Ground Water in the Western Part of the Cow Creek and Soldier Creek Grazing Units Malheur County, Oregon

By R. C. NEWCOMB

HYDROLOGY OF THE PUBLIC DOMAIN

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GROUND WATER IN THE WESTERN PART OF THE COW CREEK AND SOLDIER CREEK GRAZING UNITS, MALHEUR COUNTY, OREGON

By R. C. Newcomb

ABSTRACT

Ground water sufficient for watering livestock is available in the western part of the Cow Creek and Soldier Creek Grazing Units of Malheur County, Oreg., if deep wells are drilled to tap the supply. Each well may need to be several hundred feet deep, but perched water at shallower depth may be found in some places. Wells at the sites investigated may afford the cheapest long-range supplies of needed stock water.

INTRODUCTION

PURPOSE AND NATURE OF THE WORK

The task was to describe the geologic setting and ground-water occurrence in an area where it may become necessary to drill wells to provide water for livestock, thus permitting better use of now unwatered public grazing land. Wells at the sites investigated may afford the cheapest long-teım supplies of such water. The work was undertaken at the request of the U.S. Bureau of Land Management.

Some of the information collected on wells in this general area is given in table 1, and the location of the wells is shown on figure 26. Figure 27 shows cross sections made on the basis of field observations. They illustrate in a generalized manner the geology of the rock units in which the proposed wells will be drilled.

GEOGRAPHY

The Cow Creek and Soldier Creek Grazing Units, in southwestern Malheur County, Oreg., are part of the Payette section of the Columbia Plateaus province. They are in an area of multiple plateaus that lie at general altitudes between 3,500 and 5,000 feet. Locally, buttes, ridges, domes, and mesas rise a few hundred feet above the plateaus. A small outline map on figure 26 shows the location of the area within Oregon.

Most of the plateaus have many shallow creek valleys in which water runs but a few days in most years. The lowest levels of the plateaus are followed by perennial creeks which derive sufficient discharge from springs to maintain at least a small interrupted flow during the dry months of the year.

The Owyhee River flows generally northward in a canyon 400 to 600 feet deep. Below the confluence of its three branches at Three

Forks (sec. 34, T. 34 S., R. 45 E.) the river flows northwestward in a sharp, narrow lava-rock canyon to within 3 miles of Rome, where the west wall recedes and the canyon becomes wider. The river flows 6 miles northward across the so-called Rome basin along the east wall,

