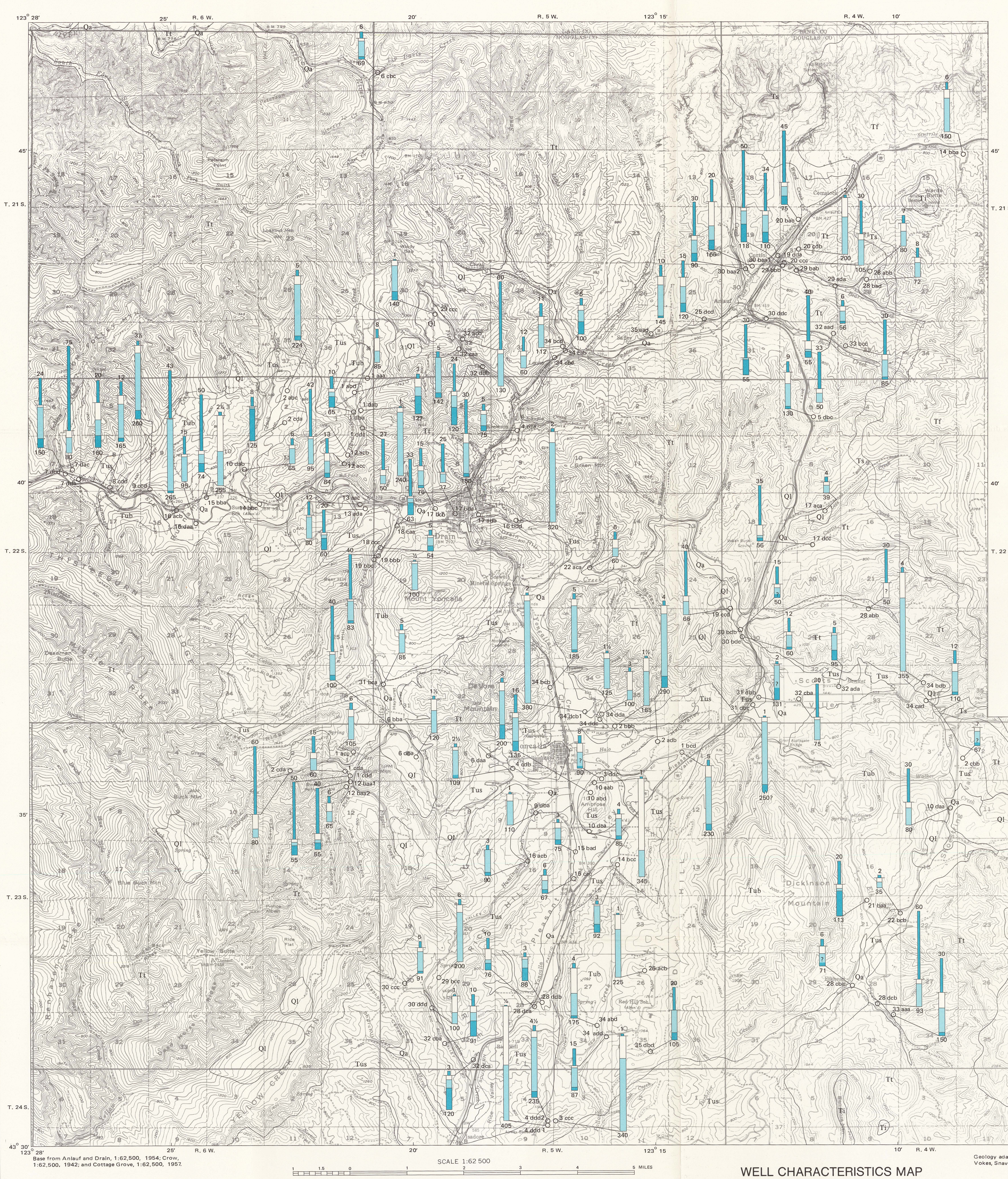
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
DOUGLAS COUNTY

WATER-RESOURCES INVESTIGATIONS 76-105
OPEN-FILE REPORT (SHEET 2 of 2)



Base from Anlauf and Drain, 1:62,500, 1954; Crow, 1:62,500, 1942; and Cottage Grove, 1:62,500, 1951.

