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Affect of Arsenic Valence and Well Water Chemistry on Arsenic Removal Efficiencies of Household Water Treatment Systems

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Study Objectives

- Quantify total arsenic, arsenic(III) and arsenic(V) concentrations, and selected geochemical constituents in domestic well water supplies in Maine
- Quantify impact of arsenic valence on efficiency of arsenic removal by household water treatment systems

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As Speciation in Aqueous Environments

- As(V)
  - dominant in oxic environments
  - strongly adsorbed to iron, alumina and manganese minerals
- As(III)
  - dominant in anoxic environments
  - adsorbed weakly and to fewer minerals
  - most mobile and difficult to remove

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Mobilization in Aqueous Environments

- Geochemical mobilization
  - Redox
  - pH
  - Competing ions (e.g. phosphate)
- Biological mobilization
  - Indirect microbial effects (e.g. reductive dissolution)
  - Direct transformation (e.g. arsenate reducing bacteria)

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Regional Distribution of Domestic Supply Wells in Study

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Total Arsenic, As(III) and As(V) Distributions

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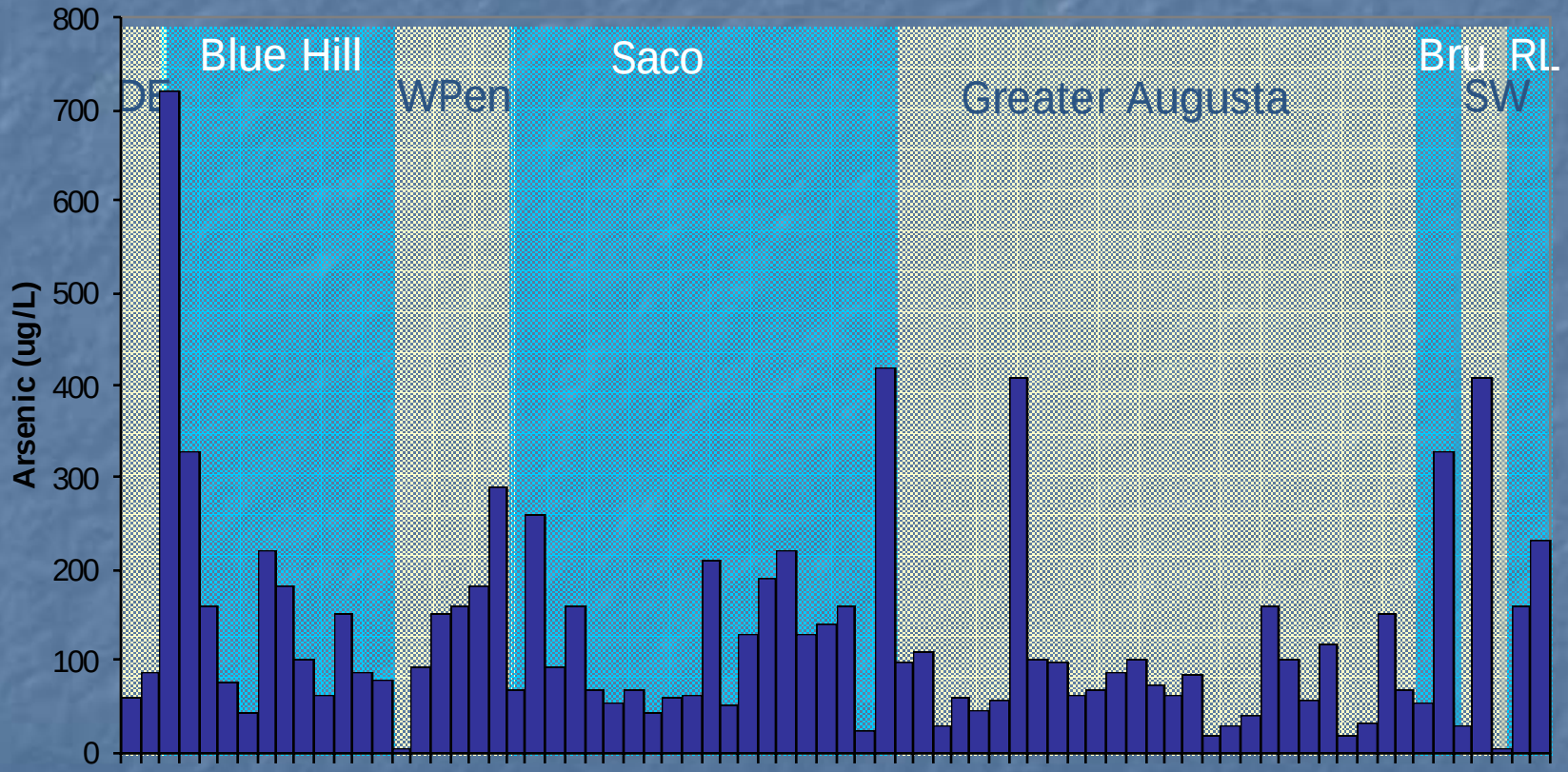
Total Arsenic



