

GROUND-WATER CONDITIONS
IN THE
DRY CREEK AREA,
EAGLE, IDAHO

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INTRODUCTION

Purpose and Objectives

Due to continued growth in the Boise Valley, increased use of the ground-water resources has brought about concerns of over-development in certain areas. Land that was once used for growing crops or raising livestock is gradually being converted to multi-family subdivisions. People who initially sought the enjoyment of the simpler country life are finding that increased urbanization is gradually encroaching on them and with it some perceived problems.

An area northwest of Boise, near the small community of Eagle (see Figure 1) is one of the areas that is feeling the effects of expanding development. Some of the problems that have been expressed by well owners in this area include: declining well yields, especially near the end of the irrigation season; sand production during extended periods of pumping, which in some cases has required cleaning and/or deepening of certain wells; and water-quality problems that include hardness and high iron content.

Beginning in spring of 1989, a study was conducted by the Idaho Department of Water Resources (IWDR) in order to address these concerns over the ground-water resources in the area. This report is the outcome of that study. The report has been organized in the following format. The local geology is presented first in order to provide a description of the media through which the ground water moves. The next section discusses the principal factors that control the movement of the ground water in the area. A brief discussion of the ground-water quality in the area follows. Sections on conclusions and recommendations complete the report.

Description of Study Area

The study area occupies about nine square miles immediately northeast of Eagle (see Figure 2). The area is drained by Dry Creek which roughly bisects the study area from northeast to southwest and is a tributary of the Boise River. Foothills of the Boise mountains occur along the northern and eastern margins of the study area. The main portion of the study area, however, consists of a gentle southwest sloping terrace. Elevations range from 2950 feet (ft) above mean sea level (MSL) at the crest of the foothills that occur in the study area to around 2560 ft above MSL near Eagle.

The Farmers Union Canal traverses the study area from southeast to west-central. It is used to deliver surface water from the Boise River system to the area for irrigation needs.

