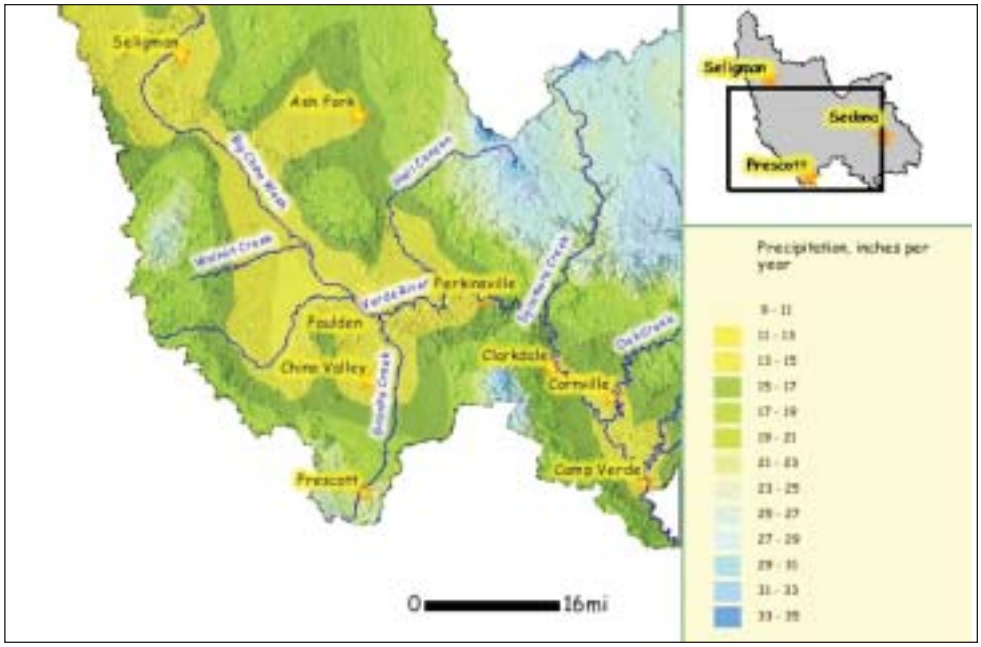
Web Site Builds Customized Maps of Arizona Rural Watersheds

A new U.S. Geological Survey (USGS) Web site features an interactive mapping capability that enables users to build maps of a large portion of rural central Arizona. Visitors can select information and create maps showing wells, springs, and streams, and other types of information about area water resources and watershed hydrogeology.

The Web site is part of USGS studies under the Arizona Rural Watershed Initiative (RWI) program. Administered by the Arizona Department of Water Resources (ADWR), the program helps rural areas of the state to address water-related issues and concerns. The USGS, in cooperation with ADWR and Yavapai County, is studying three contiguous rural areas in Arizona – the upper and middle Verde River watershed; the Fossil Creek, East Verde River, and Tonto Creek watersheds in the Mogollon Highlands; and the Coconino Plateau.



Interactive map created from the RWI Web site. Shows the headwaters area of the Verde River (near Paulden), with washes (blue) and towns (orange). Precipitation data are superimposed over the digital elevation map.

When Web site visitors select one of the three watersheds, a shaded relief map of the area is displayed. Viewers can then select from individual data layers that include wells, springs, and active streamflow-gauging stations and display them on the map. Zoom and navigation tools enable users to scale maps up or down. By clicking on data points, users can view data available in USGS databases. Additional images, such as contoured precipitation and geophysical data or a satellite view of the area, also can be superimposed on the map.

Marilyn Flynn, the USGS hydrologist who developed the site, said "It's a work in progress that we continually update as project products are developed. New covers will include geology, vegetation distribution, land ownership, topography, and aerial photography." In addition, geophysical and water chemistry data will soon be available for the Verde River area. The site also will provide progress updates on USGS RWI studies, as well as study data, preliminary interpretive products,

and links to other sources of information.

The USGS studies are designed to provide technical information and knowledge about the extent and sustainability of water resources needed by watershed stakeholders to manage and use area resources now and in the future.

Visit the Arizona RWI Web site at az.water.usgs.gov/rwi-ii/

Mitigating Arsenic in Groundwater without Treatment

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In January 2001, the U.S. Environmental Protection Agency (EPA) lowered the limit for arsenic in drinking water from 50 parts per billion (ppb) to 10 ppb. The EPA will require water providers to comply with the new standard by January 2006. More than 5 percent of the public water systems nationwide and nearly 30 percent of Arizona water systems will be impacted. About 97 percent of all affected water systems serve fewer than 10,000 customers. Therefore, this new standard chiefly affects the small water provider, who can least afford required system upgrades. Fortunately, there are several sources of funding available to assist small water providers.

In response to the EPA's actions, there has been a flurry of activity to develop treatment methods to remove arsenic, which generally carry a high capital cost for implementation and long-term operation and maintenance (O&M). Unfortunately, in the rush to develop effective treatment, these efforts appear to have largely neglected a crucial first element in the solution: Before recommending treatment, the source of the arsenic should be understood, and approaches should be considered to minimize or eliminate the need for treatment by blending supplies, adjusting pumping regimens, modifying existing wells, and/or designing new wells to maximize production from low-arsenic aquifer zones.

