ROZA IRRIGATION DISTRICT GROUND WATER SUPPLY STUDY:

REPORT FOR YAKIMA RIVER BASIN WATER ENHANCEMENT PROJECT

by Linton Wildrick and Marilyn Blair

May 1985

Open-File Technical Report 85-01

ROZA IRRIGATION DISTRICT GROUND WATER SUPPLY STUDY: REPORT FOR YAKIMA RIVER BASIN WATER ENHANCEMENT PROJECT

by

Linton Wildrick and Marilyn Blair
Washington Department of Ecology
Project Assistance and Investigations Section

May 1985 -

CONTENTS

	Page
	i
Abstract	1
Introduction	1
Scope	1
Methods	2
Well Yield Estimates	2
Well Spacing Requirements	4 5
Production From High-Yield Wells	10
Production From Lower-Yield Wells	10
Potential Production From Additional High-Yield Wells	14
Summary	15
References	

FIGURES

1. Elevation At Well Bottom Versus Specific Capacity	12
2. Elevation At Well Bottom Versus Maximum Yield (GPM)	13

TABLES

1. Estimated Interference-Drawdown for a Well Pumping 1000 GPM for 150 Days	4
2. Well Construction Data for High-Yield Wells	6
3. Well Production Test Data for High-Yield Wells	7
4. Maximum Well Yield Estimates for High-Yield Wells	8
5. Water Rights Data for High-Yield Wells	9

MAPS

1. Water Rights for Ground Water Pumpage
2. Specific Capacity and Estimated Well Yield
3. Depth to Water and Drawdown at 1000 GPM
4. Well Depth and Estimated Depth to Top of Production Zone
5. Water Level Elevations and Potentiometric Head Contours

ABSTRACT

Irrigation wells can potentially supply one-half or more of the Roza Irrigation District (District) water needs if little or no reservoir storage water is available during a drought. There are at least 51 high-yield irrigation wells in the District capable of yielding 1000 or more gallons per minute (gpm). These wells can be modified to irrigate approximately 22,000 acres or 30 percent of the 72,000 acres irrigated (reported) within the District. There are also approximately 200 lower-yield irrigation wells in the District which can irrigate another 12,000 acres. Additional high-yield wells could be drilled to irrigate an estimated 11,000 to 16,000 acres. Combined irrigation potential for all wells is estimated to be 45,000 to 50,000 acres. If this pumpage is limited to occasional use, say one year in 10 or two years in 20, with 5 or 10 years of recovery between uses, there will probably not be significant long-term water level declines (aquifer storage depletion). If the irrigation potential of these wells is to be developed, further study is needed to assess possible problems with ground-water storage depletion (water-level decline), interference with production of irrigation wells outside the District, and ground-water quality.

INTRODUCTION

At the request of the Yakima River Basin Water Enhancement Project Study Team, the potential for supplemental irrigation from wells within the Roza Irrigation District (District) was evaluated. The District has two options for obtaining supplemental ground water supplies for drought relief when reservoir storage water is not available. The first option is use of existing wells. These wells can supply both supplemental irrigation needs of current owners and excess production for neighboring lands or distribution via the Roza Canal. The second option is to drill and develop new wells in areas which cannot be served by existing wells.

SCOPE

This scope of this study is limited to assessment of the potential for developing ground water supplies for irrigation of District lands. We did not address the question of whether the ground water is available for appropriation through Washington Department of Ecology (WDOE) water rights administration procedures.

The study also did not address the questions of possible pumpage effects on production in wells outside the District and ground-water quality problems which could limit irrigation of certain crops or soil types.

Data sources for this study included well-drillers' logs, USGS computer data files (Ground Water Site Inventory File, WATSTORE data base), Washington Department of Ecology (WDOE) Central Region's computer database for Roza water rights, WDOE headquarters water rights files, and WDOE aquifer test data (Project Assistance and Investigations Section files).

METHODS

Our analysis consisted of the following steps:

1. Estimation of the maximum yield of existing wells.

2. Estimation of well spacing required, when pumping up to 3500 gpm, to keep drawdown interference in neighboring wells at acceptable levels .

3. Estimation of the total District acreage which can be irrigated with existing "high-yield" irrigation wells, each capable of producing at least 1000 gallons per minute (gpm).

4. Estimation of the total District acreage which can be irrigated with existing "lower-yield" wells as indicated by the WDOE water rights records (developed permits or certificates).

5. Evaluation of the potential for drilling additional high-yield wells in relatively undeveloped areas within the District and estimation of the acreage which could be irrigated with these wells.

WELL YIELD ESTIMATES

There are 248 irrigation wells with developed water rights located within the Roza Irrigation District. Locations of these wells are shown on Map 1. We were able to estimate the maximum yield (gpm) for about one-third of these wells from specific capacity, well construction, water levels, and water rights information.

"Specific capacity" is defined as gallons per minute per foot of drawdown (gpm/ft) and is derived from a pumping test conducted by the well driller. "Available drawdown" is defined as the difference (in feet) between the static water level and the lowest depth to which the water level may drop during pumping (the drawdown limit depth) without reducing pump efficiency. The depth to the top of the uppermost aquifer, depth to the uppermost casing perforations, or depth to the top of well screens determine the drawdown limit depth. We assumed that a pumping lift to ground surface greater than 600 feet was generally not economical and used 600 feet as a maximum drawdown limit depth.

Where specific capacity and available drawdown were known, the maximum well yield (in gpm) was calculated by multiplying "available drawdown" times the "specific capacity".

WELL SPACING REQUIREMENTS

Well spacing must be considered in order to minimize interference-drawdown effects on well production. "Interference-drawdown" is the water level decline in wells caused by pumping in a nearby well, as distinguished from drawdown occurring in the pumping well. Under complex hydrogeologic conditions the acceptable limit for interference-drawdown is best determined by direct testing. For the irrigation wells with at least 200 feet of available drawdown we estimate that yield will not be impaired by up to 50 feet of interference-drawdown. Some wells with several hundred feet of available drawdown may not be impaired by up to 100 feet of interference-drawdown. These are rough estimates which should be evaluated by direct testing.

Interference-drawdown estimates require information on aquifer transmissivity, storativity, and geometry. This information is used in standard equations for calculating drawdown.