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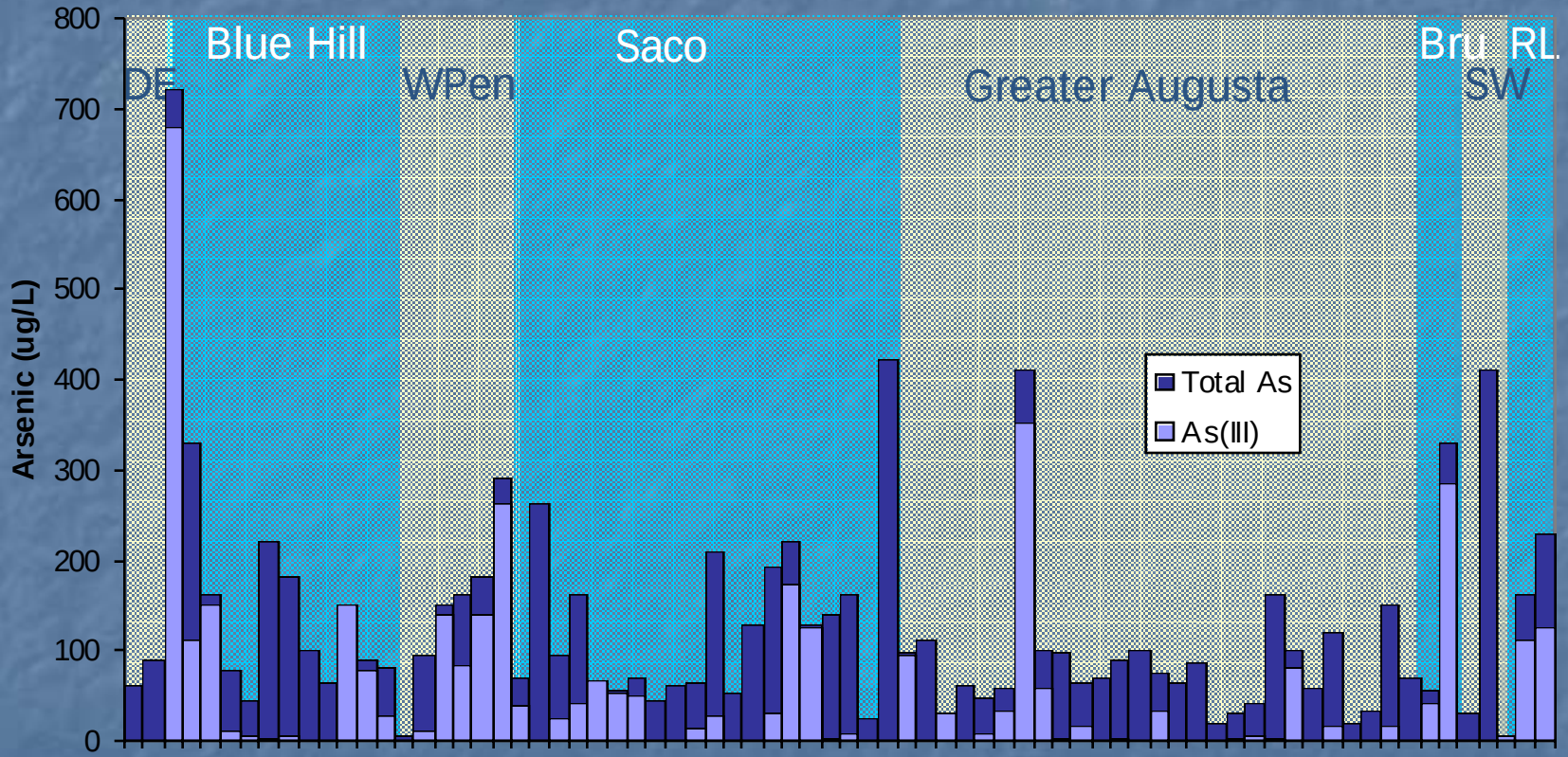
Arsenic Valence