SCALE 1:62 500

CONTOUR INTERVAL 25, 50, AND 80 FEET
DATUM IS MEAN SEA LEVEL

Geology adapted from Hoover, 1963, and Vokes, Snavely, and Myers, 1951.

WELL CHARACTERISTICS MAP

(See sheet 1 for geology explanation and base support)

EXPLANATION

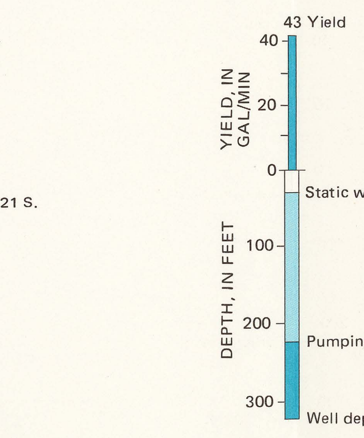


DIAGRAM SHOWING WELL DATA

CHEMICAL ANALYSIS OF WATER

(Analyses by U.S. Geological Survey)

Location number	Name	Principal geologic source	Depth interval of water-bearing zone (feet)	Date of collection	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate +nitrite, as N	Phosphate (PO_4)	Arsenic (As)	Boron (B)	Dissolved solids[1]	Hardness, as $CaCO_3$	Specific conductance (micromhos/cm)	pH (field)	Temperature °C	Temperature °F	Sodium adsorption ratio (SAR)
					Milligrams per liter																						
21S/4W-14bba	Frank Trader	Tf	32-150	9/ 4/75	9.8	0.04	0.02	37	2.9	150	1.4	213	0	1.8	170	0.1	0.06	0.00	0.013	0.40	479	100	850	7.6	16.0	61	6.4
19dda	Douglas County Parks	Tt	16-110	4/15/75	28	–	.13	50	1.0	26	.2	204	0	7.3	16	.3	.00	.67	.000	.23	230	130	460	7.4	10.5	51	1.0
20cac	Loyd Black	Tt	123-200	6/19/75	20	1.3	.17	21	.9	46	.4	156	0	6.5	19	.6	.24	.18	.001	.24	194	56	300	7.6	13.0	55	2.7
21S/5W-6cbc	M. E. Wilkes	Tt	19-69	9/ 4/75	27	.22	.08	19	3.2	20	.8	111	0	4.5	4.9	.1	.02	.03	.000	.14	135	61	220	6.5	12.5	55	1.1
25dcd	Dave Hickey	Tt	32-120	9/ 4/75	25	.29	.29	62	2.0	61	.3	277	0	6.2	37	.4	.01	.06	.001	.64	332	160	560	6.8	19.5	67	2.1
32acb	Roscoe Van Cleave	Tt	123-200	4/15/75	14	.04	.04	83	.6	210	1.1	194	0	78	300	1.7	.02	.06	.000	.67	785	210	1,500	7.7	9.5	49	6.3
32ddb	Wooley Logging Co.	Tt	23-120	9/ 4/75	33	.07	.41	28	5.1	15	1.1	128	5	.8	6.8	.2	.08	.03	.002	.04	159	91	240	–	21.0	70	.7
21S/6W-1dac	BLM recreation site	Tt	-----	9/ 4/75	29	.04	.04	9.7	1.7	90	.5	138	0	.2	73	.3	.01	.00	.000	.31	273	31	480	7.6	11.0	52	7.0
22S/4W-17aca	Larry Russell	Tt	21-39	9/ 4/75	26	.94	.32	110	5.4	39	.9	181	0	6.5	150	.3	.08	.00	.003	.22	429	300	775	7.2	13.0	56	1.0