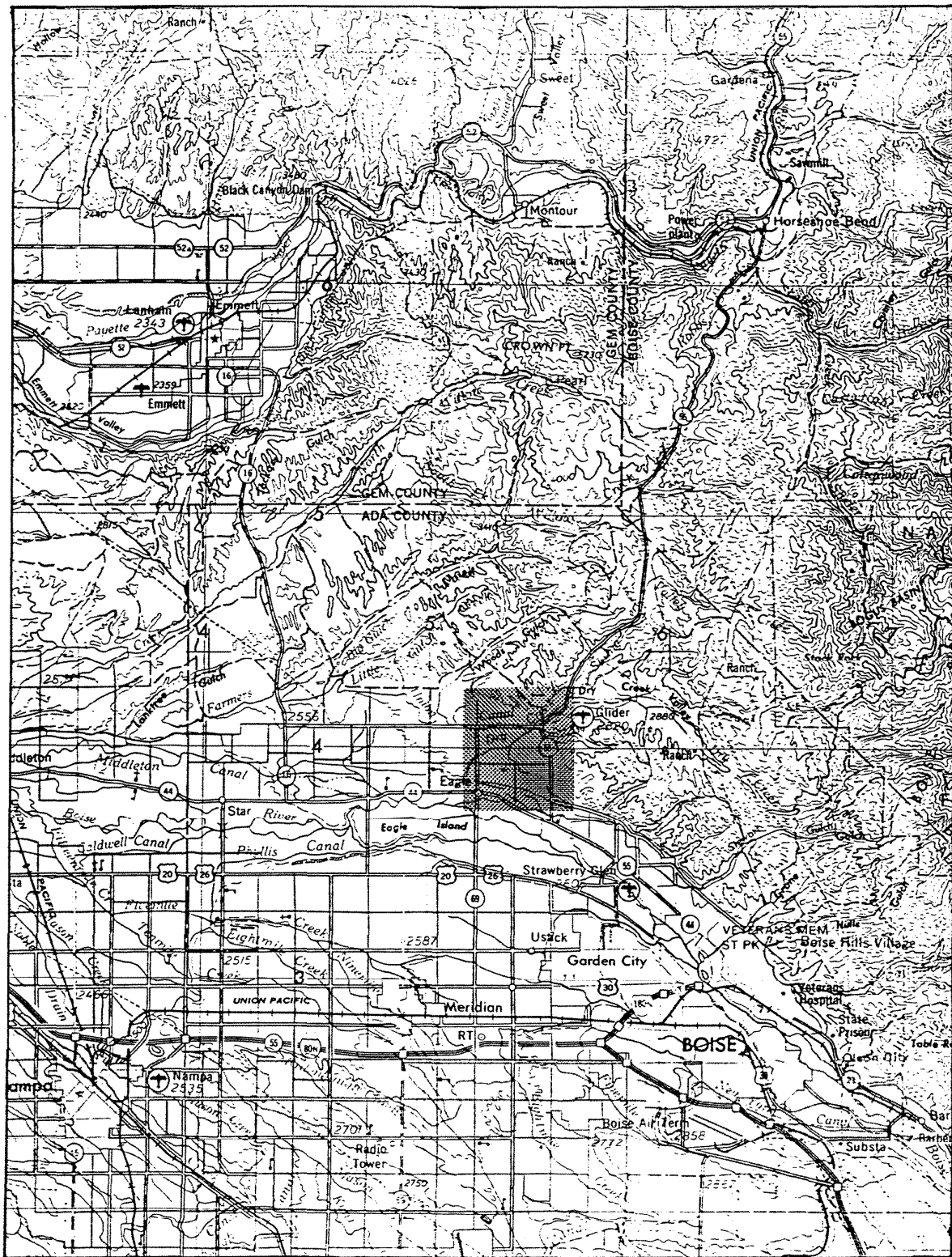


Figure 1. Location of study area

DRY CREEK AREA

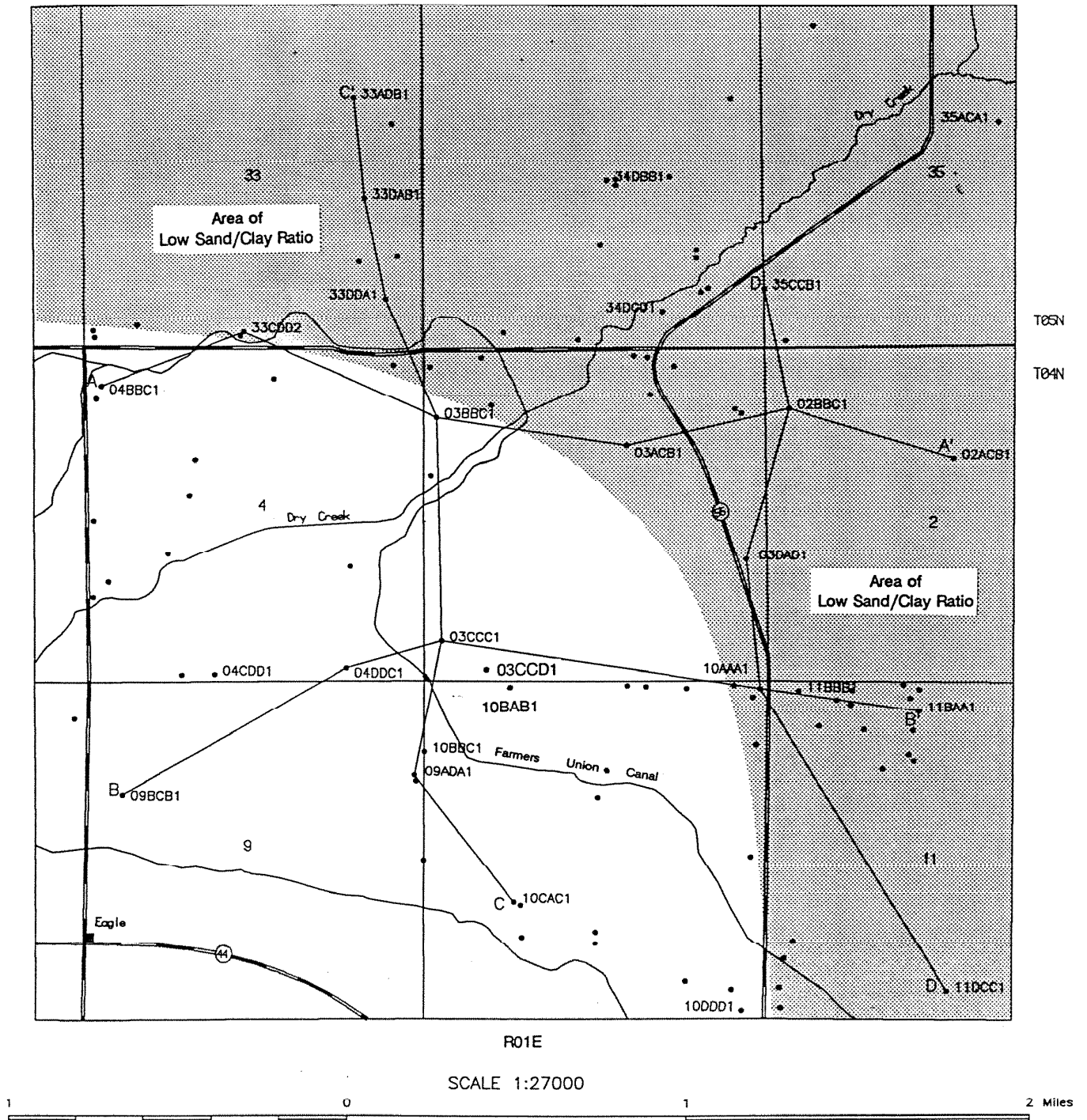


Figure 2. MAP SHOWING LOCATIONS OF INVENTORIED WELLS AND GEOLOGIC CROSS SECTIONS

Previous Work

Previous studies that have been conducted in the area were regional in nature and only briefly touched upon the area of interest. A report by Savage (1958) describes the geology of Ada and Canyon counties. Mitchell and Bennett (1979) compiled a small-scale regional geologic map that covers the area. Recent mapping in the Boise foothills have been performed by S.H. Wood (a professor at Boise State University), W.L. Burnham (retired from U.S. Geological Survey), and K.L. Othberg (a geologist with the Idaho Geological Survey), and are currently unpublished. A report by Dion (1972) discusses the effects of land-use changes on the shallow ground-water system in the Boise Valley.

Well-Numbering System

The well-numbering system used in this report is identical to the system that is used by the U. S. Geological Survey (USGS) in Idaho (see Figure 3). The system indicates the location of wells within the official rectangular subdivision of the public lands, with reference to the Boise base line and meridian. The first two segments of the number designate the township and range. The third segment gives the section number, followed by three letters and a numeral, which indicate