Wyoming's Groundwater Resource

Summary Report

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Introduction

Groundwater plays a significant role in human development and in maintaining important natural ecosystems. Groundwater uses range from providing freshwater drinking supplies to irrigating crops.

Groundwater can be found throughout Wyoming in the pore spaces between soil particles and the mineral grains that form rocks. Studies by the Wyoming State Geological Survey (WSGS) and Wyoming Water Development Commission (WWDC) show that about 6 percent of all freshwater used in Wyoming comes from groundwater sources. The other 94 percent comes from surface water. These studies are used to determine the extent of Wyoming's aquifers and define their recharge areas, knowlege that is critical to the protection of the state's groundwater resource.

Groundwater is especially important in the arid West where surface water is not as ample as in other parts of the country. This is especially true for Wyoming's interior areas where surface water supplies are located at great distances from where they are needed or allocated to senior water rights holders in bordering states.

Alluvial and shallow bedrock aquifers produce most of Wyoming's groundwater. Stream sediments composed of silt, sand, and gravel form alluvial aquifers which are typically recharged by the surface streams that flow through them. Porous sedimentary deposits of sandstone and limestone constitute important bedrock aquifers.

Recharge for Wyoming's aquifers originates largely as direct precipitation to aquifer outcrops and as snowpack in the state's mountain ranges. Mountain snow is the main source of Wyoming's surface water and groundwater. The water released during snowmelt in late spring and early summer infiltrates the ground surface to recharge underlying aquifers, or turns into runoff that contributes to stream and river flows. Wyoming's semi-arid basins, characterized by low precipitation, high evaporation, and reduced soil permeability, generally provide much less recharge to underlying aquifers.

Groundwater is obtained from wells or springs. Some groundwater in the state may be unsuitable for drinking due to poor water quality or low rates of production. The spatial occurrence, production characteristics, and groundwater quality of an aquifer are controlled by the amount and location of recharge and the stratigraphic and structural settings of the local geologic formations.

