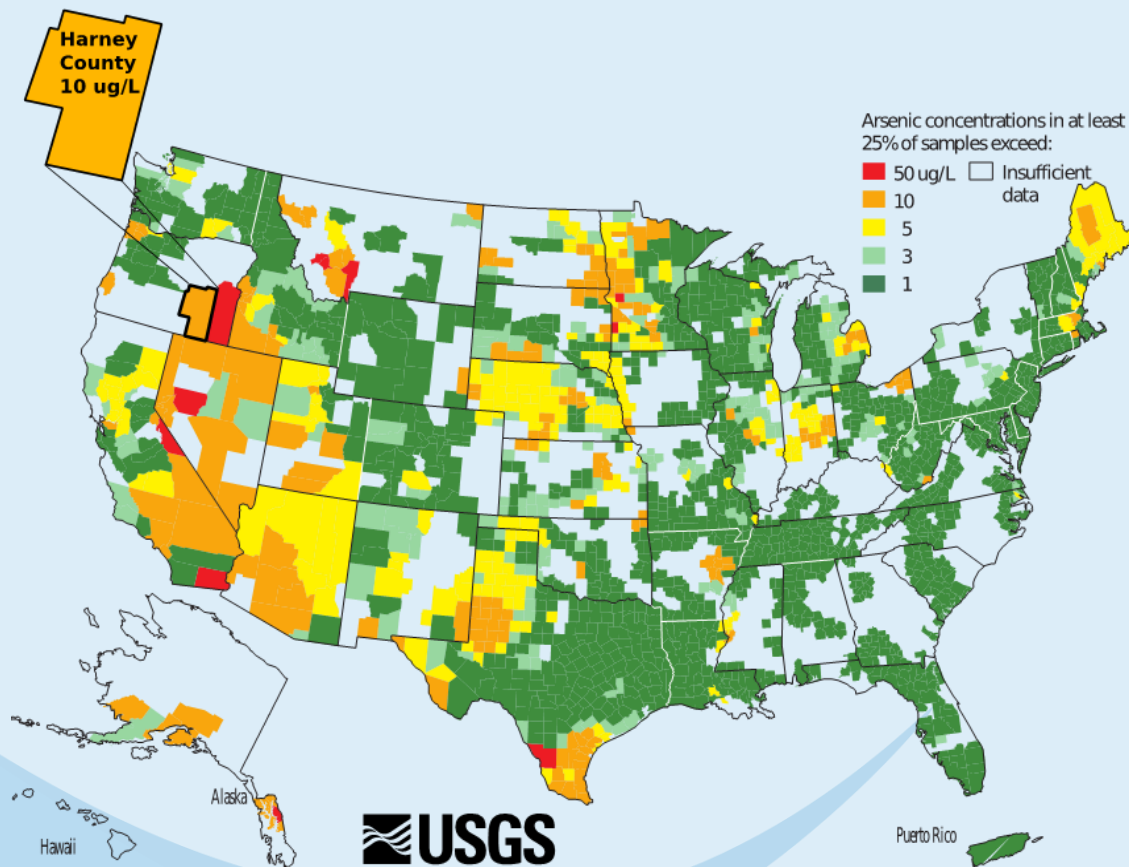
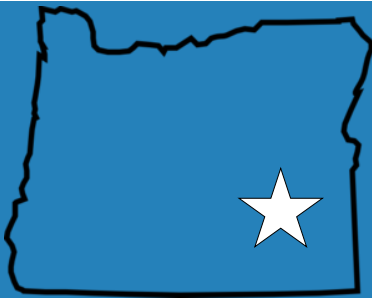


FORENSIC HYDROGEOGRAPHY: ASSESSING GROUNDWATER ARSENIC CONCENTRATIONS AND TESTING METHODS IN THE HARNEY BASIN, OREGON

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GROUNDWATER ARSENIC IN THE HARNEY BASIN

General Facts

What is Arsenic?