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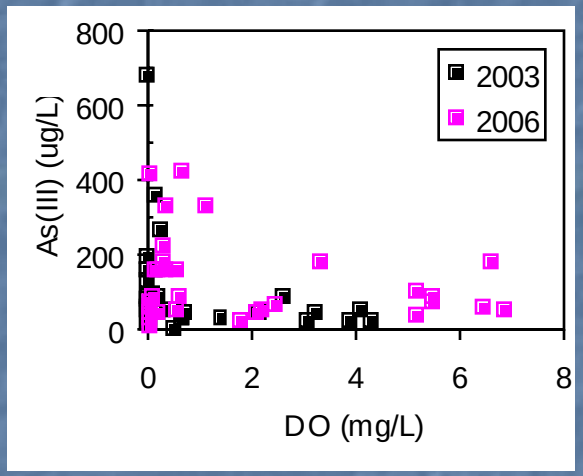
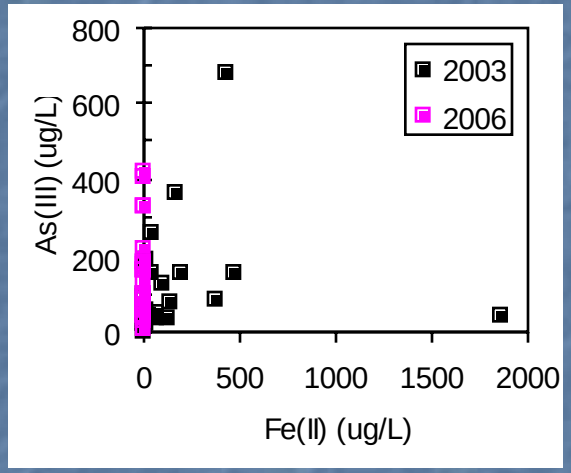
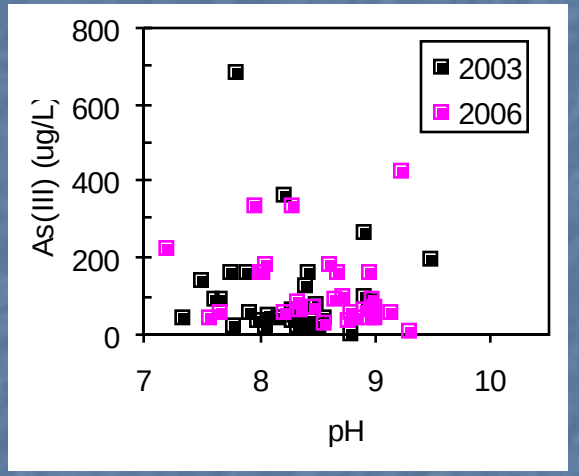
Relation between As(III) and water quality parameters