Little is known about the basalt aquifers in the vicinity of the District. The area is part of the Yakima Fold Belt, a complex series of major folds (anticlines and synclines) with east-west oriented axes and related faults and fractures. Secondary folding and faulting further complicate the basalt stratigraphy in the area. The folding and faulting has created complex fracture patterns in the basalt which control the storage and movement of ground water. As a result, the water yielding characteristics of the basalt formations are poorly understood and may vary greatly over distances of less than a mile.

WDOE personnel at the Central Region office in Yakima have identified the principal geologic formations in the area using well log lithology. These formations include the Saddle Mountains Basalt and Wanapum Basalt of the Columbia River Basalt Group, and the Ellensburg (poorly-cemented sediments). Despite our ability to identify the formations the water-bearing properties are not consistent and correlation of water-bearing zones from well-to-well using lithologic logs is generally very difficult or even impossible.

WDOE personnel conducted three aquifer tests in the middle portion of the District near Union Gap. Test data indicate an average aquifer transmissivity (T) of 25,000 $feet^2$/day and average storativity (S) of 0.0001. These aquifer characteristics may be representative of only a small portion of the District, because of the complex hydrogeology and limited areal extent of the testing. Prych (1983) estimated a "T" of 4,600 $feet^2$/day for the basalt aquifer in an area along the Yakima River between Granger and Mabon. According to Prych (1983) rough estimates of aquifer "T" may be calculated using the following rule-of-thumb formula,

$$\text{Transmissivity in feet}^2\text{/day} = 260 \times \text{specific capacity}$$

Specific capacities for the wells range from 4.1 to 186. Using the formula above these specific capacities translate to a "T" range of 1,000 to 48,000 $feet^2$/day. Aquifer testing and numerical modeling of basalt aquifers elsewhere in eastern Washington have produced estimates of "T" generally less than 10,000 $feet^2$/day and estimates of "S" ranging from 0.001 to 0.0001. For the present study a "T" range of 5,000 to 50,000 $feet^2$/day and a "S" range of 0.001 to 0.0001 were chosen for use in calculating interference-drawdown.

Table 1 shows the estimated interference-drawdown at various distances from a well pumping 1000 gpm for 150 days (the approximate length of an irrigation season). Interference-drawdown was calculated by using the Theis equation and image well theory for a hypothetical confined aquifer with "no-flow" boundaries 4 miles north and 10 miles south of the well. This analytical model represents a typical irrigation well location and basalt aquifer configuration along the lower portion of the District.

Interference-drawdown estimates are shown for the range of "T" and "S" described above.

TABLE 1. ESTIMATED INTERFERENCE-DRAWDOWN FOR A WELL PUMPING 1000 GPM FOR 150 DAYS

Transmissivity>> Storativity >>	T=50000 S=.001	T=50,000 S=.0001	T=5,000 S=.001	T=5,000 S=.0001
		Drawdown (feet)		
Distance				
0.5 miles	3.4	5.4	18.5	33.5
1.0 miles	3.0	5.0	14.5	29.6
1.5 miles	2.7	4.7	12.3	27.4
2.0 miles	2.6	4.6	11.0	26.0
3.0 miles	2.4	4.4	9.5	24.5

The "T" / "S" combinations in Table 1 result in a wide range of estimated interference-drawdown for the various distances from the pumping well. The interference-drawdown values in Table 1 illustrate that smaller "T" and smaller "S" result in greater drawdown. The most representative combination of "T" and "S", as discussed above, is 5000 feet^2/day and .001, respectively (see column 3 in Table 1). However, the aquifer characteristics vary locally and may range toward the other values of "T" and "S". The estimated "worst case" interference-drawdown values are listed in column 4 of the table.

Interference-drawdown at pumping rates other than 1000 gpm are easily calculated from Table 1 because drawdown is directly proportional to the pumping rate. For example, at a given distance from the pumping well the drawdown at 2000 gpm is twice the drawdown at 1000 gpm, the drawdown at 3000 gpm is 3 times the drawdown at 1000 gpm, and so on.

At 1000 gpm or less (lower-yield wells) well spacing of 1/2 mile or less is probably acceptable, i.e. the "worst-case" interference-drawdown of 34 feet in neighboring wells will not cause problems. At higher pumping rates of up to 3500 gpm (high-yield wells) the required well spacing may range from 1/2 mile to as much as 3 miles.

PRODUCTION FROM "HIGH-YIELD" WELLS

If the use of existing wells is selected as an alternative for drought relief, we assume that the District will first enhance the withdrawal and distribution facilities of wells with the best yields. Therefore, the wells were subdivided into two groups: "high-yield" wells - those capable of producing at least 1000 gpm; and "lower-yield" wells - those producing less than 1000 gpm.

High-yield irrigation wells, for the purposes of this study, have a pumping capability of at least 1000 gpm with a properly sized pump. Table 2 summarizes construction and water level information for the 51 high-yield wells we were able to identify. Table 3 summarizes pumping test data and specific capacities for 42 of the wells. The locations of the wells are highlighted on Map 1.

Table 4 lists the estimated maximum yield (in gpm) and related information for the identified high-yield wells. Maps 2 and 3 illustrate the distribution of these wells, together with well attributes from Table 3. Maximum yield estimates for some of these wells were unrealistically large - as high as 19,000 gpm. For both practical and economic reasons the maximum production that ordinarily is obtained from basalt aquifer wells is approximately 3500 gpm. Values of estimated maximum yield in Table 4 reflect this practical maximum yield of 3500 gpm.

Specific capacity was not available for some of the wells listed in Table 4. The estimated yield of these wells was based on the maximum permitted pumping rate indicated on the water right (Table 5).

The average water application rate required for crops in the Yakima Valley is approximately 5 gpm per acre (James et.al., 1982; and personal communications with WDOE Central Region personnel). Orchard crops require as much as 7.5 gpm per acre for frost control in early spring but extra allowance can be made for these crops through proper pump and distribution pipe design.

