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UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
GROUND WATER BRANCH

SUMMARY OF GROUND WATER IN SUBAREAS OF THE SNAKE RIVER BASIN IN OREGON SOUTH OF THE WALLOWA MOUNTAINS

by

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ILLUSTRATION

SUMMARY OF GROUND WATER IN SUBAREAS OF THE SNAKE RIVER BASIN IN OREGON SOUTH OF THE WALLOWA MOUNTAINS

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INTRODUCTION

This resume of the ground water ~~conditions~~ (in the Snake River basin in Oregon south of the Wallowa Mountains) points out the most general ~~situations~~ conditions that exist in subunits of the drainage basin. ~~Such ground water situations govern many facets~~ These conditions, although generalized in this report, are presented to assist in the preliminary planning of development projects. The study was made in 19-- by the USGS at the request of the U.S. B.R.

The meagre drainage of the high plateaus of southeastern Oregon and the somewhat greater drainage from the east end of the mountains of Central Oregon, ~~as well as from~~ and the south slopes of the Wallowa Mountains, reach the Snake River by way of the Owyhee, Malheur, Burnt, and Powder Rivers. (See fig. 1.) Much smaller amounts of runoff drain directly to the Snake from a few short creeks.

The four river basins mentioned are characterized by steep hydraulic gradients in their head-water valleys or canyons, ~~with~~ which have only small local valley areas. From their headwater areas, generally above an altitude of 5,000 feet, the streams descend through alternating canyons and basin areas at intermediate altitude (4,500 to 3,000 feet) to their lower courses. The lowest parts of the Owyhee and Malheur River basins contain broad and extensive plains, but the smaller rivers farther north reach the Snake through sharp canyons carved in strong rocks. All four streams empty into the Snake River at altitudes near 2,000 feet.

The climate is characterized by warm, dry summers and cold, somewhat humid winters. The precipitation increases with the altitude, and also increases somewhat to the north. Average annual rainfall differs from place to place, ranging from more than 30 inches in the higher parts of the Powder River basin to less than 8 inches in the low areas along the Owyhee River. The average annual runoff ranges from an amount equivalent to a depth of about 4 inches over the area in the Powder River basin, through 2 inches in the Burnt River basin, to 1 inch in the Malheur River basin and less than 1 inch in the Owyhee River basins.

The predominant use of the water in these basins is for irrigation. Recreation, domestic and stock-supply, public-supply and hydroelectric-power-generation uses are greatly subordinate. Nearly all the summer flow of these tributaries is diverted for irrigation. Storage of winter runoff is provided mainly by the large Owyhee Reservoir and other smaller reservoirs in the Owyhee River drainage; the Warm Springs, Agency, Willow Creek, and lesser reservoirs in the Malheur drainage; the Unity Reservoir in the Burnt River basin; and Thief Valley and smaller reservoirs in the Powder River basin.

The largest unit of irrigated land is the adjoining Owyhee and Vale Projects, which occupy about 350 square miles on the terraces along the west side of the Snake River and the plains along the lowest part of the Owyhee and Malheur Rivers. These projects are among the few that have sufficient water for full irrigation even in a wet (good) water year. Other irrigated areas of 50 to 100 square miles include the Baker Valley on Powder River and Halfway Valley on the neighboring Pine Creek.

Little ground water is pumped from wells for irrigation. In the Owyhee basin above the Owyhee Project there are but 4 wells in use (2 near Cow Lakes and 2 near Whitehorse Creek). In the Malheur basin above the Vale Project there are about 30 wells, ranging in yield from 300 to 1,500 gpm, supplying water for irrigation. Some of these are in valley areas, such as at Harper and Ironside, but the largest block of land irrigated with ground-water is in Cow Creek Valley west of Brogan where 16 irrigation wells are used to supply water for about 2,500 acres. A total of only about a dozen wells are used for irrigation in Baker Valley, the Keating area of the Powder River, and in a few places in the Burnt River, Powder River, and Pine Creek basins. From the approximately 50 irrigation wells outside the Vale and Owyhee Project areas about 10,000 acre-feet of water per year is supplied for the irrigation of about 6,000 acres.

