Welcome to the USGS's webinar

Potential Corrosivity of Untreated Groundwater in the U.S.

The webinar will begin shortly…..

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Potential Corrosivity of Untreated Groundwater in the United States

National Water Quality Program

Steve Moulton, Coordinator

National Water Quality Assessment Project

Gary Rowe, Chief Scientist

Kenneth Belitz, Chief for Groundwater Assessments

Briefing

National Water Quality Monitoring Council

September 21, 2016

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MOTIVATION

- The occurrence of lead in drinking water in Flint, MI has raised questions about the quality of drinking water elsewhere in the Nation
- Media attention: Comparable problems in Washington D.C., Philadelphia, and other water systems
- Groundwater provides about 45% of the Nation's drinking water
- Private wells: unregulated and largely unmonitored; lead exposure is potentially widespread (~44 million people on private wells)

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What can USGS do to inform the public on this issue?

- USGS has data, modeling, and research capabilities to characterize source-water quality – groundwater and surface water resources – spatially and over time

- NAWQA, 1991 – present

- Cooperative Water Program

How can source-water quality affect the occurrence of lead in household water supplies?

- **Previous studies: source water can interact with pipes**
  - **VA study (>2100 private systems): nearly 20% of "first-flush" water exceeded 15 μg/L (EPA action level)**
- **Mineral deposition (scaling)**
  - **Can protect pipes from corrosion**
  - **Lead can be removed from the water (sequestered)**
- **Corrosion**
  - **Dissolution of lead, if present**
  - **Presence of copper can enhance the dissolution of lead**

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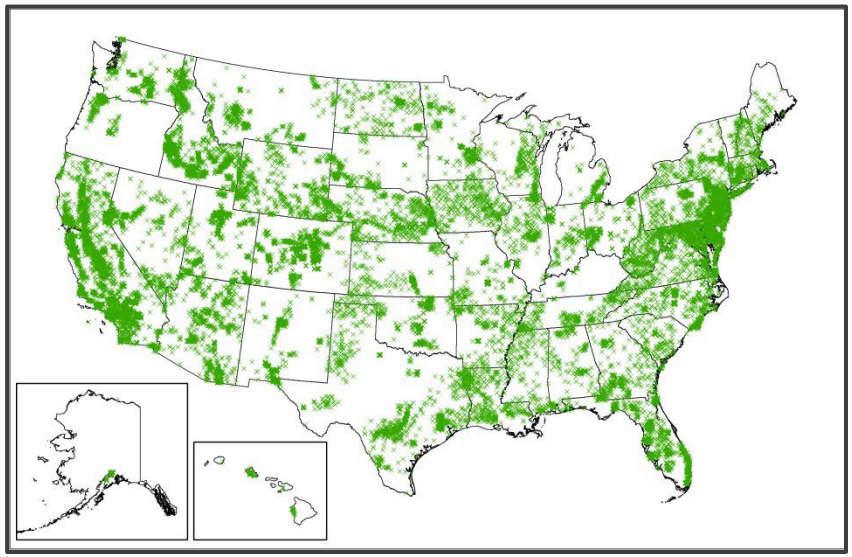
Pieper and others, 2015. Incidence of waterborne lead in private drinking water systems in Virginia. *Journal of Water and Health*, *13*(3), pp.897-908

How can source water affect the occurrence of lead in household water supply?

USGS has mapped two indicators of corrosivity at ~27,000 locations



Langelier Saturation Index (LSI)

- Potential to deposit scale

Potential to Promote Galvanic Corrosion

- Based on Chloride-to-Sulfate Mass Ratio (CSMR) and alkalinity

Corrosivity of source water is one of many factors that can affect the occurrence of lead in household water supply

Langelier, W. F., 1936, “The Analytical Control of Anti-Corrosion Water Treatment,” Journal (American Water Works Association), 28(10), 1500–1521.

Nguyen, Caroline and others, 2010, "Impact of chloride: sulfate mass ratio (CSMR) changes on lead leaching in potable water." *WaterRF., Denver*.

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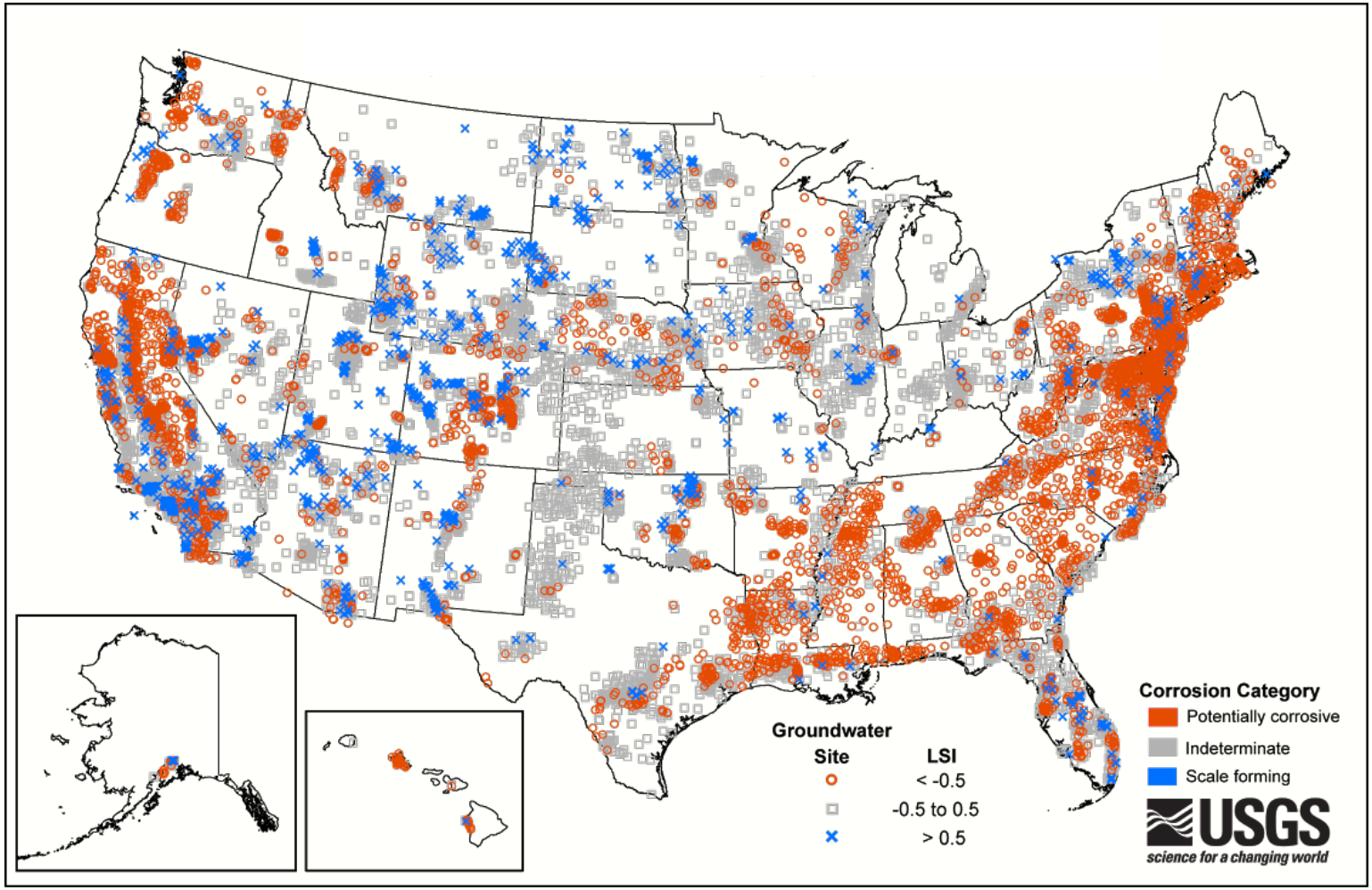
LSI: To what extent might pipes be protected?