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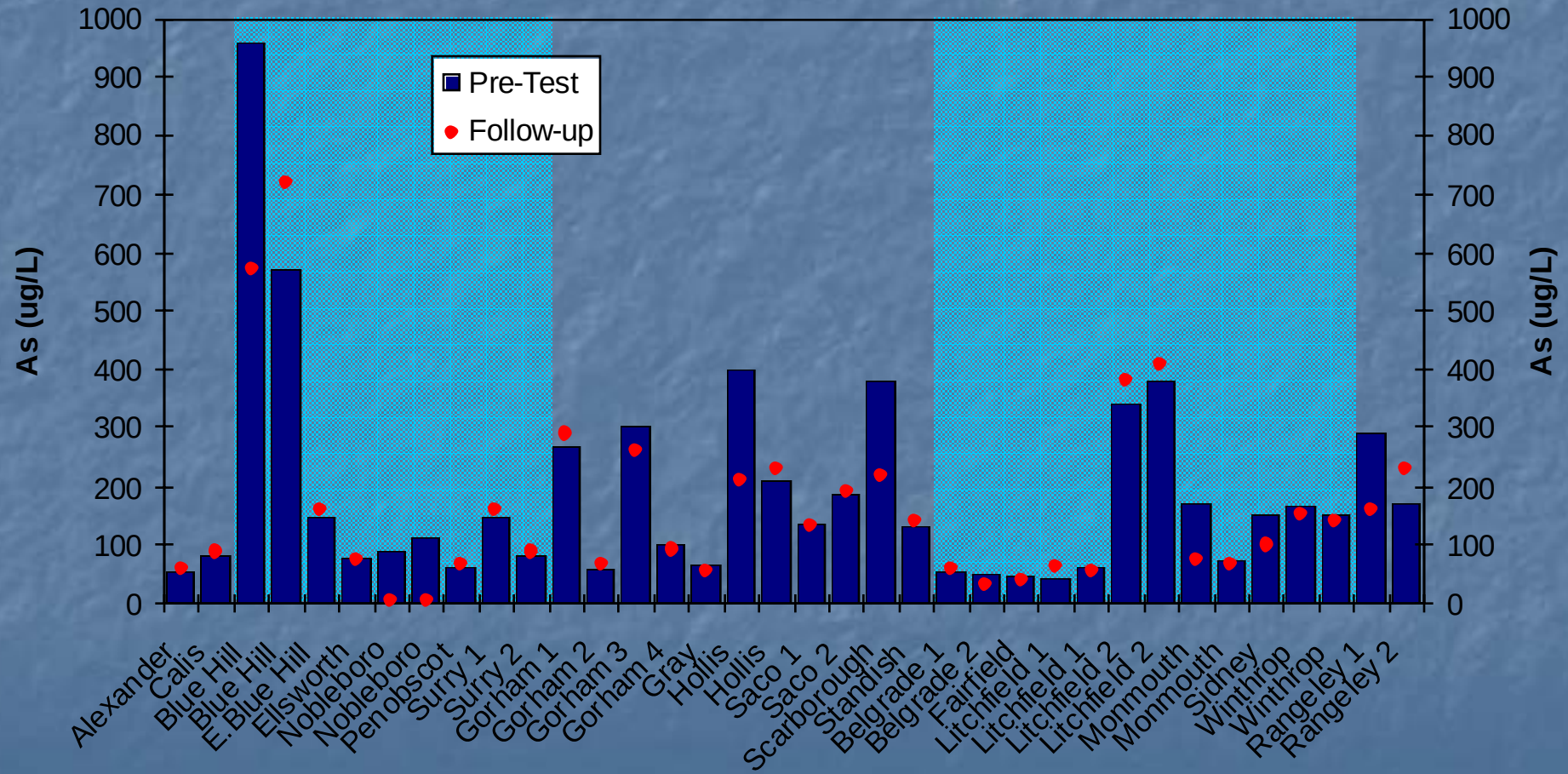
Temporal Variability in Arsenic Concentration



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Removal of Arsenic by Household Water Purification Systems

