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Water Quality Track

Blending New Water Sources

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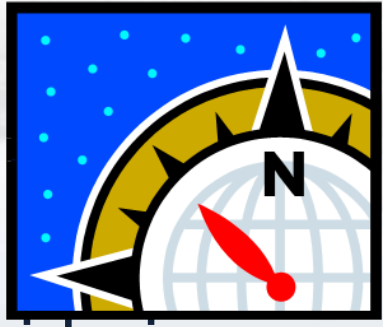
SEAL OF TUKWILA, WASHINGTON 1908

Background



- Many PNW utilities are already, or are considering blending existing water with new water sources
- Many will blend surface and ground waters with wide ranges of water quality
- Utilities face unique challenges in balancing: supply needs; managing water quality; operational changes; and potentially costly treatment changes

Purpose

- Identify water quality concerns associated with blending
- Discuss Operational Constraints
- Identify Potential Mitigation Approaches
- Develop a Framework for a Blending Evaluation

Presentation Overview

- Concept of “Blending”
- Reasons for Blending
- Key Factors Impacting Water Quality of Blends
- Key Criteria to Evaluate Before Blending
- Evaluation Approaches
- Framework for Blending Evaluation
- Mitigation Strategies
- Case Study - City of Tukwila

Concept of Blending

- Introducing a new water source that is:
  - Blended with existing source water before treatment / entering the distribution system
  - Introduced directly into the distribution system where blending may occur as a function of system hydraulics

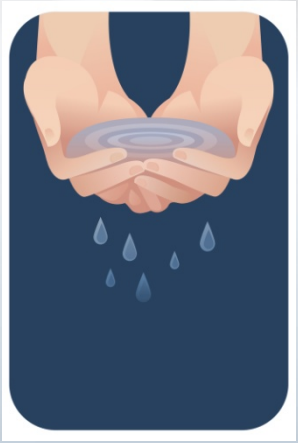
Reasons for Blending

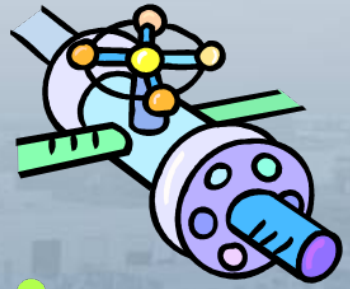
- Adding a new source or sources
  - Population increase
  - Increasing demands on shared sources
  - Climate change impacts
  - Supply agreements with purveyors
  - System consolidations
  - Operation flexibility
  - Seasonal changes

- Replacing one of the existing sources due to water quality and / or regulatory issues

Key Factors for Quality of Blended Supply

- Source Water Quality
- Treatment Processes
- Existing System Conditions
- System hydraulics
- Blending Schedule





Criteria for Evaluating Impact of Blending

1. Maintaining Regulatory Compliance
2. Water compatibility
3. System equilibrium
4. Customer concerns

Impact on Regulatory Compliance

Rule	Potential Related WQ Changes	Potential Regulatory Issues
Lead and Copper Rule	pH, alkalinity, calcium carbonate, corrosion inhibitor, chlorine residual, Temp	• Pb or Cu AL exceedance? •Interference with corrosion inhibitor effectiveness? • Need to Reoptimize Corrosion Control? •Need to provide advance notice to State (2007)?
Ground Water Rule	pH, alkalinity, Mn, Fe, DO, disinfection residual	• Introducing GW into surface water system could trigger GWR (2007) requirements
Disinfection Byproduct Rule	NOM, pH, Disinfection Residuals	• Change in DBP levels? •Change in DBP speciation?

Impact on Water Compatibility

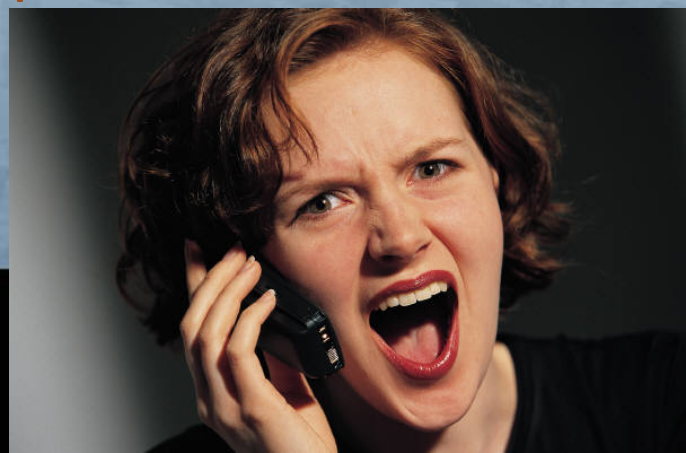
- Potential effects of blending on bulk water characteristics:
  - Disinfection residual change – regrowth in the distribution system
  - pH, Alkalinity, Hardness, TDS changes – more corrosive, tendency for scale buildup