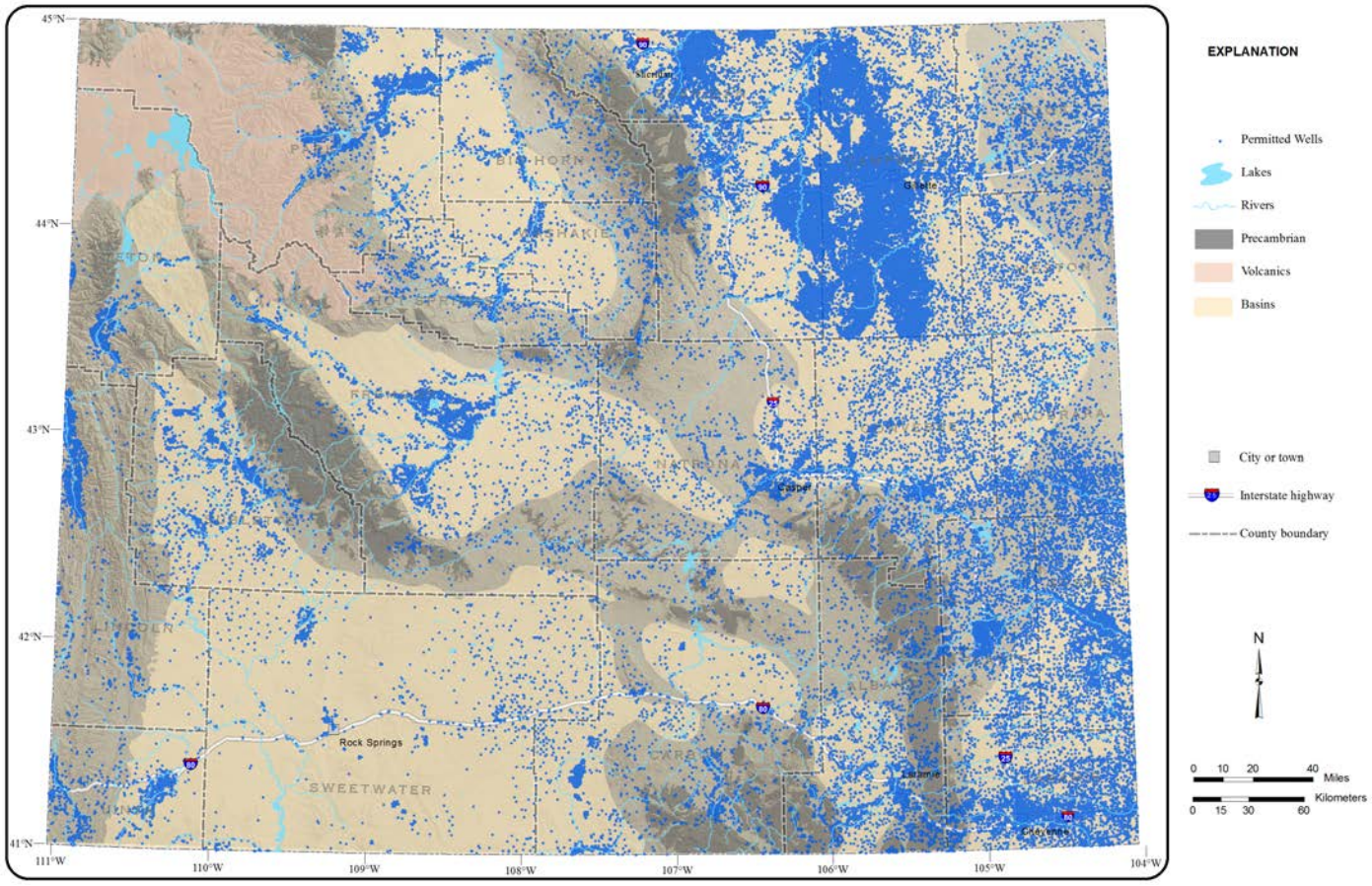

Figure 1. Wyoming Groundwater Wells. *Graphic by Phyllis Ranz, WSGS, 2015.*

Wyoming's Hydrolgeology

The availability of groundwater resources is determined by Wyoming's geology and geography. Throughout the state, mountainous and highland areas separate deep intermountain basins (see map on back). Mountainous regions correspond to Precambrian (gray) and Paleozoic (light blue) units, while basins occur where Tertiary (tan) and Quaternary (pale yellow) units are shown.

Generally, alluvial aquifers are associated with Quaternary deposits which can be seen as channel outlines of Wyoming's major rivers. Outcrops of bedrock aquifers, typically located along the flanks of uplifts, conform to exposures of Paleozoic (light blue) and Mesozoic (Cretaceous, Jurassic, and Triassic) aquifers, shown in shades of green. In contrast, little water is available from confining units, or aquitards (red), which are formations, composed of shales and claystones that restrict the flow of groundwater. Paleozoic units (gray) serve a unique hydrogeologic role in that they typically act as confining units when they are deeply buried beneath Wyoming's aquifers. However, they frequently yield small volumes (< 5 gallons per minute) of groundwater to wells and springs from fractures in areas where they are exposed at the surface.

Wells and Springs – Groundwater Uses

Groundwater is withdrawn from nearly 100,000 permitted wells and springs (fig. 1), which are widely distributed throughout Wyoming. High well densities are clustered in the Powder River Basin (PRB) due to coalbed natural gas (CBNG) development, as well as in the Denver Basin where irrigation wells are in wide use, and in alluvial deposits along many of Wyoming's major stream channels. Low well densities are generally seen in mountainous areas, in the interior of the Green River Basin, and in the wilderness areas of the northwest portion of the state.

Comparative pie charts for permitted groundwater wells and withdrawals by class of use are shown in figures 2 and 3. Domestic water supply wells which constitute 42 pecent of permitted wells account for only 16 percent of withdrawals, while irrigation wells, allocated more than 28 percent of permitted withdrawals, comprise only 1.8 percent of total well permits. Total actual groundwater withdrawals are, however, only a fraction of permitted withdrawals. In Wyoming, according to the U.S. Geological Survey (USGS), actual groundwater withdrawals are about 541 million gallons per day (Mgal/d) compared to 5,021 Mgal/d, permitted by the Wyoming State Engineer's Office (SEO).

