Tolt and Cedar Water Treatment Facilities – *O&M Optimization*

AWWA-PNWS Annual Conference

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Seattle Public Utilities

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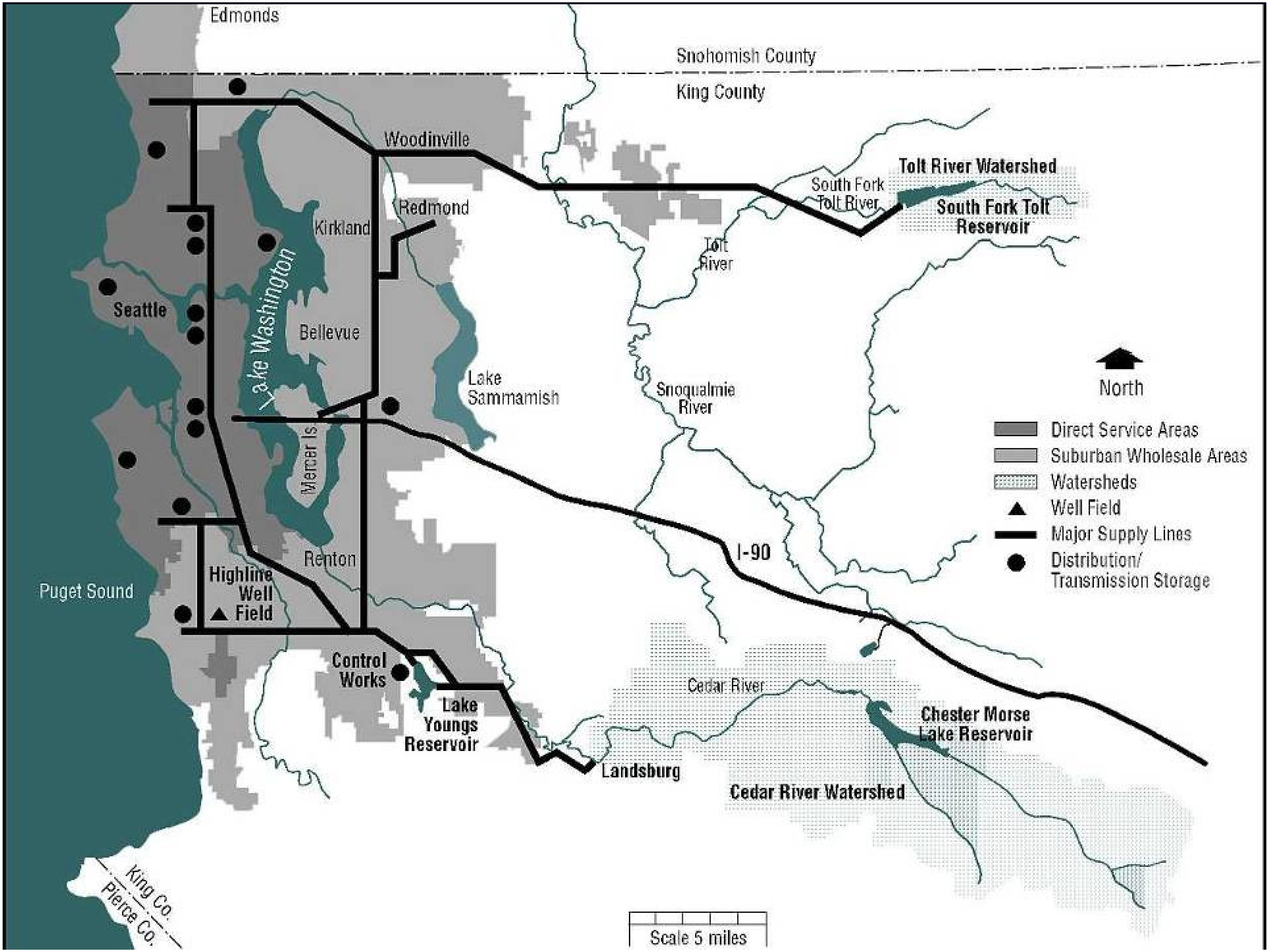
AGENDA

- Background & overview of facilities
- Optimization efforts to:
  - Optimize treated water quality
  - Reduce power & chemical costs
  - Evaluate facility O&M, performance
  - Guide decisions on “repair vs. replace”


Edmonds
Snohomish County
King County
Woodinville
Redmond
Kirkland
Lake Washington
Seattle
Bellevue
Lake Sammamish
Mercer Is
Renton
Highline Well Field
Puget Sound
Control Works
Lake Youngs Reservoir
Landsburg
Tolt River Watershed
South Fork Tolt River
South Fork Tolt Reservoir
Tolt River
Snoqualmie River
I-90
Cedar River
Chester Morse Lake Reservoir
Cedar River Watershed
North
Direct Service Areas
Suburban Wholesale Areas
Watersheds
Well Field
Major Supply Lines
Distribution/ Transmission Storage
King Co.
Pierce Co.
Scale 5 miles

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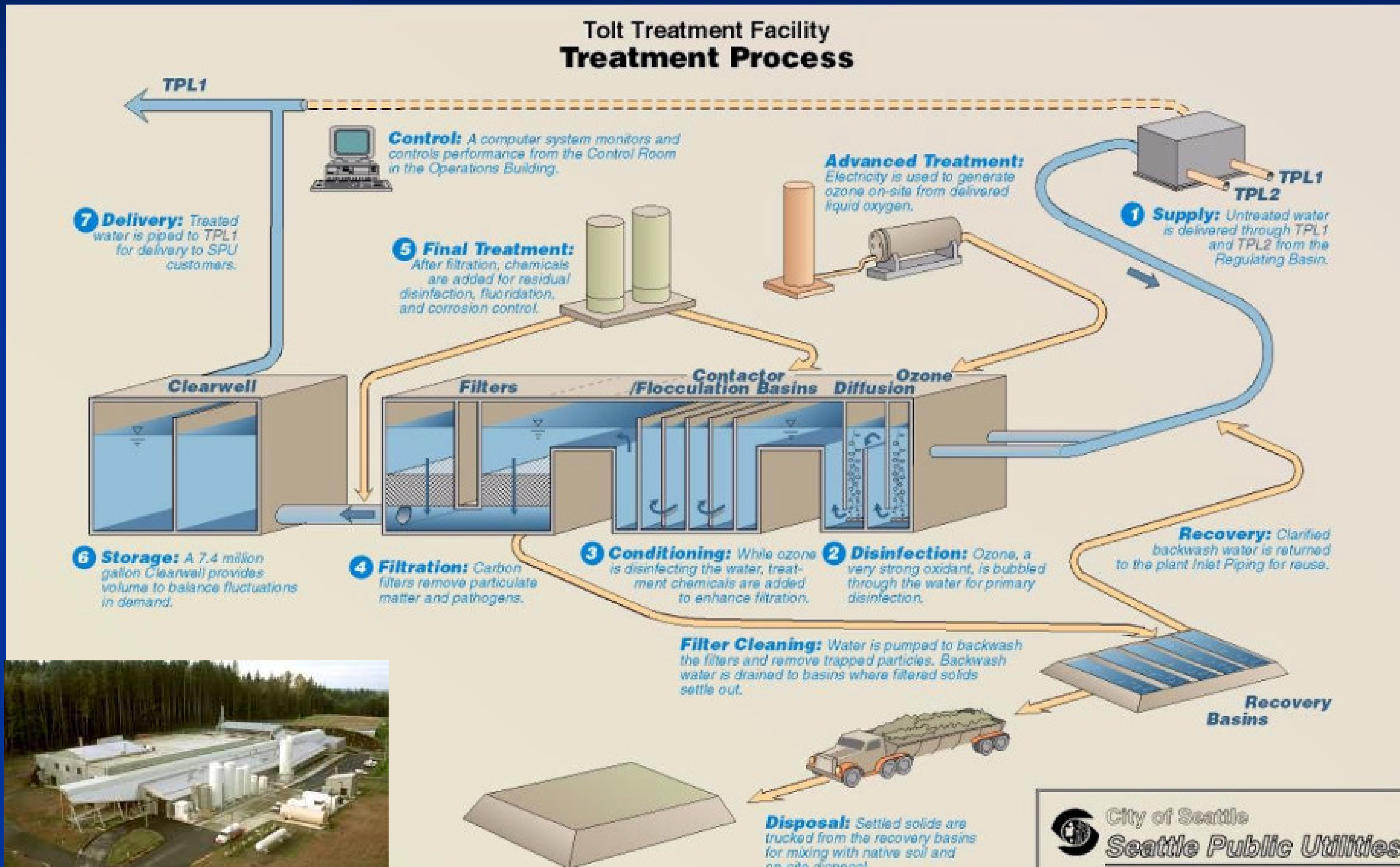
Tolt TF