Arsenic is a naturally occurring element in the earth's crust and is found in soil, bedrock and water. Because it is an element, arsenic persists in the environment and does not deteriorate. It is odorless, colorless and tasteless.

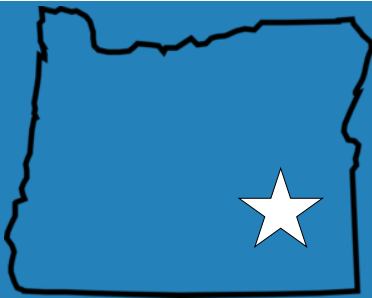
Arsenic in the environment

Arsenic and its compounds have an array of commercial uses. It is used to manufacture other metals, glass, electronic components, and wood preservatives. It is an important component of insecticides and weed killers. In the past it was used in pigments to color wallpapers, paints and ceramics. Mining, smelting and wood processing can also contribute to local arsenic burdens.

How does it get into drinking water?

The majority of arsenic exposure through drinking water is from natural geological sources rather than from mining, smelting, or agricultural sources such as pesticides and fertilizers. Some exposure may be a result of runoff from agricultural lands. Arsenic may also be found in the drinking water of homes located near waste sites where paint, pesticides or electronic components are disposed.

The drinking water standard for arsenic is 10 parts per billion (ppb). Private well owners are not required to meet the standards, but it is a health-based recommendation for short-term and long-term exposure.



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The Study

Why was research conducted in the Harney Basin?

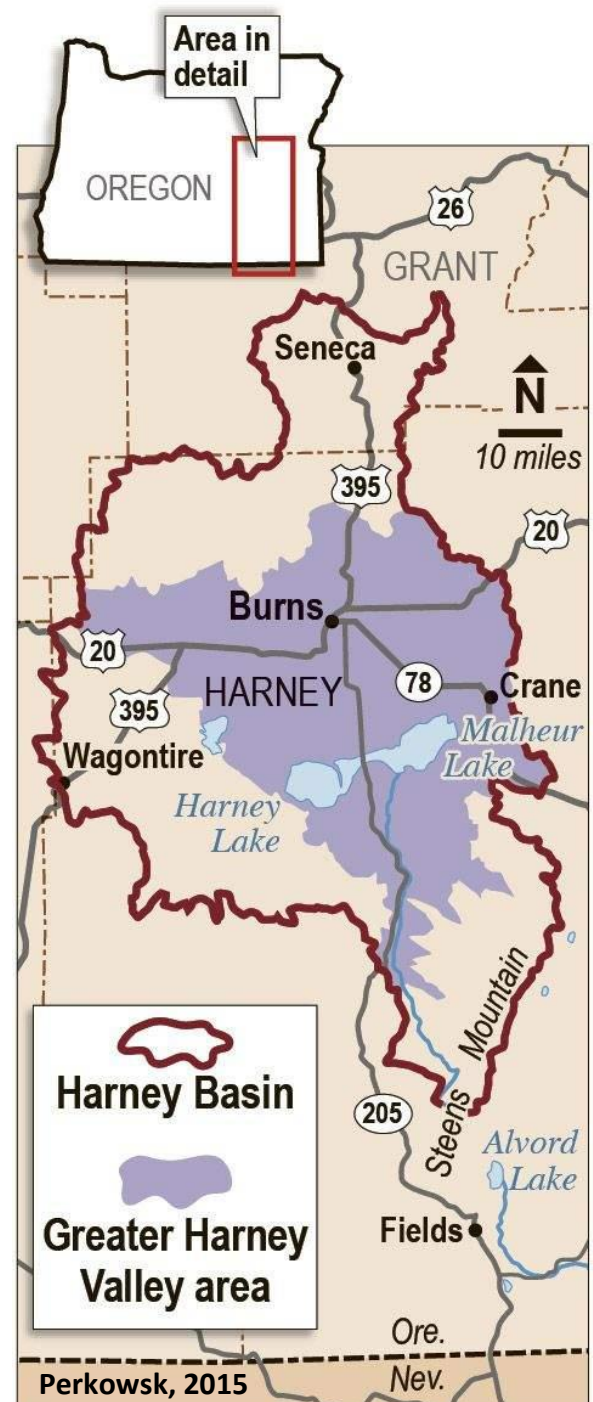
Previous geologic and hydrologic investigations were conducted in the Harney Basin that revealed high levels of arsenic in the groundwater. The tests revealed localized areas of high arsenic concentrations.

