

Drinking Water Quality And Treatment

Water System Advisory Committee

07/11/2018

Seattle Public Utilities



City of Seattle

Agenda

- Drinking water quality and treatment overview
- Contaminant monitoring and prioritization
- Public Notice and Boil Advisories
- Algae and nuisance species management



SPU Drinking Water Quality Objectives



- Public Health Protection
- Regulatory Compliance
- Maintain and Improve Community Confidence

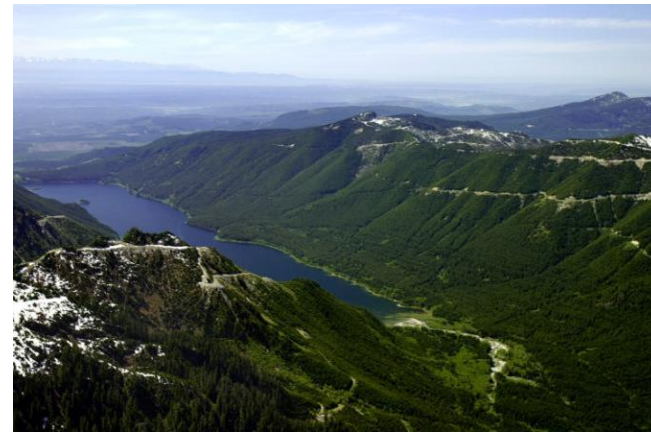
Source To Tap Influences

- Source Water Quality
- Water Treatment
- Transmission and Distribution
- On Property Plumbing



Source Water Quality

- Cedar and Tolt Watersheds have exceptional source water protection
- Naturally occurring water quality influences much greater focus for SPU than external sources of contamination
 - Source water chemistry
 - Biological water quality
- Projects and activities in the watershed



Water Treatment Facilities

- Tolt Treatment Facility
- Cedar Treatment Facility
- Seattle Well Fields
- Booster Chlorination



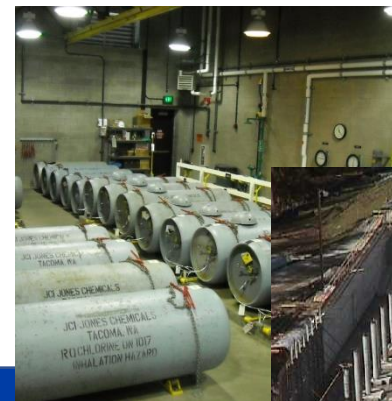
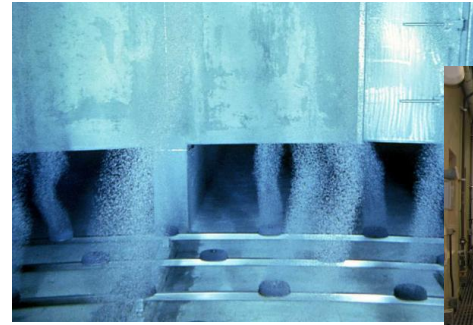
Tolt Treatment Facility



The Tolt Treatment Facility is a 120 mgd ozone and direct filtration plant, put in service in 2001

Tolt Treatment Processes

- Ozonation
- Coagulation, Flocculation, Filtration
- Corrosion Control
- Fluoridation
- Chlorination
- Clearwell Storage



Tolt Treatment Objectives

- Tolt supply was unfiltered until 2001. Only chlorine disinfection and corrosion control were provided.
- Goals of new plant: Regulatory Compliance, Public Health Protection, Aesthetics, Supply Reliability, Supply Yield
- Treatment objectives:
 - Removal of turbidity and microbes
 - Removal of natural organics
 - Improved disinfection
 - Corrosion control
 - Taste and odor reduction



Cedar Treatment Facility



Cedar Treatment Processes

- Ozonation
- Ultraviolet Disinfection
- pH Adjustment (lime)
- Chlorination
- Clearwells