22,000 locations: 32% corrosive, 63 % indeterminate, 5% scale-forming

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Belitz and others, 2016, "Langelier Saturation Indices Computed for U.S. Groundwater, 1991-2015; Water Well Data," USGS Data Release

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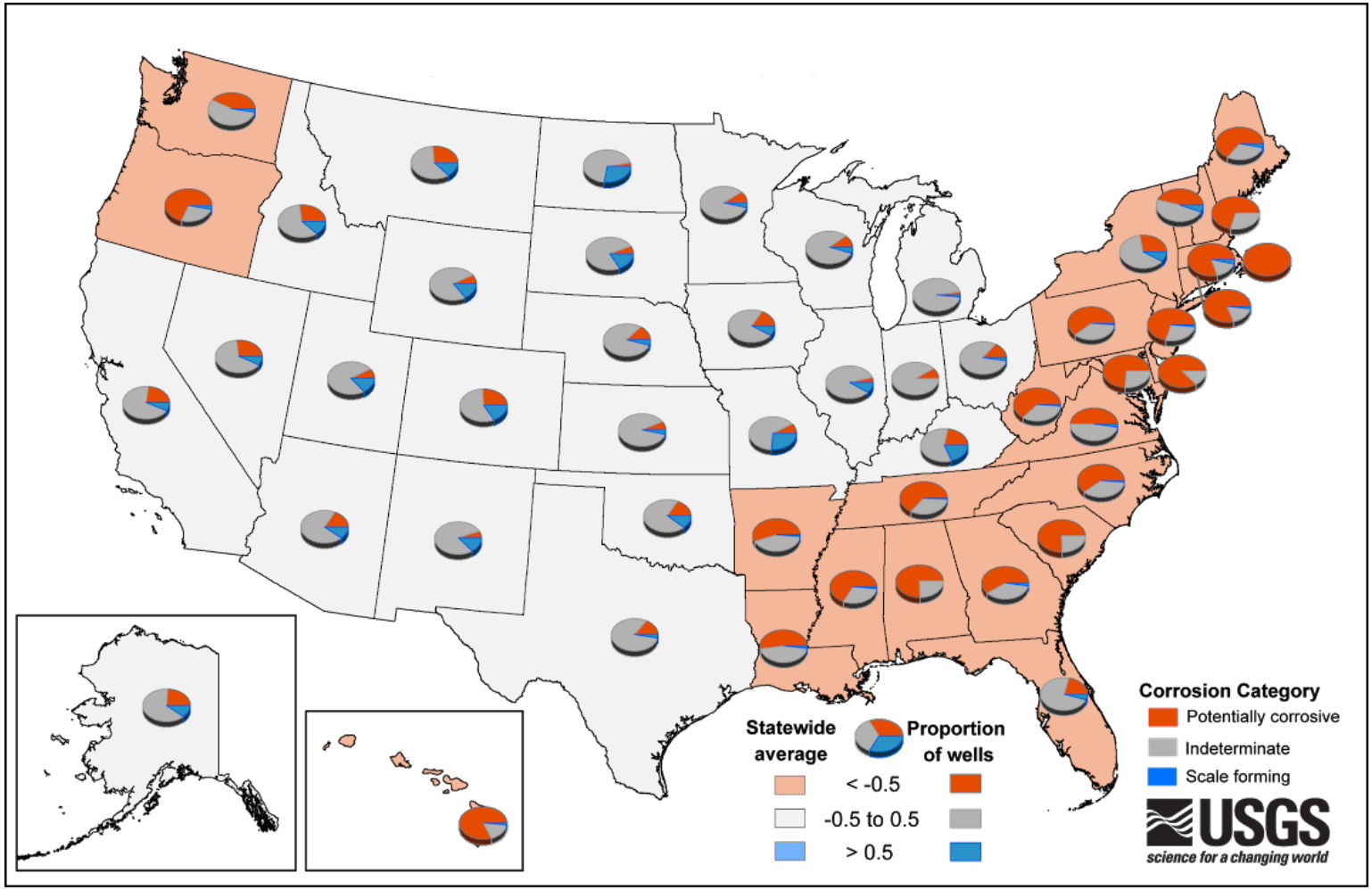