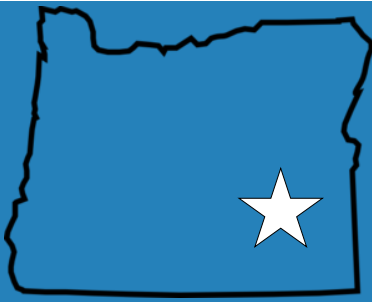
Oregon State University wanted to confirm and expand on previous arsenic sampling to determine if a relationship exists between arsenic occurrence and the geography, hydrology, and geology with the Harney Basin.

A secondary purpose of the research was to evaluate if publically-available field screening tests were as effective as laboratory analysis.

How were the samples collected and tested?

Participation in this study was voluntary and confidential. Sample collection was conducted on private and public properties. A field screening test and subsequent laboratory testing was performed.



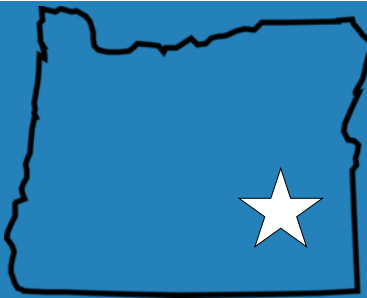


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What are the aquifers in the Harney Basin?

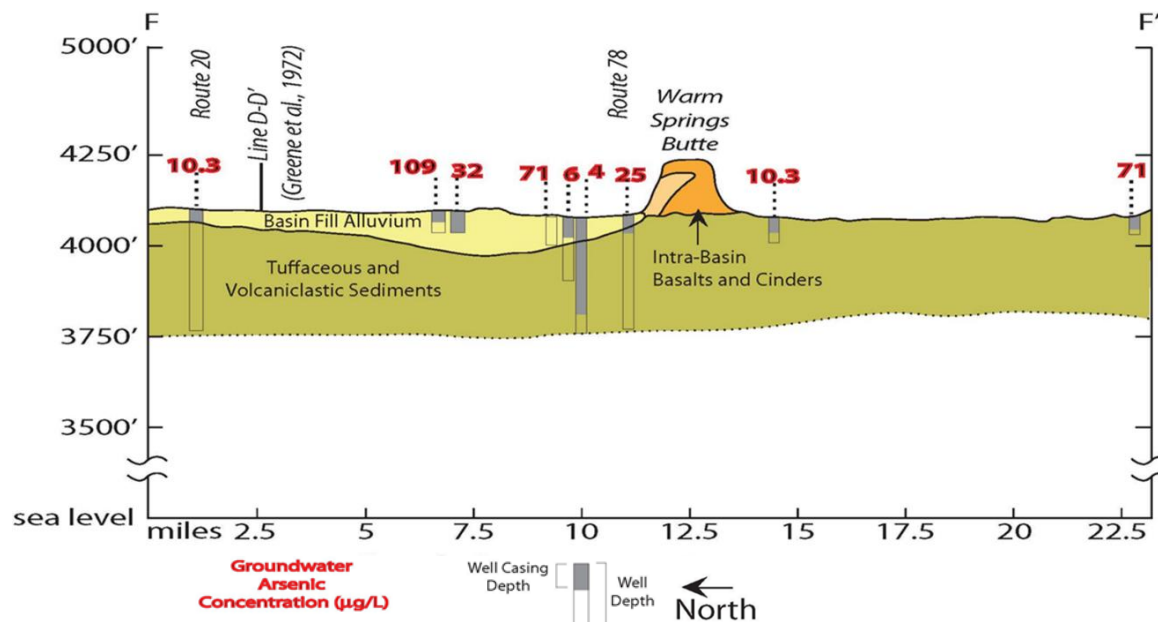
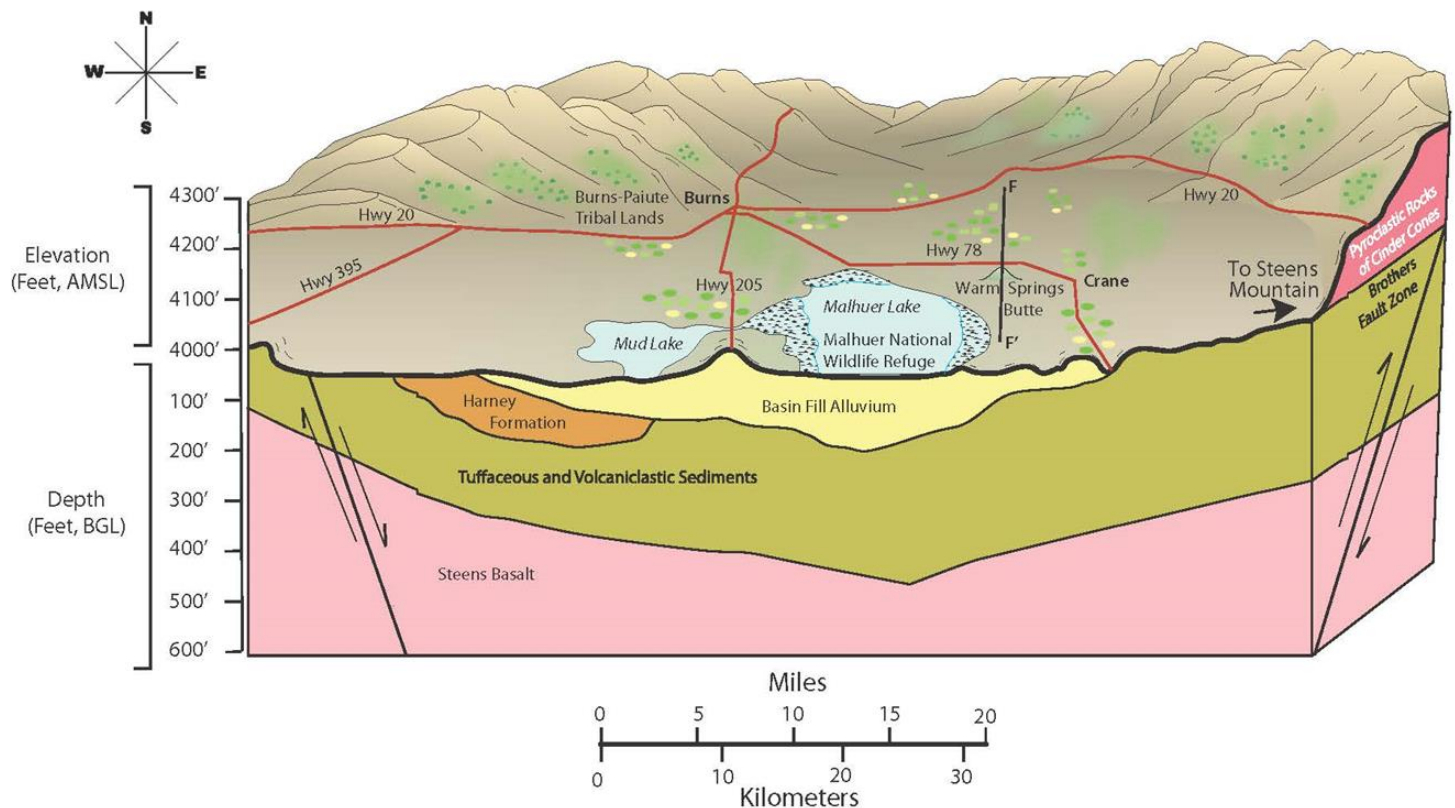
The Harney Basin has many water-bearing zones called aquifers. The rock layers (lithology) from well logs that were used to categorize the aquifers are described below.

