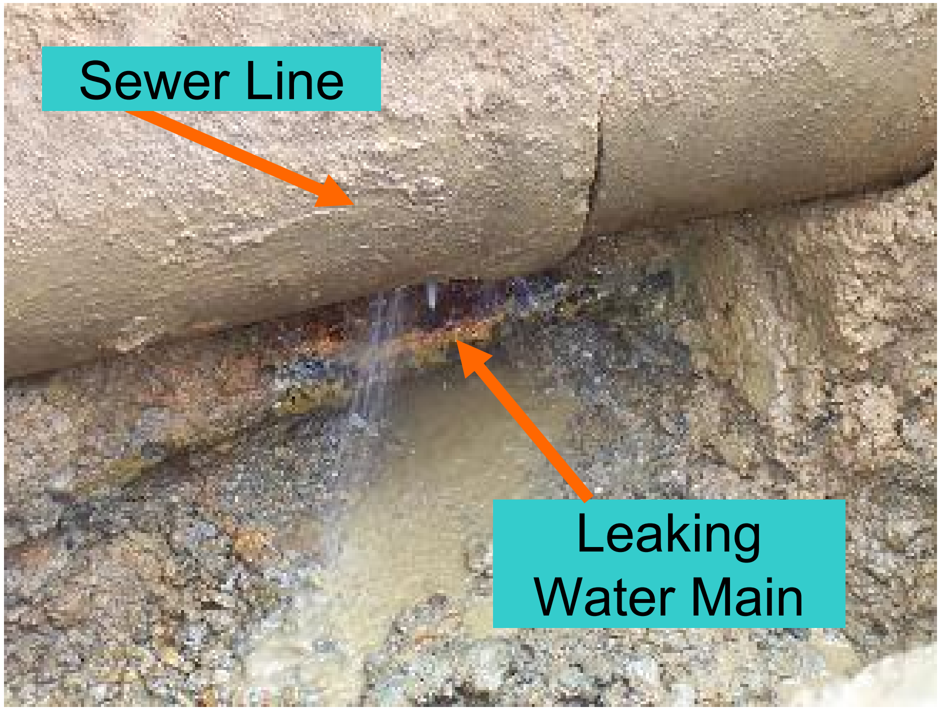
Graphics courtesy of Flow Metrics

- Low-cost, waterproof sensor installed near a water meter
- Easily strapped to service pipe
- Maintenance-free, 10+ years (battery)
- Mobile radio or AMR communication interface


MLOG Analysis: Connellsville
Sound History
Overnight Sound
Color map
Global
Sound History
6/1/05
7/1/05
Date
Time scale:
All available
Data scale:
Actual level (x1)
Sound level
Nighttime average
Low frequency
Medium frequency
High frequency
Filtered Sound History
Low, Medium and High show sound in these frequency ranges
Low is helpful with plastic; Medium may be more sensitive to mains leaks; High may indicate service or fire hydrant leaks
Log ID:
1509
Find
Map:
C1
Search
Analyze
Admin
Close
W MORTON AVE
W GREEN AVE
E GREEN AVE
WOOD AL.
W WASHINGTON AVE
E WASHINGTON AVE
LAUREL AL
E CEDAR AVE
SMITH AL
W PATTERSON AVE
E PATTERSON
PATCH AL
E NEWMYER AVE
SHORT ST
W DAVIDSON AVE
DAVIDSON AVE
EMERALD AVE
PEARL ALLEY
TRUMP AVE
TO SCHOOL
485