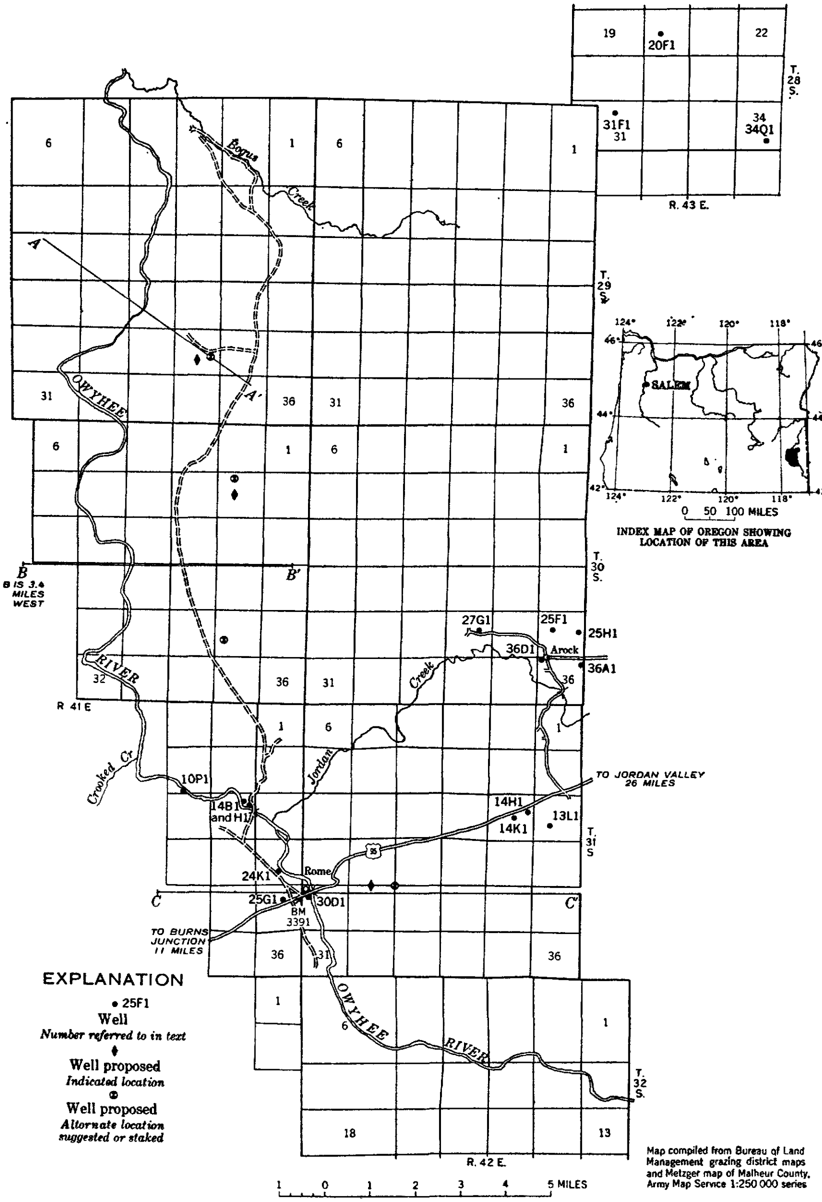

FIGURE 26.—Map of a part of Malheur County, Oreg., showing location of wells proposed in Cow Creek and Soldier Creek Grazing Units.

a 400-foot escarpment. In this "basin" the low river-cut terraces form a valley floor nearly a mile wide, and the west side of the basin slopes gently upward over soft, deeply eroded sedimentary rocks. North of the Rome basin, lava rock again rises and the sedimentary beds contain thick lava flows. The river passes through this part of its course in a variably shaped but generally sharp canyon northeast and north for an airline distance of about 80 miles to its confluence with the Snake River near Adrian. In the northern half of the canyon below Rome an irrigation storage dam impounds the water in the large Owyhee Reservoir.

The major part of the Cow Creek and Soldier Creek Grazing Units lies east of the Owyhee River canyon, between the Three Forks and the Owyhee Reservoir. Within these grazing units most of the broad plateaus lie at nearly the same altitude. The principal streams, Jordan Creek and its main tributary, Cow Creek, rise in the Owyhee Mountains in Idaho and flow westward across the plateaus in relatively broad, shallow valleys. There are few other permanent streams. Most of the water taken for irrigation from these streams is the runoff from the higher land in Idaho and along the State line in Oregon.

The climate is arid and continental, characterized by warm, very dry summers and cool winters. Most of the precipitation occurs between November and April, but a secondary rainy period commonly occurs in May or June. The average annual precipitation, given in records of the U.S. Weather Bureau for stations in and near this area, is given below.

Station	*Distance (miles) and direction from Rome*	*Altitude (feet)*	*Average annual precipitation (inches)*
Adrian	67; NNE	2, 231	13. 13
McDermitt	36; SW	4, 464	10. 51
Owyhee Dam	58; N	2, 400	13. 44
Rome	--------	3, 373	7. 56
Sheaville	35; NE	4, 560	13. 08

These averages indicate that precipitation on the plateaus at the western side of the Cow Creek and Soldier Creek Grazing Units is about 10 to 12 inches per year. Most of the precipitation evaporates or is used by plants.