the $\frac{1}{4}$ section (160-acre tract), $\frac{1}{4}$ - $\frac{1}{4}$ section (40-acre tract), $\frac{1}{4}$ - $\frac{1}{4}$ - $\frac{1}{4}$ section (10-acre tract), and serial number of the well within the tract. Quarter sections are lettered A, B, C, and D in counterclockwise order from the northeast of each section. Within quarter sections, 40-acre and 10-acre tracts are lettered in the same manner. For instance, well 01N-04E-04CDA1 corresponds to the legal location NE $\frac{1}{4}$, SE $\frac{1}{4}$, SW $\frac{1}{4}$, Section 4, Township 1 North, Range 4 East, and was the first well inventoried in that tract.

Acknowledgements

The author would like to thank each of the well owners in Dry Creek area that took the time to visit with IDWR personnel and allow them to inventory their wells. Bill Pardew, a local resident and a retired civil engineer with the Idaho Transportation Department, was an invaluable resource throughout the course of this study and his assistance is very much appreciated. Spencer Wood, a geology professor at Boise State University, spent numerous hours in the field acquiring data, in addition to providing technical assistance during this study. His help is greatly appreciated. The author would also like to thank Chuck Feast of CH2M Hill consulting firm for the meticulous work that he provided during the long-term aquifer test that was conducted in the study area.