Estimated maximum yield from the 51 high-yield wells totals 137,000 gpm (see Table 4). Average well yield is thus approximately 2,700 gpm. Well spacing requirements may preclude development of the excess yield from approximately 10 of these wells. This would reduce the total potential yield to approximately 110,000 gpm. (Field tests of interference-drawdown for most of the high-yield wells will be necessary if they are developed for drought relief.) At 5 gpm per acre this production rate could irrigate approximately 22,000 acres or 30 percent of the 72,000 irrigated acres in the District. Water rights for these wells cover only 8651 acres (see Table 5) or less than 40 percent of the potential irrigation capacity of the wells.

TABLE 2. ROZA IRRIGATION DISTRICT HIGH-YIELD[1] WELLS
— WELL CONSTRUCTION DATA —

NEAREST CANAL MILE	TOWNSHIP (NORTH)	RANGE (EAST)	SECTION	40 ACRE SUB SECTION	OWNER	SURFACE ELEVATION [2]	WELL DEPTH [2]	BOTTOM OF WELL ELEVATION [2]	DEPTH TO WATER [2]	WATER LEVEL ELEVATION [2]	CASING DIAMETERS (INCHES)	TOTAL CASING LENGTH [2]	DRILLER'S LOG AVAILABLE
3.5	14	19	16	N	ROCHE POMONA	1,300	900	400	123	1,177	16/12	400	Y
15.7	13	19	24	C	HEILY, JOHN	1,460	872	588	332	1,128	8	764	Y
16.8	13	20	19	N	SUNDQUIST FRT 2	1,420	835	585	262	1,158	18	755	Y
22.7	12	20	13	P	CHARRON	1,332	2,231	-899	179	1,153	16/8	1,248	N
23.4	12	20	16	H	DNR	1,340	1,376	-36	204	1,136	16/12	1,322	Y
23.6	12	20	09	P	ALLWORTH 2	1,167	972	195	-2	1,169	10/8	920	Y
25.5	12	20	18	B	BRULOTTE	1,200	1,035	165	56	1,144	12/10	449	Y
29.3	11	20	05	E	HORSLEY ORCH.	1,000	589	411	80	920	12	556	Y
29.7	12	20	32	H	VISTA RIDGE	1,100	495	605	112	988	12/10	495	Y
31.3	11	20	04	C	OLSON	1,179	440	739	199	980	8	406	Y
31.3	11	20	04	E	VALLEY RDS.ORC.	1,040	725	315	230	810	12/10/8	725	Y
31.3	11	20	04	M	TURCOTT	1,120	575	545	165	955	10/8	575	Y
31.3	11	20	05	R	BABCOCK,GREEN &	1,000	625	375	154	846	12/10	505	Y
31.4	11	20	04	G	VALLEY ROZ ORCH	980	645	335	102	878	12/10/8	614	Y
31.4	11	20	04	L	YOUNG	1,120	508	612	186	934	10	402	Y
32.8	11	20	09	A	GREEN, DAVID L.	1,080	543	537	215	865	12	400	Y
32.9	11	20	03	J	STROTHER ORCH.	1,200	720	480	280	920	10/8	520	Y
33.6	11	20	10	F	MORRISON	1,045	355	690	150	895	10	224	Y
36.1	11	20	12	K	RASHFORD,GEORGE	1,215	815	400	250	965	14/12/10	815	Y
37.0	11	21	07	F	ROZA INVEST CO.	1,160	1,620	-460	306	854	12/10/8	1,220	Y
38.2	11	20	13	R	SOOST BROS.	1,015	1,201	-186	139	876	20/16/12	1,178	Y
38.8	11	21	18	K	CASCADE ORCH.	1,090	535	555	170	920	10	414	Y
39.4	11	21	18	R	LEACH,MILLER &	1,070	574	496	198	872	12	468	Y
41.8	11	21	21	J	ROZA INVEST CO.	1,245	605	640	387	858	14/10	453	Y
42.3	11	21	28	C	SCHAAN, FRED J.	1,040	535	505	163	877	10	488	Y
44.6	11	21	26	F	DE LA CHAPPELLE	1,200	955	245	334	866	12	799	Y
44.9	11	21	34	C	SLAGG	1,015	773	242	177	838	14	589	Y
45.2	11	21	35	F	E.T.HEARRON CO.	1,020	810	210	172	848	14/10/8	805	Y
47.5	11	22	30	D	DE LA CHAPPELLE	1,212	2,707	-1,495	509	703	16/10	2,049	Y
48.4	11	22	29	N	ROWE FARMS 1	1,123	1,690	-567	454	669	18/14/10	490	Y
52.5	11	22	35	D	EVANS 2	1,160	1,000	160	493	667	18/16	740	Y
53.2	11	22	26	Q	EVANS	1,270	1,568	-298	623	647	20/16	620	Y
53.5	11	22	35	A	SUNNYSIDE CO 1	1,260	1,105	155	625	635	16	712	Y
58.4	10	23	04	L	YAK.VAL.COLLEGE	1,240	602	638	225	1,015	8/16	602	Y
59.2	10	23	17	B	STOUT	960	1,182	-222	150	810	18/14	432	Y
61.3	10	23	15	F	VISSER	990	985	5	280	710	18/16/14	330	Y
67.9	10	23	27	J	SCHINMANN	927	231	696	-28	955	16	231	Y
68.3	10	23	35	K	BROWN FRT	1,050	817	233	364	686	16/12/10	520	Y
69.2	09	23	01	B	WASH. FRUIT & P	1,040	282	760	120	920	10	235	Y
69.3	10	23	36	G	WHITE	1,165	923	242	503	662	20/13	625	Y
70.0	10	24	31	F	MCPHERSON 2	1,210	359	851	216	994	10	304	Y
73.6	09	24	04	H	WYCOFF FARMS	1,175	320	850	125	1,050	16	235	Y
80.0	09	25	06	K	PROSSER EXPR.	1,180	1,200	-20	550	630	20/16/12	1,200	Y
81.5	09	25	17	A	R.E.ORMISTN,INC	1,010	530	480	380	630	12/10/8	472	Y
82.6	09	25	08	J	NOONER	1,073	338	735	71	1,000	12/10	335	Y
83.5	09	25	09	N	PORTER,DONALD E	1,060	370	690	70	990	10	225	Y
85.7	09	25	14	D	OLSEN BROTHERS	1,000	465	535	50	950	8	224	Y
87.3	09	25	12	E	O'BRIEN	1,040	425	615	140	900	8	200	Y
93.7	10	26	33	D	CHAMPION ORCHRD	1,240	838	402	450	790	12	520	Y
93.9	10	26	28	L	ROBERTS	1,270	925	345	500	770	12/8	920	Y
93.9	10	26	33	C	INLND.DSRT.FRT.	1,140	835	305	411	729	16/12/10	480	Y