From much of the area the runoff is small. Many dry washes and depressions on the plateaus carry little or no runoff in most years. The steeper slopes, particularly those underlain by clayey sedimentary materials, shed some water during at least the spring months and at times of concentrated "cloudburst" rainfall. The annual runoff from the Jordan Creek headwater area in Idaho is equal to an average of about 6 inches of water over the drainage area, but the runoff from the plateau lands of the western part is much less and probably in places is less than 1 inch of water over the area. Over the whole Owyhee River drainage area the average annual runoff is equal to 1 inch of water.

GEOLOGY

The rocks underlying the western part of the Cow Creek and Soldier Creek Grazing Units belong to four main groups. From oldest to youngest these groups are the Owyhee basalt, sedimentary beds of the Rome basin, young lavas, and alluvial deposits.

OWYHEE BASALT

The thick basaltic lava in the canyon south and possibly north of the Rome basin is a series of accordantly layered flows of Miocene age. It is referred to as the Owyhee basalt. These flows were warped down to form the basins in which younger sedimentary deposits and lava flows were laid down. The Owyhee basalt is best exposed in the upwarped structures in the deep Owyhee River canyon.

SEDIMENTARY BEDS OF THE ROME BASIN

Generally horizontal massive beds of tuffaceous siltstone, claystone, tuff, volcanic ash, diatomaceous earth, and similar materials crop out in the west and east sides of the Rome basin. The beds may, in part, be equivalent to part of the Payette formation of Miocene and Pliocene (?) age. The main body of the beds in this region lies in a structural sag in the Owyhee basalt. The basin of deposition extended beyond the area of this report. The upper part of the beds extends eastward to the higher mountains along the Oregon-Idaho border, east of the area shown on figure 26. They underlie the middle parts of the Jordan Creek basin and are extensively exposed in the upper part of the Sucker Creek valley northeast of the town of Jordan Valley.

During the latter part of their deposition, some of the beds being deposited east and north of the Rome area were covered by outflows of basaltic lava from the east and north. Thus, although the known 800-foot-thick section of these sedimentary beds in the Rome area is free of lava, similar beds to the east and north contain intercalated lava flows in the Arock and Bogus Creek areas, and in parts of the Owyhee River canyon downstream from the Rome basin (see fig. 27).

East of the Owyhee River and in some other areas, the beds are overlain by a persistent caprock of lava. The sedimentary beds of the Rome basin, their intercalated lava flows, and the caprock have been mildly eroded. They had been entrenched by the integrated drainage system of ancestral Jordan Creek when an extrusion of young lava, in late Pleistocene time, issued from low shield-type eruptive vents and from other vents in the Jordan Creek basin. Extrusions of young lava have continued intermittently to Recent time.