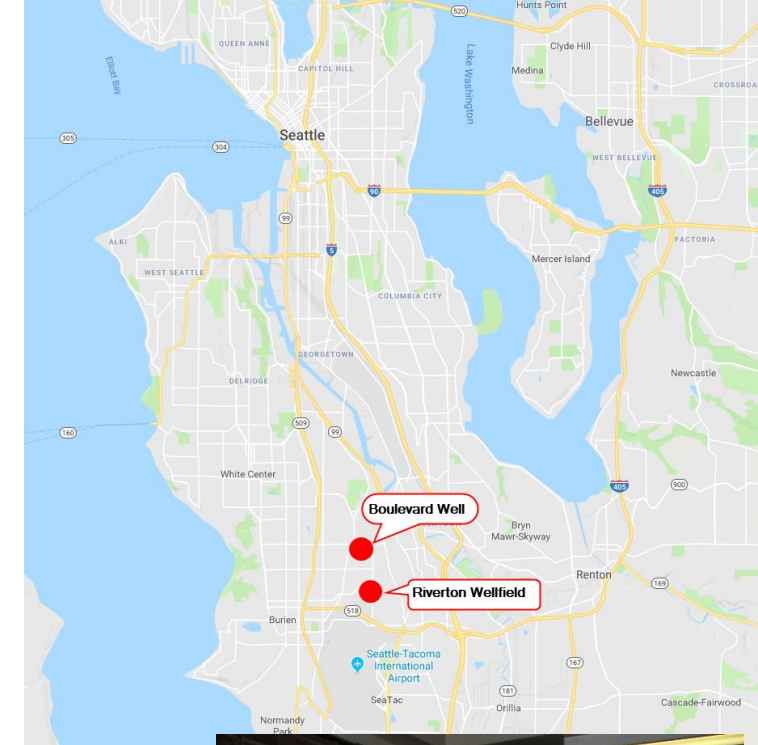


Cedar Treatment Objectives

- Prior to 2004, treatment was chlorination and pH adjustment.
- New treatment for regulatory compliance, improved public health protection, aesthetics
- Objectives of new treatment
 - Improved disinfection
 - Corrosion control
 - Taste and odor improvement
- “Limited Alternative to Filtration” regulatory status
 - Different from “unfiltered” status
 - Requires additional inactivation of Cryptosporidium, Giardia, and viruses beyond that achieved by traditional filtration and disinfection

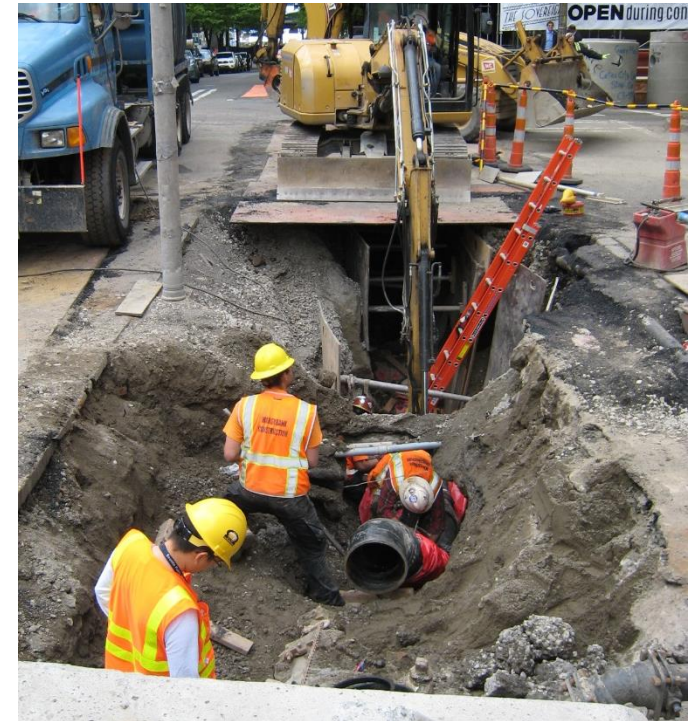
Seattle Wells

- Two well sites just north of Sea-Tac Airport
- Used some years for summer peak demands and to provide emergency backup to the Cedar (10 mgd)
- Well site treatment includes:
 - Sodium hypochlorite (chlorine)
 - Fluoride
 - Sodium hydroxide (for pH adjustment / corrosion control).
- Objective of treatment is to match the Cedar source quality, but wells have much higher mineral content.
- Blended 20-50% well water with Cedar R. Water



Transmission and Distribution

- Influences on water quality between treatment and customer service connections:
 - Water age
 - Un-lined cast iron water main (40%)
 - Bacteriological re-growth
 - Sediments
 - Low Pressure
 - Construction



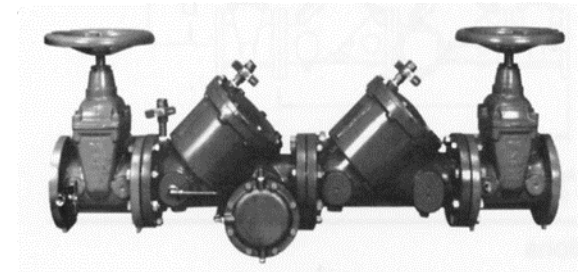
Transmission and Distribution (continued)

- Extensive Monitoring (mostly chlorine and bacteria)
- Actions taken to preserve water quality:
 - Booster chlorination (permanent and manual)
 - Storage facility cycling
 - Storage facility sanitary inspection, maintenance, and cleaning
 - Water main sanitation, disinfection of new facilities, main break repair



On Property Plumbing

- Building plumbing materials and water age
 - Type of pipe, age, type of solder, location in the system
- Management of building systems
 - Legionella
- Alternative water supplies (rainwater catchment)
- Cross Connection Control
 - A “cross connection” is an actual or potential physical connection between a public water system and a non-potable source that could contaminate the potable water supply by backflow
 - SPU undertakes a program jointly with Public Health Seattle- King County



Contaminant Monitoring and Prioritization

- Monitoring priorities
- Regulatory History & Highlights
 - DBPR
 - TCR
 - LCR
 - UCMR
- Future Changes
- Challenges and Strategies
- Plans: Federal and SPU



Monitoring Priorities

- National Primary Drinking Water Regulations (NPDWR)
 - Protect health
 - Legally enforceable by Maximum Contaminant Level (MCL) or treatment techniques
- National Secondary Drinking Water Regulations
 - Non-enforceable guidelines
 - May cause cosmetic effects or aesthetic effects (such as taste, odor, or color)
- Operational or investigative
 - Examples include algae, source water nutrients, dissolved oxygen, temperature trends
- Unregulated Contaminants