Impact on System Equilibrium

- Possible effects of blending on interior lining of transmission, storage and distribution facilities, premise plumbing:
  - Dissolved Oxygen (DO): possible solubilization or iron scales
  - Flow (reversal): Re-suspension of sediment
  - Nutrients: Bacterial regrowth
  - pH, Alkalinity: Lead and copper corrosion, stability of corrosion scales

Customer Concerns

- Possible effects of blending on customer satisfaction with water quality.
  - Disinfection: Taste and Odor
  - Iron and Manganese: Color and staining
  - Fluoride: Dental health / Customer preference



Evaluation Approaches

- Desktop Evaluation

- Benchscale Testing

- Hydraulic Modeling

Framework for Blending Evaluation

1. Identify Water Quality for Each Supply:
   - Physical, Chemical, Microbiological
   - Seasonal Fluctuations
   - Existing and Future Treatment
2. Describe Physical Characteristics for System:
   - Major facilities
   - Materials and Linings
   - Recent and Future Modifications
   - Housing ages (lead solder, plumbing)

Framework for Blending Evaluation cont..

3. Describe System Hydraulics:
   - Connection Points
   - Flow / Blending Ratios
   - Blending Schedule
4. Identify Operational Constraints
   - Minimum/Maximum Quantity of New Source Water
   - Degree of Control System has over Variability of Supply
   - System Needs Flexibility to Take Large or Small Quantities
   - Range of Water Quality of Supply Received

Framework for Blending Evaluation cont..

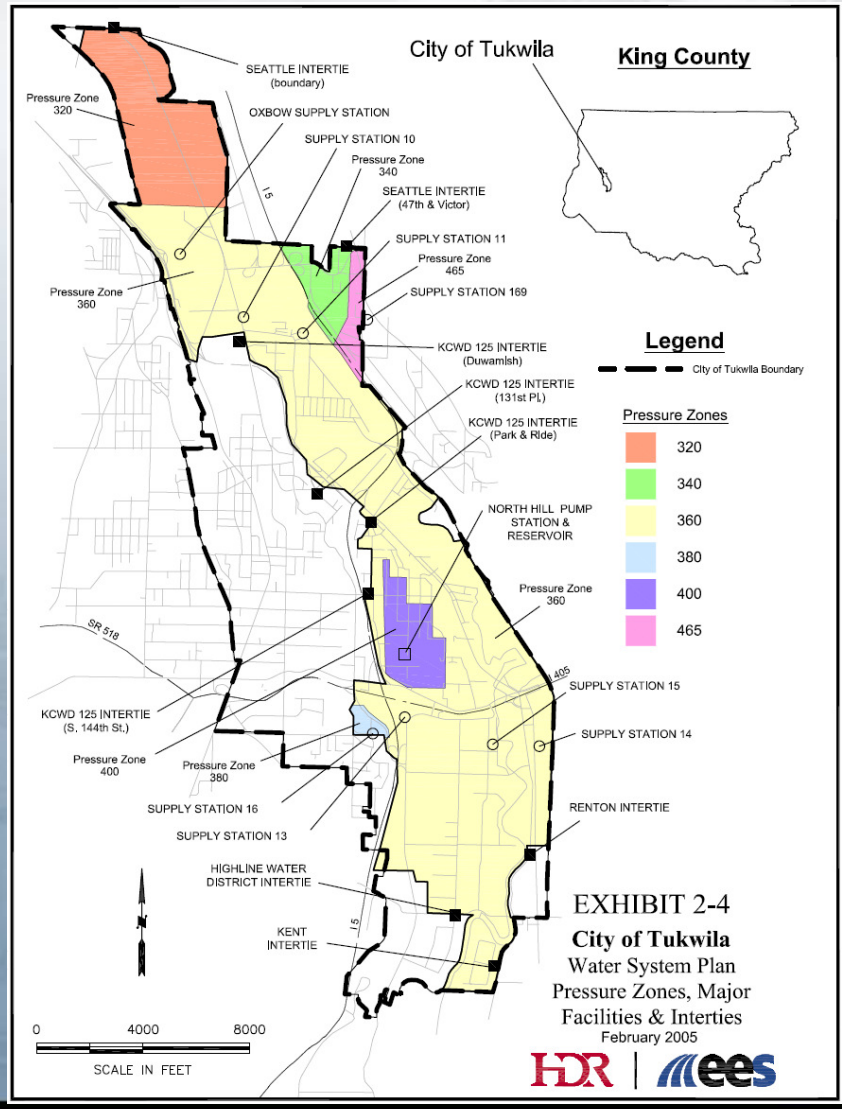
5. Evaluate Potential Impacts Based on Key Criteria:
   - Regulatory Compliance – Existing and Future
   - Water Compatibility
   - System Equilibrium
   - Customer Concerns
6. Identify Tools for the Evaluation
   - Blending Models (RTW, H2Eau, Others)
   - Bench Tests
   - Hydraulic Models
   - Decision Charts
   - AwwaRF Manuals