1) ALL WELLS ESTIMATED TO PRODUCE 1000 OR MORE GPM
2) ALL LENGTH UNITS IN FEET UNLESS OTHERWISE NOTED

TABLE 3. ROZA IRRIGATION DISTRICT HIGH-YIELD[1] WELLS
— WELL PRODUCTION TEST DATA —

NEAREST CANAL MILE	TOWNSHIP (NORTH)	RANGE (EAST)	SECTION	40 ACRE SUB SECTION	OWNER	PRODUCTION TEST GPM	PRODUCTION TEST DRAWDOWN (FEET)	PRODUCTION TEST DURATION (HOURS)	SPECIFIC CAPACITY (GPM/FT OF DRAWDOWN)
3.5	14	19	16	N	ROCHE POMONA	1,960	104	4	19
15.7	13	19	24	C	HEILY, JOHN	250	4	4	62
16.8	13	20	19	N	SUNDQUIST FRT 2	3,525	73	3	48
22.7	12	20	13	P	CHARRON	3,024	280	4	11
23.4	12	20	16	H	DNR	N/A	N/A	N/A	N/A
23.6	12	20	09	P	ALLWORTH 2	700	146	4	4.8
25.5	12	20	18	B	BRULOTTE	1,500	194	8	7.7
29.3	11	20	05	E	HORSLEY ORCH.	900	220	N/A	4.1
29.7	12	20	32	H	VISTA RIDGE	N/A	N/A	N/A	N/A
31.3	11	20	04	C	OLSON	N/A	N/A	N/A	12
31.3	11	20	04	E	VALLEY RDS.ORC.	800	70	5	11
31.3	11	20	04	M	TURCOTT	60	1	4	60
31.3	11	20	05	R	BABCOCK,GREEN &	1,810	69	4	26
31.4	11	20	04	G	VALLEY ROZ ORCH	N/A	N/A	N/A	38
31.4	11	20	04	L	YOUNG	450	50	3	9.0
32.8	11	20	09	A	GREEN, DAVID L.	500	58	24	8.6
32.9	11	20	03	J	STROTHER ORCH.	538	130	22	4.1
33.6	11	20	10	F	MORRISON	N/A	N/A	N/A	N/A
36.1	11	20	12	K	RASHFORD,GEORGE	500	32	8	16
37.0	11	21	07	F	ROZA INVEST CO.	420	40	4	10
38.2	11	20	13	R	SOOST BROS.	2,000	131	5	15
38.8	11	21	18	K	CASCADE ORCH.	180	30	5	6.0
39.4	11	21	18	R	LEACH,MILLER &	1,500	29	4	52
41.8	11	21	21	J	ROZA INVEST CO.	440	20	4	22
42.3	11	21	28	C	SCHAAN, FRED J.	100	4	1	25
44.6	11	21	26	F	DE LA CHAPPELLE	1,000	27	N/A	37
44.9	11	21	34	C	SLAGG	800	N/A	N/A	N/A
45.2	11	21	35	F	E.T.HEARRON CO.	682	60	7	11
47.5	11	22	30	D	DE LA CHAPPELLE	N/A	N/A	N/A	N/A
48.4	11	22	29	N	ROWE FARMS 1	1,175	112	4	10
52.5	11	22	35	D	EVANS 2	2,400	181	24	13
53.2	11	22	26	Q	EVANS	N/A	N/A	N/A	N/A
53.5	11	22	35	A	SUNNYSIDE CO 1	2,420	13	24	186
58.4	10	23	04	L	YAK.VAL.COLLEGE	340	N/A	21	100
59.2	10	23	17	B	STOUT	2,050	356	5	6.1
61.3	10	23	15	F	VISSER	N/A	N/A	N/A	N/A
67.9	10	23	27	J	SCHINMANN	2,000	27	24	74
68.3	10	23	35	K	BROWN FRT	N/A	N/A	N/A	N/A
69.2	09	23	01	B	WASH. FRUIT & P	N/A	N/A	N/A	63
69.3	10	23	36	G	WHITE	1,000	9	24	111
70.0	10	24	31	F	MCPHERSON 2	912	N/A	4	100
73.6	09	24	04	H	WYCOFF FARMS	1,500	54	8	28
80.0	09	25	06	K	PROSSER EXPR.	1,500	26	6	58
81.5	09	25	17	A	R.E.ORMISTN,INC	1,200	12	4	100
82.6	09	25	08	J	NOONER	732	23	3	32
83.5	09	25	09	N	PORTER,DONALD E	N/A	N/A	N/A	4.9
85.7	09	25	14	D	OLSEN BROTHERS	550	20	24	27
87.3	09	25	12	E	O'BRIEN	525	45	15	12
93.7	10	26	33	D	CHAMPION ORCHRD	750	N/A	24	100
93.9	10	26	28	L	ROBERTS	600	N/A	N/A	N/A
93.9	10	26	33	C	INLND.DSRT.FRT.	625	38	24	16