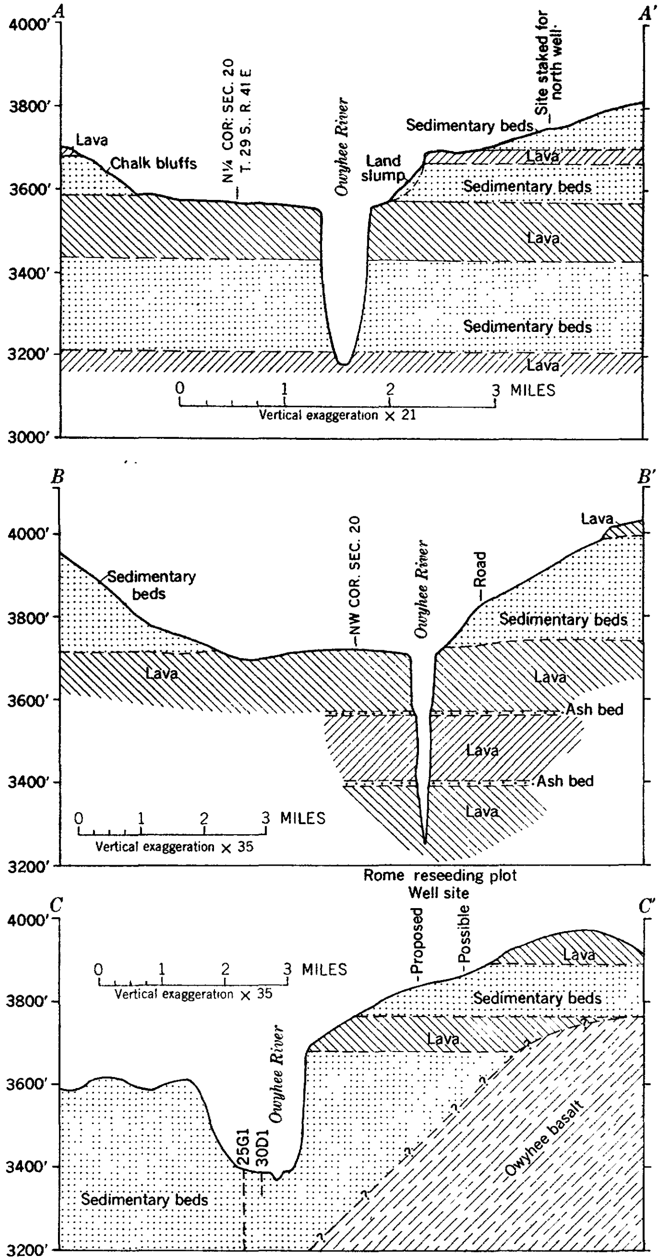

Figure 27.—Geologic sections across the Owyhee River gorge showing general relations of rock units. (See fig. 26 for location of the sections.)

YOUNG LAVAS

These flows blocked Cow Creek and diverted it southward to Jordan Creek. They blocked the Jordan Creek valley near Danner (15 miles west of the town of Jordan Valley) and caused the valley above to be alluviated and widened. The lava flowed down Jordan Creek valley past Arock and displaced the creek against sedimentary beds along the sloping valley sides, where valley plains are still being widened. The young lavas in the Cow Creek valley flowed down Bogus Creek to Owyhee Canyon and now underlie the floor of the Bogus Creek canyon in its lower part to a depth of over 100 feet.

The young lavas are shown in part on most maps of the Jordan Creek valley. The grazing-district maps show the larger areas of young lava, and the Army Map Service 1:250,000 series of topographic maps (Boise and Jordan Valley sheets) show some of the young lava areas and include some of the older lava-rock areas under the symbol "lava."

ALLUVIAL DEPOSITS

These deposits underlie some of the valley floors. The largest body of alluvium underlies the board valley at and near the town of Jordan Valley upvalley from the young-lava dam near Danner. Other bodies of alluvium lie upstream from other lava dams. The alluvium extends to shallow depth beneath various other parts of the valley floors. The deposits may be as much as 100 feet thick near the town of Jordan Valley.

GROUND WATER

OCCURRENCE

Below the level of the Owyhee River and a gentle gradient laterally from it, all the pores of the rocks are saturated. This upper limit of saturation is known as the water table, or the regional water table. The ground water of that zone is commonly under the pressure of the atmosphere only and is called unconfined. Because the resistance to percolation toward the river is greater in rocks of low permeability, the water table in them stands higher above the river level than it does in more permeable rocks.

At certain places above the water table local zones of impermeable rock obstruct the downward percolation and cause ground water to saturate some zones of porous rock. This type of ground water is called perched water.

In areas of varied rock types where the information on ground water is meager, it is difficult in places to distinguish the occurrence of ground water, unconfined or perched, in isolated wells. Some bodies of perched water are large enough and sufficiently recharged that they will sustain withdrawals common in stock wells; other bodies of perched water may be depleted. Thus, the unconfined water below the regional water table or a strong perched zone is the target of most stock wells.

The infiltration of water to the ground and its subsurface transfer to saturated places is called recharge. This process is of vital importance to the sustained withdrawal of water from wells. Over much of the grazing units the silty soils undoubtedly absorb and hold a major part of the precipitation. This soil moisture probably is entirely removed in most years through evaporation and transpiration, leaving little, if any, water for ground-water recharge. Precise observations of water-level fluctuations in several similar areas in the Pacific Northwest have shown that, during most years, little or no moisture passes below the soil zone. Infiltration of precipitation is greatest in areas of young lavas, in the slightly older lava that forms valley fillings, and in the still older lavas that cap many of the plateaus. The evidence of infiltration of water to the subsurface is apparent where water has become concentrated in rills and at the lower parts of steep slopes. Undoubtedly considerable recharge to the ground water occurs below the valley floors of the intermittent and perennial streams and beneath the irrigated lands.