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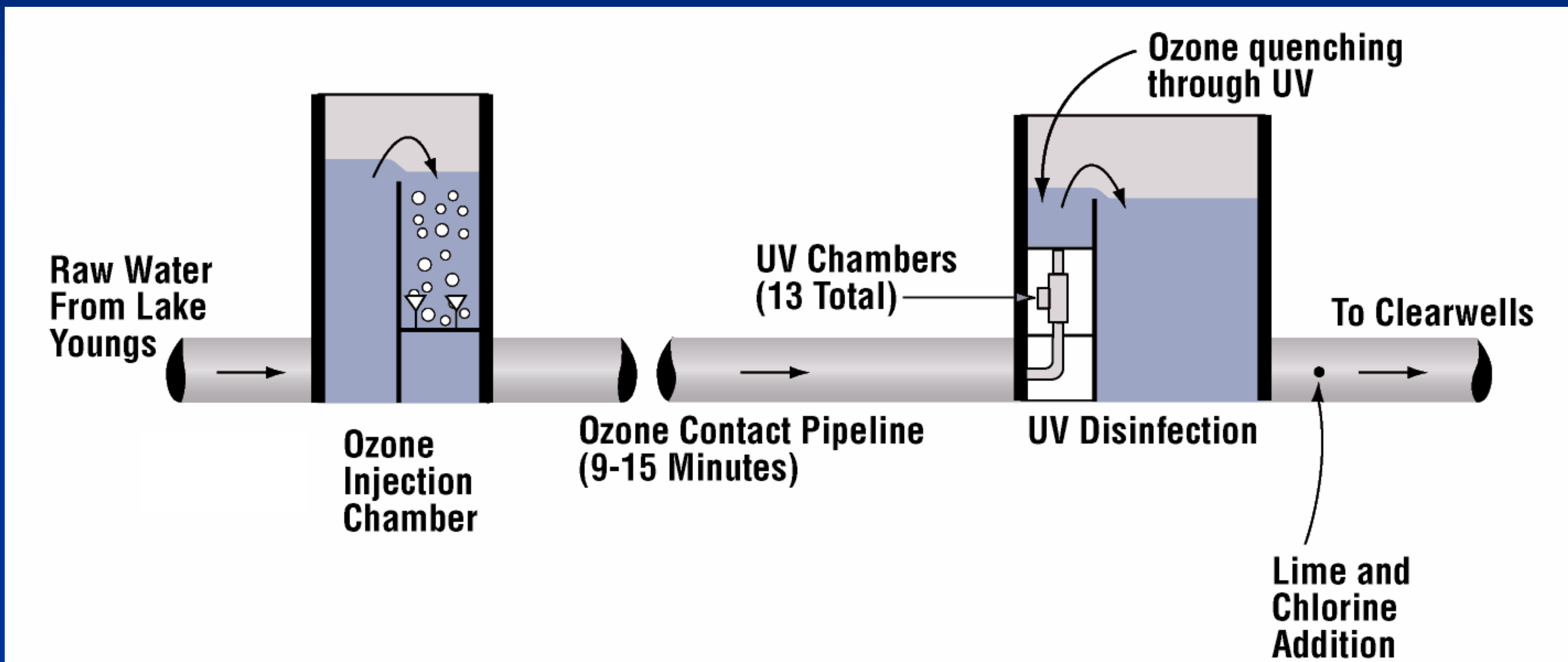
Cedar TF



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What is There to Optimize?

- Operations
  - Water quality
  - Power & chemical costs
  - Operational procedures/diagnostics
- Maintenance
  - Scheduling and tracking Preventive/Corrective/Emergency Maintenance
  - Maintenance diagnostics
  - Repair vs. Replacement strategy

Optimizing Water Quality - 1

- Set WQ goals above regulatory requirements
  - Tolt TF turbidity (combined filter effluent)

	Goal	Maximum Value
SPU Goal	<0.1 NTU 95% of the time	0.2 NTU
DOH Optimization Program	<0.1 NTU 95% of the time	0.3 NTU
DOH - WAC	<0.3 NTU 95% of the time	1.0 NTU

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Optimizing Water Quality - 2

- Use additional analytical tools such as particle counting
  - More sensitive indicator for filter performance & early warning for filter breakthrough
  - Use to analyze log removal of *Giardia* and *Crypto* sized particles

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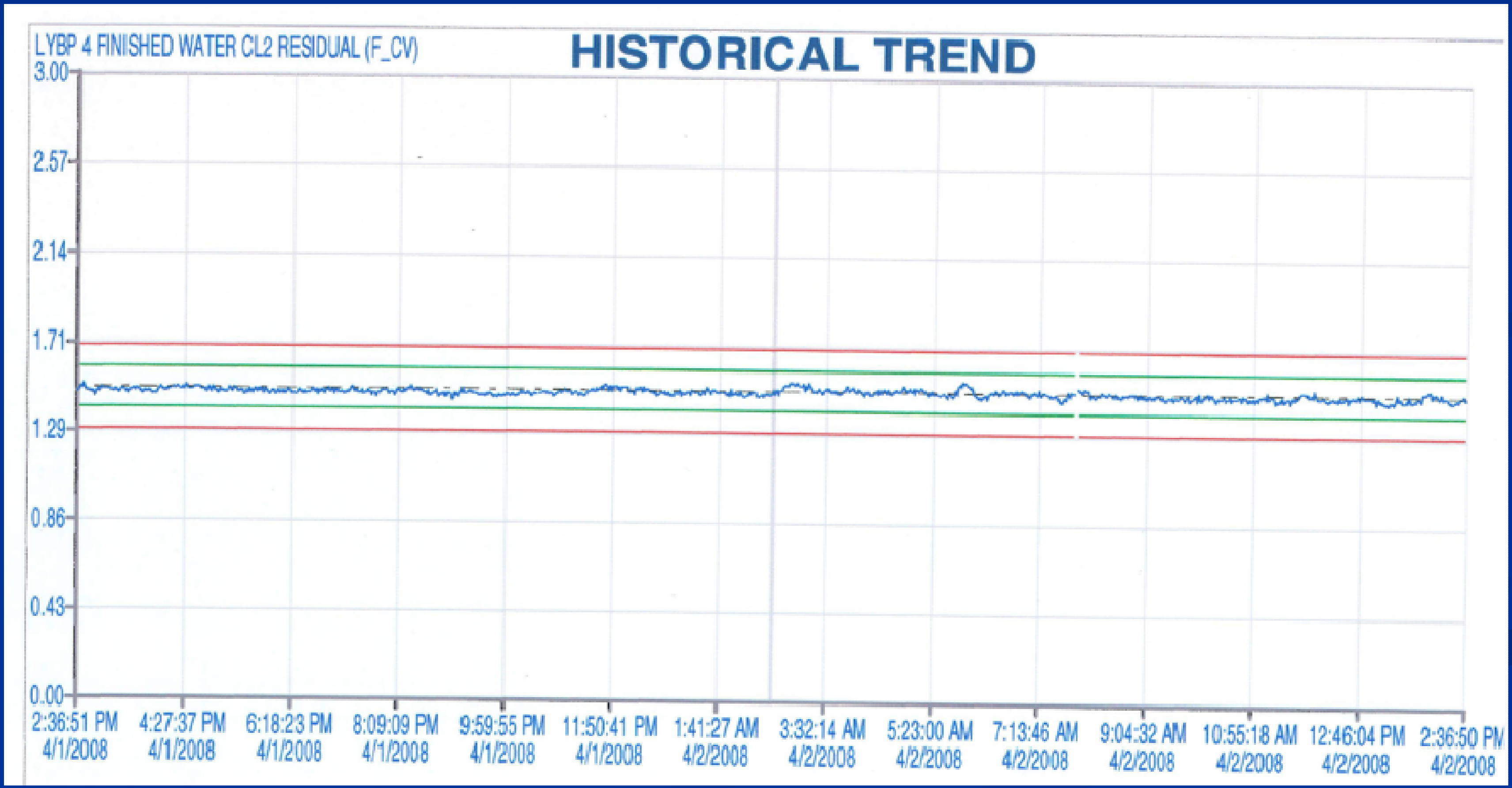
Optimizing Water Quality - 3

- Use SCADA to track performance



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Optimizing Power & Chemical Costs