Groundwater Overuse – Aquifer Water Level Declines and Streamflow Depletions

Groundwater is not an inexhaustible resource. Its overuse can result in declining aquifer groundwater levels and subsequently,

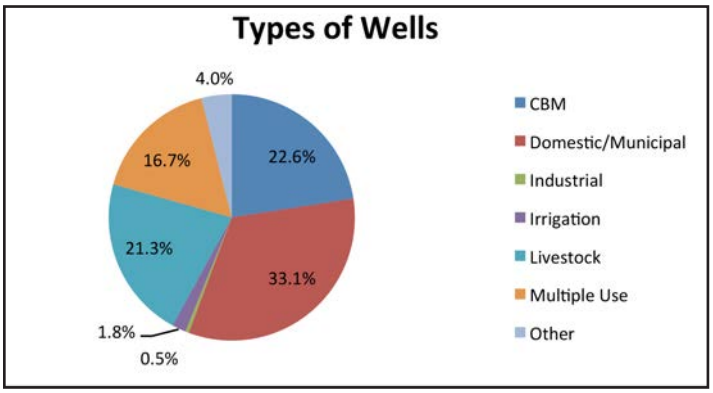

Figure 2. Percentage of the types of water wells in Wyoming. (Wyo. State Engineer's Office, 2015.)

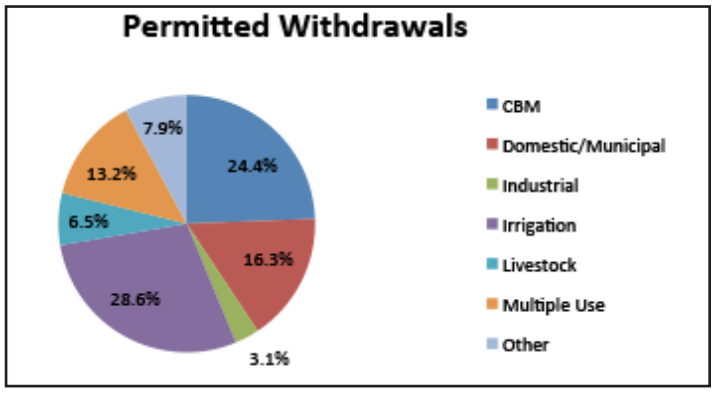

Figure 3. Percentage of the types of permitted water withdraws in Wyoming. (Wyo. State Engineer's Office, 2015.)

flows and changes in the timing of peak river flows impact water consumption, agriculture production, economic growth, recreation opportunities, and electricity generation, among other vital services.

In Wyoming, most groundwater declines have been relatively minor drops that are restricted to local areas. However, declines of more than 50 feet in some areas of the High Plains aquifer of southeastern Wyoming have been observed. These are being closely monitored by the SEO and the USGS. Water level declines of 600 feet and more, resulting from CBNG development have been documented in some coal seam aquifers of the PRB by the U.S. Bureau of Land Management. Recent data indicate that some of the coal seam aquifers in the PRB are starting to recover as CBM development has decreased in the last few years.

Declining groundwater levels may reduce flows from springs into nearby streams, thus diminishing streamflows that are appropriated to surface water rights holders. In extreme cases, flows have ceased completely in long stream reaches only to resume when pumping in adjacent groundwater wells was curtailed.

Most of the water in the ground comes from precipitation that infiltrates downward from the land surface.

The connection between groundwater and surface water has long been recognized in the interstate water compacts established between Wyoming and its neighboring states. The SEO has investigated a number of cases of groundwater-surface interference, most recently in Campbell, Goshen and Laramie counties.

Sustainability of Our Groundwater Resource

Groundwater, like other valuable resources, must be developed and used in a sustainable manner to ensure its long term availability. The concept of "sustainable development" recognizes that the use of any natural resource must meet the needs of the present and future generations. Sustainable development of water resources has become increasingly important. Especially since recent USGS studies have documented widespread groundwater storage declines in the United States and the related effect of surface water depletion.

A groundwater development project that incorporates sustainable development involves detailed studies of the hydrologic system, including determining the ultimate sources of groundwater withdrawals, defining the first unacceptable effect(s) of storage and surface flow depletions, and establishing minimal acceptable water levels that may result. Further, a sustainable development program includes a long term monitoring plan that utilizes adaptive management of the groundwater resource. This approach has been used over the last two decades in groundwater development programs throughout the state, and funded by the Wyoming Water Development Commission.