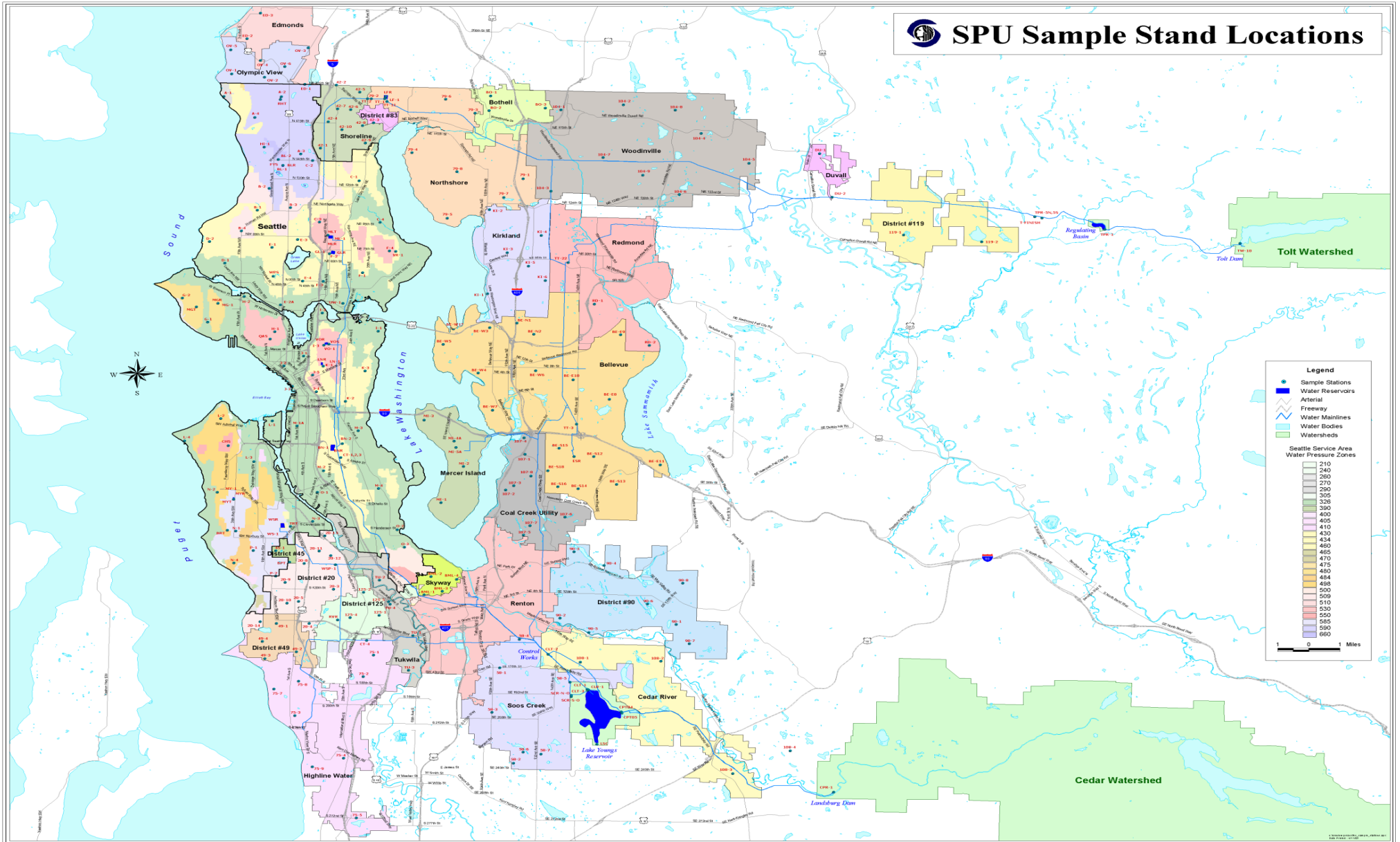


Source and Distribution Monitoring

- Purposes:
 - Regulatory
 - Operational
 - Aesthetic
- Approach
 - Monitoring Plans
 - Sample Collection
 - Analysis
 - Data and Reporting