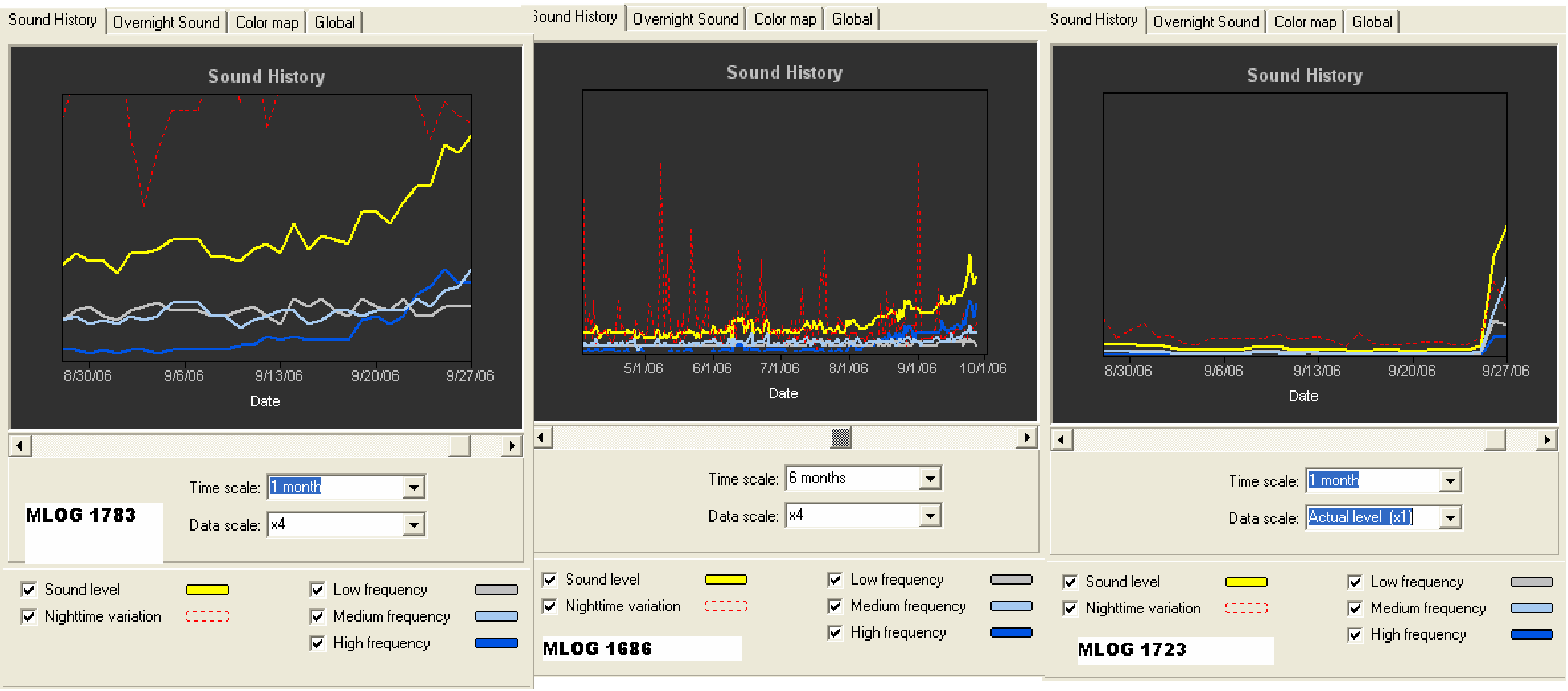
Initial MLOG Results are Encouraging

- A pilot study of 500 MLOG units in Connellsville, PA has detected 46 leaks, 50% of the annual non-revenue water loss, within the first 6 months of monitoring.
  - 24 leaks before surfacing
  - 10 leaks surfaced before repairs
  - 12 leaks surfaced without an acoustic signature
- NRW dropped from 25% to <10%, representing an annual reduction of $250,000 in purchased water expense. Estimated pay-back in 6-8 months.



Morgan, W. 2006. JAWWA 98(2): 33-35.