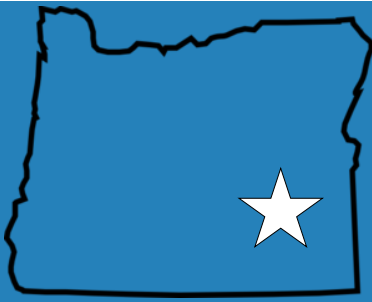
Aquifer	Lithology	Aquifer Region
Valley (Basin) Fill	Gravel, sand, silt, clay, sandy-clay, clayey-sand, gravel, and clayey-gravel	Valley floor and up the major tributary valleys
Tuffaceous and Volcaniclastic Sediments	Clay, claystone, minor sand, sandstone, pumice	Underlies Basin Fill
Diamond/Voltage Basalt, includes Mafic Vent Complexes	Lava flows, cinders, and vent complexes	Directly south of Malheur Lake
Intra-Basin Basalts and Binders	Lavas flows, pyroclastics, palagonite, cinders	West of Harney Valley and within the Harney structural basin
Harney Formation	Sandstone, claystone, conglomerate, sand and gravel	West of Harney Valley and within the Harney structural basin
Volcaniclastic Sedimentary Rocks	Rhyolitic siltstone, claystone, sandstone, conglomerate	North, east and southeast outside the structural basin
Steens Basalt	Lava Flows	North, east and southeast outside the structural basin



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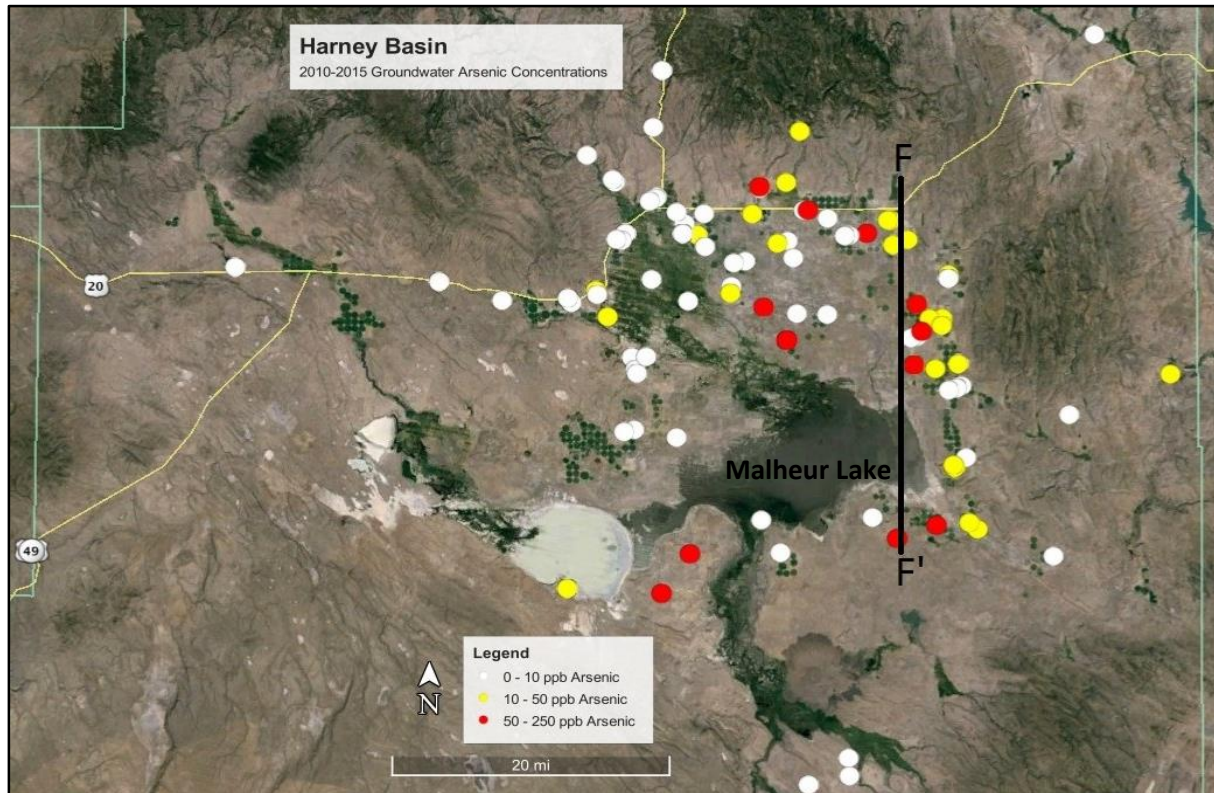
Where are the aquifers in the Harney Basin?