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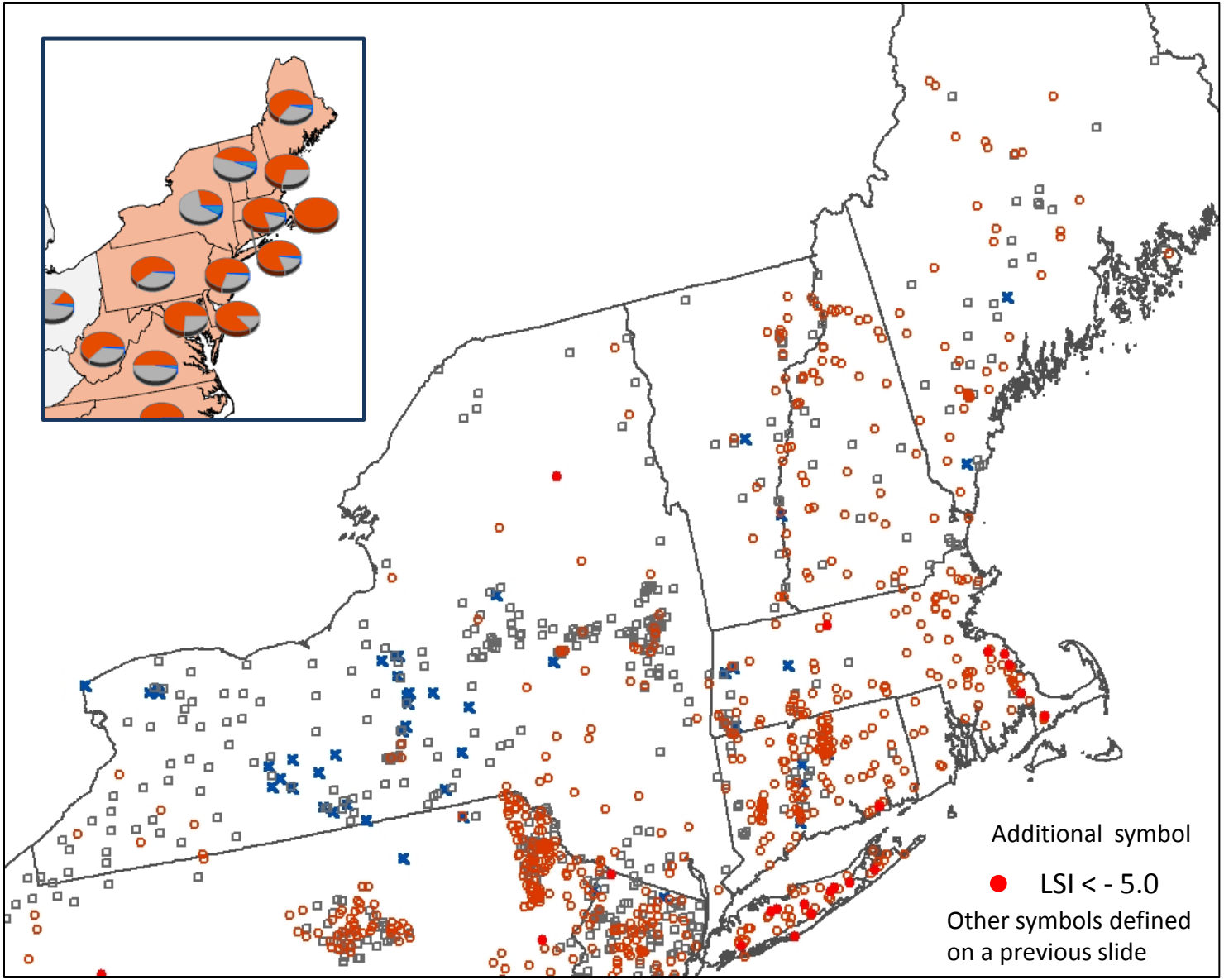

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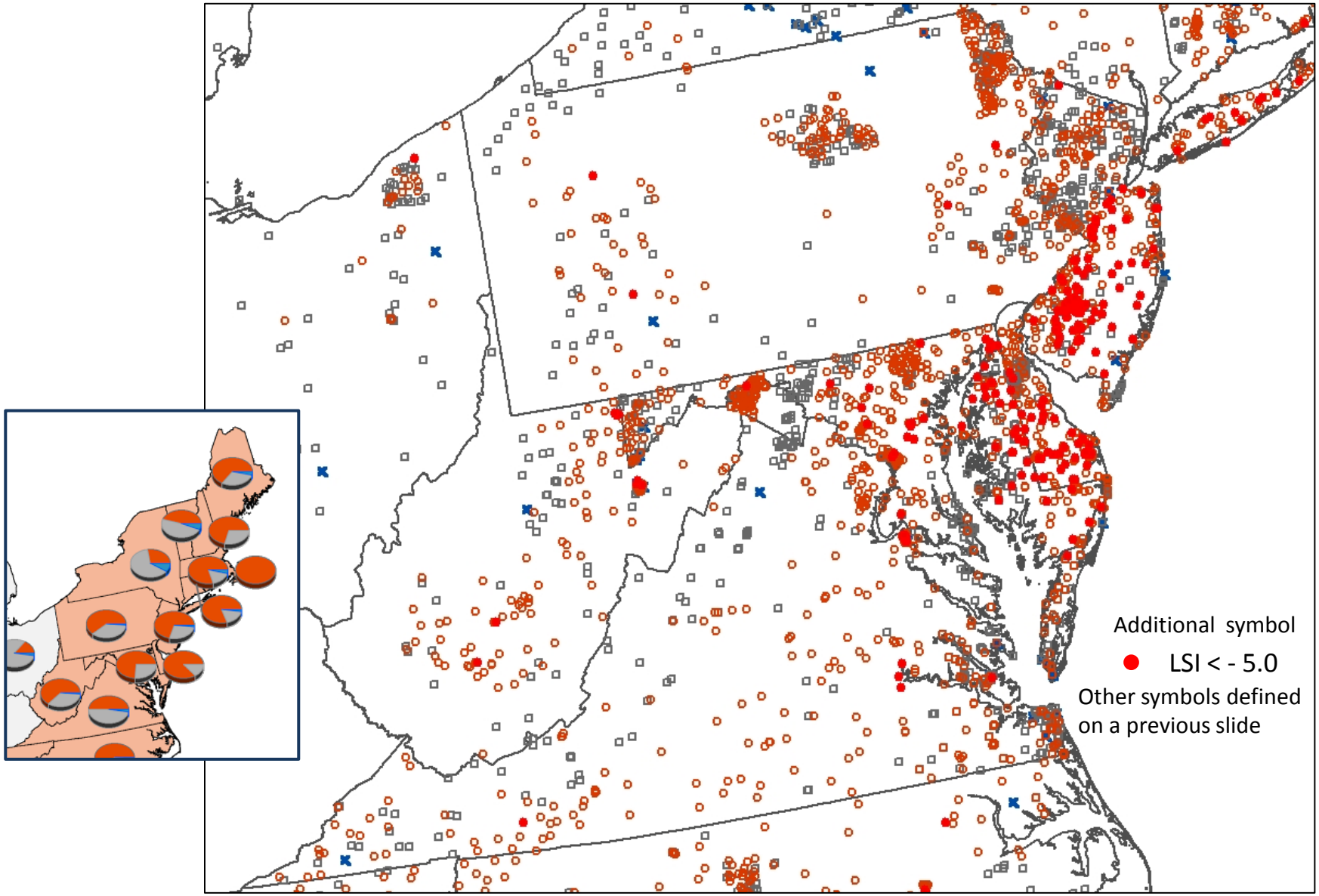