- Major power costs:
  - Ozone generation
  - Raw water pumping at Cedar
  - UV at Cedar
- Major chemical costs:
  - Tolt (coagulants, LOX, chlorine, lime, CO2, fluoride)
  - Cedar (LOX, chlorine, lime, fluoride)
- Good targets for optimization:
  - Ozone (LOX & power)
  - UV (power)

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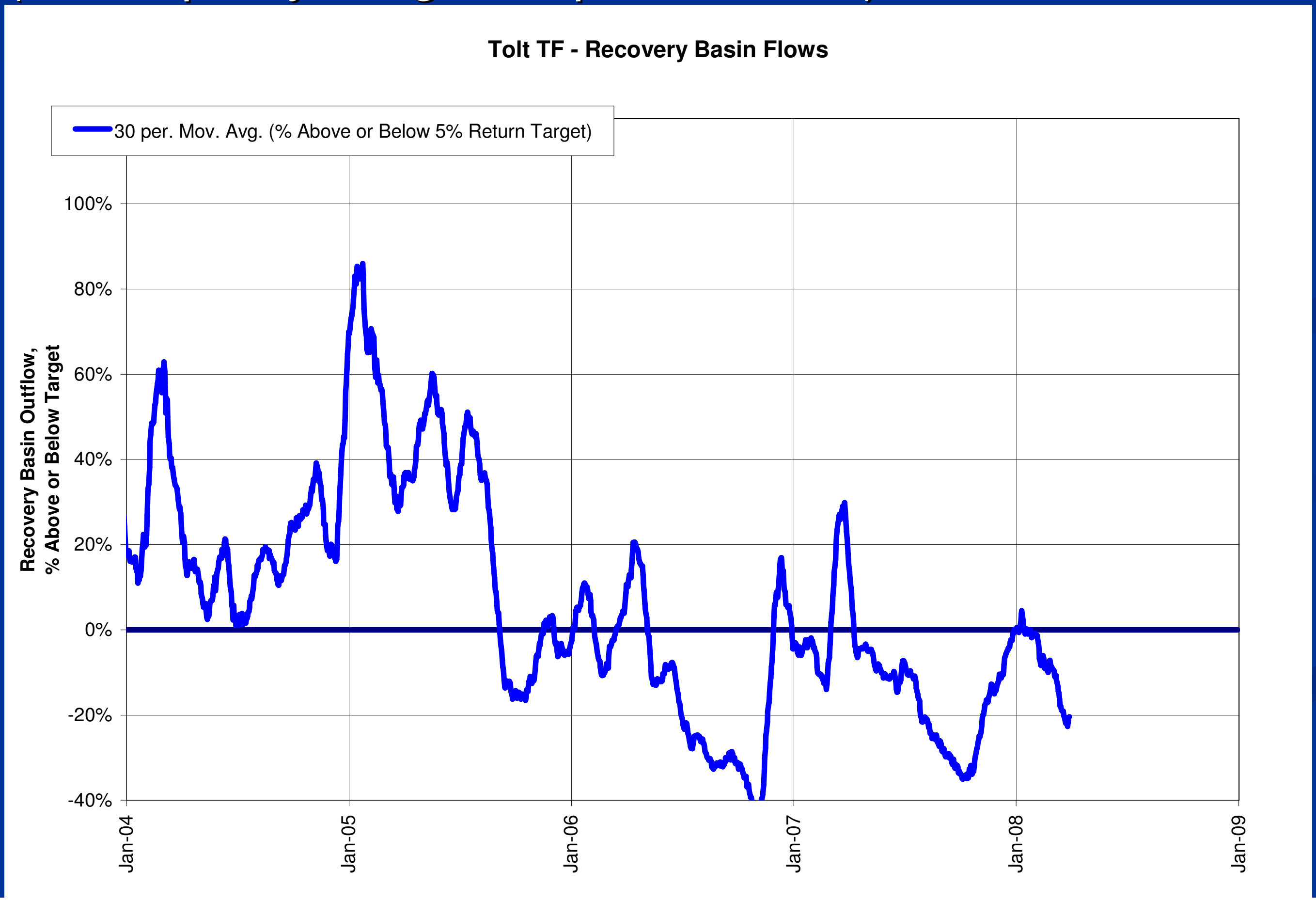
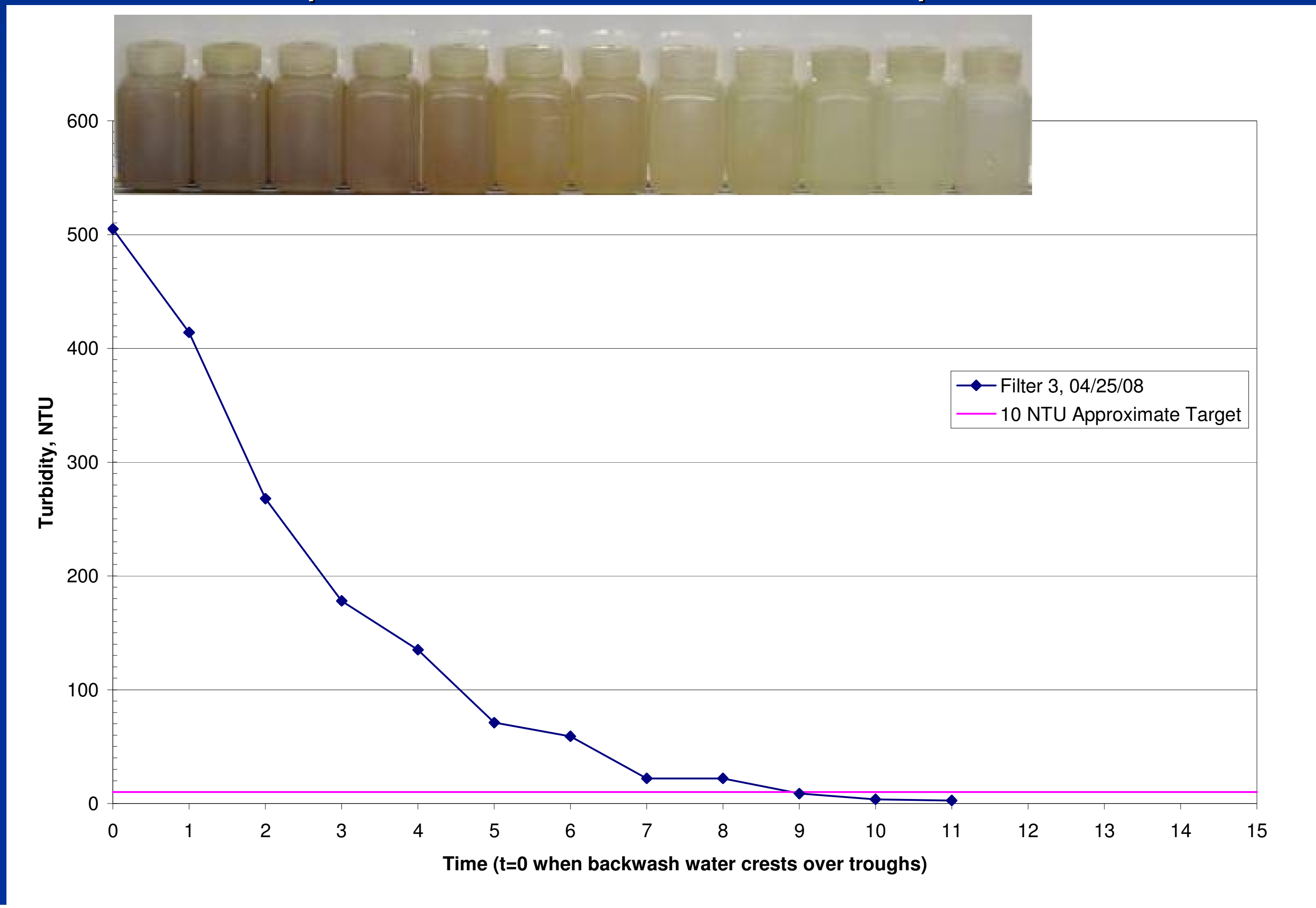
Optimizing Operations - 1

- Track / maximize filter efficiency (95% target)
  - Minimize backwash/filter-to-waste while meeting other targets (water quality, long-term performance)



Optimizing Operations - 2

- Filter optimization – backwash turbidity profile
  - Evaluate shape of curve, time to NTU setpoint