1) ALL WELLS ESTIMATED TO PRODUCE 1000 OR MORE GPM

TABLE 4. ROZA IRRIGATION DISTRICT HIGH-YIELD[1] WELLS
— MAXIMUM WELL YIELD ESTIMATES —

NEAREST CANAL MILE	TOWNSHIP (NORTH)	RANGE (EAST)	SECTION	40 ACRE SUB SECTION	OWNER	DRAWDOWN LIMIT DEPTH[2]	DEPTH TO WATER[2]	AVAILABLE DRAWDOWN[2]	SPECIFIC CAPACITY (GPM/FT OF DRAWDOWN)	ESTIMATED WELL YIELD (GPM)	DRAWDOWN AT 1000 GPM[2]
3.5	14	19	16	N	ROCHE POMONA	502	123	379	19	3,500	53
15.7	13	19	24	C	HEILY, JOHN	760	332	268	62	3,500	16
16.8	13	20	19	N	SUNDQUIST FRT 2	755	262	340	48	3,500	21
22.7	12	20	13	P	CHARRON	1,248	179	420	11	3,500	91
23.4	12	20	16	H	DNR	1,322	204	400	N/A	1,200	N/A
23.6	12	20	09	P	ALLWORTH 2	920	-2	600	4.8	2,900	208
25.5	12	20	18	B	BRULOTTE	449	56	390	7.7	3,000	130
29.3	11	20	05	E	HORSLEY ORCH.	556	80	480	4.1	2,000	244
29.7	12	20	32	H	VISTA RIDGE	280	112	160	N/A	1,000	N/A
31.3	11	20	04	C	OLSON	406	199	200	12	2,500	83
31.3	11	20	04	E	VALLEY RDS.ORC.	460	230	230	11	2,500	88
31.3	11	20	04	M	TURCOTT	454	165	290	60	3,500	17
31.3	11	20	05	R	BABCOCK,GREEN &	508	154	350	26	3,500	39
31.4	11	20	04	G	VALLEY ROZ ORCH	614	102	500	38	3,500	26
31.4	11	20	04	L	YOUNG	402	186	220	9.0	2,000	111
32.8	11	20	09	A	GREEN, DAVID L.	383	215	170	8.6	1,400	116
32.9	11	20	03	J	STROTHER ORCH.	520	280	240	4.1	1,200	244
33.6	11	20	10	F	MORRISON	235	150	80	N/A	1,000	N/A
36.1	11	20	12	K	RASHFORD,GEORGE	690	250	350	16	3,500	63
37.0	11	21	07	F	ROZA INVEST CO.	1,220	306	290	10	2,900	100
38.2	11	20	13	R	SOOST BROS.	1,178	139	460	15	3,500	67
38.8	11	21	18	K	CASCADE ORCH.	416	170	240	6.0	1,400	167
39.4	11	21	18	R	LEACH,MILLER &	468	198	270	52	3,500	19
41.8	11	21	21	J	ROZA INVEST CO.	492	387	100	22	2,300	46
42.3	11	21	28	C	SCHAAN, FRED J.	500	163	340	25	3,500	40
44.6	11	21	26	F	DE LA CHAPPELLE	840	334	270	37	3,500	27
44.9	11	21	34	C	SLAGG	621	177	420	N/A	1,600	N/A
45.2	11	21	35	F	E.T.HEARRON CO.	555	172	380	11	3,500	91
47.5	11	22	30	D	DE LA CHAPPELLE	2,220	509	90	N/A	2,100	N/A
48.4	11	22	29	N	ROWE FARMS 1	900	454	150	10	1,500	100
52.5	11	22	35	D	EVANS 2	790	493	110	13	2,400	77
53.2	11	22	26	Q	EVANS	840	623	N/A	N/A	2,400	N/A
53.5	11	22	35	A	SUNNYSIDE CO 1	770	625	20	186	1,700	5
58.4	10	23	04	L	YAK.VAL.COLLEGE	340	225	110	100	3,500	10
59.2	10	23	17	B	STOUT	631	150	450	6.1	2,700	164
61.3	10	23	15	F	VISSER	350	280	70	N/A	1,000	N/A
67.9	10	23	27	J	SCHINMANN	100	-28	130	74	3,500	14
68.3	10	23	35	K	BROWN FRT	520	364	160	N/A	1,400	N/A
69.2	09	23	01	B	WASH. FRUIT & P	240	120	120	63	3,500	16
69.3	10	23	36	G	WHITE	625	503	100	111	3,500	9
70.0	10	24	31	F	MCPHERSON 2	310	216	90	100	3,500	10
73.6	09	24	04	H	WYCOFF FARMS	280	125	150	28	3,500	36
80.0	09	25	06	K	PROSSER EXPR.	730	550	50	58	2,900	17
81.5	09	25	17	A	R.E.ORMISTN,INC	462	380	80	100	3,500	10
82.6	09	25	08	J	NOONER	285	71	200	32	3,500	31
83.5	09	25	09	N	PORTER,DONALD E	350	70	280	4.9	1,400	204
85.7	09	25	14	D	OLSEN BROTHERS	224	50	170	27	3,500	37
87.3	09	25	12	E	O'BRIEN	415	140	270	12	3,400	86
93.7	10	26	33	D	CHAMPION ORCHRD	770	450	150	100	3,500	10
93.9	10	26	28	L	ROBERTS	820	500	100	N/A	1,600	N/A
93.9	10	26	33	C	INLND.DSRT.FRT.	690	411	190	16	3,000	63
									COLUMN TOTAL	136,900	