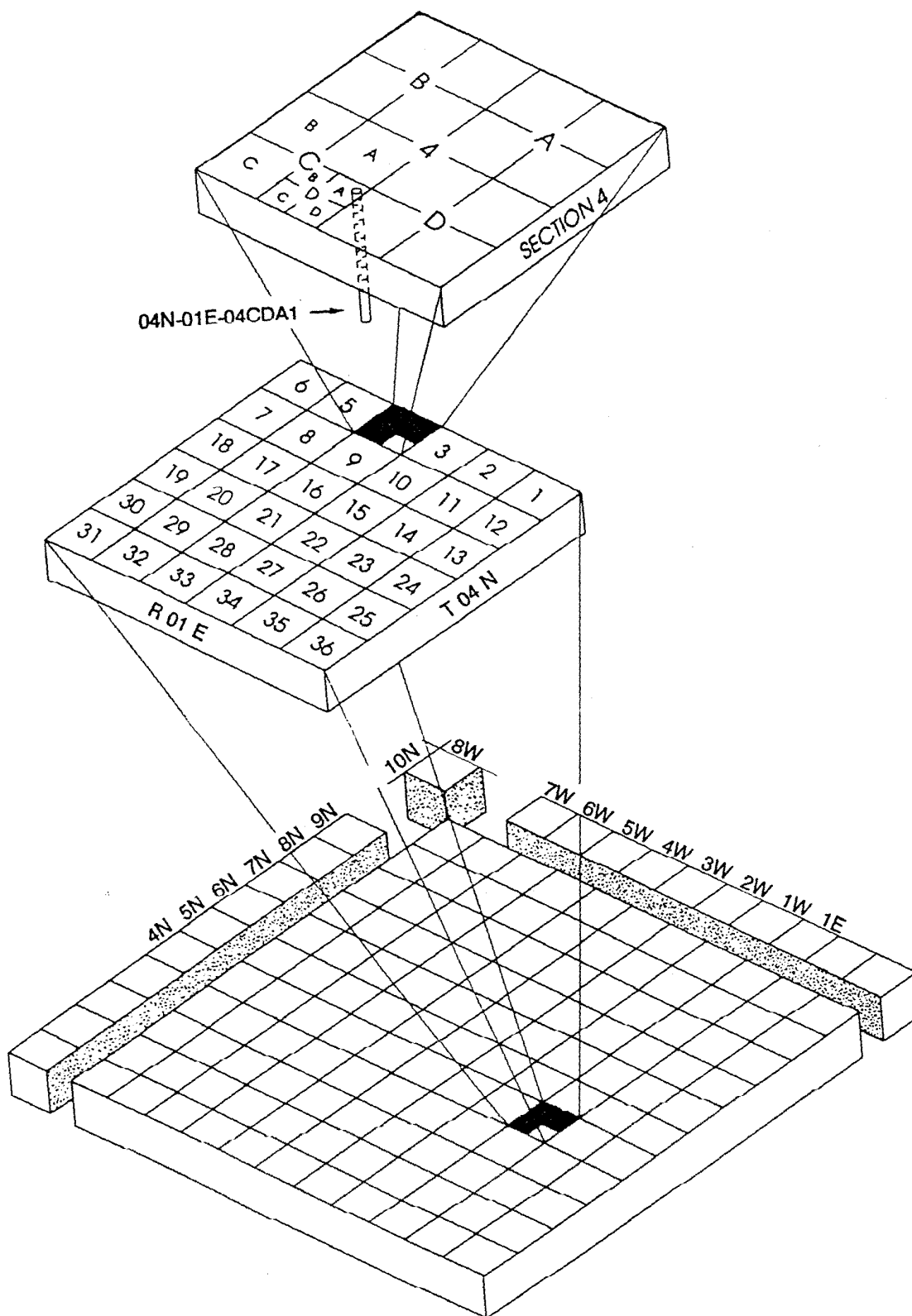


Figure 3. Well-numbering system

GEOLOGIC FRAMEWORK

The rocks that underlie the study area range in age from Pliocene to Holocene. During these past five million years of geologic history, numerous events have taken place and are recorded in rocks that were deposited in the region. Four geologic cross sections were constructed from Well Driller's Reports and are shown on Figures 4 - 7. The locations of each of the sections are shown on Figure 2. These sections were included to assist in describing the subsurface geology of the Dry Creek area.

Certain geologic events that occurred prior to the emplacement of the known rocks in the area greatly influenced the types of rocks that were deposited later. These earlier events include a long period of intrusion, uplift, and volcanism, and are responsible for the creation of the western Snake River Plain graben (down-thrown fault block) during this time. Within this large depression in the plain, a lake was created. Streams carrying sediments from the adjacent uplands were deposited in the lake. The Dry Creek area occurs within this transition zone between fluvial (stream-deposited) sediments and lacustrine (lake-deposited) sediments.