Belitz and others, 2016, "Langelier Saturation Indices Computed for U.S. Groundwater, 1991-2015; Characteristic Values for States," USGS Data Release

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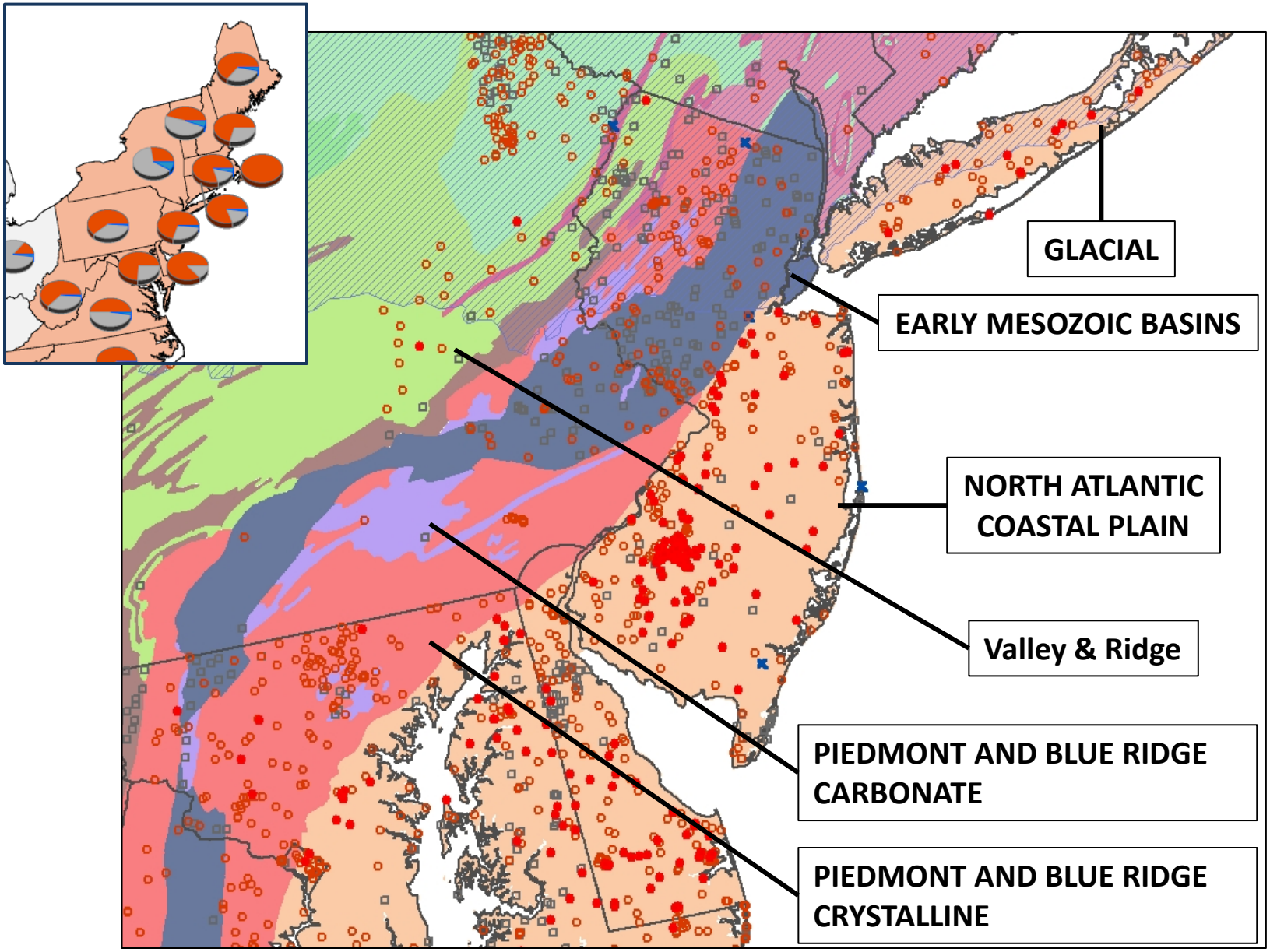
LSI: Relation to Aquifer