19ccd	G. L. Hickey	Tt	35-66	4/15/75	33	7.9	.49	37	6.4	13	1.4	178	0	.9	5.1	.4	.02	.15	.000	.08	194	120	340	7.0	10.5	51	.5
31dbb	Scotts Valley school	Tus	19-131	6/ 4/74	3.9	.03	.00	3.9	.4	98	.4	205	15	26	5.1	.4	.03	.06	.002	.55	255	11	435	9.1	14.0	57	13
32cba	Archie Damon	Tub (?)	20-75	4/16/75	8.6	1.6	.38	5,000	2.7	1,200	3.3	7	0	8.6	11,000	.0	.01	.25	.000	1.9	17,200	13,000	27,500	7.9	9.5	49	4.7
34bdb	C. O. Newell	Tt	89-355	4/16/75	9.8	.01	.01	340	.1	400	1.2	27	0	29	1,200	1.5	.01	.06	.000	2.0	2,000	850	3,740	9.1	12.0	54	6.0
22S/5W-16bdd	Charles Orr	Tus	56-320	5/15/75	11	.11	.005	6.3	.2	56	.7	74	0	57	7.0	2.0	.00	.03	.000	2.4	179	17	320	9.1	13.0	55	6.0
17bbc	Wilford Haines	Tt (?)	-----	4/15/75	30	2.2	.18	30	2.5	34	.9	164	0	6.9	12	.2	1.4	.28	.000	.06	206	85	330	7.1	11.5	53	1.6
17bcb	R. A. Douglas	Tus (?)	55-76	4/15/75	11	2.7	.47	39	6.3	30	1.4	198	0	1.3	24	.2	.02	.03	.000	.13	214	120	420	7.4	9.0	48	1.2
21caa(s)	Boswell Spring	Tub	-----	9/ 3/57	17	.0	.00	7,080	.0	3,900	13	6	0	2.1	18,800	-----	0	-----	-----	7.8	33,000	-----	40,900	7.1	----	----	13
22aca	M. G. Ziegaus	Tt	30-60	9/ 5/75	42	3.0	.35	26	4.0	14	1.5	112	0	2.2	5.0	.3	.02	.40	.000	.03	154	81	220	6.7	14.0	57	.7
31bca	F.W. Miller	Tus	20-85	9/ 5/75	22	.04	.01	320	6.6	110	.4	174	0	7.4	670	.1	1.1	.00	.000	.18	1,230	830	2,200	7.9	21.0	70	1.7
34dcbl	Grant McCormick	Tus	21-380	4/16/75	7.7	.01	.01	2.9	.1	200	.9	384	0	7.8	89	1.1	.01	.31	.000	1.3	500	8	870	9.0	13.0	55	31
34ddc	H. Warner	Tus	65-100	9/11/75	8.9	.04	.02	8.1	1.9	700	1.3	486	7	7.2	790	1.8	.01	.12	.000	1.7	1,770	28	3,000	8.6	19.0	67	58
22S/6W-2abc	John Pfahler	Tus	89-224	9/ 5/75	21	.10	.03	13	1.8	49	.2	137	0	12	11	.3	.04	.00	.001	.26	176	40	310	7.9	17.0	63	3.4
2abc(s)	John Pfahler	Tus	-----	9/ 5/75	22	.04	.00	32	11	28	.7	194	0	14	3.0	.1	.37	.09	.003	.05	208	130	350	7.3	22.5	72	1.1
8cdd	W. G. Myers	Tub	43-165	4/15/75	22	.01	.00	15	1.5	27	.2	119	0	1.3	2.7	.3	.02	.09	.000	.20	129	44	200	8.4	9.5	49	1.8