Coarser materials were deposited along the stream channels and shores of the lake. Finer silts and clays were carried out into the lake where they settled to its floor. The lake level changed throughout time and as a result so did the areal extent of the lake. At low levels, streams would deposit coarser sediments further into the interior of the plain, whereas, during high levels, the lake would inundate previous shorelines and deposit fine sediments.

The sediments that accumulated during this period are collectively known as the Glenns Ferry Formation. This formation underlies the Dry Creek area, however, its composition appears to vary considerably throughout the area according to Well Driller's Reports. The sediments that occur in the foothills and adjacent lowlands comprise massive silty clay with fine sand stringers. The shaded area shown on Figure 2 approximately delineates this area of low sand/clay ratio. The Glenns Ferry Formation that underlies the shallow subsurface in the remaining portion of the study area contains greater quantities of sand and lesser amounts of clay. The occurrence of a northwest-trending normal fault is thought to explain these lateral changes in sediment composition (Wood, 1991). Detailed geologic mapping immediately to the east along with data from an east-west seismic profile a few miles to south of the study area support this theory.

By the beginning of the Pleistocene (about two million years ago), downcutting by the ancestral Snake River in Hells Canyon caused the natural dam of the lake to become breached and allowed it to drain. Fluvial processes predominated during this time and the ancestral Boise River system was created. Coarse sands and gravels were