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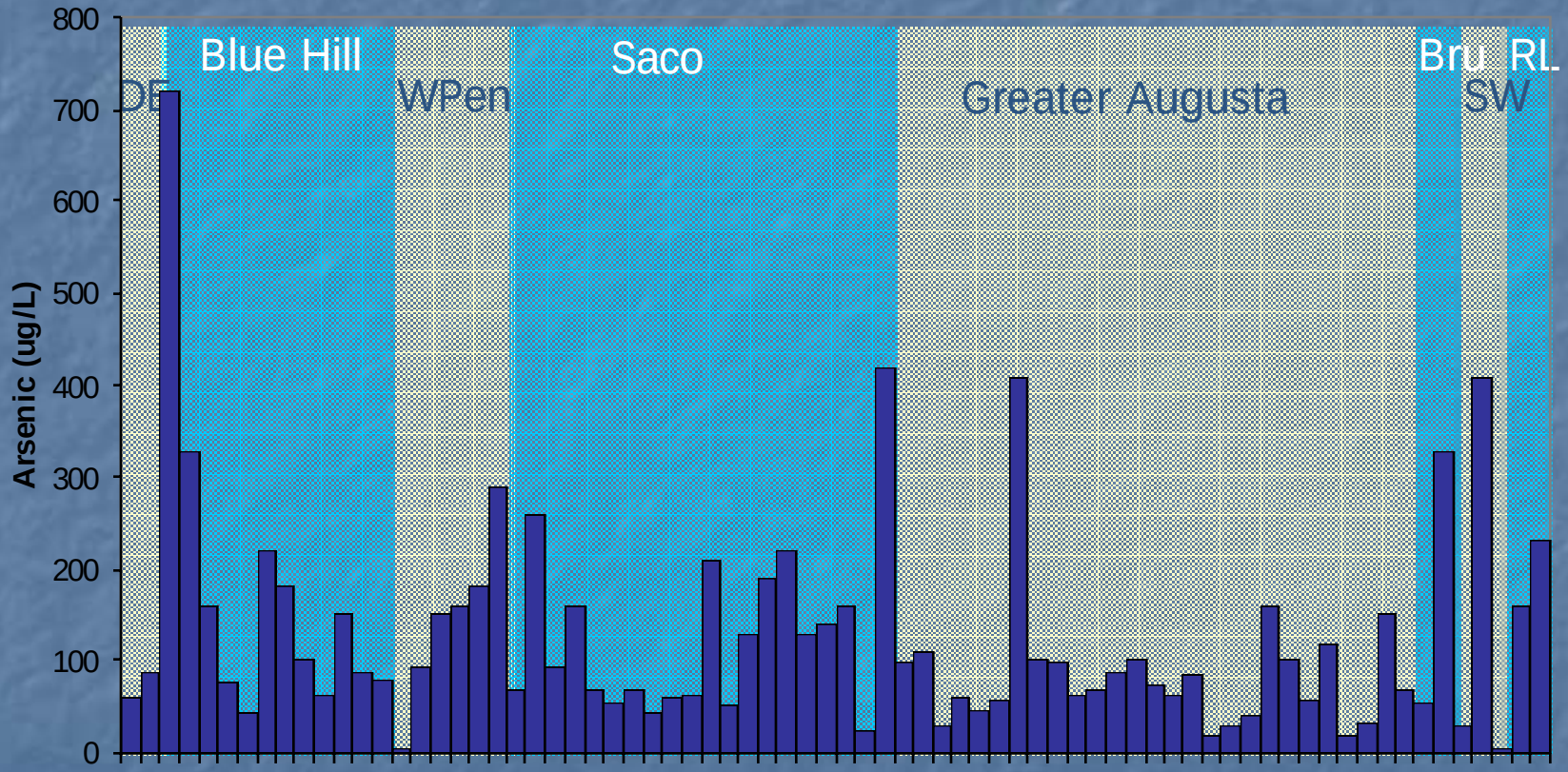
Pre-Treatment Arsenic