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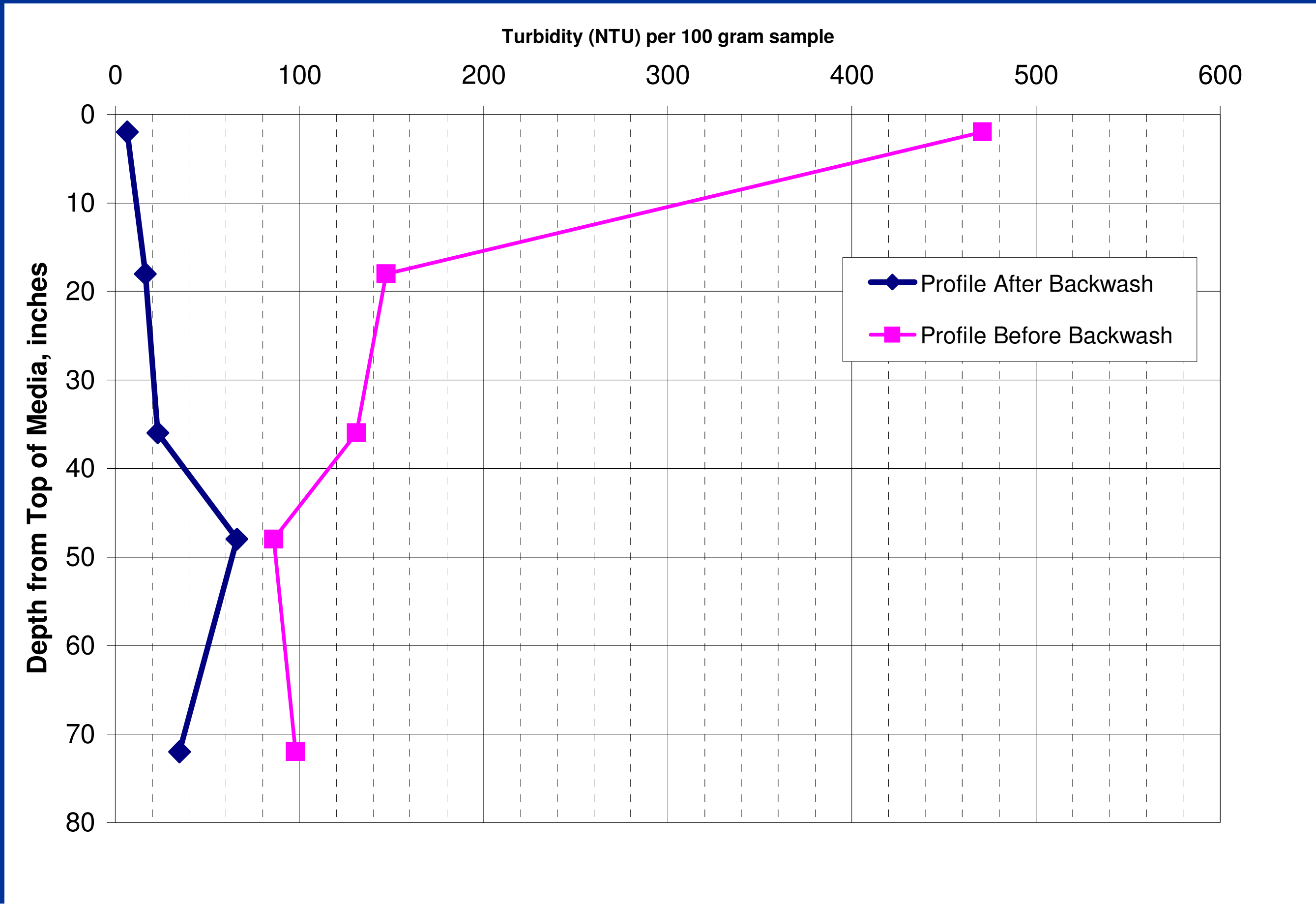
Optimizing Operations - 3

- Filter optimization – floc retention analysis
  - Indicates floc capture across media depth, also effectiveness of backwash



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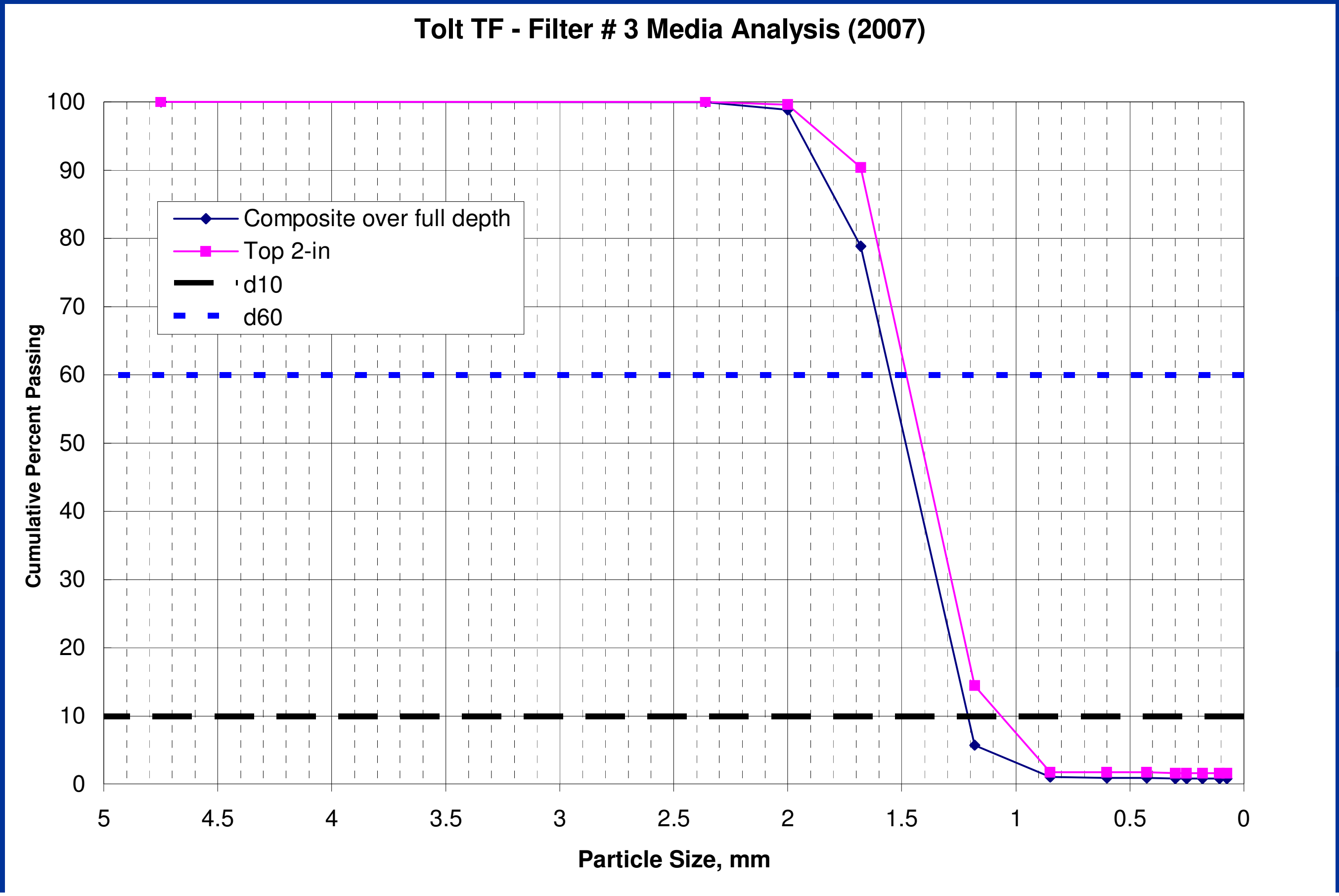
Optimizing Operations - 4

- Filter optimization – media analysis
  - Composite media depth (compare to original specs)
  - Top 2 inches (look for excessive fines)