SPU Sample Stand Locations



Legend

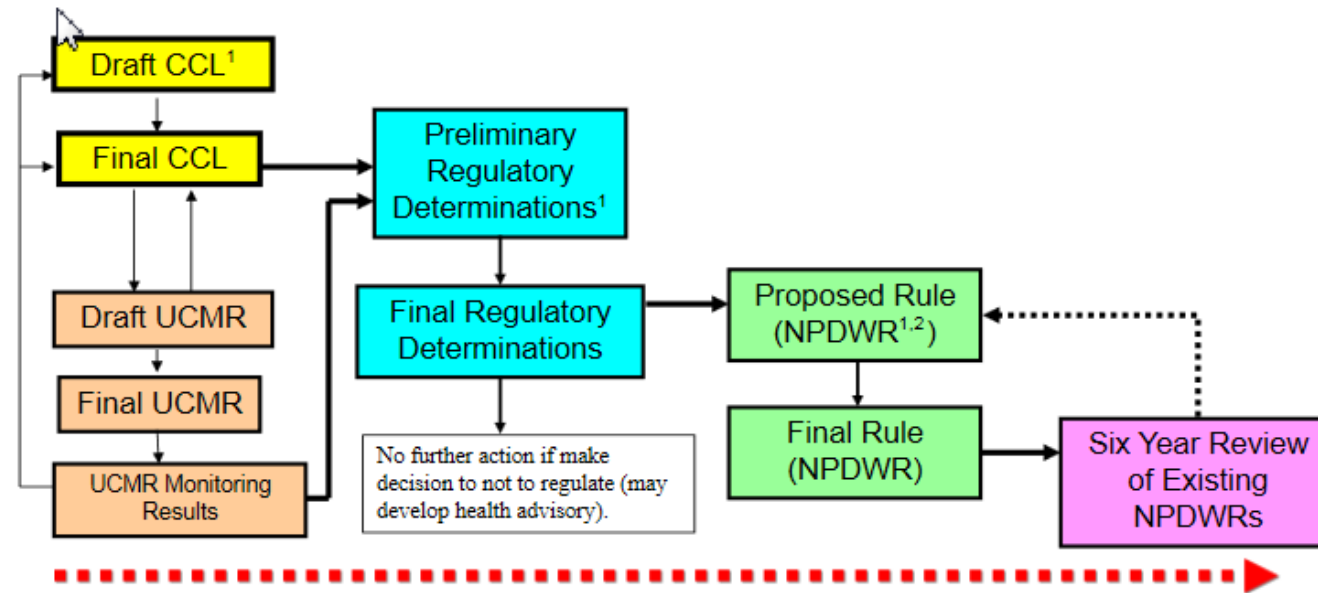
- Sample Stations
- Water Reservoirs
- Arterial
- Freeway
- Water Mainlines
- Water Bodies
- Watersheds

Seattle Service Area Water Pressure Zones

- 210
- 240
- 260
- 270
- 290
- 305
- 326
- 330
- 340
- 350
- 360
- 370
- 380
- 390
- 400
- 405
- 410
- 430
- 434
- 480
- 484
- 488
- 498
- 500
- 509
- 510
- 530
- 550
- 585
- 590
- 660

0 1 Miles

Setting Primary Drinking Water Standards



Source: EPA Office of Groundwater and Drinking Water Presentation

Regulatory Background

- EPA has delegated primary enforcement authority (primacy) to Washington State Department of Health
- WDOH must develop and implement regulations that are as stringent or more stringent than those in the federal regulations.
- State Drinking Water Regulations
 - WAC 246-290: Group A Public Water Supplies (> 15 residential connections or > 25 people/day for > 60 days/yr)
 - WAC 246-292: Water Works Operator Certification
 - WAC 246-294: Operating Permits