● LSI < - 5.0

Other symbols defined on a previous slide

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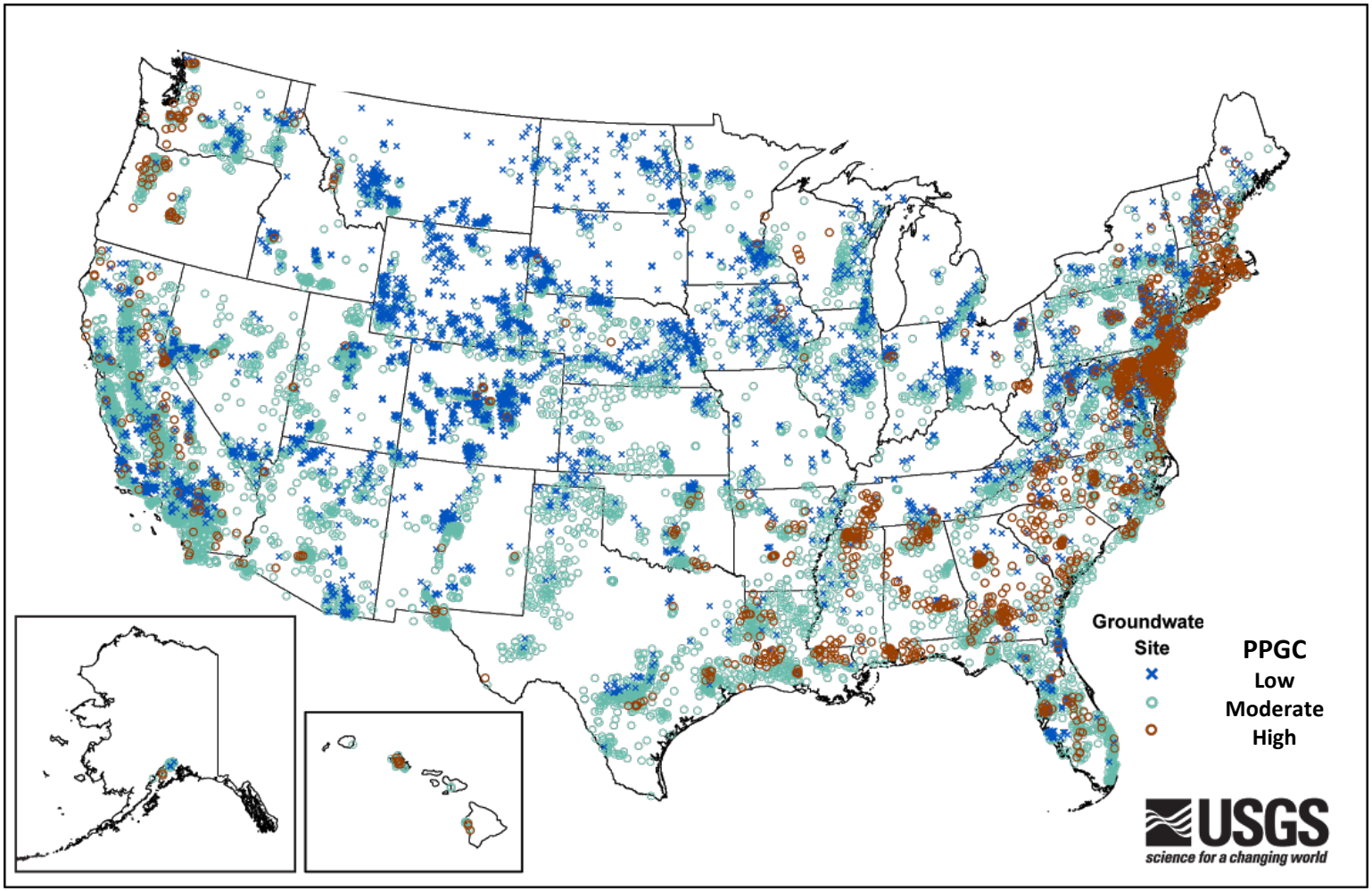
PPGC: To what extent are pipes susceptible to galvanic corrosion?



27,000 locations: 8% high, 67% moderate, 26% low

Belitz and others, 2016, "Potential for Galvanic Corrosion of Lead Based on Chloride-to-Sulfate Mass Ratio and Alkalinity for U.S. Groundwater, 1991-2015; Water Well Data and Characteristic Values for States," USGS Data Release

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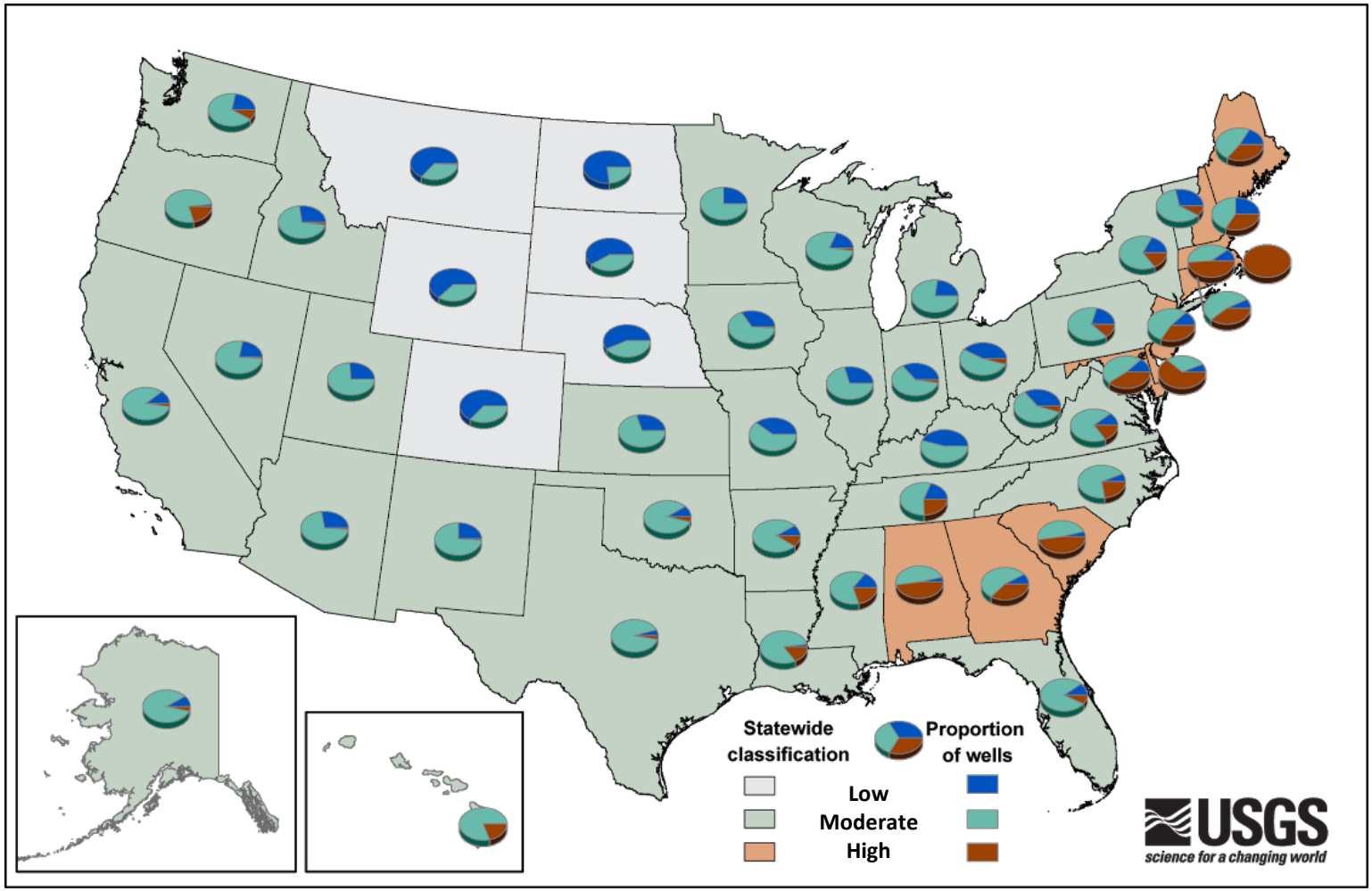