Within the Owyhee and Vale Project areas there are several dozens of wells capable of supplying water for irrigation. Many of these are pressure-relief wells from which water flows to drainage canals. A dozen or so are intended for irrigation with a secondary purpose of lowering the ground-water level and relieving waterlogging of the soil. In all, probably not over 2,000 acre-feet is pumped directly for irrigation and about 5,000 acre-feet flows from pressure-relief wells ~~for drainage purposes~~. More water could be pumped for these dual purposes.

The chemical quality of the ground water in the Malheur, Burnt, and Powder River basins is mostly good to excellent, but in some valley areas of heavy evapotranspiration there are some concentrations of alkali salts in the soil and the ground water. Aside from these local areas of sodium concentration and the very hard water in parts of the Idaho formation of Pliocene age beneath the lower Malheur River valley, ~~no known detrimental features impair~~ the quality of the ground water should be satisfactory for irrigation. ~~use.~~

Owyhee River Basin

The three main forks of the Owyhee River enter Oregon and flow in canyons cut 600 to 1,000 feet into the lava and interbedded sedimentary deposits that underlie the high plateaus of southeastern Oregon and southwestern Idaho. From Three Forks the main stem flows 30 miles northwest in a sharp canyon cut in volcanic rocks and enters the Rome Basin, where the lavas are downwarped and the river valley has widened in the overlying soft sedimentary deposits. Jordan Creek enters the river from the east and, in the canyoned section just below, Crooked Creek enters from the west.

Below Rome Basin, which is about 7 miles long, the river is again in a canyon for 70 miles or more to the plains of the Owyhee Irrigation Project. The large Owyhee Dam and storage reservoir are in this stretch of the river.

Except for a few basins and broad valley areas, the Owyhee Basin south of the Snake River Plain consists of high plateaus and mountain uplands that stand well above the regional water table. Generally only stock-watering supplies are available from wells, and in some places even adequate stock-water supplies are difficult to obtain.

Rome Basin is underlain mainly by fine-grained sedimentary rocks, and water in quantity sufficient for irrigation may be available from wells in the underlying lavas only in the upper end of the basin.

At some places in the tributary-stream basin, ground water is available for irrigation. The town of Jordan Valley lies in a section of Jordan Creek valley where alluviation behind a lava dam has produced a broad fertile plain. Some of the sand and gravel layers of the alluvium contain ground water available to properly constructed wells. Some of the lavas also contain ground water in advantageous position. Below the mouth of Cow Creek, the course of Jordan Creek was blocked by several minor lava dams, behind which alluvium accumulated in shallow basins. Near Arock, domestic wells obtain good supplies of water at about 200 feet in the interbedded sedimentary and lava units, but water in ~~irrigation~~ quantities sufficient for irrigation apparently are lacking. Southwest of Arock, Jordan Creek drops about 400 feet in a distance of about 4 miles as it cascades through a deep canyon to join the Owyhee River. North of Jordan Valley, younger lava that partly filled Cow Creek valley contains ground water that may be greater in volume than the capacity of present surface reservoirs in the Owyhee basin. However, special techniques might be necessary to explore, develop, and utilize this ground-water.

The base flow of Crooked Creek arises from large springs in T. 33 S., R. 39 E., west of the Burns Junction--McDermitt highway (U. S. 95). Upvalley to the west and southwest, this swale contains areas where ground water for irrigation could be developed from basaltic lava aquifers.

The terraces, plains, and slopes of the Owyhee Project at the north end of the basin are underlain mostly by a shallow layer of gravelly stream alluvium and the fine-grained, unconsolidated and semiconsolidated deposits of the Idaho formation. The Idaho formation is many hundreds of feet thick beneath most of the project lands. The lowest terrace next to the Snake River is underlain by the deepest and coarsest of the alluvial deposits. The gravelly alluvium is commonly about 40 feet thick beneath many parts of this terrace. Wells for the cities of Nyssa and Ontario secure yields of more than 1,000 gpm from the gravel. Elsewhere wells pass through the alluvial deposit and tap water in layers of sand in the Idaho formation. The wells for the sugar refinery at Nyssa, the former city wells of Nyssa, and other wells yield 200-300 gpm from these strata. The use of well screens, proper gravel packs, and special techniques of well construction should permit well yields of 500 gpm from the Idaho formation at many places in the Owyhee Project.