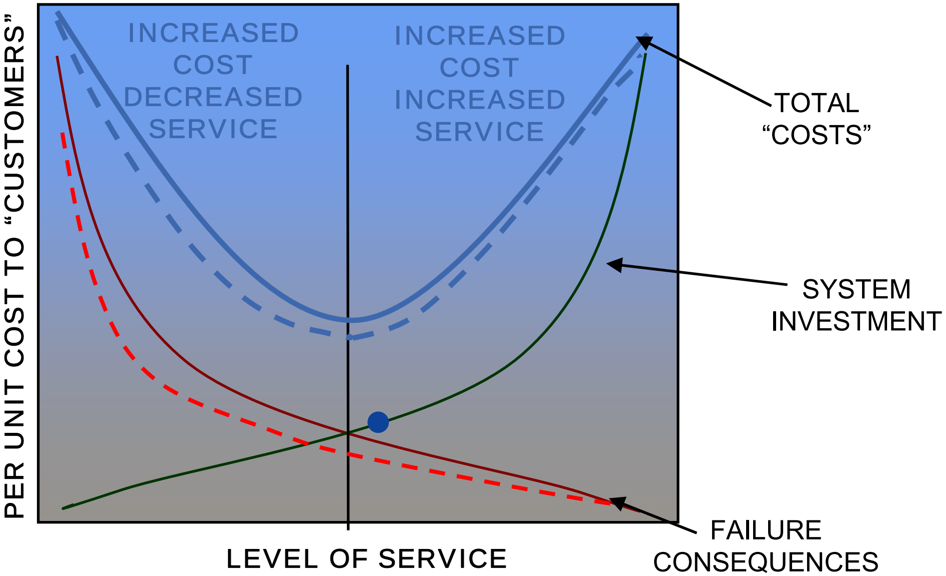
Examples of Acoustic Signatures



- Research will evaluate whether most winter breaks are actually unseen leaks that can be repaired before the disruptive main break ever begins

Implications for Asset Management Planning

- Knowledge of more pipe failures (including some long undiscovered) add to information gathered about condition of pipe segments.
  - More informed decisions made about all pipe failures
  - Potential ability to identify acoustic character and nature of failure will allow cost effective decision of when to fix leaks.



Remote Turn on/off

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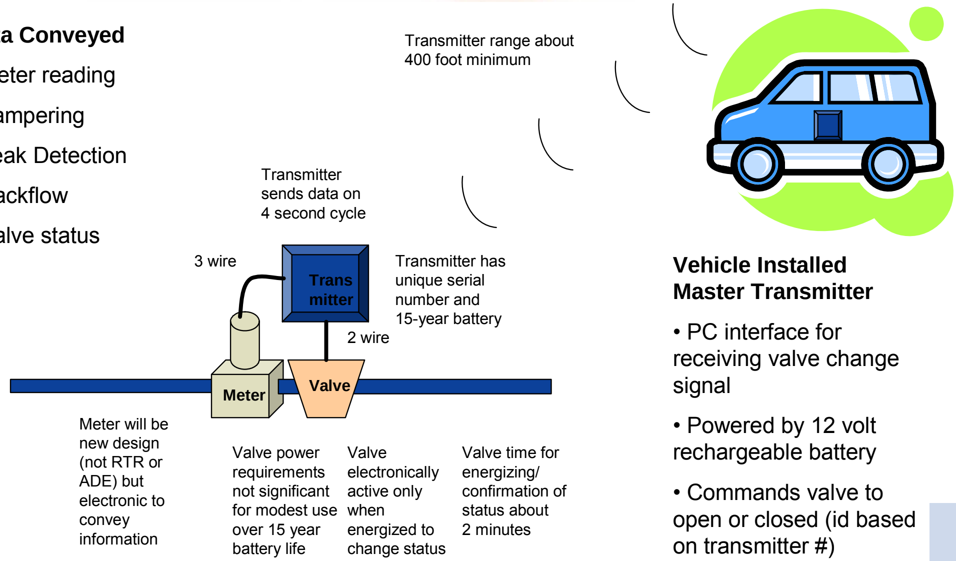
- Research is investigating the possibility of using a remote activated solenoid operated through the AMR system
- A workgroup has been formed to evaluate issues associated with: operations, security, logistics, liability, regulations, etc.
- A remotely controlled shut-off/on would change the way we handled customer non-payment, security, turn-on requested, etc.

Data Conveyed

- Meter reading
- Tampering
- Leak Detection
- Backflow
- Valve status



Vehicle Installed Master Transmitter

- PC interface for receiving valve change signal
- Powered by 12 volt rechargeable battery
- Commands valve to open or closed (id based on transmitter #)
- Mapping Capabilities in PC for confirmation

On-Line Monitoring

- Provides an overview on the reliability of chemical parameters and commercially available monitors
- Discusses issues of data collection, transmission, and analysis
- Data from collaborative project with the USEPA and the USGS using YSI probe measuring temperature, pH, specific conductance, ORP, turbidity, and free chlorine.
- Outlines an integrated strategy with backflow sensing meters, AMR, on-line monitors, sample collectors, and event verification procedures
- TEVA analysis of distribution system models for optimum placement of sensors