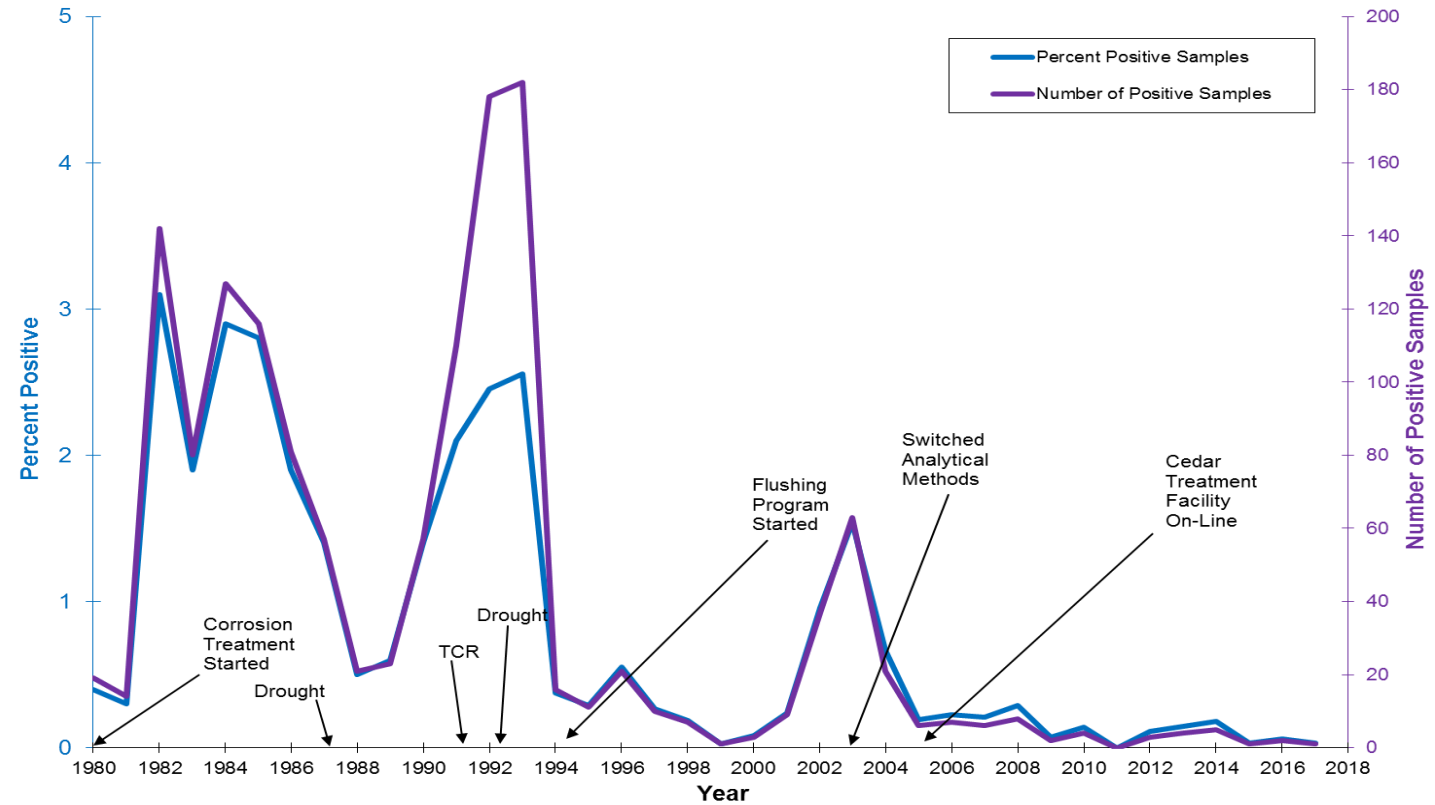
Regulatory Background

Key Regulations:

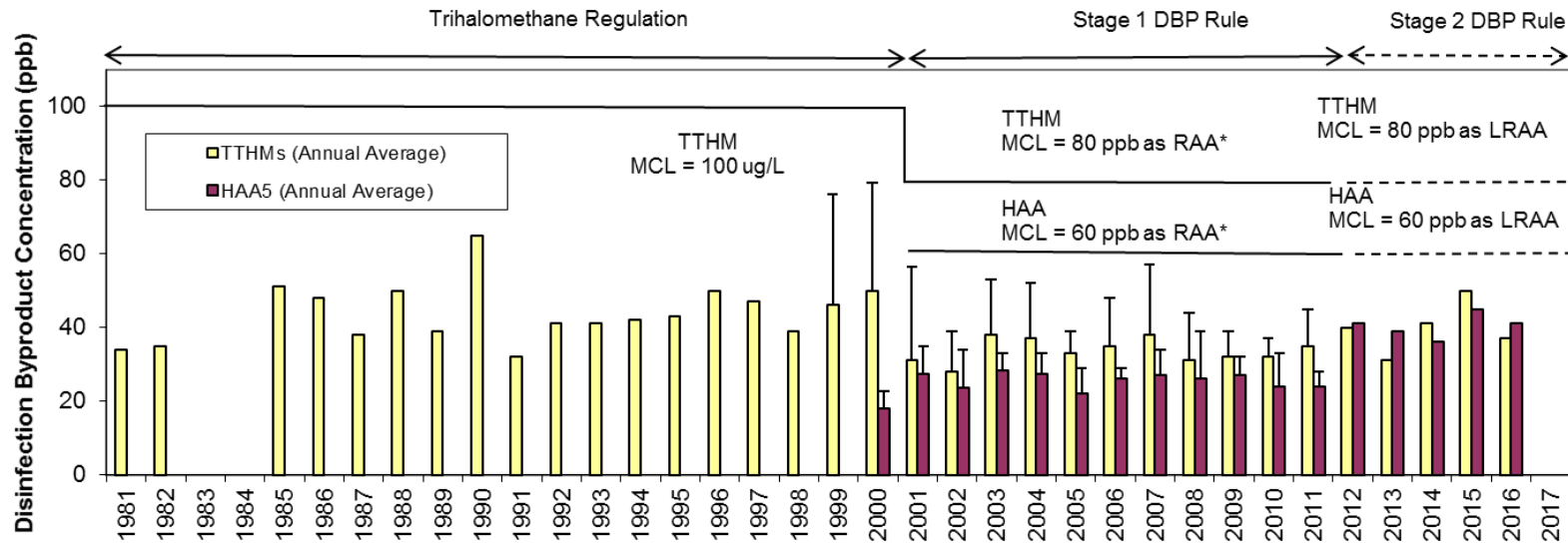
- Surface Water Treatment Rule/ Limited Alternative to Filtration (LAF) – targets pathogens in the source water by setting filtration and disinfection treatment requirements at the Cedar and Tolt facilities
- Total Coliform Rule (TCR) – addresses microbial contamination in the distribution system with sampling for coliform, E. Coli, HPCs, and chlorine residual.
- Disinfection By-products Rule (DBPR) – limits contaminants formed in treatment plant and distribution system when chlorine reacts with natural organic matter
- Lead and Copper Rule (LCR) – sets pH and alkalinity requirements for Cedar and Tolt TFs in order to reduce corrosivity of water to plumbing. Based on sampling at customers' homes.