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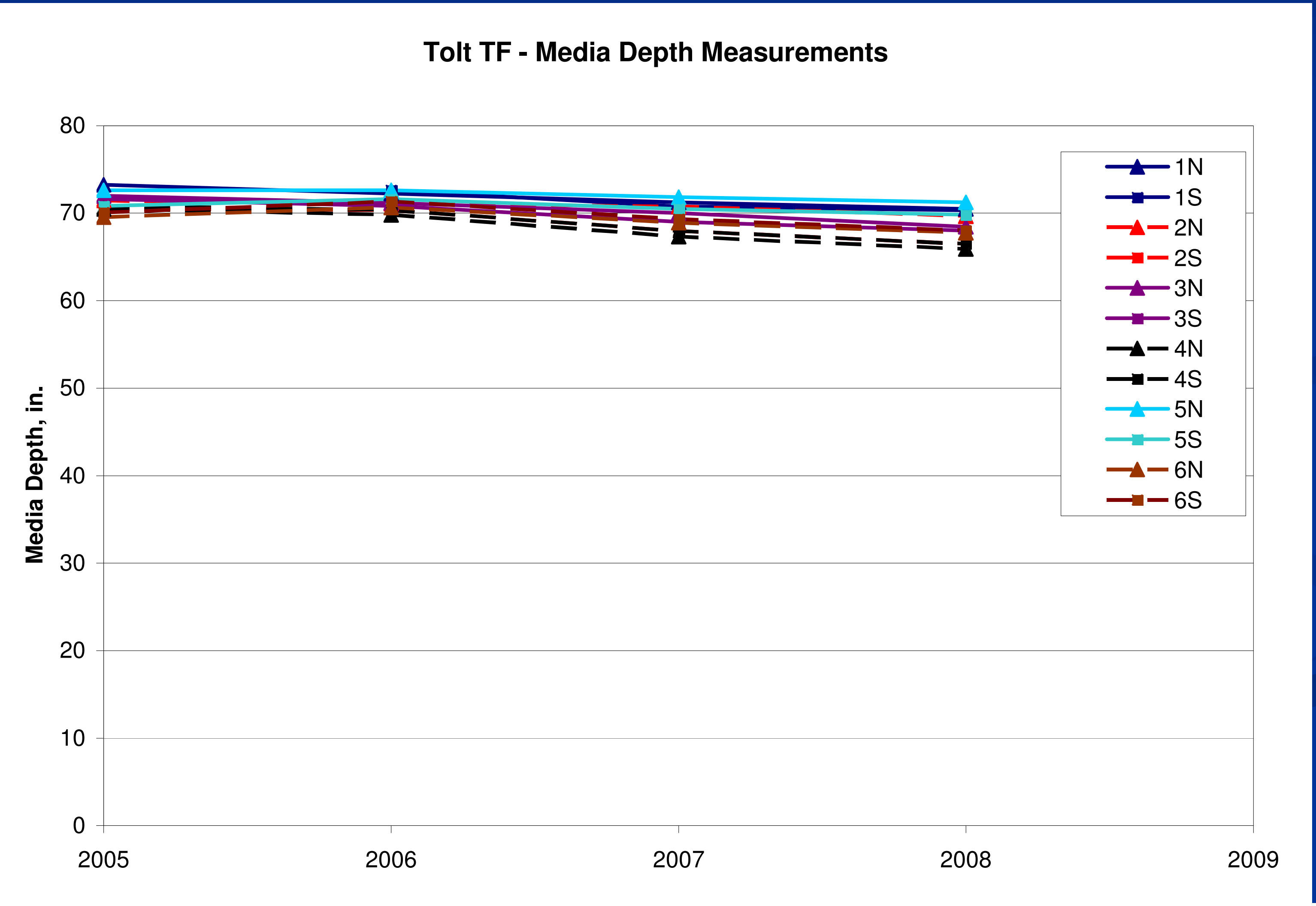
Optimizing Operations - 5

- Check and trend media depth



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Optimizing Maintenance - 1

- Computer-based maintenance management system (CMMS)
  - Scheduling preventive maintenance
  - Tracking corrective & emergency maintenance
  - Predictive maintenance capability
  - Analysis of work order history, hours spent, vendor use & cost, etc.

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Optimizing Maintenance - 2

- Regular inspection, including:
  - Ozone contact & flocculation basins
  - Sample lines
  - Filter media beds
  - Filter underdrain plenums

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Optimizing Maintenance - 3

- Regular inspection, including:
  - Ozone contact pipelines
  - Chemical diffusers
  - Clearwells

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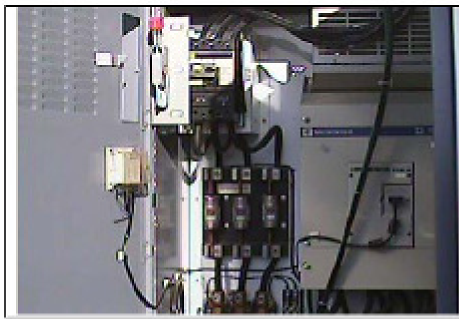
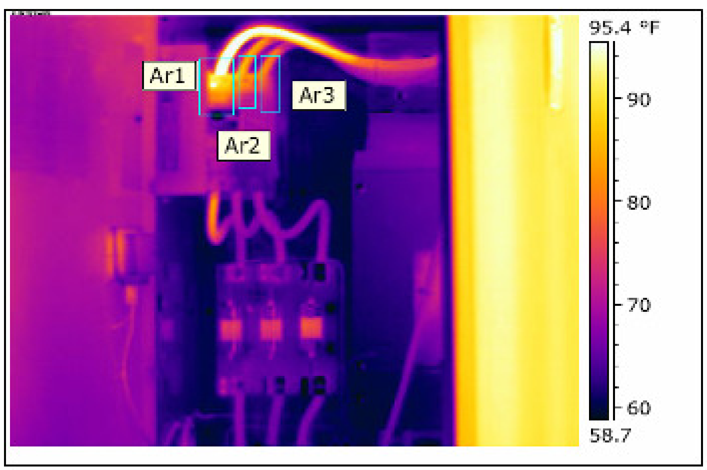
Maintenance Diagnostic Tests - 1

- Thermographic (Infrared) surveys for electrical equipment



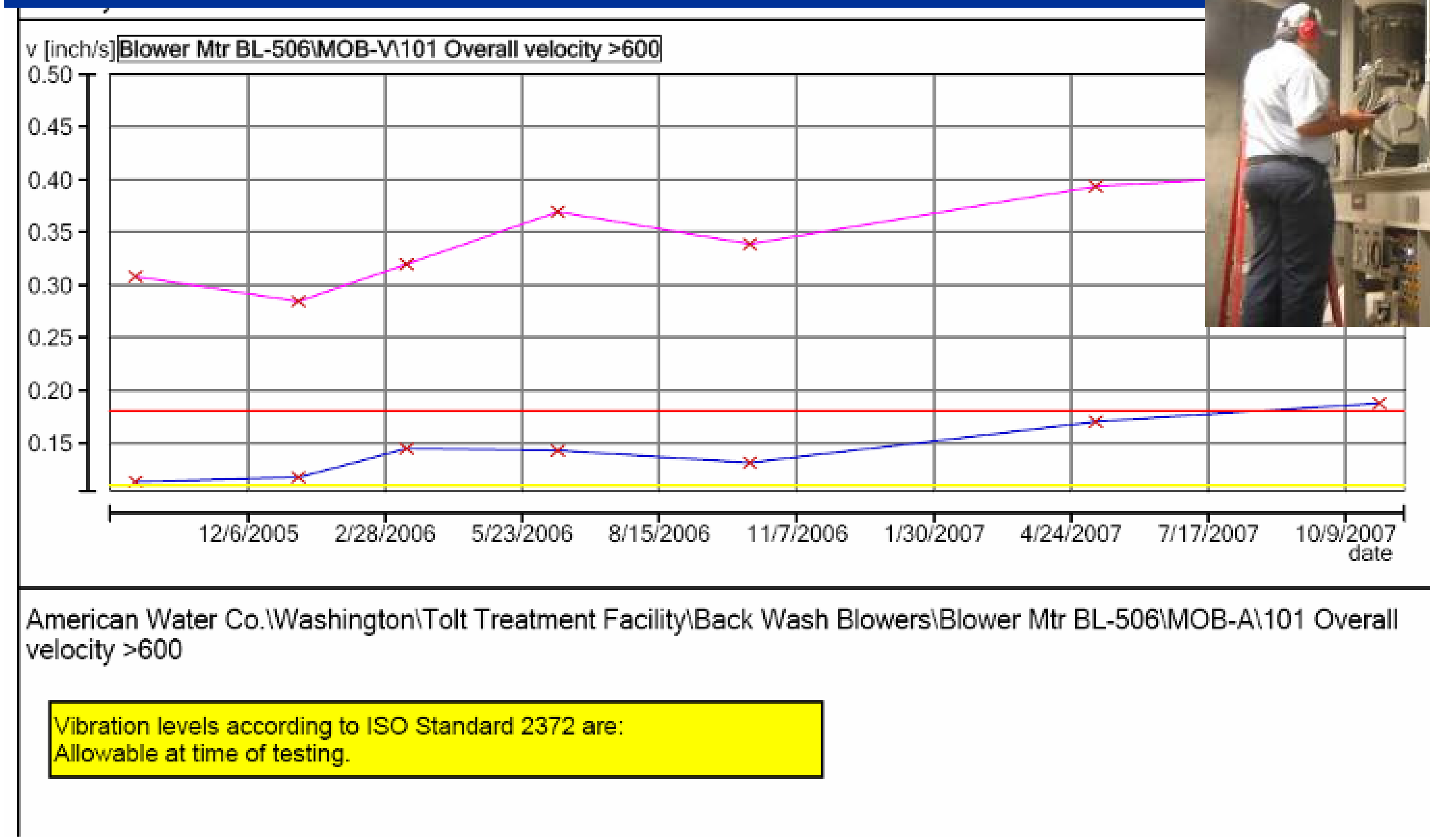
Equipment	Reclaim Pump Station P702 Pump
Component	Breaker and fuses
Date Tested	11/1/2007