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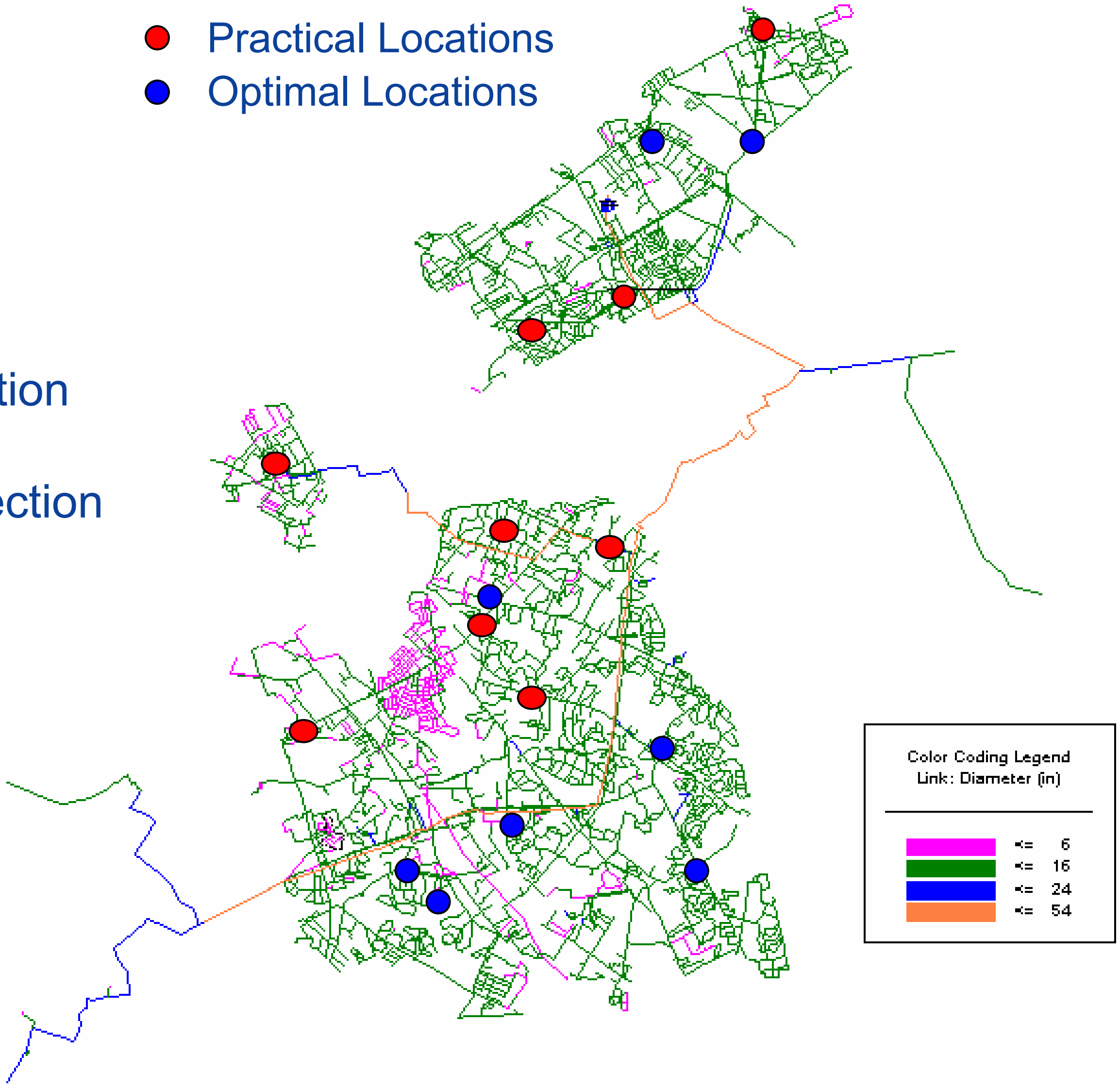
Sensor Location

USEPA TEVA model used Monte Carlo simulations for various scenarios:

- Contaminant concentration
- Injection site
- Duration (or rate) of injection
- Exposure

All non-zero demand nodes assumed to be equally vulnerable to introduction of the biological or chemical contaminants.

Time delay from detection to implementation of a mitigation response assumed to be zero.