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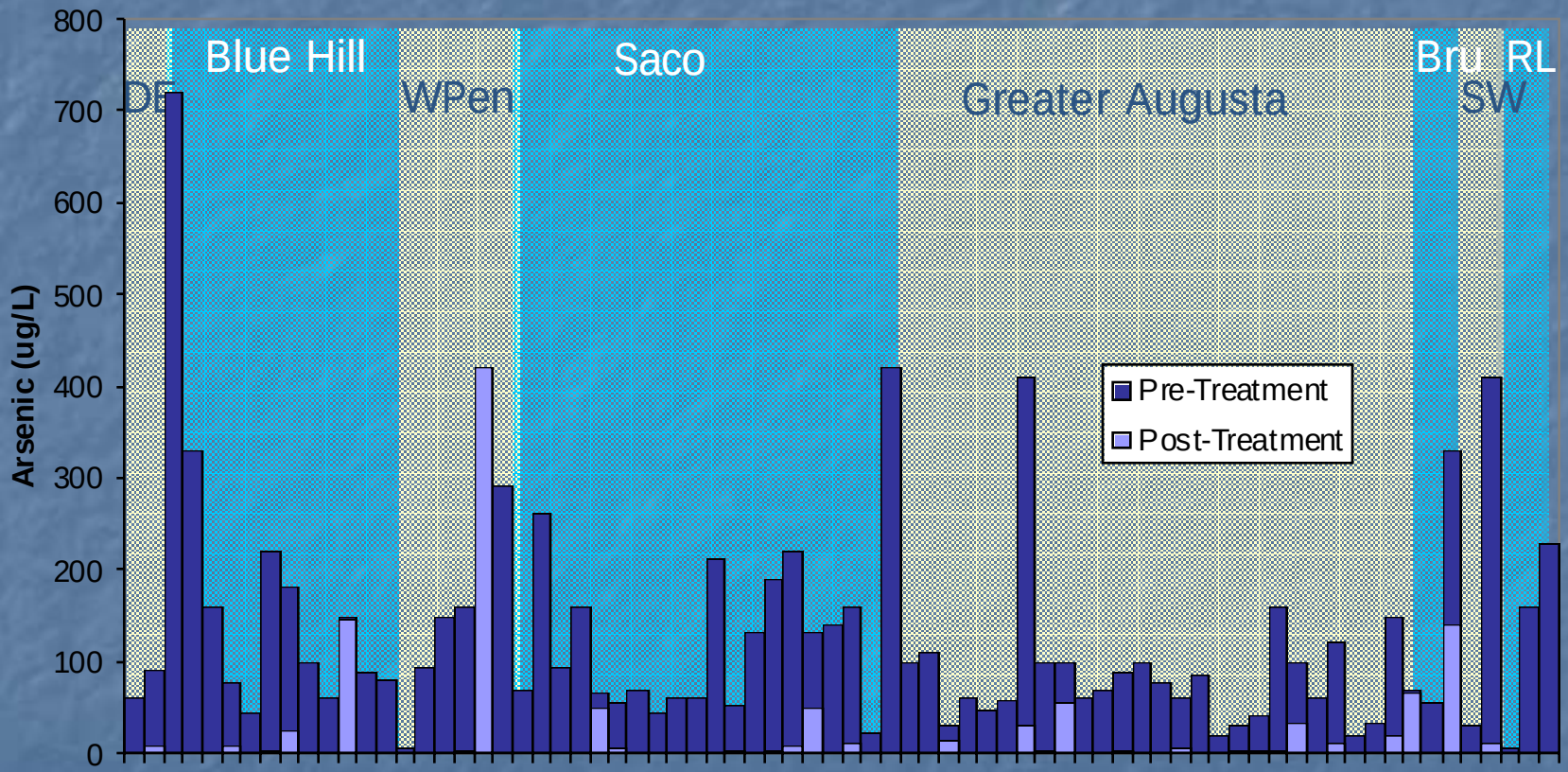
Pre- and Post-Treatment Arsenic