The feasibility of using well field modifications to meet water quality standards is evaluated using a range of hydrogeologic investigative methods that have long been established in the water well industry. Feasibility of a non-treatment approach improves where concentrations of undesirable constituents vary vertically and/or horizontally in an aquifer or sequence of aquifers. Vertical variations in concentrations are found most commonly in multilayered aquifer systems, which occur in many alluvial basins in the southwestern United States. Sedimentary and igneous fractured-rock aquifers also provide opportunities where confining units separate groundwater flow in fractures. Horizontal variations in concentrations occur in nearly every aquifer system.

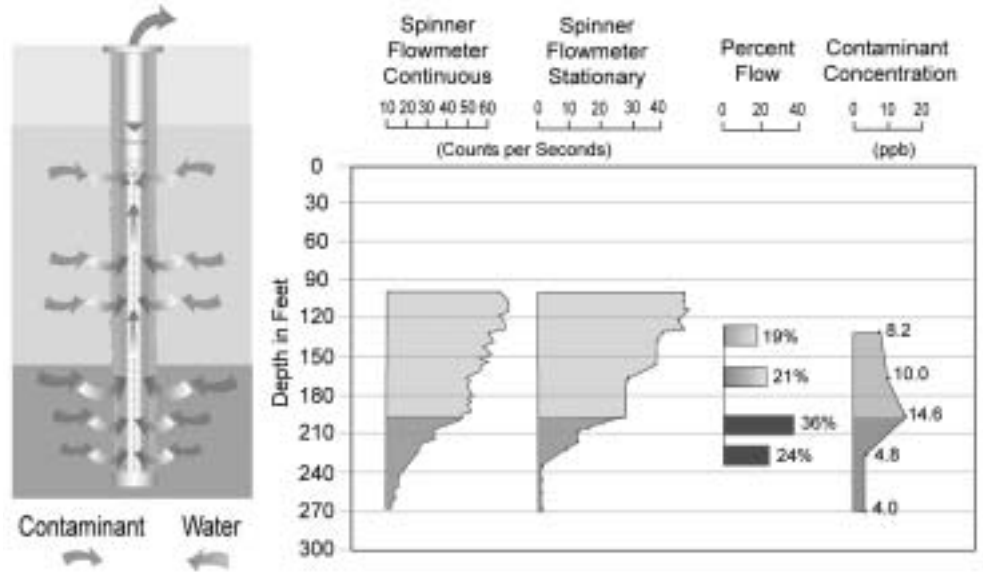
Hydrogeologic investigations may include, but are not limited to, one or more of the following:

- review of existing data and/or acquisition of new data to evaluate subsurface conditions, determine arsenic distribution in a defined study area, and identify impacted wells;
- downhole video surveys to verify well construction details and condition;
- downhole fluid-movement surveys and depth-specific sampling under pumping and non-pumping conditions and, if appropriate, at varying pumping rates to determine the relative contribution of flow, arsenic, and other chemical constituents from each aquifer zone;
- pumping tests to estimate aquifer hydraulic properties, well efficiency, sustainable well yield, and well-head arsenic concentration at different pumping rates;
- borehole geophysical logging to verify occurrence and condition of annular seals and to characterize aquifer lithology; and
- analysis of aerial and satellite photos, field mapping, and surface geophysical surveys to identify pertinent geological features and drilling targets for new wells.

Investigations are conducted in a logical, phased approach to maximize cost efficiency, allow the scope of work to be modified as necessary based on interim results, and provide appropriate milestones at which to determine feasibility of a non-treatment solution.

Where determined feasible, a strategic water management plan can be prepared to meet present and future demand through integration of one or more of the following measures with the existing water supply system:

- modification of pumping regimens and/or schedules to discontinue or limit the use of high-arsenic wells and to maximize production from low-arsenic wells or aquifer zones;
- blending of water supplies from other wells or water sources;
- rehabilitation of existing wells to improve yield from low-arsenic aquifer zones;
- modification of existing wells to seal off



Depth-Specific Analysis of Flow and Chemistry from Aquifer Zones

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high-arsenic aquifer zones or to increase yield from untapped low-arsenic zones;

- installation of replacement wells, designed according to system need and hydrogeologic conditions to produce from low-arsenic aquifer zones; and
- identification of alternate water supplies, and modification or addition of infrastructure to use them.

Non-treatment options are generally far less expensive than treatment options, especially when long-term O&M costs are considered. Hydrogeologic investigations can be conducted for a low-to-moderate cost commitment to assess the feasibility of achieving arsenic compliance either without treatment or with a substantially reduced level of treatment. Even in cases where conditions are not conducive to a non-treatment approach, data obtained are valuable for long-term operation of the well field and for proper design of a treatment alternative. In addition, these methods may be used to simultaneously evaluate a wide range of groundwater quality problems, such as nitrate, fluoride, sulfate, total dissolved solids, heavy metals, pesticides, and solvents.

Although the deadline for compliance with the new arsenic standard is 2006, hydrogeologic investigations and feasibility assessments for both non-treatment and treatment alternatives should be conducted early in the planning process so that all options and associated costs are identified prior to selecting a compliance method. State and federal funding is available for these feasibility assessments.

The Arizona Arsenic Master Plan provides information on treatment and non-treatment methods, as well as funding mechanisms for grants and low-interest rate loans to small water providers, and can be viewed at www.adeq.state.az.us/environ/water/dw/arsenic.html.

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