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Public Health Benefits with Various Sensor Designs

Site	Response delay	Mean Infections	Reduction in Health Risks
No Sensors	-	10,427	-
7 practical sites	None	7,289	30.1%
7 optimal sites	None	1,852	82.2%
9 practical sites	None	5,273	49.4%
7 optimal + 2 practical sites	None	1,796	82.8%
7 practical sites	12 h	8,642	17.1%
7 optimal sites	12 h	6,148	41%

Cost per Unit

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Capital Costs	Cost ($)
– Multi-parameter WQ units	12,000
– Data communications cables	100
– Auto-sampler	6,000
– Physical Installation	500
– Hook up & programming	
• SCADA	500
• Wireless	2,500
– Software	400
TOTAL	20-22,000

Operating Costs	
– Calibration / reagent costs	250
– Maintenance labor	1,750
TOTAL	2,000

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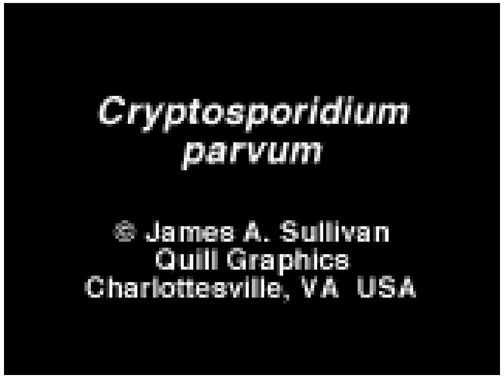
UV and Cryptosporidium Research



- Cell culture assay for infectious *Cryptosporidium parvum*
- Extensive experience with monitoring source & treated waters
- UV validation testing:
  - Pittsburgh, PA   12-inch Calgon Sentinal
  - St. Louis, MO   24-inch Trojan Swift
- Other UV Research:
  - *Cryptosporidium* inactivation/reactivation
  - Large-scale UV reactor validation
  - UV design criteria