OWYHEE BASALT

In layered basaltic lavas the cracked and part-rubbly tops of some of the lava flows are the main permeable zones. Jointing cracks and other openings also furnish pore spaces for water movement. Infiltration which reaches these permeable zones generally moves down the inclination of these tabular zones to the water table or to the surface. Locally some water may be trapped above the water table in perched zones, but the location of the main zone of unconfined ground water can be more reliably predicted. Also, the main unconfined zone will afford greater supplies of water to wells.

SEDIMENTARY BEDS OF THE ROME BASIN

These beds contain a few layers of sand or fragmental volcanic breccia that are permeable and yield small amounts of water to wells, but the great mass of the deposit is relatively impermeable. The intercalated lava flows are largely massive and have only a moderate to low permeability. However, in places small scoriaceous zones occur and may yield some water to wells.

YOUNG LAVAS

The young lavas are highly permeable and readily absorb water. Their main importance in the water resources of the area may be that their permeability allows infiltration and the storage of water where it is protected from evaporation and transportation. The young lavas are not of direct importance in the water situations covered by this report, as they do not underlie the sites of any of the proposed wells.

ALLUVIAL DEPOSITS

Sand and gravel layers in the alluvium yield water to wells. The alluvial deposits are not of direct importance to the water situations described in this report, as they underlie none of the sites of the proposed wells.

QUALITY OF THE WATER

Most of the ground water of the region is hard and contains moderate to considerable amounts of dissolved minerals. Water from the lava rock is commonly hard and has a slight sulfurous odor, but it is otherwise of satisfactory quality.

Water that percolates through the sedimentary beds varies in quality from place to place but may be of poorer taste and less sweet than that from the lava. Some of the water from the sedimentary beds in the Rome area has a soda-water taste and some has a sour taste. However, to date, no ground water is known to be totally unusable for domestic or stock use; consequently, it is assumed that water from these proposed wells will be satisfactory for stock use.

Samples were taken and chemical analyses made on water from the Crosby and Dowell wells (31/41–25G1 and –14H1, table 1) which obtain water from permeable zones in the sedimentary beds. The analyses of these waters are shown below.

Analyses of water from sedimentary beds

[Chemical constituents in parts per million]

Well	31/41-25G1 (Crosby well)	31/41-14H1 (Dowell well)
Date sampled	10/30/58	10/30/58
Date analyzed	11/24/58	11/24/58
Silica (SiO_2)	52	60
Calcium (Ca)	195	0
Magnesium (Mg)	32	0
Sodium (Na)	885	148
Potassium (K)	19	2. 6
Bicarbonate (HCO_3)	392	224
Carbonate (CO_3)	0	47
Sulfate (SO_4)	1, 620	36
Chloride (Cl)	254	18
Nitrate (NO_3)	257	. 4
Dissolved solids:		
Calculated	3, 510	422
Residue on evaporation	3, 580	435
Hardness as $CaCO_3$:		
Total	620	0
Noncarbonate	298	0
Specific conductance (micromhos at 25°C)	4, 560	638
pH	7. 5	9. 1
Color	0	5

Because of the possibility of finding some water of inferior quality, it would be advisable to take samples each time a potential water-bearing zone is tested with bailer or pump.

WELL-NUMBERING SYSTEM

The number given each existing well is derived from the township and range, whose numbers are separated by a diagonal slash, followed by a hyphen, the number of the section, a letter indicating the 40-acre tract in the section, and consecutive numbers for wells in each 40-acre tract. The letters denoting the 40-acre tract start with A in the NE¼NE¼ of any section, run westward across the northern tier, to D in the NW¼NW¼, eastward through E to H in the second tier, westward through J to M in the third tier, and eastward from N to R in the southern tier of 40-acre tracts, to end with R in the SE¼SE¼ (the letters I and O are omitted).