Mitigation Strategies

- Lower Impact
  - Control Blend Ratios to Control WQ
  - Adjust Treatment Doses
  - Isolate Service Areas
  - Increase Monitoring and Process Control
  - Pre-Blend
- Higher Impact
  - System and Treatment Modifications
  - Capital Improvements

City of Tukwila - Background

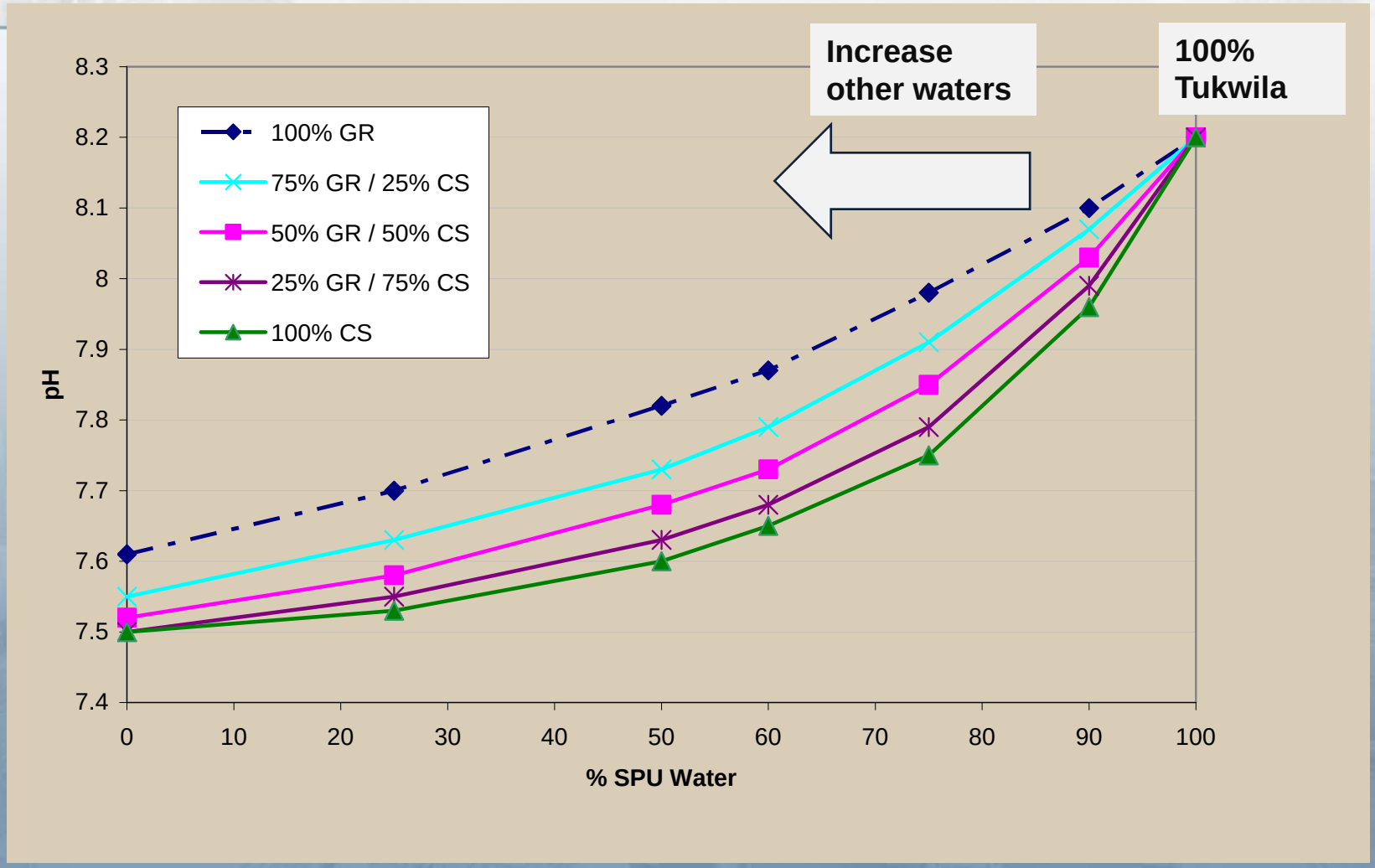
- Purchases Cascade (Cascade Water Alliance) water – primarily SPU Cedar River water
- Investigated additional treated supply from neighboring City through southern intertie
  - Several wells
  - Spring water
  - Future surface water from Green River