1) ALL WELLS ESTIMATED TO PRODUCE 1000 OR MORE GPM
2) ALL LENGTH UNITS IN FEET

TABLE 5. ROZA IRRIGATION DISTRICT HIGH-YIELD [1] WELLS
-- WATER RIGHTS DATA --

NEAREST CANAL MILE	TOWNSHIP (NORTH)	RANGE (EAST)	SECTION	40 ACRE SUB SECTION	OWNER	WDOE CONTROL NUMBER	WDOE ASSIGNED GPM	PRIMARY [2] AC-FT/YR	PRIMARY ACREAGE	SUPPLEMENTAL [3] AC-FT/YR	SUPPLEMENTAL ACREAGE
3.5	14	19	16	N	ROCHE POMONA	G4-24593C	1,500	241	63	216	137
						GWC-6800A	500	320	80	0	0
15.7	13	19	24	C	HEILY, JOHN	G4-27535P	240	91	24	0	0
16.8	13	20	19	N	SUNDQUIST FRT 2	G4-24846C	2,250	0	0	933	245
						G4-28256P	2,250	887	225	0	0
22.7	12	20	13	P	CHARRON	G3-21507C*	2,200	980	245	626	157
						G4-27779P	600	68	17	89	110
23.4	12	20	16	H	DNR	G4-25817P	1,200	457	120	0	0
23.6	12	20	09	P	ALLWORTH 2	G4-24579C	1,300	0	0	529	130
25.5	12	20	18	B	BRULOTTE	G4-25207C	800	304	80	N/A	N/A
						G4-26178C	1,200	648	180	N/A	N/A
29.3	11	20	05	E	HORSLEY ORCH.	G4-24494C	900	155	41	187	50
29.7	12	20	32	H	VISTA RIDGE	G4-24568C*	1,000	259	68	482	127
31.3	11	20	04	C	OLSON	GWC-4281-A	400	250	50	0	0
31.3	11	20	04	E	VALLEY RDS.ORC.	GWC-5061A*	500	112	28	32	8
31.3	11	20	04	M	TURCOTT	G4-25137C*	700	38	10	304	80
31.3	11	20	05	R	BABCOCK,GREEN &	G4-24644C*	875	146	39	614	162
31.4	11	20	04	G	VALLEY ROZ ORCH	GWC-2930-A	400	216	54	0	0
31.4	11	20	04	L	YOUNG	G3-20889C*	800	375	68	64	12
32.8	11	20	09	A	GREEN, DAVID L.	G4-24543C	500	87	23	217	57
32.9	11	20	03	J	STROTHER ORCH.	G4-25898P	1,200	494	130	0	0
33.6	11	20	10	F	MORRISON	G4-01316C	1,000	560	140	0	0
36.1	11	20	12	K	RASHFORD,GEORGE	G3*-21860C	500	404	100	0	0
37.0	11	21	07	F	ROZA INVEST CO.	G4-27809C	650	0	0	586	150
38.2	11	20	13	R	SOOST BROS.	G4-24557C	1,000	65	17	380	100
38.8	11	21	18	K	CASCADE ORCH.	G4-24659C*	450	14	4	201	53
39.4	11	21	18	R	LEACH,MILLER &	G4-24799C	1,440	8	2	239	63
						G4-25202C	1,440	0	0	53	14
						G4-25206C	1,440	0	0	537	134
41.8	11	21	21	J	ROZA INVEST CO.	G4-24827C	800	50	13	348	92
42.3	11	21	28	C	SCHAAN, FRED J.	G4-24813C	550	33	9	233	61
44.6	11	21	26	F	DE LA CHAPPELLE	G4-24702C	800	0	0	514	135
44.9	11	21	34	C	SLAGG	G4-24634C	1,600	144	38	464	122
45.2	11	21	35	F	E.T.HEARRON CO.	G4-24595C	1,000	14	4	399	98
47.5	11	22	30	D	DE LA CHAPPELLE	G4-26355P	2,100	0	0	836	210
48.4	11	22	29	N	ROWE FARMS 1	G4-27285C	200	61	16	49	64
						G4-24652C	800	0	0	457	120
52.5	11	22	35	D	EVANS 2	G4-27805P	2,400	0	0	935	487
53.2	11	22	26	Q	EVANS	G3-00975C	1,750	646	170	0	0
						G4-27032	2,450	46	12	244	305
53.5	11	22	35	A	SUNNYSIDE CO 1	G4-26933C	1,700	0	0	608	160
58.4	10	23	04	L	YAK.VAL.COLLEGE	G4-10194P	280	220	40	N/A	N/A
59.2	10	23	17	B	STOUT	G4-24629C	2,500	128	32	1,857	458
61.3	10	23	15	F	VISSER	G4-26486C	1,000	0	0	420	200
67.9	10	23	27	J	SCHINMANN	G4-24845C	1,400	3	1	499	139
68.3	10	23	35	K	BROWN FRT	G4-24914C	1,400	367	68	394	72
69.2	09	23	01	B	WASH. FRUIT & P	G4-24630C	550	27	7	258	68
69.3	10	23	36	G	WHITE	G4-24831C	1,000	90	24	381	100
70.0	10	24	31	F	MCPHERSON 2	G4-25907C	800	450	70	140	40
73.6	09	24	04	H	WYCOFF FARMS	G4-25176C	2,000	0	0	1,292	360
80.0	09	25	06	K	PROSSER EXPR.	G4-25096C	2,000	0	0	2,444	520
81.5	09	25	17	A	R.E.ORMISTN,INC	G4-24805C	700	0	0	285	75
82.6	09	25	08	J	NOONER	G4-24837C	400	0	0	200	57
83.5	09	25	09	N	PORTER,DONALD E	G4-24855C	450	15	4	143	41
85.7	09	25	14	D	OLSEN BROTHERS	G4-24861C*	750	0	0	392	120
87.3	09	25	12	E	O'BRIEN	G4-24681	600	0	0	323	85
93.7	10	26	33	D	CHAMPION ORCHRD	G4-24633C	925	110	29	498	131
93.9	10	26	28	L	ROBERTS	G4-25613C	1,600	270	77	290	83
93.9	10	26	33	C	INLND.DSRT.FRT.	G4-24632C	770	0	0	608	160
						COLUMN TOTALS	64,510	9,853	2,422	21,800	6,352

1) ALL WELLS ESTIMATED TO PRODUCE 1000 OR MORE GPM
2) PRIMARY RIGHTS USED EACH YEAR
3) SUPPLEMENTAL RIGHTS USED FOR DROUGHT RELIEF

Considerable enhancement of the pumping and distribution facilities for the high-yield wells would be necessary to fully develop their irrigation potential. Most of these wells are not equipped to pump the estimated maximum yield. But in most cases the well-casing diameters are large enough to allow retrofitting with larger pumps.

PRODUCTION FROM LOWER-YIELD WELLS

There are 197 irrigation wells within the District which likely yield less than 1000 gpm per well. These wells have developed water rights permits and certificates covering 12,200 acres or 17 percent of the irrigated acreage in the District. This acreage is very likely a conservative estimate of the true irrigation capacity of the wells. Maximum permitted pumping rates for all lower-yield wells total 72,845 gpm (Table 5). At an application rate of 5 gpm per acre this yield can potentially irrigate 14,570 acres.

We did not evaluate whether application of the excess pumping rate capacity to neighboring cropland would be cost effective for these lower-yield wells.

POTENTIAL PRODUCTION FROM ADDITIONAL HIGH-YIELD WELLS

Well construction records, pump test results, and distribution maps for existing wells provide sufficient information for selecting areas for future drilling.

The distribution of high-yield wells generally indicates that it is possible to drill and develop high- yield wells almost anywhere within the District. There are several large areas in the District with only a scattering of wells. These areas are probably good prospects for future drilling. We would ordinarily expect well owners to obtain water rights for even low-yield wells in an effort to recover some benefit from the high cost of drilling. Thus irrigation well drilling has probably not been attempted in the areas lacking wells with water rights (Map 1).