Object Parameter	Value
Emissivity	0.96
Object Distance	4.0 ft
File Name	IR_8336.JPG
Label	Value
Max	120.0 °F
Area Max	
AR 1	120.0 °F
AR 2	86.4 °F
AR 3	81.9 °F

Maintenance Diagnostic Tests - 2

- Vibration analysis /motor analysis for major rotating equipment



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Maintenance Diagnostic Tests - 3

- Ultrasound surveys for bearings and transformers (plus transformer oil analysis for transformers)

American Water

200710 Ultrasound Analysis Report
Tolt Water Treatment Facility
American Water Services

TOLT TREATMENT FACILITY.Bearing.Back Wash System.txt

Name	Date	dB	Module Type	Location	Record	Application	Instrument	Low Alarm	High Alarm	Status	RPM
1	6/14/2006:8:57 AM	44	STM	BL-506	INNER	Bearing	UP9000	52	60	OK	1780
1	10/9/2006:4:37 PM	45	STM	BL-506	INNER	Bearing	UP9000	52	60	OK	1780
1	5/8/2007:11:07 AM	52	STM	BL-506	INNER	Bearing	UP9000	52	60	OK	1780
1	10/30/2007:8:06 AM	52	STM	BL-506	INNER	Bearing	UP9000	52	60	OK	1780
2	6/14/2006:8:57 AM	44	STM	BL-506	OUTER	Bearing	UP9000	52	60	OK	1780
2	10/9/2006:4:34 PM	49	STM	BL-506	OUTER	Bearing	UP9000	52	60	OK	1780
2	5/8/2007:11:08 AM	50	STM	BL-506	OUTER	Bearing	UP9000	52	60	OK	1780
2	**10/30/2007:8:10 AM**	**62**	**STM**	**BL-506**	**OUTER**	**Bearing**	**UP9000**	**52**	**60**	**High**	**1780**
3	6/12/2006:12:41 PM	41	STM	BL-507	INNER	Bearing	UP9000	49	57	OK	1780
3	10/9/2006:4:54 PM	43	STM	BL-507	INNER	Bearing	UP9000	49	57	OK	1780
3	5/8/2007:11:56 AM	46	STM	BL-507	INNER	Bearing	UP9000	49	57	OK	1780
3	**10/30/2007:8:24 AM**	**61**	**STM**	**BL-507**	**INNER**	**Bearing**	**UP9000**	**49**	**57**	**High**	**1780**
4	6/12/2006:12:42 PM	47	STM	BL-507	OUTER	Bearing	UP9000	53	61	OK	1780
4	10/9/2006:4:53 PM	49	STM	BL-507	OUTER	Bearing	UP9000	53	61	OK	1780
4	5/8/2007:11:56 AM	45	STM	BL-507	OUTER	Bearing	UP9000	53	61	OK	1780
4	**10/30/2007:8:25 AM**	**56**	**STM**	**BL-507**	**OUTER**	**Bearing**	**UP9000**	**53**	**61**	**Low**	**1780**
5	10/9/2006:5:04 AM	38	STM	P-502	INNER	Bearing	UP9000	57	65	OK	705
5	5/8/2007:12:02 PM	42	STM	P-502	INNER	Bearing	UP9000	57	65	OK	705
5	10/30/2007:8:33 AM	49	STM	P-502	INNER	Bearing	UP9000	57	65	OK	705
6	10/30/2007:8:33 AM	47	STM	P-502	OUTER	Bearing	UP9000	55	63	OK	705
7	10/30/2007:8:30 AM	48	STM	P-503	INNER	Bearing	UP9000	56	64	OK	705
8	10/30/2007:8:30 AM	54	STM	P-503	OUTER	Bearing	UP9000	62	70	OK	705

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Maintenance Diagnostic Tests - 4

- Some tests address immediate issues
  - Thermographic (IR) scans
- Other tests can evaluate short-term and long-term condition
  - Vibration analysis
  - Motor analysis
  - Ultrasound analysis
  - Transformer oil analysis
- Use long-term trends to plan for repair/replacement

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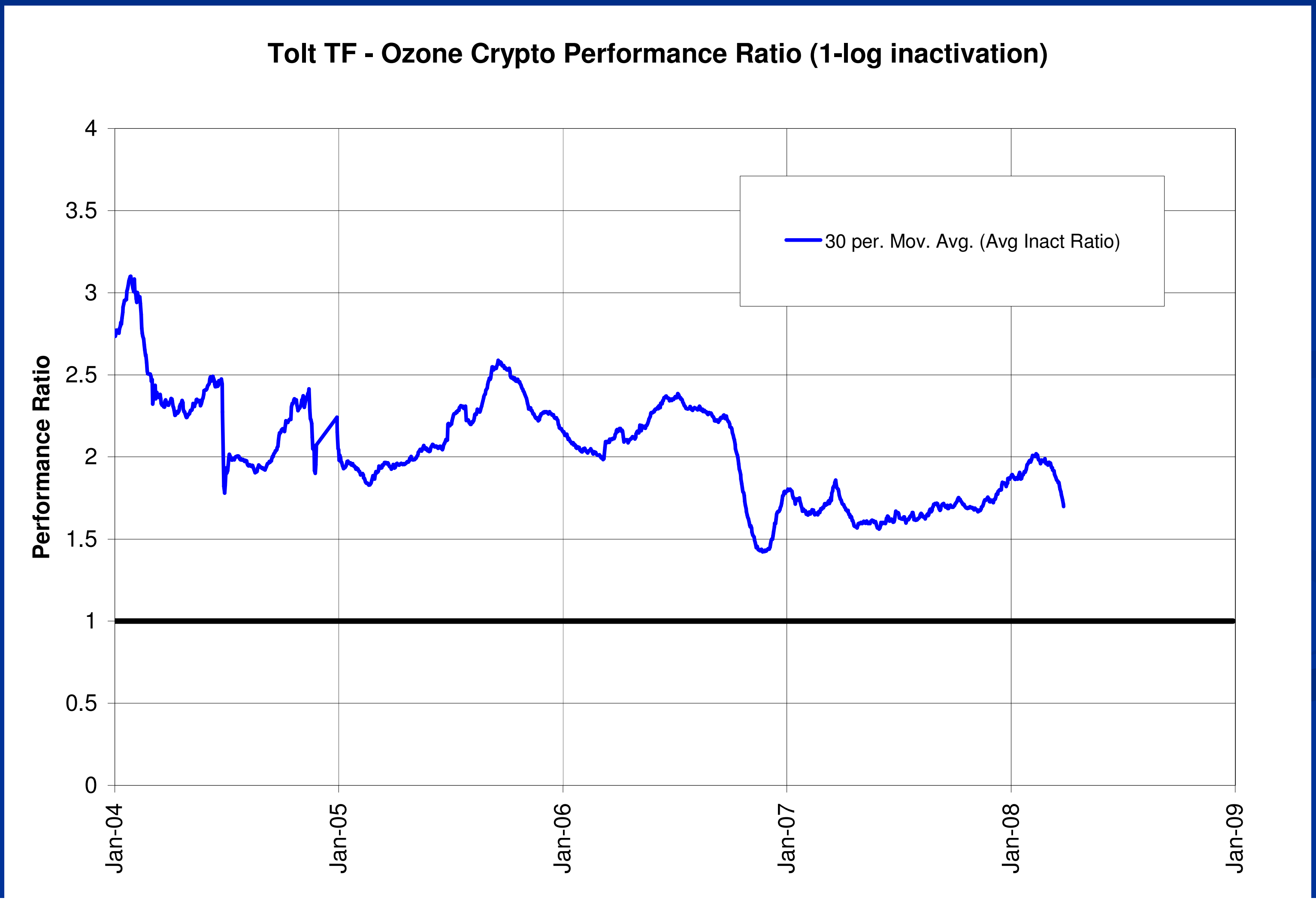
Ozone Basics