10dcc	Andy Hergert	Tub (?)	?-120	9/11/75	9.4	.04	.02	500	1.0	420	1.1	19	0	27	1,500	.3	.06	.00	.000	1.1	2,470	1,300	4,540	8.5	16.5	62	5.2
14bbc	Andy Hergert	Tt	130-255	9/11/75	10	.08	.01	3.1	.1	130	.4	254	22	15	8.6	1.9	.02	.00	.000	1.3	318	8	570	8.5	19.5	67	20
16acb	Jack Conway	Tub	21-265	5/13/75	18	.02	.01	430	1.9	380	1.0	23	0	14	1,300	.6	.01	.06	.000	.86	2,160	1,100	4,500	8.1	13.5	56	5.0
23S/4W-2cbb	J. A. Haynie	Tus	15-67	4/16/75	14	1.5	.21	55	7.9	29	1.0	263	0	7.3	3.7	.2	.01	.03	.013	.52	250	170	437	7.4	12.0	54	1.0
21baa	Art Rufener	Tus	40-113	9/11/75	41	.02	.00	30	14	8.9	.2	162	0	.7	5.8	.1	.15	.15	.002	.07	181	130	290	6.6	16.0	61	.3
28dcb	Earnest Tucker	Tt (?)	42-93	4/16/75	30	.7	.19	29	5.9	23	1.3	174	0	.9	7.4	.2	.01	1.1	.013	.11	186	97	288	7.8	7.5	46	1.0
23S/5W-1bcd	Jack Tann	Tus	40-230	9/11/75	11	.02	.05	38	1.2	230	.7	163	0	17	320	1.3	.02	.00	.000	1.3	701	100	1,200	7.6	22.0	72	10
3ddc	Frank Mesa	Tus	32-90	9/12/75	17	.07	.00	2.0	.4	71	.2	119	19	18	6.6	.2	.60	.49	.008	.39	197	7	310	8.9	18.5	65	12
4cdb	Jesse Lane	Tus	18-109	9/12/75	15	.04	.07	12	4.3	170	.8	258	0	6.9	150	.6	.01	.58	.000	.72	488	48	900	7.9	15.0	59	11
15cac	Gary Spellman	Tus	22-67	6/17/75	9.6	.17	.49	200	4.4	670	1.4	136	0	5.3	1,300	.5	.11	.09	.000	.60	2,260	520	4,150	7.9	13.5	56	13
28dca	ARCO Station	Tus	38-76	9/11/75	16	.04	.01	34	.6	65	.5	202	0	5.8	35	.2	.08	.00	.000	.19	257	87	440	7.4	23.0	73	3.0
29bcc	John Bonner	Tus	23-200	4/16/75	26	.04	.04	11	4.8	65	1.0	162	0	11	34	.1	.00	.12	.000	.39	233	47	370	8.6	10.5	51	4.1
35dbd	K. D. Olson	Tub	33-105	4/16/75	28	.04	.00	18	.6	23	.6	110	0	5.4	2.5	.1	.00	.09	.000	.05	133	47	200	8.2	9.5	49	1.5
23S/6W-2cda	J. A. Doran	Tt	53-80	4/16/75	12	.04	.02	26	1.3	160	.9	181	0	19	170	1.9	.00	.03	.001	.34	481	70	850	8.1	8.5	47	8.3
24S/5W-4ddd	John Ringer	Tub	53-235	9/11/75	21	.07	.04	9.0	3.3	3.9	.2	55	0	.6	2.6	.1	.20	.00	.000	.03	69	36	100	6.4	16.0	61	.3
14-3220.00	Elk Creek at Drain	-----	-----	4/18/68	17	-----	-----	13	3.4	6.6	.5	50	0	3.4	13	.0	.02	.01	-----	.00	78	46	131	7.8	----	---	.4