PROPOSED WELL SITES

The location of four wells that may be desired in the near future were designated by the Bureau of Land Management on the basis of the positions most advantageous for stock watering. The geologic and ground-water situations at the sites of these proposed wells are evaluated below.

EVALUATION OF THE SITES

SOLDIER CREEK UNIT, ROME RESEEDING PLOT

The original location of this proposed well was near the north ¼ corner of sec. 29, T. 31 S., R. 42 E. The approximate altitude is 3,840 feet, about 460 feet above the level of the Owyhee River at Rome. The materials that may be expected to be penetrated by a well at this site are given below.

	Depth (feet)
Soil and unconsolidated materials	0–10
Lava (caprock)	10–75
Sedimentary rocks, largely tuffaceous siltstone	75–450(?)
Basalt	450(?)

The presence of basalt at 450 feet is postulated from a projection of the contact of the Owyhee basalt with the overlying sedimentary beds exposed in the Owyhee River canyon in sec. 6, T. 32 S., R. 42 E., and on the presence of lava rock at depths below 140 feet in the Griffith well in sec. 14, T. 31 S., R. 42 E. (see fig. 26 and table 1). This long-distance projection of the basalt-sedimentary contact is tenuous. The possibility of reaching the basalt at or above the river level is more favorable the farther east the well is located. Accordingly, an alternate well site half a mile farther east along the drainage way just south of the northeast corner of sec. 29 might increase the chances of reaching the water-yielding basalt at or above a depth of 450 feet. This site for the proposed well may be advisable, even though it is 20 or 30 feet higher than the original proposed site. Static level of the water in the basalt probably will be at an altitude of about 3,400 feet at either the proposed or alternate site.

Water may be present in permeable layers in the sedimentary beds below the level of the regional water table, which may be found at a depth of about 400 feet below the surface at the original proposed site, if these beds continue to that depth. If the basalt is not present at or above river level, as the writer postulates, it may be necessary to continue drilling the well in the sedimentary beds until an adequate supply of water is obtained from permeable layers in these strata. The records of wells tapping water in these beds indicate that much of the material is impervious siltstone, but most wells drilled to a depth of 100 to 200 feet below the water table have found at least one bed that yields adequate amounts of water. There is a possibility of finding perched water in the sedimentary beds above the regional water table.

In summary, the proposed well at the Rome reseeding plot is expected to reach water-yielding basalt at depth of about 450 feet or to obtain water from thin permeable strata in the sedimentary beds at depths of 350 to 550 feet. Water is expected to stand in the well at about 340 to 450 feet below the surface. The possibility of obtaining water from the basalt, which would furnish a greater yield, is considered better half a mile farther east, near the northeast corner of sec. 29.

Generally the caprock lava, the basalt, and the sedimentary rocks stand well in an open hole, but caving zones and strata may occur within these formations. It would be advisable to anticipate the need of some casing or liner sections and to start the well diameter large enough to permit their installation if necessary. A 10-inch hole through the caprock lava (to an expected depth of 75 feet) is advisable in order to permit the later installation of 8-inch casing as needed to assure the completion of a well of at least 6-inch diameter in the water-bearing zone.

COW CREEK UNIT

The south well.—The proposed location of the south well is the central eastern part of the NW¼SW¼ sec. 26, T. 30 S., R. 41 E. The site is in a shallow sag in the plateau surface at an approximate altitude of 3,800 feet.

The materials that may be expected to be penetrated by a well at this site are given below.

	Depth (feet)
Soil, chalky ash beds, and an intercalated lava flow	0–150
Lava	150–200
Beds of volcanic ash	200–225
Lava	225–500+

The regional water table should be found at a depth of about 400 feet. The well may need to be drilled about 100 feet below the water table in order to tap sufficient water. Bodies of perched water may be present but are not expected. It may be desirable to start this well at a diameter of 10 inches.