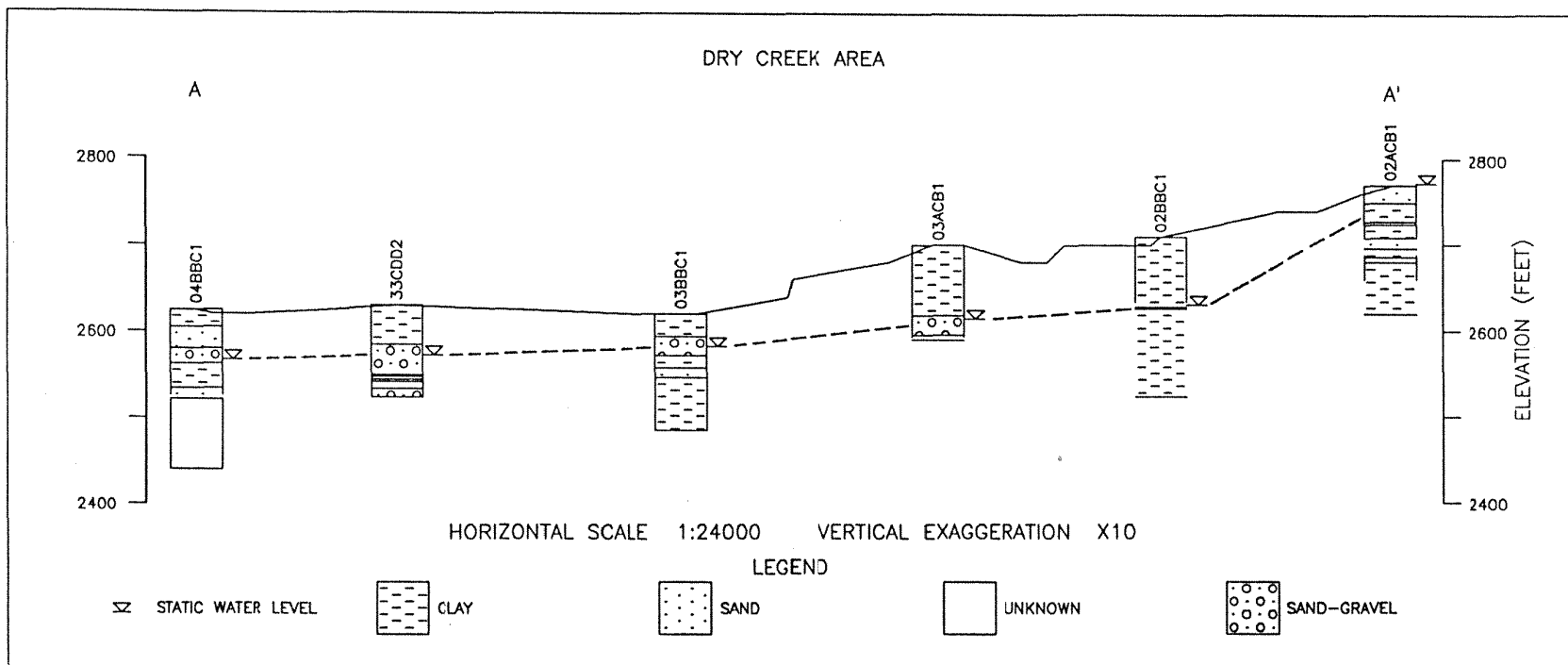
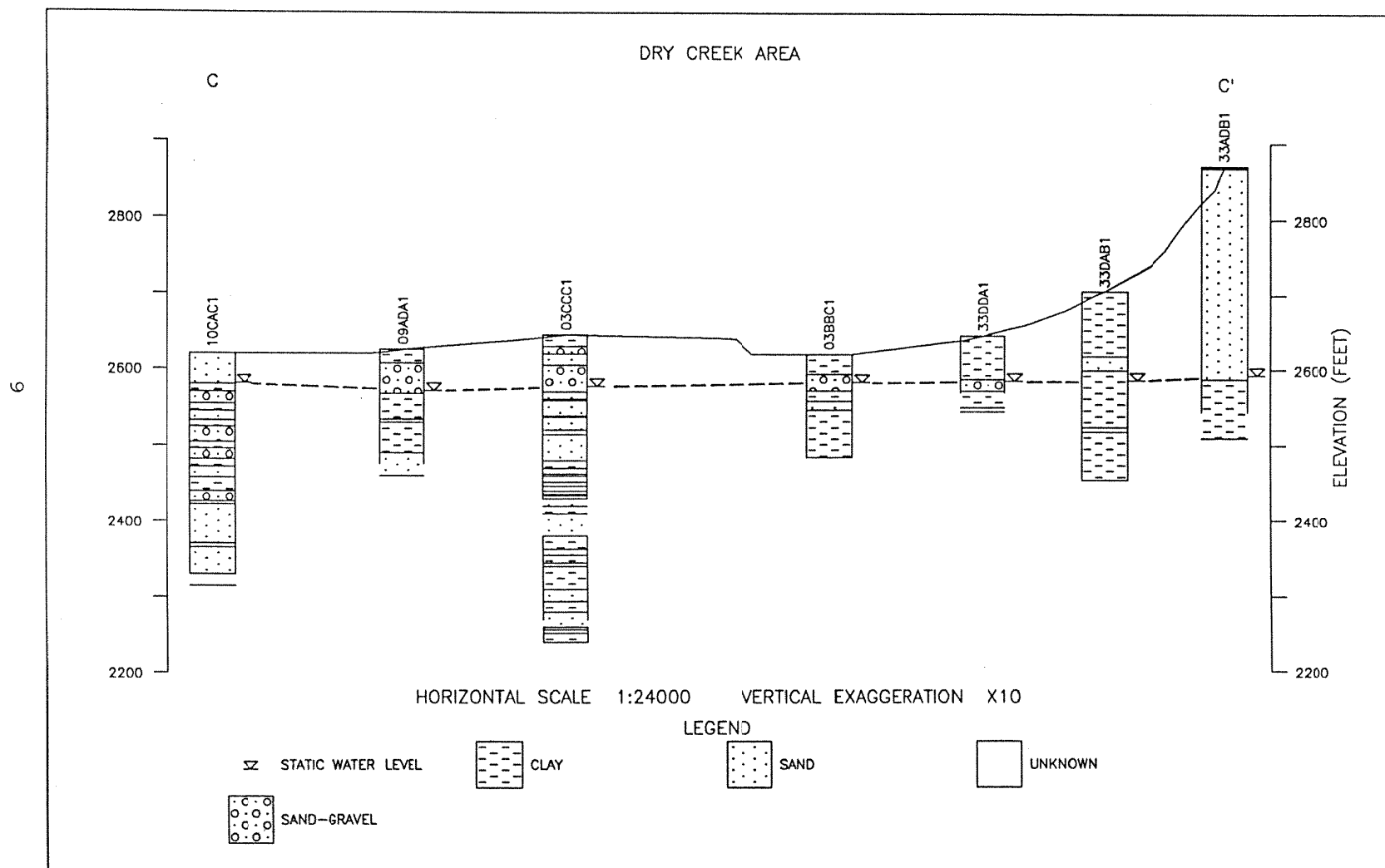