State is low if >50% of wells are low
State is high if >25% of wells are high
Otherwise moderate

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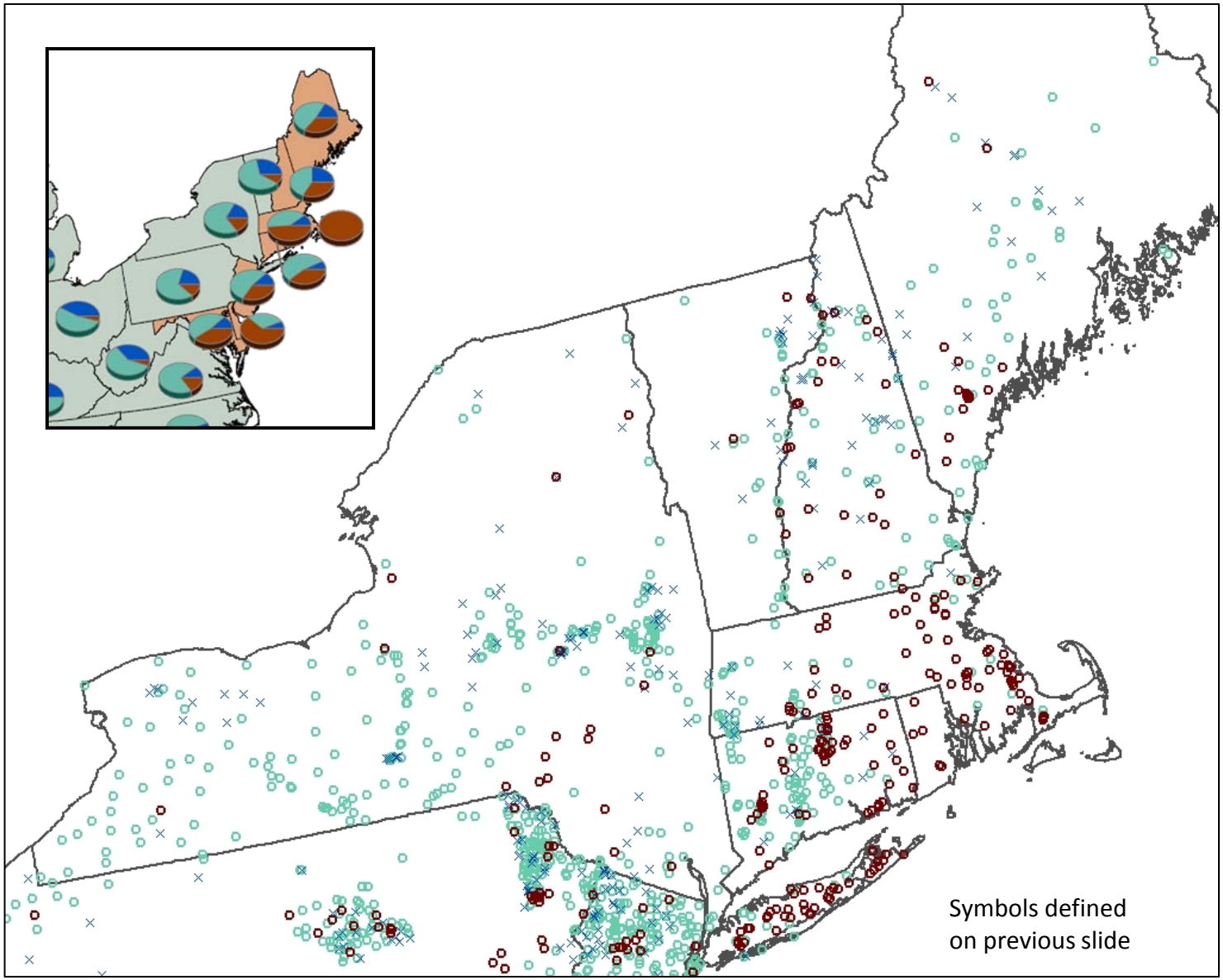
PPGC: To what extent are pipes susceptible to galvanic corrosion?