SPU TCR

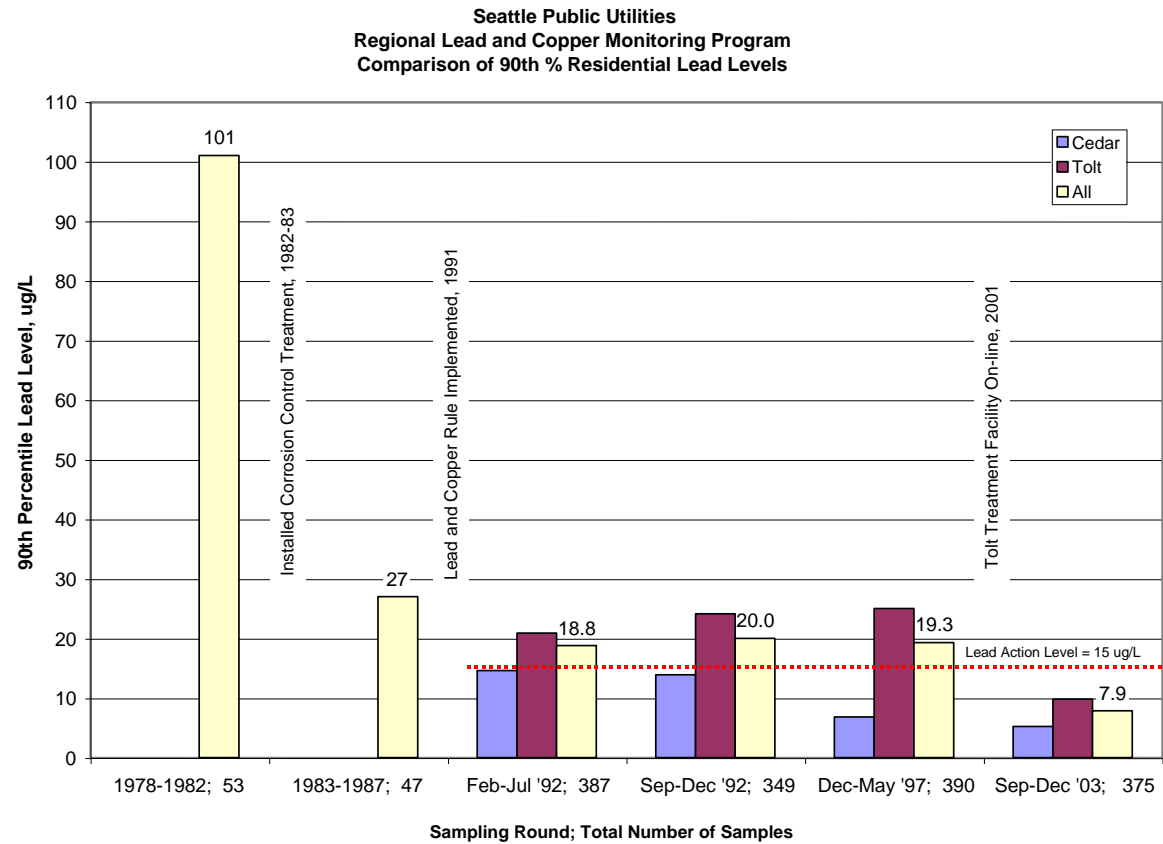
Seattle Public Utilities
Direct Service Area Distribution System Total Coliform Levels
Percent Positive and Number of TC Positive Samples per Year
1980 to 2017