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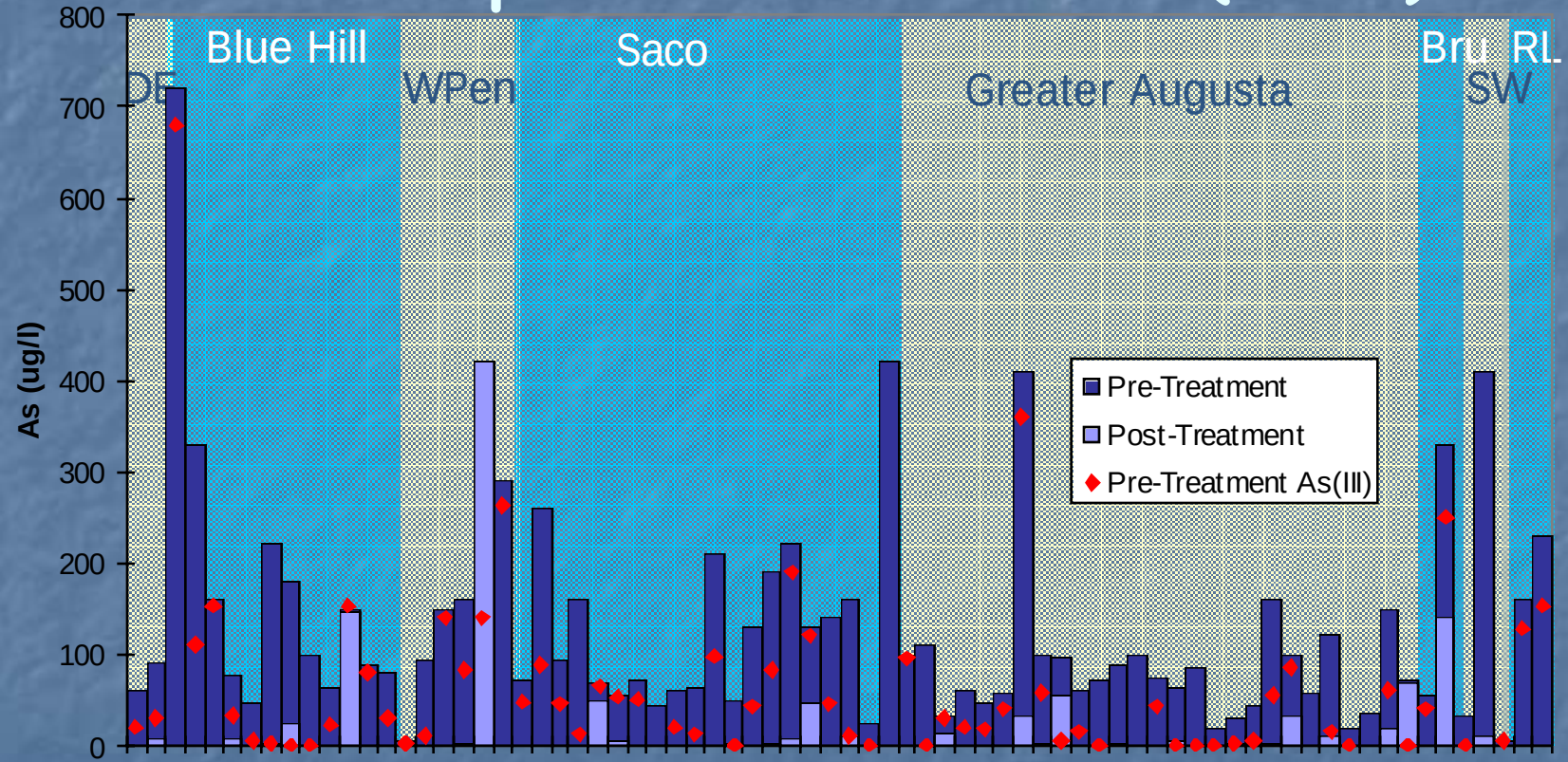
Pre- and Post-Treatment Arsenic in the presence of As(III)



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Summary

- Arsenic concentrations and valence varied regionally and temporally among targeted households
- Arsenic concentration and valence were uncorrelated to well depth, pH and all geochemical parameters except DO
- Water treatment systems (RO) effectively removed arsenic although pre-treatment steps were required when significant concentrations of As(III) were present

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Environmental Implications for Water Treatment

- Water treatment systems are only effective when routinely maintained
  - Filters contain extremely high concentrations of As
  - No indication of filter efficiency
- Environmental concerns
  - Disposal of arsenic-rich filters (landfills, incineration)?
  - RO systems
    - 1:4 house:septic
    - ~25% enrichment in septic system
    - Easily mobilized (high organic carbon, microbial activity)
    - Likely in As(III) form


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