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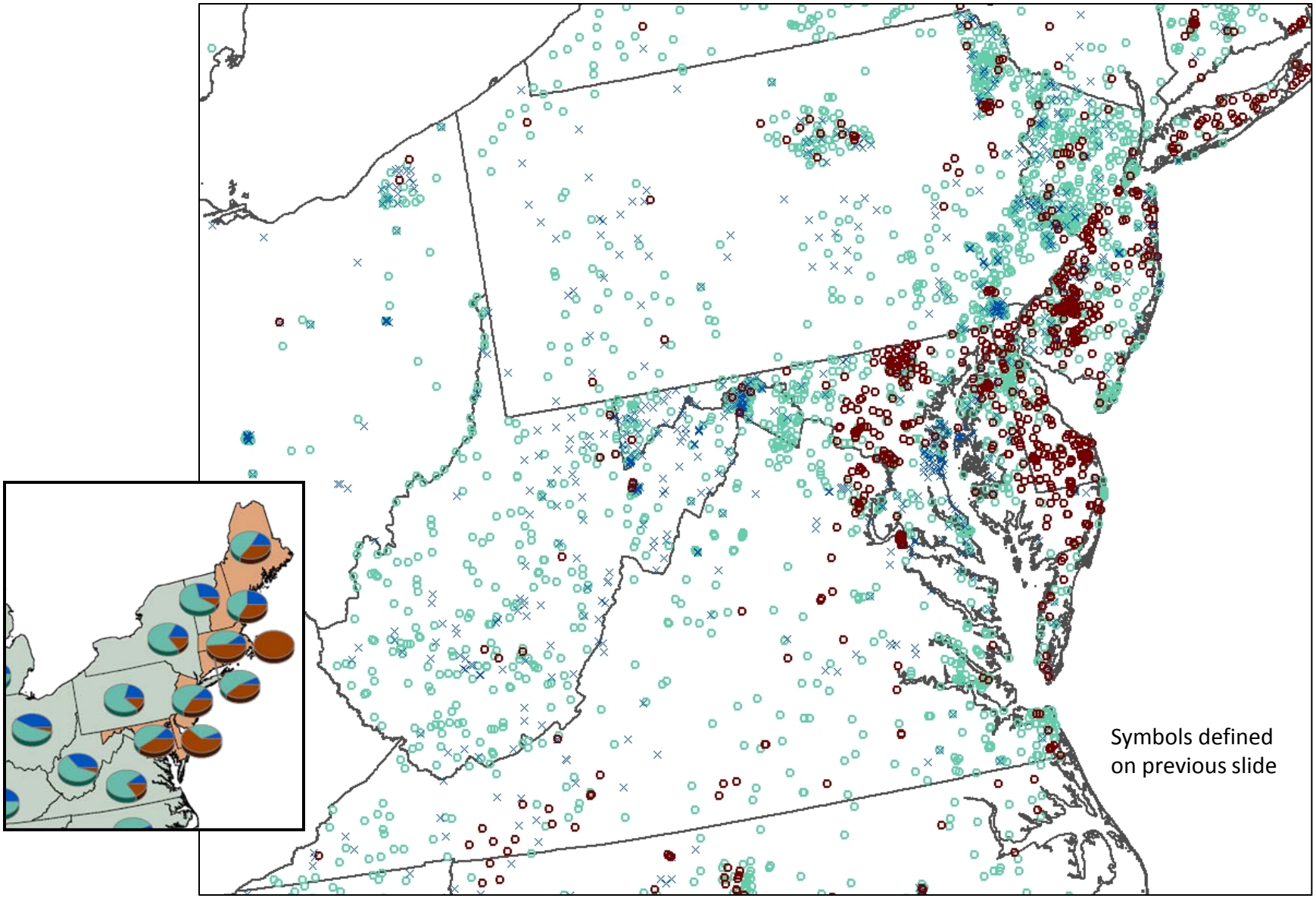

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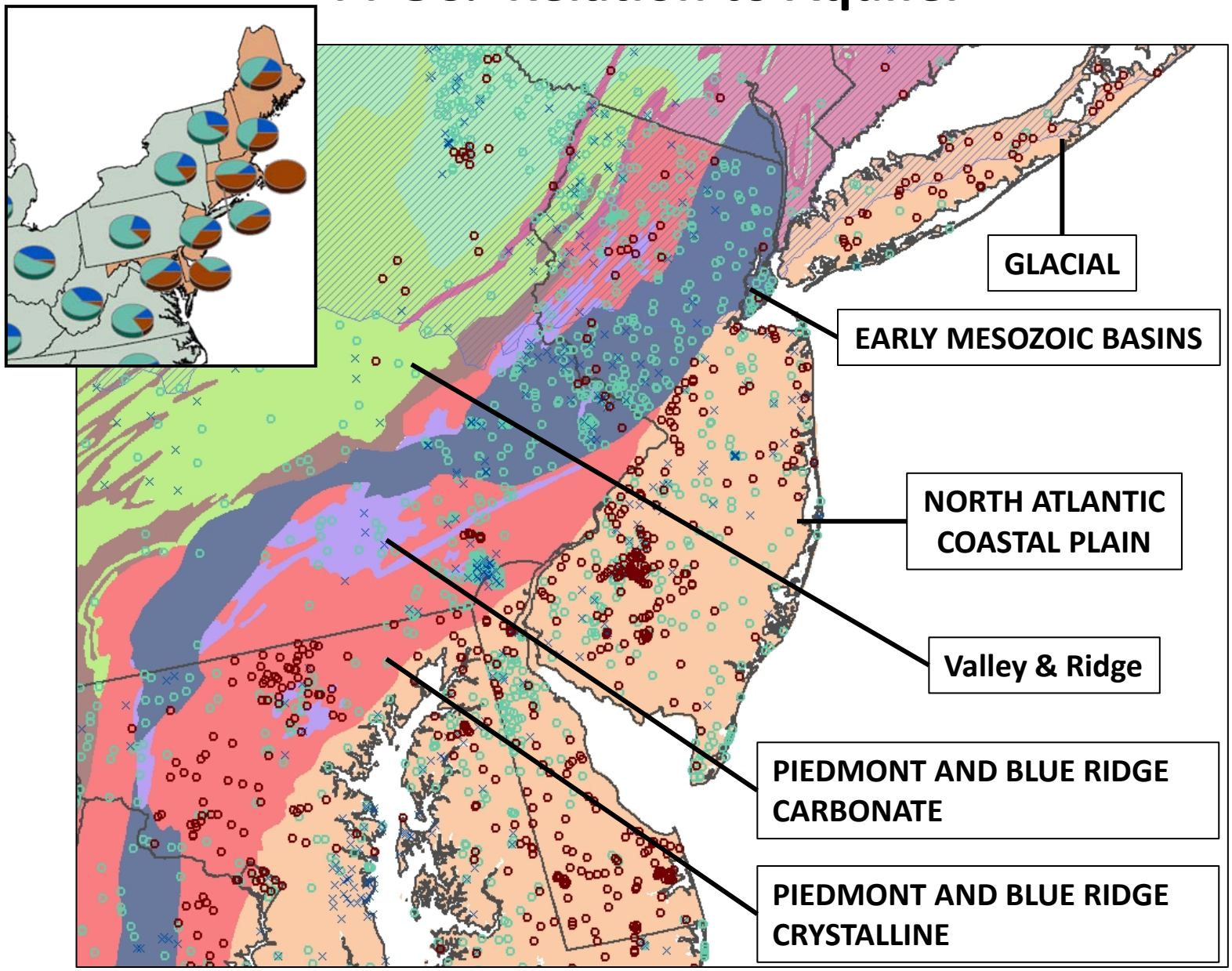
PPGC: Relation to Aquifer