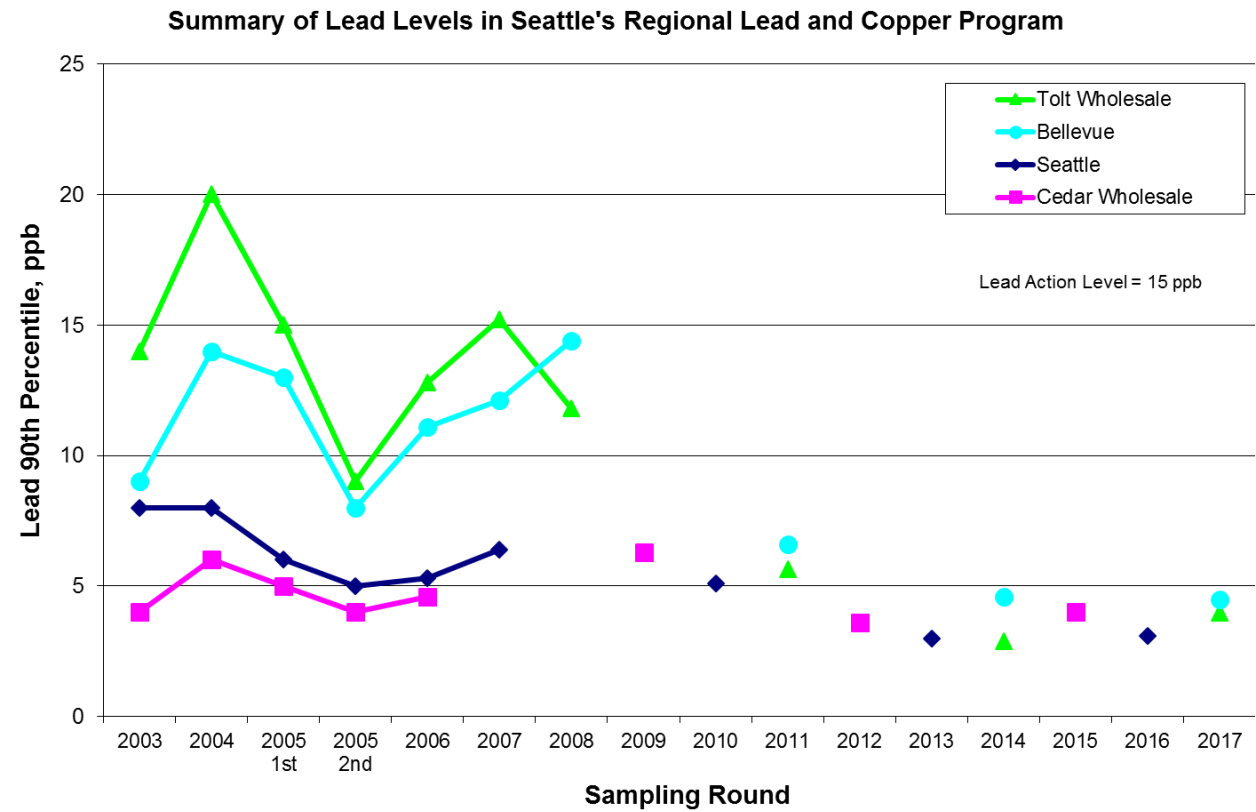
SPU DBPR



SPU LCR 1978 - 2003



SPU LCR 2003 - Present



SPU UCMR 3 – completed 2015

SEATTLE'S 2015 UCMR3 MONITORING RESULTS		
Contaminant	Range	Average
Strontium, ppb	12–36	29
Vanadium, ppb	ND–0.76	0.5
Total Chromium, ppb	ND–0.33	0.24
Hexavalent Chromium, ppb	0.063–0.17	0.12
Chlorate, ppb	ND–61	17

ND = not detected; ppb: 1 part per billion = 1 ug/L = 1 microgram per liter

There were also 23 contaminants that were monitored for but not detected for UCMR3, shown in the following table.

CONTAMINANTS NOT DETECTED	
1,2,3-Trichloropropane	17-β-Estradiol
Chlorodifluoromethane (HCFC-22)	17-α-Ethynylestradiol
Bromomethane (methyl bromide)	Estriol
Chloromethane (methyl chloride)	Equilin
Bromochloromethane (Halon 1011)	Estrone
1,3-Butadiene	Testosterone
Perfluorooctanoic Acid (PFOA)	4-Androstene-3,17-Dione
Perfluorononanoic Acid (PFNA)	Molybdenum
Perfluorobutanesulfonic Acid (PFBS)	Cobalt
Perfluorohexanesulfonic Acid (PFHxS)	1,4-Dioxane
Perfluoroheptanoic Acid (PFHpA)	1,1-Dichloroethane
Perfluorooctanesulfonic Acid (PFOS)	

Monitoring conducted in January, April, July, and October 2015.

SPU UCMR 4 – beginning August 2018

10 Cyanotoxins (Nine Cyanotoxins and One Cyanotoxin Group)

total microcystins	microcystin-LA	microcystin-RR	microcystin-LF	microcystin-YR
microcystin-LR	microcystin-LY	nodularin	cylindrospermopsin	anatoxin-a

20 Additional Contaminants

germanium	manganese	alpha-hexachlorocyclohexane	profenofos	chlorpyrifos
tebuconazole	dimethipin	total permethrin (cis- & trans-)	ethoprop	tribufos
oxyfluorfen	HAA5 ¹	HAA6Br ¹	HAA9 ¹	1-butanol
2-propen-1-ol	2-methoxyethanol	butylated hydroxyanisole	o-toluidine	quinoline

Future Changes

- EPA funding has decreased
 - No new regulated contaminants since 1996
 - Limited research on health effects
 - Health advisory approach continues to be problematic
- Most state funding has decreased as well
- Yet, changes occur and new things keep coming up
 - 1,4 dioxane
 - PFOA and PFOS
 - Microplastics
 - Renewed emphasis on legionnaires
 - Fluoridation standard controversial to some



Challenges and strategies

- Uncertainty of timing and scope for new regulations
 - Affordability and diminished funding
 - Public trust and perception
- ✓ Partner with regulatory community
 - ✓ Efficient, resilient application of public resources
 - ✓ Effective health risk communication

Public Notice and Boil Advisories

Regulatory Public Notice

- Tier 1 – immediate health concern
 - Deliver within 24 hours.
 - Eg. is boil notice for confirmed *E. Coli*
- Tier 2 – treatment technique violation or exceedance of non-health related limit
 - Deliver within 30 days
 - E.g. Tolt treatment in 2015
- Tier 3 – minor monitoring or reporting violation
 - Deliver within 1 year
 - E.g. missed sample or report data

Public Notice and Boil Advisories

Non-regulatory

- Precautionary boil advisory –
 - Likely issued due to a large main break and major pressure loss in the distribution system without confirmed bacteria results
 - Non mandated, but strongly encouraged by the state. Issued within a few hours or soon as practical. Seattle has done 3 over the past 10 years (Beacon Hill, Graham Hill, and Cap. Hill).

Water Main Break Water Quality Response

WDOH Guidance

Type I Break	Type II Break	Type III Break	Type IV Break
Positive pressure maintained during break	Controlled pipe repair with limited depressurization after shutdown	Loss of pressure at break site and/or depressurization elsewhere in system	Water Research Foundation has proposed 4 categories of breaks
Pressure maintained in pipe during repair	Pressure maintained at break site until pipe exposed & hole dewatered, shutdown limited to immediate valved off area, no loss of pressure elsewhere in system	Loss of pressure at the break site while the pipe is still buried or submerged and /or pressure loss elsewhere in the system	
No signs of contamination intrusion	Limited possibility of contamination intrusion	Possible / actual contamination intrusion	



Water Main Break Water Quality Response

- Initial Assessment
- Water Quality Actions
 - 2 rounds of sampling
 - Site specific flushes
 - Appropriate repair practices
- Messaging
 - Must be prompt, consistent, and repeatable
24/7