[1] Calculated values with bicarbonate recomputed as carbonate.

WELL CHARACTERISTICS AND PERFORMANCE

General Statistics

Records of wells drilled in 1960 or later were analyzed for depth to water, total depth, completion method, and construction. Information about wells drilled since 1960 is virtually complete, and these wells are likely to have been constructed according to practices that minimize potential for pollution.

Most of the wells are 6-in. (150-mm) diameter domestic wells. (See diagram of typical well installation.) Wells are airlift or bailer tested by the driller to determine yield.

About half the wells were drilled by the cable-tool method and half by rotary or air-rotary method. More than 95 percent of the wells were completed by open-hole construction, using a surface or conductor casing but no screen or perforated pipe opposite water-yielding intervals.

In 50 percent of the wells the reported water levels have been 20 ft (6 m) or less and in 90 percent the levels have been shallower than 60 ft (18 m) below land surface. Fifty percent of the wells have total depths of 110 ft (34 m) or less and 90 percent have total depths less than 225 ft (69 m).

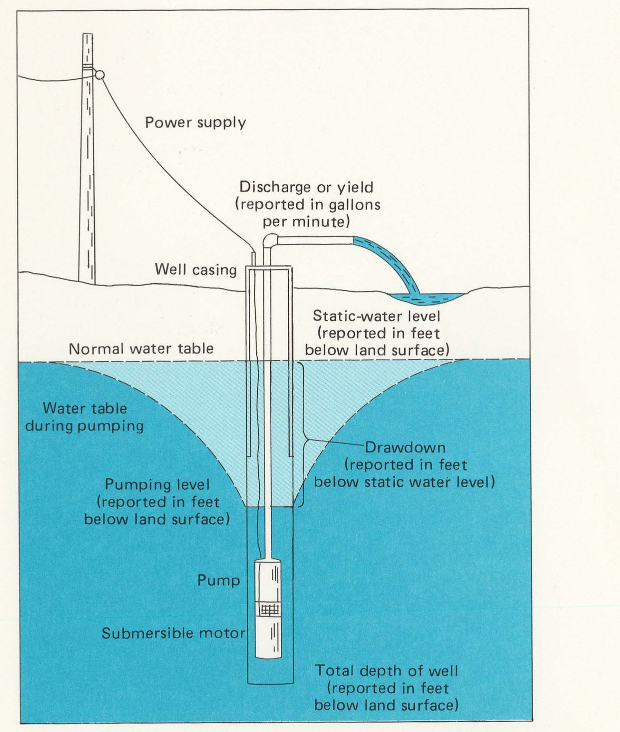


DIAGRAM OF TYPICAL WELL INSTALLATION

The specific capacity of a well is a measure of the potential yield of the well and is reported as the discharge rate divided by the amount of lowering of the water level during bailing or pumping. Specific capacity depends on the ability of the geologic formation to transmit water and on the efficiency of the particular well. The specific capacity of nearly half the wells is 0.1 gal/min or less per foot of drawdown (0.02 l/s per meter). Many wells are adequate for domestic supplies, but the low values of specific capacity indicate that yields would be too low and power consumption too high for practical use of well water for crop irrigation.

In areas underlain by rocks of low permeability, some of the wells were "overtested" by the driller; that is, the reported rate of withdrawal may have been attained only through drawdown of the water level to near the bottom of the well. This means that the well could only sustain a pumping rate smaller than the tested rate. Most wells were tested for only 1 hour; reported values for tests of longer duration are more reliable for estimating the specific capacity or the sustained yield of the well.

Well-Characteristics Map

The well-characteristics map covers the same areas as the geohydrologic map. It is intended to show data for selected existing wells that will help the prospective owner or driller of a well to estimate the probable depths and performance that may be expected. However, because local conditions are highly variable, depths or performance of the wells shown on the map are not necessarily typical of the local area. Also, in many local areas, the number of wells is insufficient to determine average values. Other factors being equal, wells located in valleys will generally require shallower depths or yield more water than wells located in adjacent highlands.

One or more of the following approaches can be used to estimate prospects for obtaining a water well: (1) Use data shown on the map for nearby wells that can be expected to be in similar formations (keeping in mind the possibilities shown in the diagram showing depth-horizontal distance relation of dipping beds); (2) obtain advice from a well driller with local experience; (3) check on the availability of new or more recent information from the office of the U. S. Geological Survey in Portland, Oreg., or the Oregon Water Resources Department in Salem, Oreg.; (4) consult with well owners in the vicinity of the proposed drilling location.

CHEMICAL CHARACTER OF THE GROUND WATER

Ground water in the Drain-Yoncalla area is diverse in chemical character, as indicated by the different shapes and sizes of the chemical diagrams on the geohydrologic map. There is no definite pattern of distribution of the types of water, but waters with a high concentration of dissolved solids are more likely to be found near the contacts of the basalt member and the sandstone and siltstone member of the Umpqua Formation. In waters of high dissolved-solids concentrations, calcium and chloride or sodium and chloride are commonly dominant over the other ions. Calcium and chloride are usually dominant in water from the basalt member of the Umpqua Formation. Sodium and bicarbonate are dominant in most waters from the sandstone and siltstone member of the Umpqua. Calcium and bicarbonate are likely to be dominant in surface water and ground water from alluvium and terraces. The Tyee Formation is not characterized by a single type of water, except that high concentrations of dissolved solids are not common.

FACTORS AFFECTING THE USABILITY OF GROUND WATER

Criteria and Standards

The National Academy of Sciences (NAS) and the National Academy of Engineering (NAE) (1974) recommended criteria that might be used to establish standards of quality for water used for drinking or other purposes. The Environmental Protection Agency (EPA) (1975) published preliminary regulations that will become standards for public water supplies in June 1977. Some (but not necessarily all) of the criteria or standards that may be pertinent to samples listed in the table of chemical analyses include:

Constituent	Recommended limit of concentration in mg/l (milligrams per liter): NAS, NAE; 1974	EPA, 1975
Iron (Fe)	0.3	–
Manganese (Mn)	.05	–
Sulfate (SO_4)	250	–
Chloride (Cl)	250	–
Fluoride (F)	1/1.8	1/1.8
Boron (B)	2/2	–
Arsenic (As)	.1	.05
Nitrate (NO_3) + nitrite (NO_2), expressed as N	3/10	10

1/ Value based on average maximum air temperature in vicinity of Drain.
2/ For tolerant crops; for sensitive crops limit is 0.75. No recommended limit for human consumption.
3/ A separate limit of 1.0 mg/l recommended for nitrite.