In recent years many farmers have developed supplemental water supplies from wells and secured beneficial drainage effects on water-logged land by constructing gravel-packed wells of 500 to 1,000 gpm capacity drawing water from the alluvial deposits and the uppermost part of the Idaho formation.

There is a considerable range in depth to water within the project lands, but beneath much of the area the water table is about 10 feet below the surface during the winter. It rises as much as ~~5 to~~ 10 feet during the irrigation season. The general rise causes the water table to reach the surface in some of the lower stream scars on the terraces and to waterlog some low strips between the drainage canals and ditches. Many flowing pressure-relief wells have been drilled to a general depth of 50 feet in the drainage canals in an effort to relieve the waterlogged[ing] ~~conditions~~.

The quality of ground water in the Owyhee River basin varies from good to poor. Water in some of the younger lavas of the upper part of the basin is recently influent from precipitation and is of good quality. Water in the sedimentary deposits of the Rome Basin is high in sodium, sulfate, and other dissolved materials. Most of the ground water in the basin is hard or very hard. Ground water in the Idaho formation beneath the Project area has a hardness of about 300 ppm. (parts per million) The domestic and public supply wells adjacent to the Snake River obtain water that is only hard or moderately hard.

Malheur River Basin

The headwaters of the Malheur River drain part of the south flank of the Blue Mountains of central Oregon and a northern part of the plateaus and mountains extending southward. Below the headwater creeks the branches of the river traverse mountain valleys in which wider basin areas occur at intervals. Downstream, from the mountainous headwaters to the valley plains below Harper, the basin is underlain by tilted lava rocks and sedimentary deposits--ridges and canyons mark the lava sections, and basins have formed on the areas of softer sedimentary rocks. Below Harper the valley plains are underlain mostly by the soft Idaho formation.

Within the upper part of the basin, old crystalline and indurated rocks as well as the sedimentary formations beneath the basin areas are mostly of low permeability and small ground-water potential. The layered lava series forms a northward-trending ridge, through which the river flows in a canyon between Juntura Basin and Harper, and contains permeable layers that are a possible source of considerable ground water. The eastward-dipping lava layers may store water which could be developed by wells northwest and southwest of Harper. This water may be stored under conditions that would enable the withdrawal during the irrigation season to be replaced during the winter ~~months~~

Bully Creek, tributary to the Malheur on the north, and Cottonwood and other creeks on the south, drain the east slope of this lava rock ridge and, farther east, wide areas of hill land underlain by the Idaho formation with its own minor lava interbeds. A few irrigation wells in this area obtain yields of 500 gpm from lava associated with the Idaho formation and probably more wells will be constructed as more is learned about the subsurface of this part of the basin.

The last major downstream tributary of the Malheur River from the north is Willow Creek which drains high areas underlain by non-permeable rocks of Jurassic age. Willow Creek valley broadens at several places where sedimentary rocks of the Idaho or the Payette formation underlie the shallow alluvium. The longest of these reaches extends nearly 25 miles from Brogan to the Malheur River plain at Vale.

Cow Creek, which is tributary to Willow Creek upstream from Brogan, has alluviated a structural basin formed in the Jurassic rock and its pre-deformation capping of basaltic lava. Sixteen wells obtain water from the alluvium and the buried lava caprock, in this broad, shallow upland basin, for irrigation of about 2,500 acres. The continuous decline in water level of 1 to 2 feet per year since pumping was started in 1950 has prompted administrative efforts to prevent overdraft of the ground-water resources of the valley. The area has been declared a critical ground-water area by the State of Oregon and the ground-water rights are reported to be involved in litigation. Preliminary studies have indicated the average annual rate of recharge to the Cow Valley ground-water body to be in the order of 5,000 acre-feet a year while about 7,000 acre-feet has been pumped in most of the recent years.

Elsewhere in Willow Creek valley, only a few wells have obtained amounts of water sufficient for irrigation--most of that water is tapped in the rubble layers of the Payette or Idaho formations.