Limnology, Algae, and Aquatic Nuisance Species



Limnology

- Lake Youngs, Chester Morse Reservoir, Lower Cedar R., Tolt Reservoir, Reg Basin
- Monitor for:
 - Temperature, pH, dissolved oxygen, conductivity
 - Nutrients (phosphorus, nitrogen, etc.)
 - Algae
 - Zooplankton and Phytoplankton

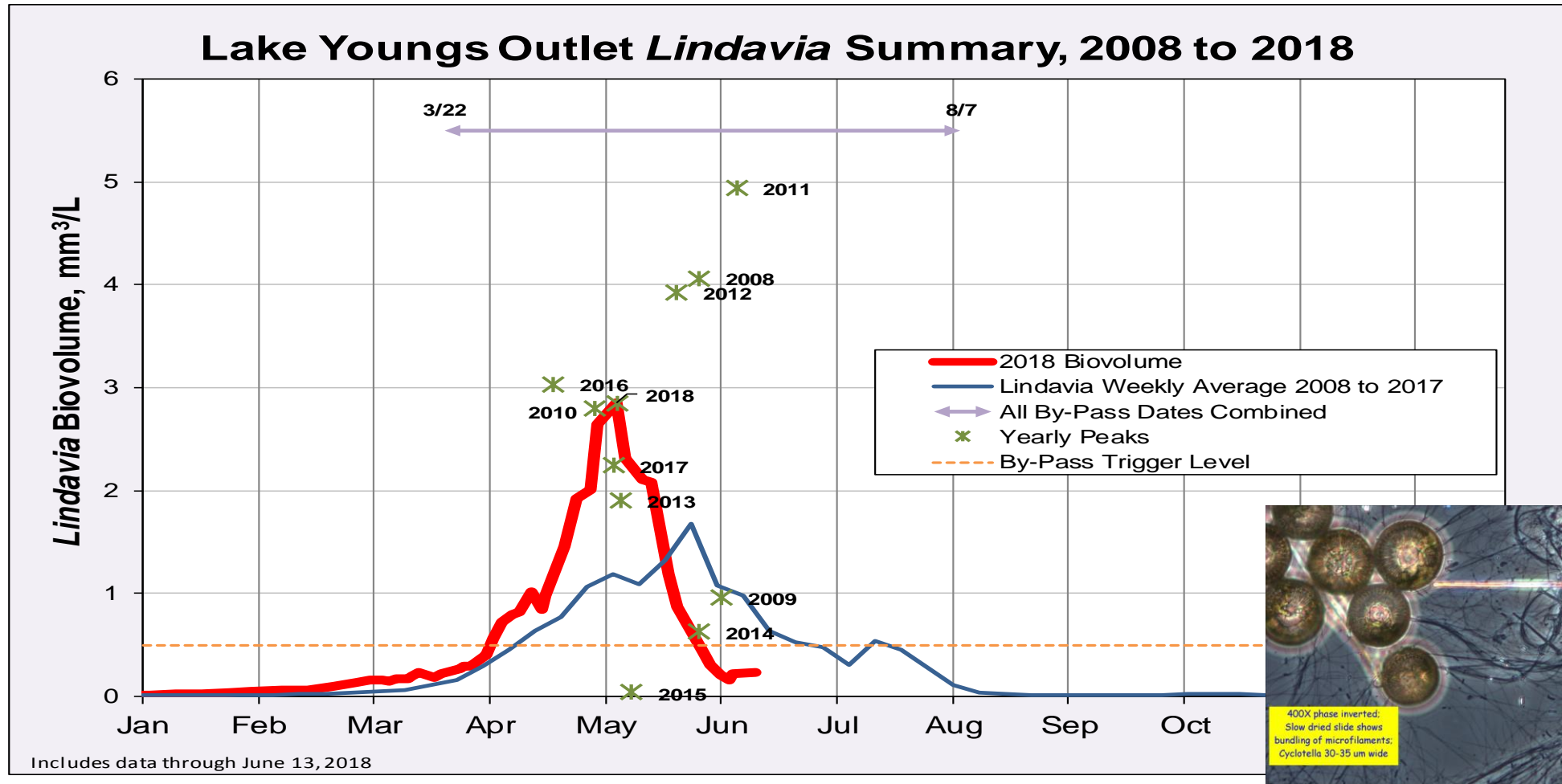


Lake Youngs

- Biologically most productive water body in system
- Potential impacts on water system and customer
- Algae, algae, algae
 - Dozens of background algae
 - Taste & odors
 - Filter cloggers
 - Screen clogger (Lindavia)



Source Water Quality – Lake Youngs Algae



Aquatic Nuisance Species

- A species that threatens native species' abundance or diversity, stability of aquatic systems and commercial or water recreational use.
- Possible operational, water quality, and financial impacts.
- Some ANS we've encountered
 - Lake Youngs milfoil
 - Walsh Lake milfoil
 - Cedar River didymo
- Many ANS are already in Washington State and King County.



SPU Actions for ANS

- Maintain ANS Plan
 - Prevention
 - Monitoring
 - Rapid Response
 - Control and Eradication

- Conduct ANS early detection and monitoring training

- Equipment decontamination

- Coordinate with regional partners

Prevention of Aquatic Invasive Species In Seattle Water Supply Watersheds



Thank you.

Questions?