Considering the well spacing requirements and the available undeveloped areas, we estimate that another 20 to 30 high-yield wells can be drilled and developed within the District. At an average yield of 2700 gpm, as in existing high-yield wells, the new wells could irrigate approximately 11,000 to 16,000 acres.

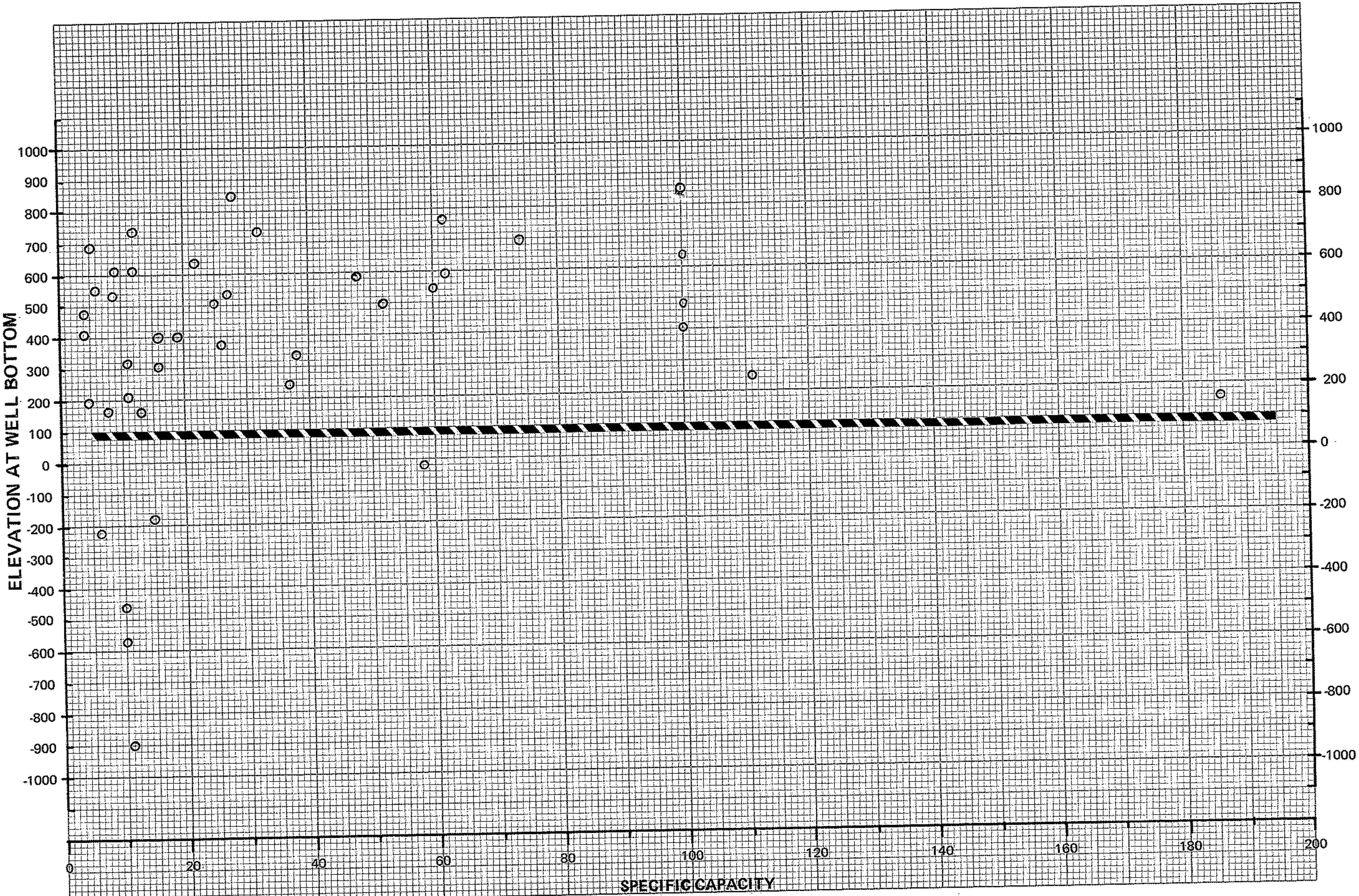
Map 4 illustrates information on high-yield well depths from Table 2 and the estimated depth to the top of the uppermost aquifer in each well (drawdown limit depth) from Table 4. It appears that the depth to major water-bearing zones cannot be predicted with any accuracy from this data because of complex hydrogeologic conditions in the basalts.

Depth to water throughout the area is more predictable. Map 5 illustrates static water level (hydrostatic head) elevations and potentiometric surface contours interpreted from the water levels for a portion of the District. The potentiometric surface is a surface which represents the hydrostatic head and is contoured in the same manner as is land surface topography. The potentiometric contours on Map 5 and the specific capacities on Map 2 may be used to roughly estimate pumping lift to ground surface at future drilling sites. The data on Map 5 also indicates that there is a decided advantage in drilling at lower elevation sites in order to obtain a minimum pumping lift to ground surface.

Figure 1 is a graph of the relationship between well bottom elevation and specific capacity for the high-yield wells. Specific capacity is a partial measure of pumping economy. That is, a higher specific capacity means less drawdown and smaller pumping lift at a given pumping rate. The graph indicates that nearly all the wells with specific capacity greater than 20 were completed above elevation 100 feet (msl). Drilling below elevation 100 feet (msl) would probably not improve specific capacity and would not be cost effective if a specific capacity of 15 or 20 has been obtained above that elevation.

Figure 2 compares well bottom elevation to the theoretical maximum yield in each well. The graph indicates that high yields are generally obtained above elevation 100 feet (msl). Of the 37 high-yield wells completed above elevation 100 feet (msl), nearly two-thirds can produce the practical maximium yield of 3500 gpm; whereas, of the 6 wells completed below elevation 100 feet (msl) only two can yield 3500 gpm.