The valley plains of the Vale Project, which extend downstream from the Harper area to below Vale, like those of the adjacent Owyhee Project, are underlain by gravelly alluvium, which in turn is underlain by the fine-grained semiconsolidated sediments of the Idaho formation. The thin alluvium affords water for good domestic wells, and a few deeper wells have explored the Idaho formation for irrigation water. A few wells obtain irrigation water from lava units within the Idaho formation. Little attempt has been made to obtain ground water for irrigation within the Project lands, and most of the adjacent unirrigated land lies too high above the water table to permit economic pumping, even, if water were? was available.

Burnt River Basin

The headwater creeks which drain metamorphic and crystalline rocks, flow together in Unity valley above Hereford. The easily eroded Idaho and Payette formations of Tertiary age, their associated volcanics, and some slightly older volcanic-sedimentary rocks underlie the broad basinal areas of the valley eastward to its last 12-mile reach, which is a canyoned ~~course~~ through strong rock.

A few wells of large capacity have been drilled in the lavas and the other volcanic rocks associated with these units. At present only one or two irrigation wells are in use. Much of the valley slopes lie above the level of feasible economic pumping lifts for ground water, and in much of the valley bottoms permeable members from which wells may obtain irrigation water are lacking. Consequently, the future ground-water developments will probably follow the present pattern of isolated developments in low basinal areas where permeable volcanic aquifers can be reached economically.

Powder River Basin

Below the headwater creeks that drain the eastern part of the Blue Mountains and the Elkhorn Ridge extention of these mountains, the Powder River and its branches flow through mountain valleys and intramountain basins. The basins are underlain by soft sediments of Tertiary age and alluvial deposits. Between the basins the river crosses the intervening strips of harder rock in narrow canyoned reaches. The river makes the final descent to the Snake River in a 6-mile long rock-bound canyon below Richland basin.

Of the basins, Baker Valley is much the largest and most important; through it the Powder River flows north to its narrow exit east of North Powder. Much of Baker Valley is underlain by a fine-grained alluvial fill that reaches a thickness of at least 700 feet in the lowest "sump" of the valley floor southeast of Haines. The gravelly and sandy parts of the alluvium underlie the alluvial fan of Powder River at Baker and the fans of tributary creeks along the west and north sides of the valley. In places these gravels have sufficient permeability to yield large quantities of water to wells. Some wells have been constructed to tap this ground water but it has not been widely developed or used.

In most of the other basinal segments of the Powder River the alluvium is too thin or located in the wrong places to provide water needed for irrigation. In some of these areas permeable alluvium occurs in the bottom-land areas which have a sufficient assigned surface-water right for irrigation whereas the nearby bench lands have neither permeable aquifers nor feasible pumping lifts. Aside from a few places, mostly in lava units of the sedimentary formations of Tertiary age where some wells have tapped permeable materials for irrigation water, very few irrigation wells are used in the smaller valleys of the Powder River basin.

In ~~all~~ the Powder River basin the irrigation wells in use include only 1 or 2 in the basins above Baker, about 8 in the Baker Valley, only 1 at Keating. In all, not ~~over~~ 2,000 acres is being irrigated by water from wells in the river basin. The gravelly alluvium around the south, west, and northwest sides of the Baker Valley constitutes the largest unit of permeable material from which large quantities of ground water may be systematically withdrawn for irrigation.

Pine Creek Basin

Northeast of the lower part of the Powder River basin, Pine Creek drains from the southeast slope of the Wallowa Mountains, flows through an alluviated valley which centers at Halfway, and drops through a canyon exit for 20 miles to the Snake River. It is the farthest downstream of the Oregon tributaries south of the main part of the Grand Canyon of the Snake River.