- Liquid oxygen (LOX) vaporized into gas oxygen (GOX)
- Ozone (O3) made using GOX and electricity
- Ozone diffused into water column

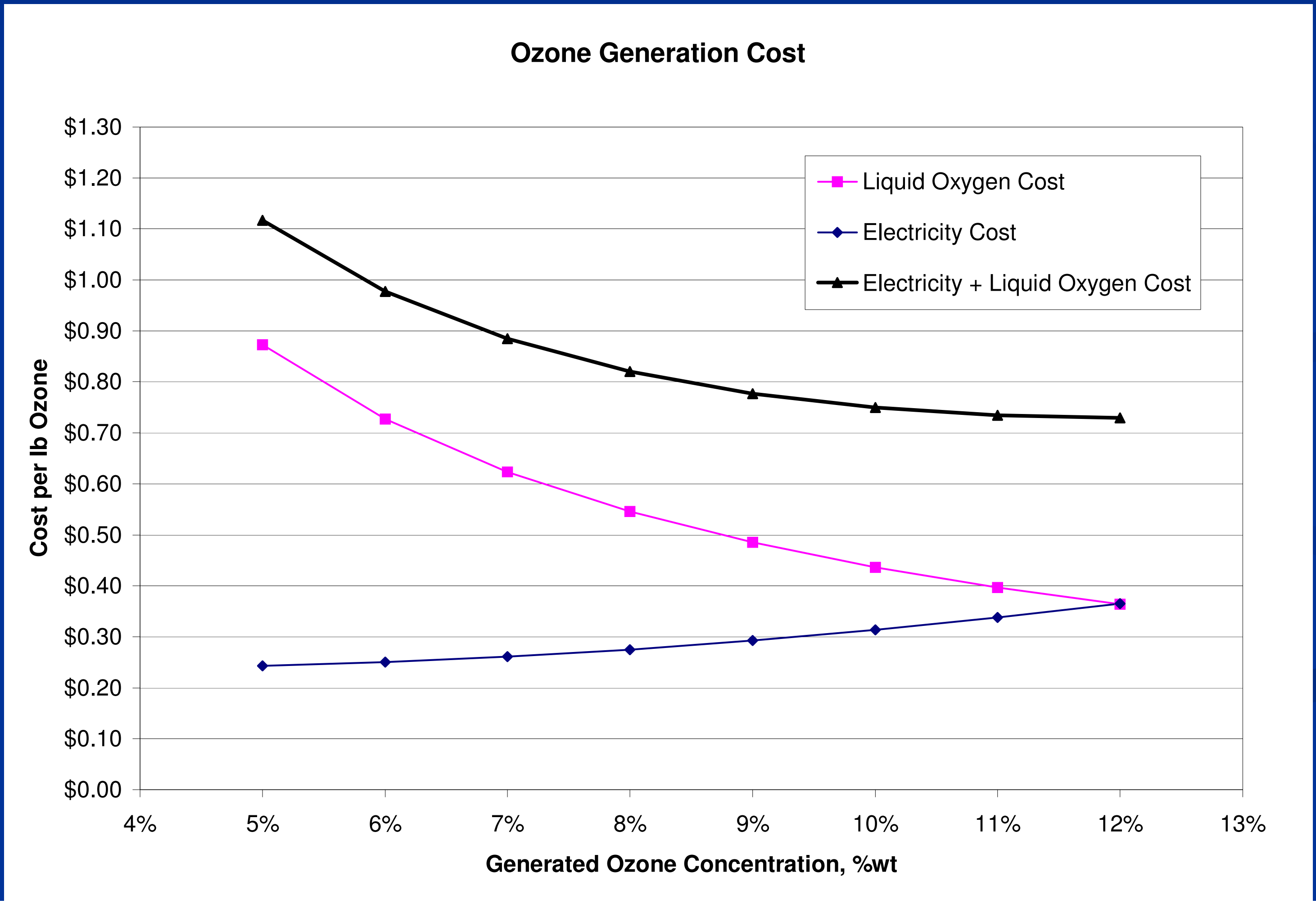
Ozone Power & Chemical Costs - 1

- Set and track targets for performance ratio (allowable safety factor)



Ozone Power & Chemical Costs - 2

- Optimize operational cost by operating generators at highest ozone concentration



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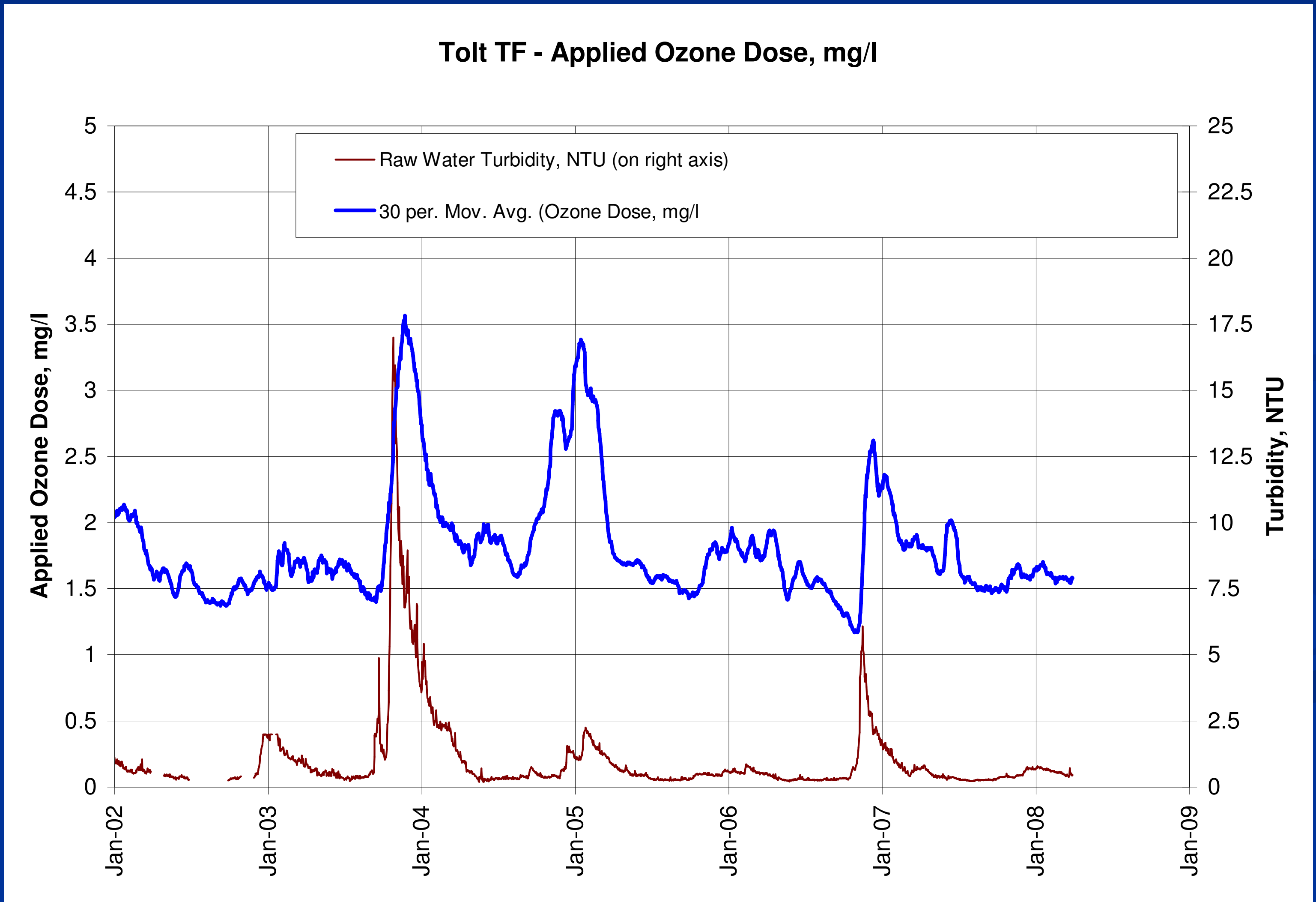
Ozone Power & Chemical Costs - 3

- Track overall system efficiency to watch for:
  - Leaks in pipes or valves
  - Degradation of diffusers or diffuser hardware
- Regular testing & inspection of diffusers