The preceding recommended limits are for public supplies; however, concentrations exceeding these values may be acceptable to many users.

Excessive iron or manganese causes staining of plumbing fixtures and laundry and can give a peculiar taste to the water. Chloride in excess of about 500 mg/l and dissolved solids in excess of 1,000 mg/l may give a salty or mineral taste to the water. Sulfate in excessive concentrations can have a laxative effect on persons not accustomed to the water. Fluoride is beneficial in moderate amounts because it retards dental decay, but in concentrations of more than several milligrams per liter can eventually cause darkening or mottling of children's teeth. Large amounts of nitrate can cause methemoglobinemia (blue-baby effect) in infants.

Excessive hardness is undesirable but seldom is cause for rejection of a water supply. Commercial softeners can be used for most water supplies. The U. S. Geological Survey uses the following rating for hardness:

Hardness range (as $CaCO_3$) (mg/l)	Rating
0-60	Soft
61-120	Moderately hard
121-180	Hard
More than 180	Very hard

A boron concentration of only a few milligrams per liter has a toxic effect on plants; yellowing of leaves is one symptom. Some plants are more sensitive than others; many nut and fruit trees are among the more sensitive plants.

The sodium-adsorption-ratio (SAR) of a water is a measure of the suitability of the water for irrigation. Where SAR values are high, sodium in the water tends to replace calcium and magnesium adsorbed in the soil, which results in clogging of the soil. The limit of SAR is about 4 for sensitive fruits. Water will be suitable for most other crops if the SAR is less than about 8 to 18 (National Academy of Sciences, National Academy of Engineering, 1974, p. 330).

Local Water Quality

Available water-quality data are listed in the chemical-analysis table. One analysis of water from a stream (Elk Creek at Drain) is included for comparison with ground water.

Iron and manganese are excessive in some ground water that is otherwise of good quality. Ten samples had excessive chloride. Recommended limits for fluoride were equaled or exceeded in four samples, but none was so high that mottling of teeth is likely to occur.

No excessive nitrate concentrations were noted. However, a significant concentration (even though it is less than the recommended limit) is sometimes an indication of possible bacterial pollution. Bacterial pollution can occur if a well is improperly located or constructed. (See Oregon Water Resources Department for current well-drilling regulations.)

No samples exceeded recommended limits for arsenic. Although several contained more arsenic than is typical for ground water, they had far less than has been found in the Fisher Formation in Lane County, where more than 1 mg/l (milligram per liter) has been reported for water from some wells about 20 mi (30 km) northeast of Drain (Goldblatt and others, 1963).

Water from well 23S/4W-28dcb, located in the mercury-mining area, was found to contain less than 0.0001 mg/l of mercury.

Nine of the samples had more than 1 mg/l of boron—enough to be unsuitable for irrigating sensitive plants. One-fifth of the samples had more than 1,000 mg/l of dissolved solids or a high specific conductance. (Specific conductance can be used to approximate the dissolved solids, which commonly range from 0.5 to 0.8 of the conductance values.) Thirteen of the 39 samples were hard or very hard. SAR's of 10 samples exceeded 8.

Temperature measurements reasonably representative of water in the formations are sometimes difficult to obtain. In the table, the range is from 46° to 73°F (7.5° to 23°C). The average water temperature reported by drillers was 54°F (12°C)—almost the same as the mean annual air temperature at Drain (53°F, or 12°C).

Users of some well waters complain of hydrogen sulfide (H_2S) odor; the problem can be minimized if the water is aerated prior to use.

On the basis of the table of chemical analyses, areas where dissolved constituents in some of the ground water may typically be high include Putnam, Scotts, and Pleasant valleys, Yoncalla, and Boswell springs.

Water from some wells shows a seasonal increase in dissolved constituents as more water is used. The increase occurs when most of the pumped water comes from the lower part of the aquifer where the dissolved-solids concentrations are higher.

AVAILABILITY AND QUALITY OF GROUND WATER IN THE DRAIN—YONCALLA AREA, DOUGLAS COUNTY, OREGON

By J. H. Robison and C. A. Collins, 1976