City of Tukwila – Water Quality

- High pH / low alkalinity water
- pH average ~ 8.2 in the Distribution System
- Modeled blending – likely to result in low pH / low alkalinity
- Could cause problems for lead corrosion

Water Quality Parameters	Primary Supply	Potential Supply		
		Springs	Wells	Surface
pH	7.9 - 8.5	7.2 - 7.5	8.0	7.6 - 8.2
Alkalinity (mg/L as CaCO3)	18.5	39 -50	51	21
Temp (degC)	5 - 20	9	10	18
TDS (mg/L)	40.0	43 - 75	87	33
Calcium (mg/L CaCO3)	22.6	34	51	15


Increase other waters
100% Tukwila
100% GR
75% GR / 25% CS
50% GR / 50% CS
25% GR / 75% CS
100% CS
pH
8.3
8.2
8.1
8
7.9
7.8
7.7
7.6
7.5
7.4
0
10
20
30
40
50
60
70
80
90
100
% SPU Water

City of Tukwila – Evaluation Approaches

- Develop ranges of probable source mixtures that Tukwila would receive from neighboring system:
  - Supply volumes for each source
  - Service zones and sources used
  - System hydraulics
- Model blends of Tukwila's existing source with probable range of source mixtures from neighboring system
- Evaluate ranges of blend water quality
- Identify Operational Constraints

City of Tukwila - Constraints

- Could receive a range of mixtures from supply partner (i.e. ground water, surface water, well water and spring water)

- Would not have a great degree of control over which source mixtures would be received

Potential Mitigation Strategies

- Impose Operational Constraints
  - Blending constraints – at least 60% SPU water
  - Pre-blend new sources rather than introduce directly into the distribution system to avoid pH / alkalinity fluctuations
  - Isolate new sources to one service zone
- Treatment
  - Adjust pH of new sources prior introducing to Tukwila system

Conclusions

- Blending will likely increase to meet growing water demands
- Increasingly complex regulations must be considered:
  - LCR, GWR, Revisions to TCR “Distribution System Rule”
  - Simultaneous Compliance

Contributing Authors

- Kylee Dewis HDR Inc.
- Michael Cusick – City of Tukwila
- Glen Boyd HDR Inc.

Additional Slides - only if needed

Medium Size System in Ohio

- Meeting Lead requirements
- Low pH, high alkalinity groundwater
- Wanted to blend with high pH, low alkalinity Cincinnati water
- Either water ok on it's own, but most blends predicted:
  - More corrosive
  - Tendency to scale (high pH with high alkalinity combination)
- Result - restrict Cincinnati water to one zone

Large Pacific Northwest System II

- Low pH, high alkalinity spring water all year
- Blend with surface water in summer in some zones
- Ok for lead, but copper close to Action Level
- Noticed that high copper in areas served only by ground water
- Utility wanted to switch to even lower pH ground water
- Concern that copper levels would increase even more
- Recommended pH adjustment