GROUND-WATER DEVELOPMENT IN BEAVER, PIUTE, IRON, GARFIELD, WASHINGTON, AND KANE COUNTIES, UTAH

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INTRODUCTION

For practical purposes, ground water may be considered as all water present beneath the surface of the earth. It is the water encountered by shallow "dug" wells or deeper "drilled" wells or the water that enters caves, tunnels and other underground mine workings, the artificial openings providing freer avenues of escape for the water contained in the rocks of the earth's crust. Ground water, like surface water, has its ultimate source in precipitation, which in Utah comes mainly in the winter months as snowfall. Gentle, protracted rains are also beneficial, but the "cloud-burst" type of summer thunderstorms produces only "flash floods" which are harmful rather than helpful and are wholly ineffective in adding to the ground-water supply. The distribution of precipitation in Utah is closely controlled by the topography, particularly by the height of the relief features; mountains get the most, desert floors the least. The west-facing slopes of the mountain ranges and high plateaus (in this region, usually the windward side) get more abundant precipitation than the opposite or leeward side.

GROUND-WATER RESERVOIRS

A satisfactory supply of ground water depends primarily upon the presence of two fundamental conditions: first, there must exist a suitable body of both porous and highly permeable material, preferably fairly uniform sized particles of gravel or sand, to act as a reservoir that will not only hold a large volume of water in storage but will also transmit it freely to wells. Such a body of pervious gravel or sand should be relatively near the earth's surface so that water can be recovered from it at a reasonable pumping cost. Second, there must be an assured and adequate supply of water, either seasonal or in cycles of wet years, to replenish the reservoir and replace the water withdrawn by pumping. These two foregoing conditions, just described, are absolutely essential if a reliable water supply is to be obtained.

Water exists underground under either one or the other of the following two hydrologic conditions: (1) "free" or unconfined ground water, or (2) "confined" or artesian water. (See Figures 1 and 2). In the first case the water fills the pores or interstices in gravels or sands up to a certain level, called the "water table," which is the top of the saturated zone. The water table may be near the earth's surface as in most intermontane valleys or it may lie at great depths, often hundreds of feet, beneath the borders of desert floors. Movement of the free water body is controlled by gravity, and, like surface water, it moves downslope, but ever so much more slowly because of the friction offered by the small openings in the porous material. This can be easily demonstrated by filling a glass tumbler with marbles, then pouring it full of water. By carefully tipping the glass, and restraining the marbles with the fingers, the water can be emptied out almost instantly. But, if sand is substituted for the marbles, the water drips out slowly and it takes considerable time to drain all of the water out of the glass. If very fine silt or clay is used, the material may be fully saturated, but the water will hardly drain out at all.

Confined water occurs in porous beds of sand or gravel, or in pervious sandstones, overlain widely by tight or impervious layers of clay, or in the case of consolidated sedimentary rocks, shale. The water thus confined is under hydrostatic pressure, determined by the elevation of the porous bed or "aquifer," as it is called, at the highest level of the zone of saturation within the aquifer. Confined water, when penetrated by wells, may rise many feet above the boundary of the overlying confining layer, even to the surface, thus giving rise to flowing or "artesian" wells.

In Utah, the ground-water reservoirs that yield water most abundantly by means of wells are of two fundamental types:

(a) Reservoirs in alluvium (unconsolidated deposits of gravel, sand, silt, and clay).

(b) Reservoirs in bedrock, either porous or highly fractured solid rock bodies.

Practically all of the water obtained from wells in Utah for municipal, industrial, and agricultural use comes from the former or "alluvial" type of reservoirs, which, in order of relative importance, may be further classified as:

1. Alluvial fans
2. Desert basin floors
3. Watercourses (underflow)

Driving wells in bedrock in Utah has generally been disappointing both because of excessive drilling costs and small yields. Of the three types of alluvial reservoirs listed above, the alluvial fan reservoirs have been by far the most productive sources of ground water in Utah. Fortunately, they are found most often in those parts of Utah where...