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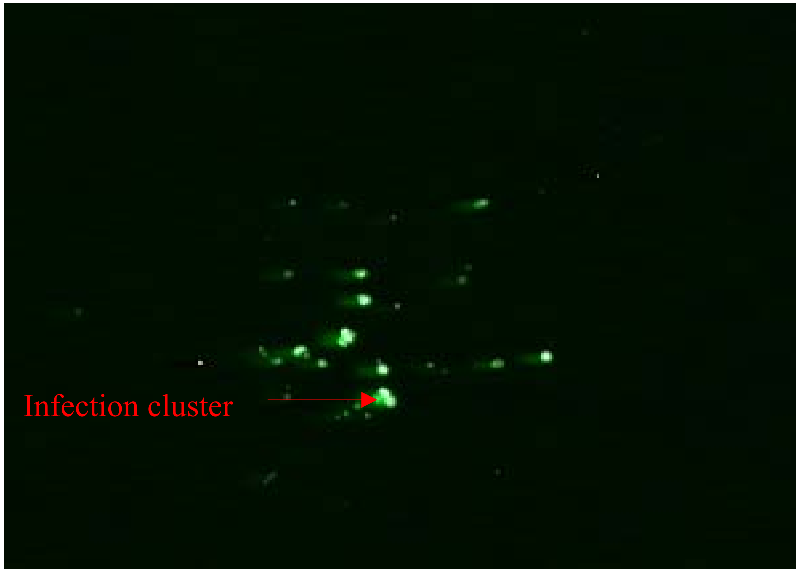
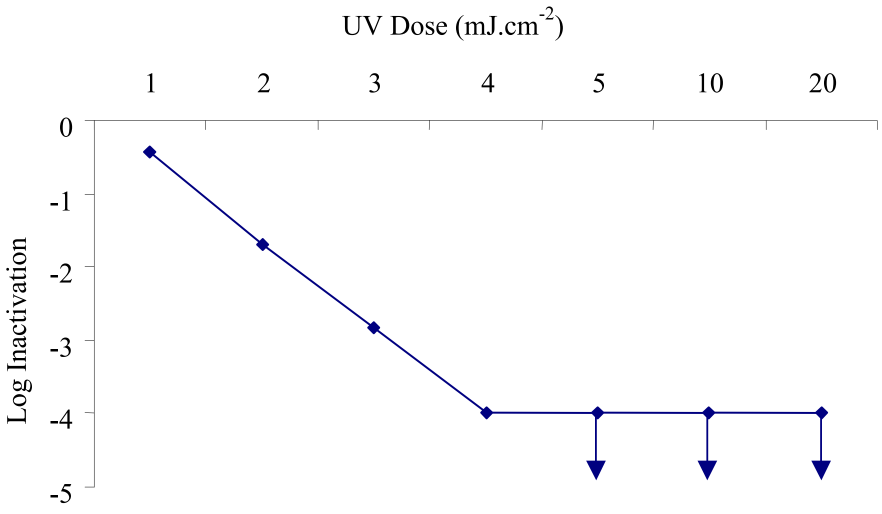
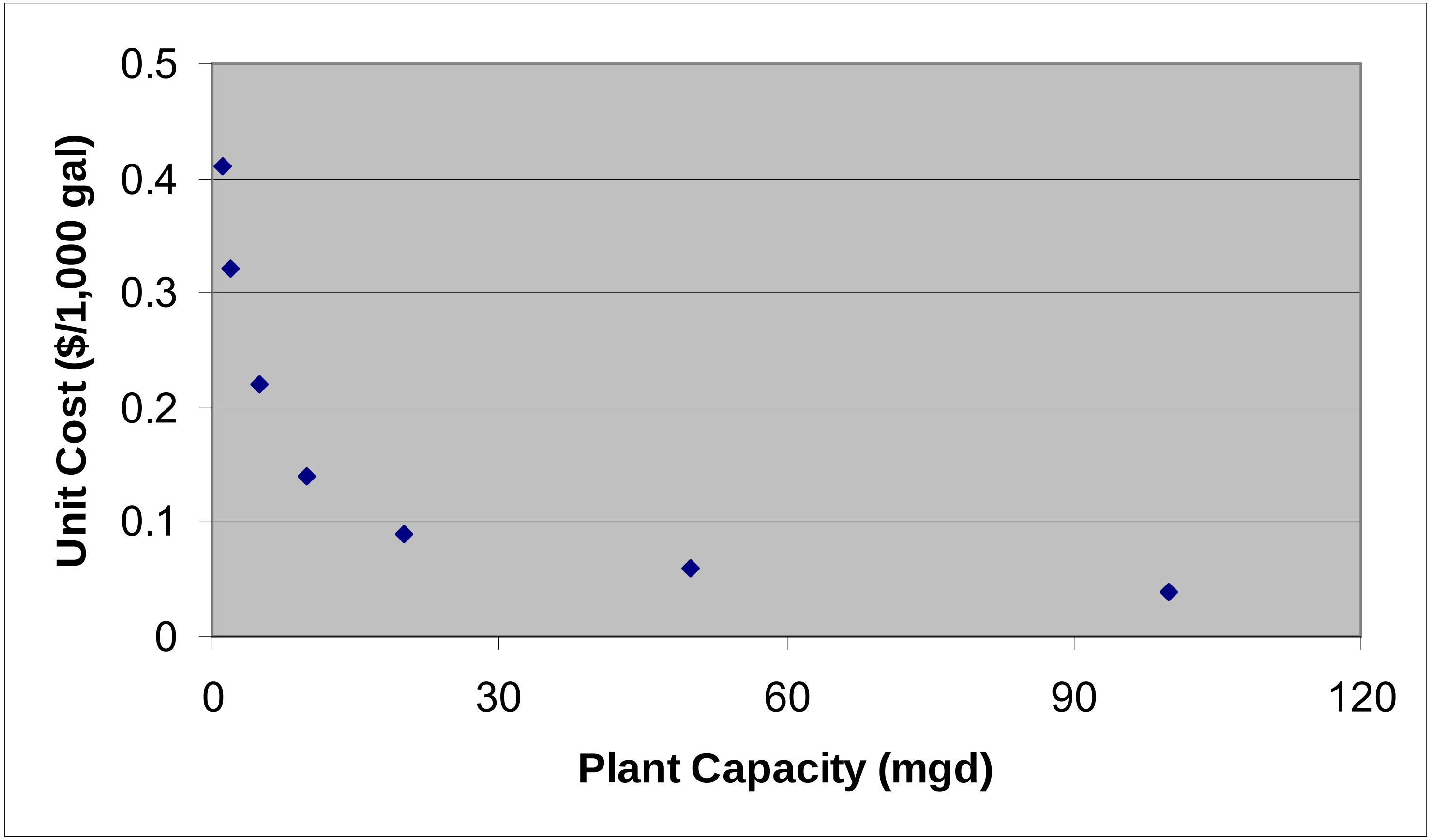
Cryptosporidium Inactivation by UV