The center well.—The original proposed location of this well is in the SE¼NW¼ sec. 11, T. 30 S., R. 41 E. The suggested alternate location, where a stake was placed, is one-fourth mile north of the site originally proposed. This change was made in order to locate the well at a point 50 feet lower and below a rimrock plateau. The altitude at the new location is 3,880 feet (aneroid-barometer measurement).

The materials that may be penetrated by a well at this site are given below.

	Depth (feet)
Soil and chalky subsoil	0–15
Sedimentary rocks, possibly containing an intercalated lava flow	15–80
Sedimentary rocks and intercalated lava flows	(80–500)
Sedimentary rocks, volcanic ash, and siltstone	80–140
Porous lava, massive flows	140–300
Beds of volcanic ash	300–320
Porous lava, massive flows	320–480
Beds of volcanic ash	480–500
Basalt	500–

The regional water table probably lies at a depth of about 550 feet. Bodies of perched ground water may occur, especially at the base of the lava flows. Careful watch for them should be maintained, as special methods of completing wells are sometimes required to exploit this type of ground-water occurrence.

Because of the interlayering of lava flows with sedimentary materials that may slough and require casing, it is desirable to start this well at a diameter of 12 inches, or at least 10 inches. The initial casing may be landed on the top of the first thick lava unit, but the uncased well should be continued as deep as possible at the same diameter as the inside of the casing, in order to allow for other casing settings that may be necessary.

The north well.—The suggested location of this proposed well was staked in the northwest corner of NE¼SE¼ sec. 27, T. 29 S., R. 41 E. The approximate altitude of the staked site is 3,760 feet.

The materials that may be penetrated by a well at this site are given below.

	Depth (feet)
Soil; chalky sedimentary beds	0–50
Lava	50–100
Sedimentary beds	100–180
Lava	180–320
Sedimentary beds, chalky tuffs	320–540
Basalt	540–

The regional water table may occur at about 500 feet. Perched water may occur and should be carefully observed and tested to determine if it will provide enough water for requirements. Because of the interlayering of lava and sedimentary beds, it may be desirable to start the well at a diameter of 10 inches.

DRILLING PROCEDURES

The wells proposed at the Rome reseeding plot and on the western plateau of the Cow Creek unit will need to be deeper than most of the operating stock wells of the region. Because of the drilling hazards, cost, and desirability of almost perpetual use, it is desirable to plan the wells for the foreseeable difficulties.

Most of the rocks to be drilled are massive lava flows and will stand uncased except for some caving zones of broken rock. If the lava is to be left uncased, these zones of broken rock can best be secured by pulling the loose rock into the hole, or by cementing it into place. These operations are easiest while a zone of broken rock is being drilled, or immediately thereafter.

The sedimentary beds are semiconsolidated and in part will stand uncased in a well, but parts of them may not stand without "ravelling," or sloughing into the hole. The necessity of setting some casing or liner sections in these beds should be anticipated. To provide for durable and trouble-free wells it would be desirable to case the wells completely to the aquifer. The setting of screens or carefully perforated casing or liners in water-bearing strata of the sedimentary beds may be necessary. To properly prepare for withdrawing water from unconsolidated or semicompetent material, the correct selection of the screens or size of perforations is commonly based on samples carefully bailed from the water-bearing zone with a sand-pump type of bailer. The samples are usually placed in 1-gallon waxed cardboard ice-cream cartons and collected at the rate of one carton of representative sample for each foot of unconsolidated water-bearing material drilled. The size of the screen openings, or perforation slots, is determined by making mechanical, or particle-size, analyses of the samples; these samples are retained until the well is in satisfactory operation.

Because of the layered succession of sedimentary beds and lava flows and the differences in permeability between successive layers, some perched ground water may be found. Each occurrence of perched water will need to be evaluated for capacity and a plan devised either to exclude it or admit it. Commonly, perched water is immediately underlain by an impermeable layer. After this layer is penetrated by the drill, the perched water may drain into permeable materials below, unless the well is constructed to prevent this loss.

