WATER WITHDRAWALS
BALANCING QUANTITY AND QUALITY

Watershed Action Alliance of Southeastern Massachusetts
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Presentation Outline

• General Overview of Typical PWS
• Geology in New England and Impacts on Water Quality
• PWS Balancing Act – Quantity and Quality
• Challenges facing Typical PWS
Overview
Typical PWS

Sample Overburden
Gravel Packed Well

Variations
- Depth
- Soil Layers and Types
- Size (casing and pack)
- Gravel Pack vs Natural
Overview

Sample Drawdown Curve

Image from “Groundwater and Wells”
by Fletcher G. Driscoll
1986
Johnson Division, Minnesota
## Overview - Typical PWS MassDEP Protective Zones

<table>
<thead>
<tr>
<th>Zone</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 1</td>
<td>400 foot radius around well (varies if less than 100,000 gpd)</td>
</tr>
<tr>
<td></td>
<td>Must be owned or controlled by PWS</td>
</tr>
<tr>
<td>Zone 2</td>
<td>Modelled extent of drawdown</td>
</tr>
<tr>
<td></td>
<td>180 days of pumping at approved yield, no precipitation</td>
</tr>
<tr>
<td>Zone 3</td>
<td>Extent of watershed in which well is located</td>
</tr>
<tr>
<td></td>
<td>Excludes downgradient portions that do not contribute</td>
</tr>
</tbody>
</table>
Overview - Typical PWS
MassDEP Protective Zones II
Geology in New England
Impact on Water Quality

Overburden Materials (aka Surficial Geology)

Elements typically impacting Massachusetts PWS
- Iron (discoloration and potential buildup/clogging)
- Manganese (discoloration and health impacts)
- Arsenic (health impacts)
Manganese Levels in Wells in NE

White < 0.001 mg/L
Yellow 0.001-0.3 mg/L
Red > 0.3 mg/L

Shading is Aquifer Group defined for study

EXPLANATION
[Triangle represents well completed in the material beneath the uppermost aquifer]

Manganese, in micrograms per liter
○ ▲ < 1
△ ▲ ≥ 1 and ≤ 300
▲ ▲ > 300

The findings from our study support the hypothesis that low-level, chronic exposure to manganese from drinking water is associated with significant intellectual impairments in children.
Geology in New England Impact on Water Quality
Geology in New England Impact on Water Quality
Geology in New England Impact on Water Quality

![Graph showing manganese levels over time with health advisory and secondary MCL levels marked.](image-url)
Well/Source Management
- Ideally limit to 16 hours daily, allows recovery and avoid “stressing” well
- Weekly rotation of multiple sources

Multiple sources
- Reduced flow and reduced drawdown
- Reduced Water Quality Deterioration (or delayed impact)
- Side benefit of supply redundancy is increased system resiliency
- Preferential use of sources in different (less stressed) river basins
- Problem - difficult to locate new “clean” sources

Promote conservation
- Banning of lawn irrigation system or separate irrigation meters/rates
- Adherence to MassDEP Conservation goals of 65 gpcd and 10% UAW
# PWS Balancing Act

<table>
<thead>
<tr>
<th>Month</th>
<th>Average Demand (mgd)^2</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Zone</td>
<td>High Zone</td>
<td>South St</td>
<td>Millgate</td>
<td>Soules Pond</td>
</tr>
<tr>
<td>January</td>
<td>0.98</td>
<td>0.13</td>
<td>South St</td>
<td>Millgate</td>
<td>Soules Pond</td>
</tr>
<tr>
<td>February</td>
<td>0.98</td>
<td>0.14</td>
<td>South St</td>
<td>Millgate</td>
<td>Soules Pond</td>
</tr>
<tr>
<td>March</td>
<td>0.99</td>
<td>0.13</td>
<td>South St</td>
<td>Millgate</td>
<td>Soules Pond</td>
</tr>
<tr>
<td>April</td>
<td>1.02</td>
<td>0.16</td>
<td>South St</td>
<td>Millgate</td>
<td>Soules Pond</td>
</tr>
<tr>
<td>May</td>
<td>1.16</td>
<td>0.20</td>
<td>HZ Transfer</td>
<td>1-86</td>
<td>Soules Pond</td>
</tr>
<tr>
<td>June</td>
<td>1.33</td>
<td>0.33</td>
<td>HZ Transfer</td>
<td>South St</td>
<td>Millgate</td>
</tr>
</tbody>
</table>

Client Focused, Responsive, Quality Service • Experienced, Knowledgeable Technical Staff • Innovative, Cost Effective Designs
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Mitigation Methods for Manganese

- Flushing Water Mains
- Cleaning Wells
- New Source Development
- Blending Source Waters
- Resting Wells
- Reduced Pumping Rates
- Sequestering through chemical addition
- Fe & Mn Removal through Treatment Facility
Sequestering through chemical addition

- Addition of chemical (phosphate)
- Binds Mn in solution to prevent oxidizing by air or chlorine, preventing color/staining

- Common approach for managing Mn

- Limitations
  - Only effective for Mn up to approximately 0.1 mg/L
  - Ineffective at higher temps (hot water heaters)
  - Mn is not removed (potential health impacts remain!)
Manganese Removal Options
(through new Treatment Facility)

- Oxidation
- Adsorption
- Filtration
  - Pressure Filtration
  - Traditional Filtration
  - Membrane Filtration
- Biological
- Ion Exchange
PWS CHALLENGES
Treatment Impacts (Mn Example)
PWS CHALLENGES
Treatment Impacts (Mn Example)

Manganese Removal Treatment Facility
*Estimated Cost $5M*

Pump Station (low Mn)
*Estimated Cost $1M*
Many PWS are (or strive to be) financially self-sufficient. Increased costs (or reduced water use) leads to increased rates.
Questions?

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