- *Cryptosporidium* is highly sensitive to UV inactivation
- USEPA guideline of 12 mJ/cm^2 is effective for inactivation of *Cryptosporidium* and *Giardia*

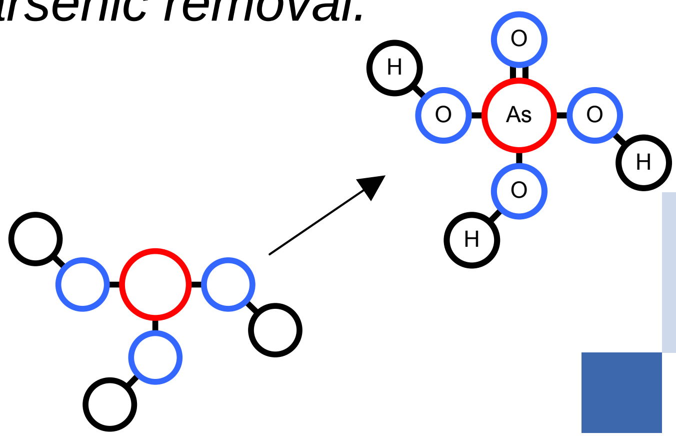
Estimated Unit Cost of UV Disinfection



Hubel, IUVA, 2001.

Arsenic Treatment

- EPA Arsenic Rule
  - MCL = 10 ug/L
  - Effective Date – January 23, 2006
- Treatment Technologies:
  - Granular Iron Media - *silica, fluoride, phosphate, sulfate.*
  - Ferric Coagulation/Filtration - *at existing facilities.*
  - Ion Exchange - *low arsenic and relatively high sulfate.*
  - Activated alumina - *low arsenic and high sulfate.*
  - Membrane Filtration - *high-level arsenic removal.*
  - POU – *very small systems.*
- Oxidation state of arsenic
  - Oxidized arsenic adsorbs better
  - As^{+3} is oxidized to As^{+5}



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What is Granular Iron Media?

- Naturally-occurring or synthetic material with high percentage of oxidized iron.
- Arsenic-bearing groundwater flows through bed of granular iron media, which is retained within specially-designed vessels
- Arsenic is chemically attracted (absorbs) to oxidized (ferric) iron.
- Periodic backwashing req'd to prevent channeling or plugging of media
- After arsenic adsorption capacity is exhausted, media is replaced

Phoenix Well 280 GIM Facility

Arizona American Water Arsenic Removal Projects

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Description	*Treatment Type*	*Arsenic System Capacity (mgd)*	*Total Plant Capacity (mgd)*	*Construction Cost*	*Total*
Paradise Valley	Coag/Filtration	12.5	19.3	$21,200,000	$25,100,000
Sun City West #1	Coag/Filtration	5.0	7.5	$10,400,000	$12,300,000
Sun City West #2	Granular Iron Media	2.6	7.4	$2,700,000	$3,400,000
Agua Fria #1	Granular Iron Media	5.2	6.9	$2,800,000	$3,300,000
Agua Fria #2	Granular Iron Media	3.5	5.2	$2,000,000	$2,400,000
Agua Fria #5	Granular Iron Media	2.2	4.3	$2,000,000	$2,400,000
Havasu Plant #4	Granular Iron Media	1.7	0.9	$1,700,000	$2,100,000
Totals		***32.7***	***51.5***	**$42,800,000**	**$51,000,000**

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Climate Change

Climate Leaders: *A voluntary EPA partnership with U.S. companies to develop long-term, comprehensive climate change strategies; see* www.epa.gov/climateleaders

Key Tasks

- Enroll in the Program
- Develop Green House Gas Emission Inventory
- Establish Tracking Protocols
- Develop Baseline
- Set GHGe Reduction Goals
- Track and Report to EPA on progress

CLIMATE LEADERS
U.S. Environmental Protection Agency

Produces 585,000 kilowatts of energy / year

Eliminates 1,577 pounds of nitrogen oxide, 4,875 pounds of sulfur dioxide & 699,856 pounds of carbon dioxide/year

Acknowledgements

Funding for this research was provided by the utility subsidiaries of American Water, as well as by the American Water Works Association Research Foundation (AwwaRF) and the New Jersey Department of Environmental Protection.

Dr. Kala Fleming; Dave Hughes, PE; Dr. Orren Schneider; Dr. Zia Bukhari; and Peter Keenan, PE;

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