The desirable depth of the average stock well will be the point where a depth of about 50 feet of water remains after prolonged bailer testing at a rate of 5 or 10 gallons per minute. The maximum yield of a thin horizontal aquifer is obtained when the water level in the well is held even with the base of that aquifer. Commonly an additional 30 to 40 feet of hole, for a pump chamber, is drilled below the aquifer. In a perched-water situation such a chamber must be completely sealed or water may be lost to the unsaturated rock below.

Table 1.—*Data on representative wells of a part of Malheur County, Oreg.*

Well	Owner or occupant of property	Topography [1]	Approximate altitude (feet above sea level)	Type of well [2]	Depth (feet)	Diameter (inches)	Depth of casing (feet)	Water-bearing zone or zones: Depth to top (feet)	Thickness (feet)	Character of material	Ground-water occurrence [3]	Water level: Distance below land-surface datum (feet)	Date	Use [4]	Remarks
28/43-20F1	U.S. Government	Uv	4,470	Dr	----	10	----	----	----	----	----	----	----	Rc	Known as "whistling well."
31F1	do	Uv	4,350	Dr	430	6	21	388	17	Lava	----	----	----	S	Known as Mud Lake well; driller's log on file with BLM and USGS.
34Q1	do	Uv	4,450	Dr	280	6	22	270	10	Lava "gravel"	----	----	----	S	Known as Lava well; driller's log on file with BLM and USGS.
30/42-25F1	Bruce	Sv	3,890	Dr	365	6	350	350	15	Sand layers	P	60	----	D	Drilled entire in sedimentary beds.
25H1	Lesquerica Bros	Sv	3,890	Dr	290	6	170	250	40	do	U	250	----	D	Do.
27G1	Fred Aquerne	V	3,870	Dr	150	----	----	----	150±	----	----	----	----	----	Under construction in October 1958.
36A1	J. Montgomery	V	3,880	Dr	265	6	110	215	50	Lava	U	215	----	D	Drilled in lava 100 to 265 feet.
36D1	Jordan Valley Irrigation District.	V	3,870	Dr	245	6	----	210	35	do	U	210	----	D	Drilled in lava 140 to 245 feet.
31/41-10P1	Robert Dowell	V	3,360	Dr	100+	5	----	----	----	----	U	23	Oct. 30, 1958	----	Water level slightly above river nearby.
14B1	do	V	3,370	Dr	350	6	----	350	----	Conglomerate layer.	----	----	----	S	Drilled entirely in sedimentary beds.
14H1	do	V	3,370	Dr	160	6	----	----	----	"Chalkrock"	----	----	----	D	Drilled entirely in sedimentary beds; analysis of water is given in text.
24K1	D. E. Brown	V	3,370	Dr	36	6	----	----	----	Alluvial gravel	----	----	----	----	
25G1	Ike Crosby	V	3,390	Dr	265	6	----	100	60	Sandy layers, thin.	U	50±	----	D	Drilled entirely in sedimentary beds; analysis of water is given in text.
31/42-13L1	H. Brown	Uv	3,870	Dr	380	6	----	345	35	Lava	U	345	----	D, S	Entered lava flows at 80 feet.
14H1	do	Uv	3,860	Dr	365	6	----	330	35	do	U	330	----	D, S	Entered lava flows at 100 feet.
14K1	Griffith	U	3,900	Dr	402	6	----	367	35	do	U	367	----	D, S	Do.
30D1	Fred Scott	V	3,380	Dr	60	6	----	40	20	Sandstone	U	25±	----	D, S	Entered sedimentary beds at 12 feet.

[1] Slope of valley, Sv; Upland, U; Upland valley, Uv; Valley, V.
[2] Drilled, Dr.
[3] Perched, P; Unconfined (regional water table), U.
[4] Domestic (household), D; Rc, range cabin; Stock, S.