Ozone Power & Chemical Costs - 4

- Track large-scale trends



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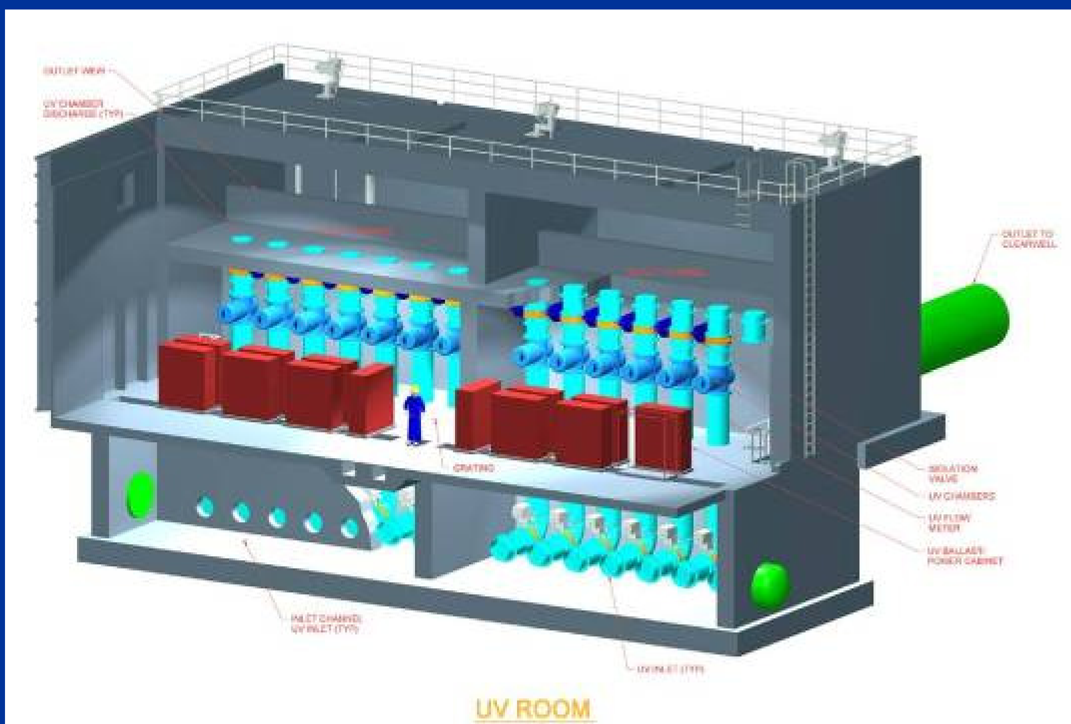
Ultraviolet Disinfection Basics

- Disinfection (*Giardia* & *Cryptosporidium*)
- UV light denatures DNA, rendering organisms unable to replicate



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UV Power & Chemical Costs - 1

- Set and track targets for inactivation ratio and allowable safety factor
  - Design dose of 40 mJ/cm^2
  - Dose varies with respect to flow, UV transmittance, and lamp power
- Computer-based controls for optimizing number of reactors and power setting
  - Minimize the number of reactors operating (maximize flow per reactor)
  - Avoid setting system with lamps at lowest power setting while providing excessive dose (too high a safety factor)

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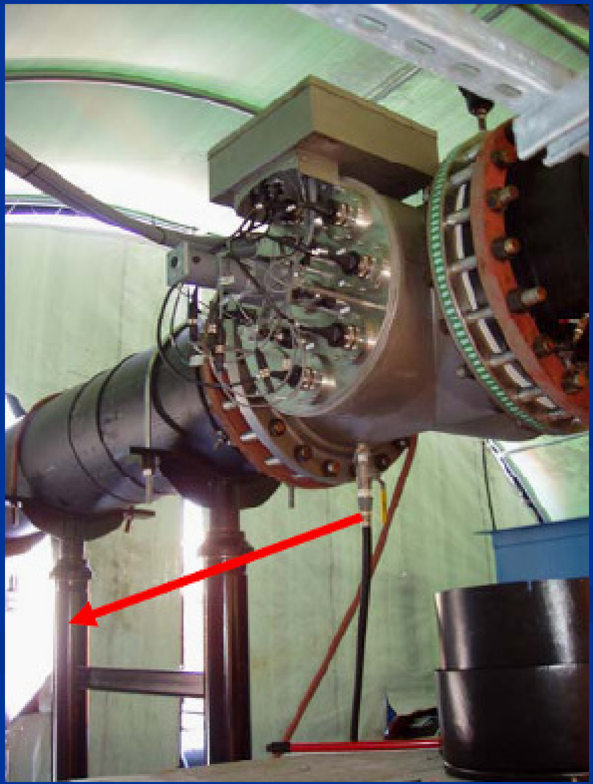
UV Power & Chemical Costs - 2

- Re-validation study allowed higher flow through each UV reactor than original validation work
  - Decreases UV power required to achieve same inactivation credit
  - In most cases, allows one less UV reactor to operate than before (several $K / month savings)



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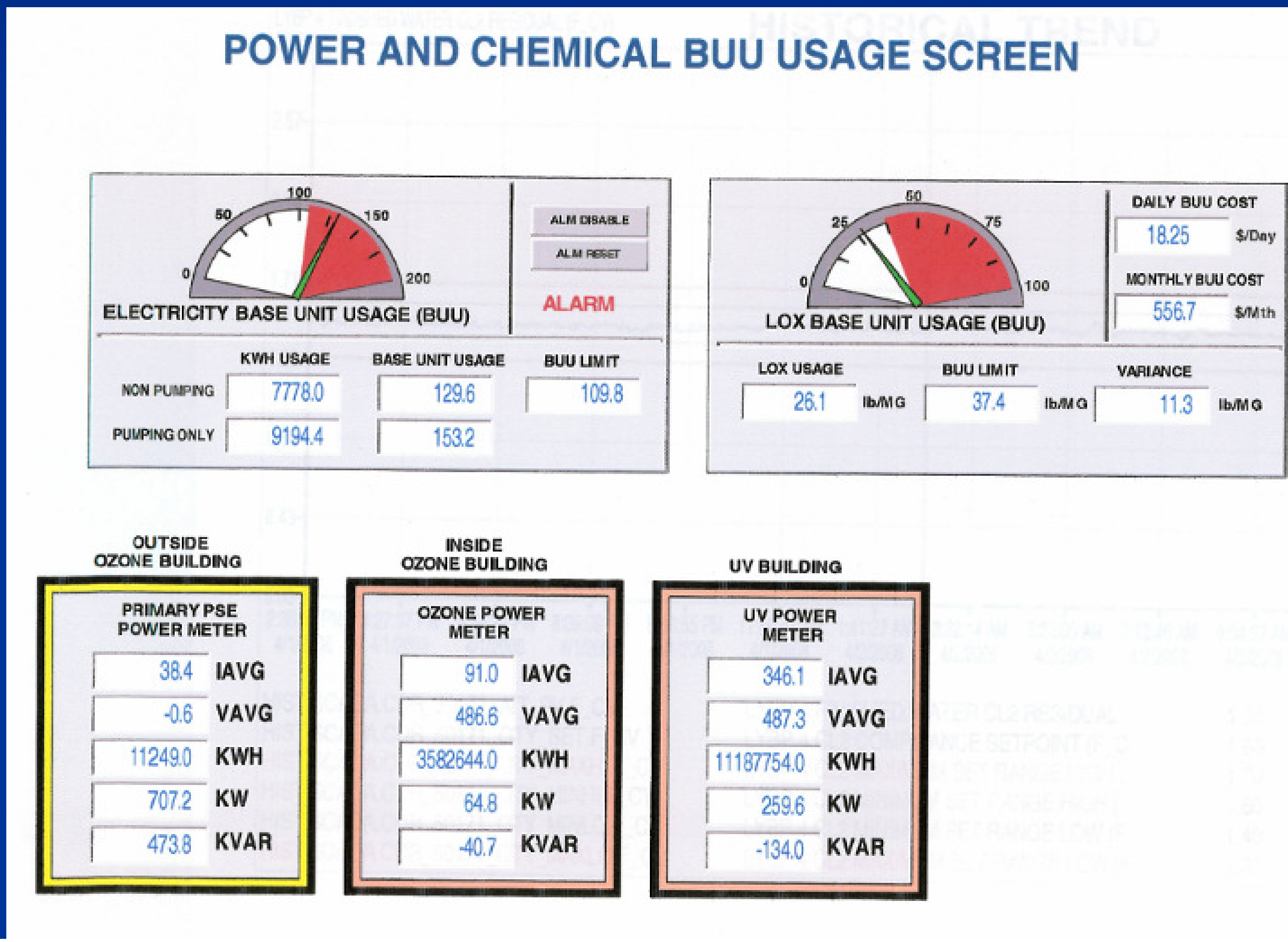
Power & Chemical Costs

- Use SCADA to track power & chemical efficiency



Questions?