GROUNDWATER ARSENIC IN THE HARNEY BASIN

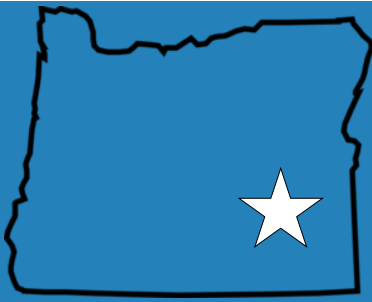
Where was arsenic found in the Harney Basin?



A total of 49 samples were collected across the basin and 91 prior arsenic values were incorporated into the analysis. Of the 140 samples, 68% were below 10 ppb; 21% of the samples were between 10 and 50 ppb; and 11% of the groundwater contained above 50 ppb.

While the Tuffaceous and Volcaniclastic Sediment Aquifer is the most likely to contain arsenic levels above the MCL, it was found that **all aquifers in the Harney Basin contain arsenic**. While some aquifers contain higher concentrations of arsenic than others, there is not one that is responsible for the extremely high levels found in some wells.

All residents must test their well water to confirm the presence of arsenic.



GROUNDWATER ARSENIC IN THE HARNEY BASIN

How do I test my well water? Field Screening Kit or Laboratory Test?

Many water quality tests are available for public purchase. However, the accuracy of the 49 tests fluctuated in precision. The tests may be useful as a general tool for determining the presence of arsenic, but not the quantity.

The field tests only screen for one type of arsenic (inorganic), generally more prevalent in groundwater. Industry standard tests, such as ICP-MS analysis, tests for total arsenic (organic + inorganic). A 2015 study through the University of Oregon (Maguffin, 2015) indicates arsenic can cycle through forms in aquifers and is highly dependent on the pH and other geochemical factors.

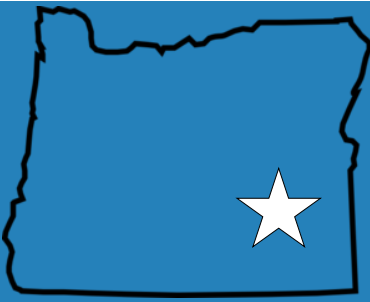
It is advised to send samples to an accredited laboratory for total arsenic analysis.

Find an accredited laboratory that does water testing for private property owners. These labs can provide information and instructions on collecting well water samples and will often provide a container.

For a list of accredited laboratories in Oregon - call the Oregon Environmental Laboratory Accreditation Program (ORELAP) at 503-693-4122 or visit:

<http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Documents/acclab.pdf>

Children are more susceptible to all environmental chemicals, including arsenic due to their greater water consumption on per unit body weight basis and the fact that their bodies are still developing. Therefore, it is usually recommended that additional efforts should be made to **identify** and **reduce** children's exposure to arsenic. Pregnant women should also reduce their exposure to arsenic because it can cross the placental barrier which leads to risks for the fetus.



GROUNDWATER ARSENIC IN THE HARNEY BASIN

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