Sources: Wyoming Water Development Commission, Wyoming State Engineer's Office, U.S. Geological Survey

Information on Wyoming's groundwater resource, www.wsgs.wyo.gov/Research/Water-Resources/Groundwater.aspx

WYOMING STATE GEOLOGICAL SURVEY
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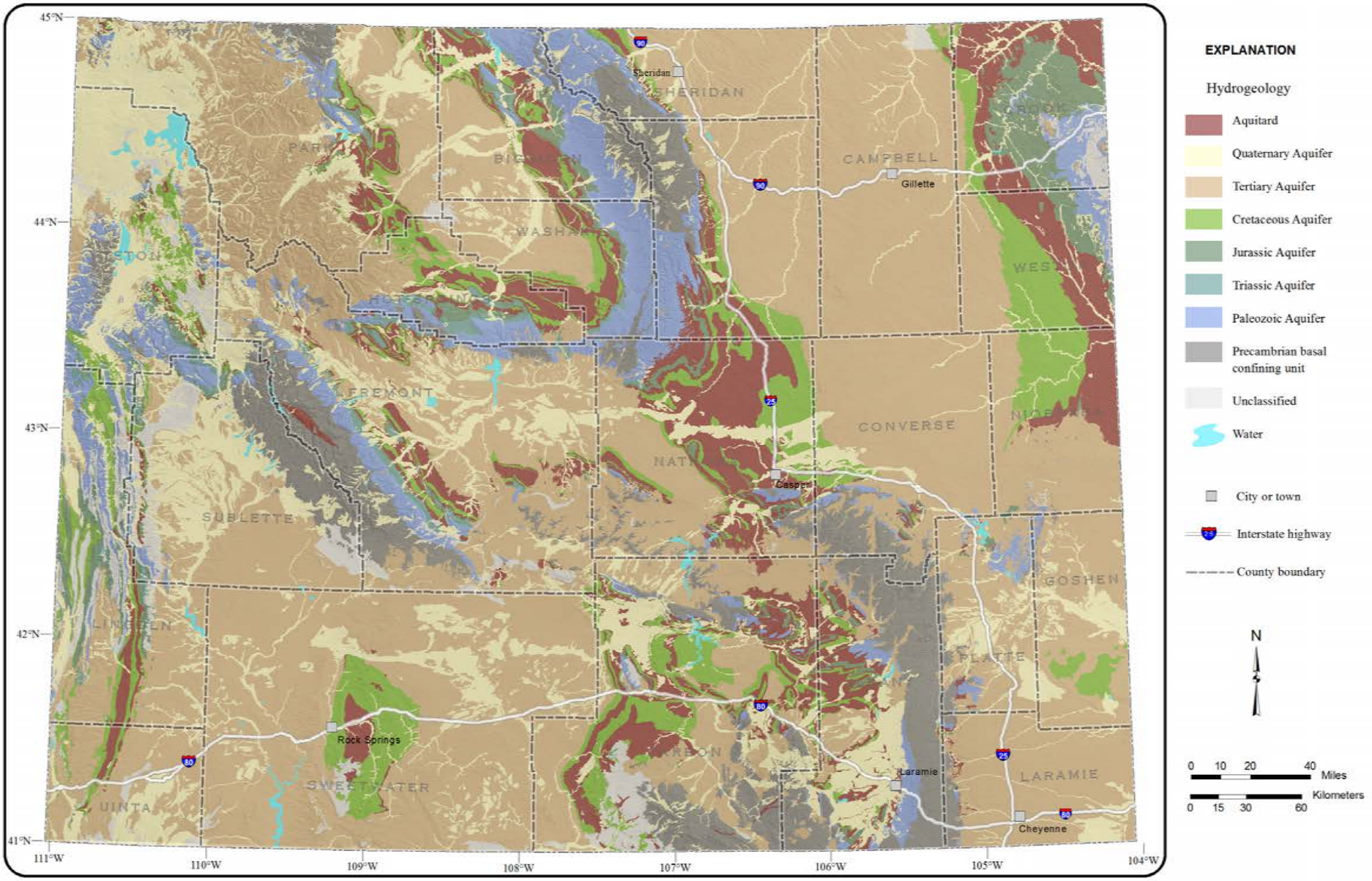
Geology - Interpreting the past - Providing for the future



Wyoming Aquifers

Map design by Phyllis Ranz 1/2015