Both figures 1 and 2 indicate that there is no advantage to drilling below elevation 100 feet (msl) except at sites where productive water-bearing zones cannot be located above that elevation. Judging from existing high-yield wells, adequate yields can be obtained above this elevation in most areas of the District. Therefore, maximum recommended well depths at future drilling sites can be determined from the difference in surface elevation and elevation 100 feet (msl). For example, maximum well depths for drilling along the Roza Canal should be approximately 1100 feet. Judging from the depths of existing high-yield wells, depths of the new wells can be expected to range from 600 to 1200 feet, depending partly on surface elevation at the drilling sites.



ELEVATION AT WELL BOTTOM VERSUS SPECIFIC CAPACITY

NO. 340-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.

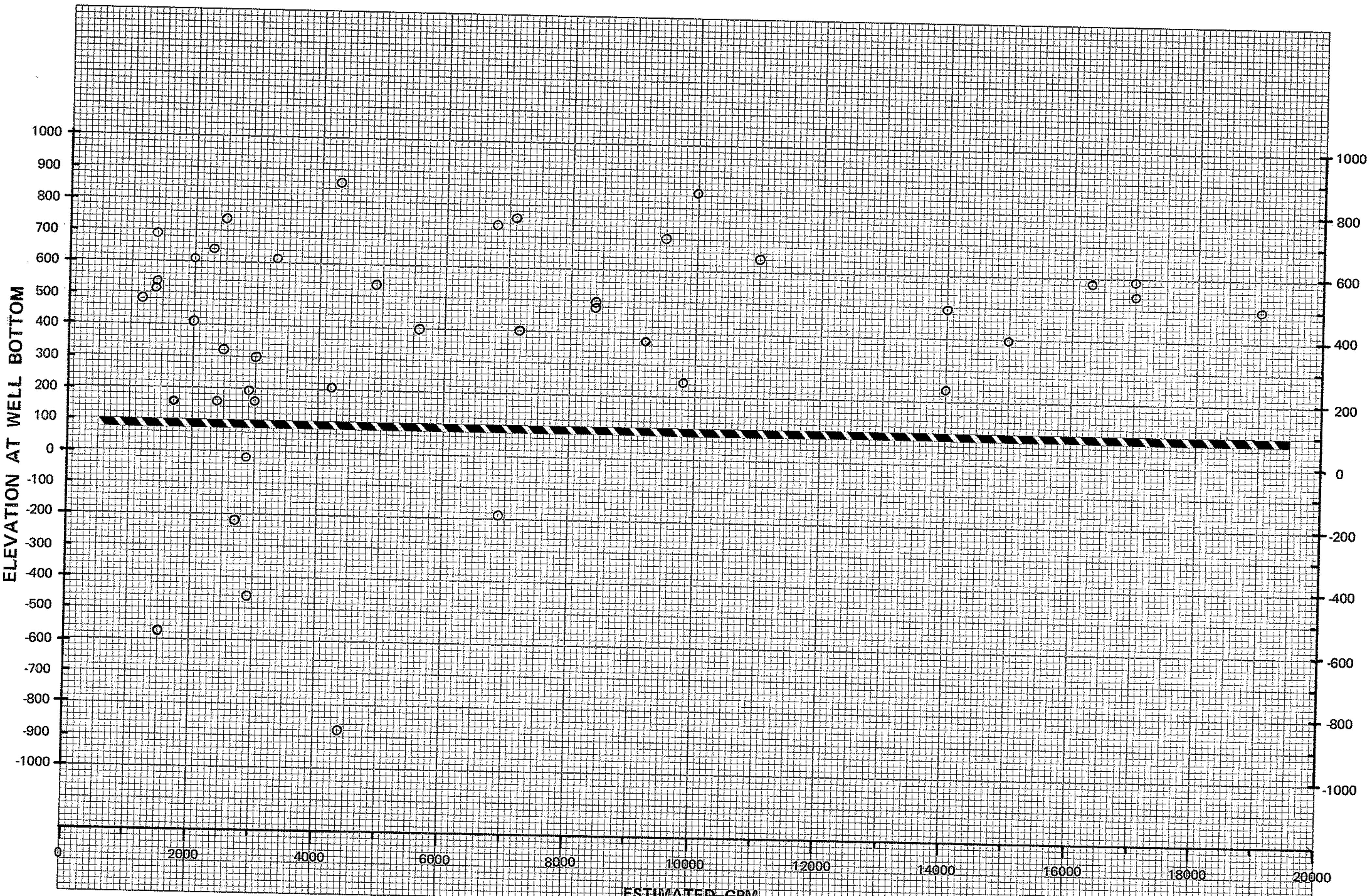


Figure2. ELEVATION AT WELL BOTTOM VERSUS ESTIMATED MAXIMUM YIELD (GPM)

SUMMARY

The potential for obtaining ground water within the District for drought relief appears to be very favorable. With proper alterations to existing wells and distribution systems and with development of new wells, ground water yields can supply one-half or more of the District's irrigation requirements.

Impairment of water rights by interference-drawdown does not appear to be a major problem but some field testing may be necessary to adequately address the effects of high-yield (up to 3500 gpm) pumpage in some areas.

The District will also have to decide if it is cost-effective to use the lower-yield (less than 1000 gpm) wells for irrigation of neighboring croplands not cover by existing water rights for these wells.

Water quality is poor in at least two of the existing high-yield wells. This may be a problem in several other of the deeper wells and should be studied further to determine if the water quality will limit use of the water on certain crops or soil types.

Irrigation of 45,000 to 50,000 acres with ground water could consume 150,000 or more acre-feet per year. If this level of pumpage is continued for several consecutive years there will probably be some long-term basalt aquifer depletion on a scale similar to that occurring in other parts of eastern Washington. On the other hand, if these large withdrawals occur only once in ten years or twice in 20 years, with 5 to 10 years between uses, we do not expect significant problems with aquifer depletion.

REFERENCES

James, L.G., J.M.Erpenbeck, D.L.Bassett and J.E.Middleton (1982) Irrigation Requirements for Washington - Estimates and Methodology. Washington State University, Agricultural Research Center, Research Bulletin XB 0925, 37 p.

Prych, Edmund A. (1983) Numerical Simulation of Ground-Water Flow In Lower Satus Creek Basin, Yakima Indian Reservation, Washington. U. S. Geological Survey, Water-Resource Investigation 82-4065, 77 p.