The bedrock of Pine Creek basin has a low permeability, and the alluvial fill of Pine Creek valley is the only significant body of even partly permeable material. The alluvial fill contains some sand and gravel layers and in places will yield water in quantities sufficient for irrigation. Ground water has been little used within or adjacent to the lands irrigated with water from Pine Creek and its tributaries.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

~~PLATE 8~~
Figure 1
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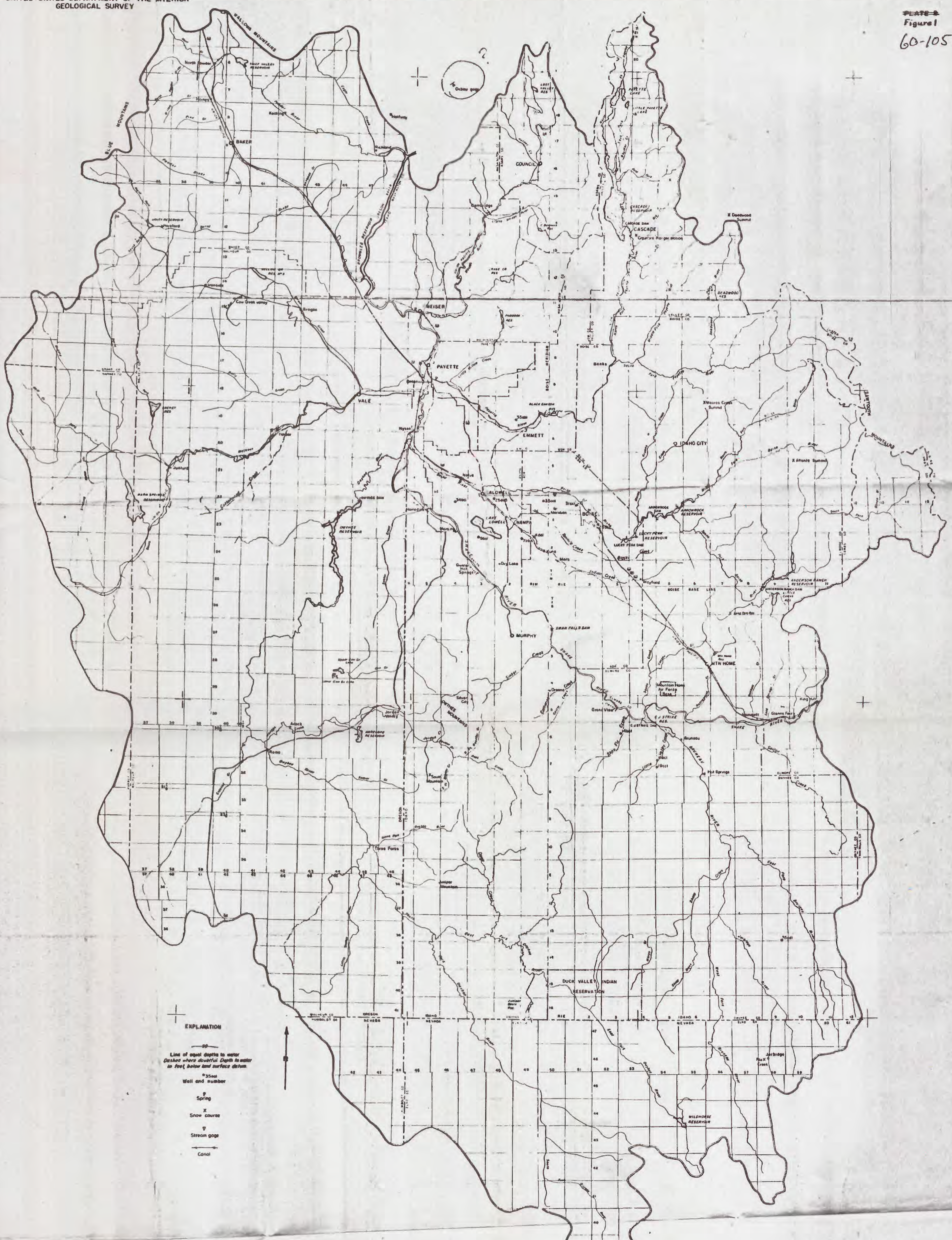

Base from United States Geological Survey maps of Western United States (Mil. series)

Figure 1.-- Map of the Central part of the Snake River Basin.

~~PHYSIOGRAPHIC, WELL LOCATION, AND DEPTH TO WATER MAP OF THE SNAKE RIVER BASIN~~

10 0 10 20 Miles
Scale