Symbols defined on previous slide

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Combined Index
State-Scale Occurrence of Potentially Corrosive Groundwater

		PPGC Class		
		High	Moderate	Low
LSI Class	Potentially Corrosive	Very High	High	NA
	Indeterminate	NA	Moderate	Low
	Scaling	NA	NA	NA

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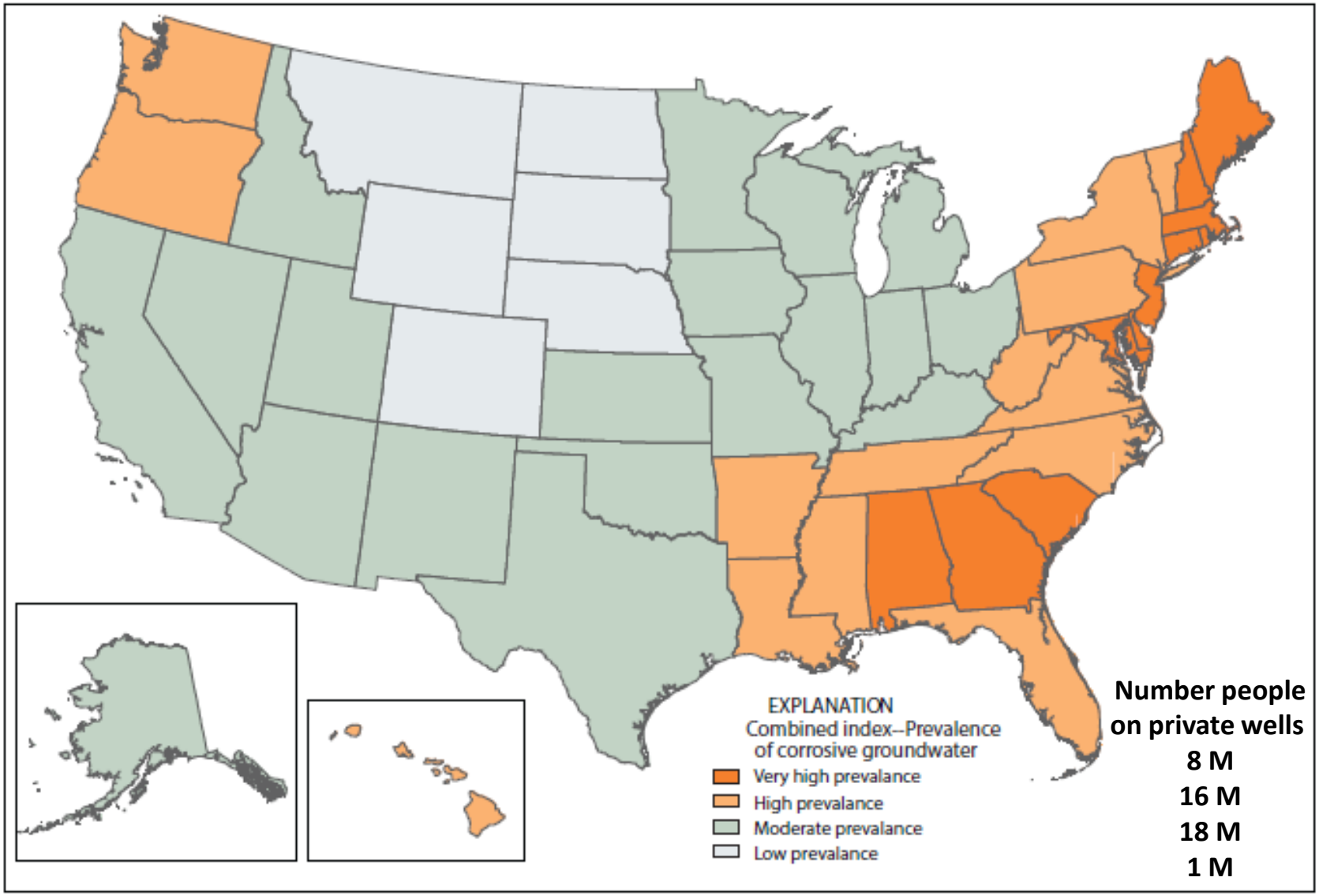
Combined index: state-scale occurrence



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Belitz and others, 2016, "Potential Corrosivity of US Groundwater," USGS Scientific Investigations Report

SUMMARY

- **Corrosive source water, if untreated, can dissolve lead from pipes and other components in water distribution systems**
- **USGS has prepared maps of the potential corrosivity of untreated groundwater in the U.S.**
  - Langelier Saturation Index (LSI) – calcite saturation
  - Potential to Promote Galvanic Corrosion (PPGC) – based on chloride-to-sulfate mass ratio and alkalinity
  - Combined Index – based on joint classification
- **Potentially corrosive groundwater occurs in all 50 states**
- **25 states were classified as high or very high prevalence; 24 million people depend on private wells in these states**
- **19 states were classified as moderate prevalence; 18 million people depend on private wells in these states**
- **Scientific Investigations Report, Data Releases, Web-site**

Potential Corrosivity of Untreated Groundwater in the United States

QUESTIONS?

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http://water.usgs.gov/nawqa/pubs/gw_corrosivity/

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Potential Corrosivity of Untreated Groundwater in the U.S.

Press Release | Report | Data (LSI : PPGC) | FAQs

Please type your questions into the question box

The prevalence of potentially corrosive groundwater is rated high to very high in 25 states, the District of Columbia. About 24 million people in these areas rely upon community water systems for their source of drinking water.

The combined corrosivity index map combines the Langelier Saturation Index and the Potential to Promote Galvanic Corrosion (based on the chloride-to-sulfate mass ratio) into one general indicator of potentially corrosive groundwater to summarize study results at the state level.

Naturally corrosive water is not dangerous to consume by itself. Nevertheless, it can cause health-related problems by reacting with pipes and plumbing fixtures in homes. If plumbing materials contain lead or copper, these metals may be leached into the water supply. Signs of corrosive water causing leaching of metals may include bluish-green stains in sinks, metallic taste to water, and pitting or small leaks in plumbing fixtures.