Figure 4. GEOLOGIC CROSS SECTION A - A'

Figure 5. GEOLOGIC CROSS SECTION B - B'



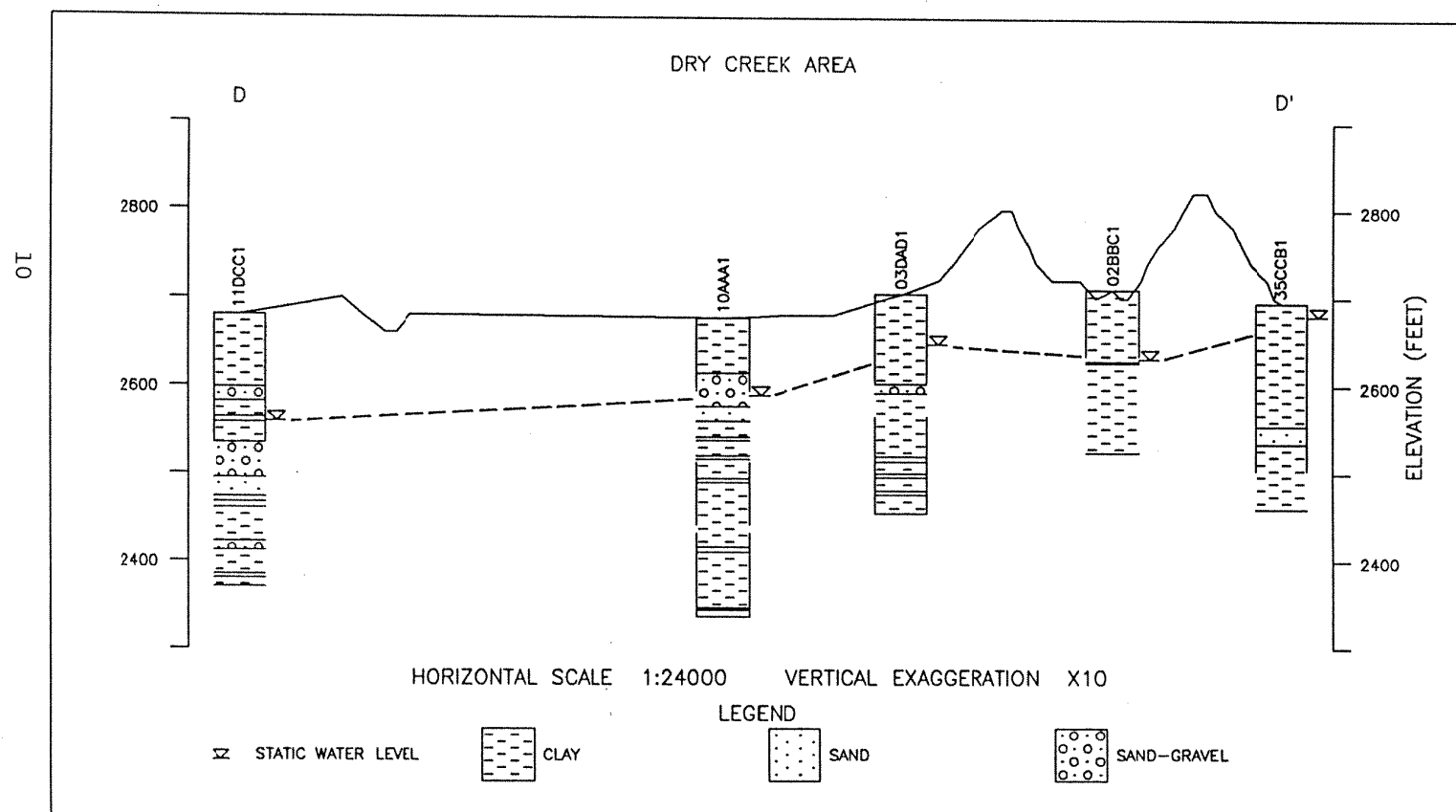


Figure 7. GEOLOGIC CROSS SECTION D - D'

deposited within its channel and fine silts and clays accumulated along its banks during floods. The course of the river continuously changed through time. Sediments that were deposited would later be entrenched during successive downcutting phases. Sand and gravel deposits that occur in the shallow subsurface in the study area record a time when the Boise River occupied the area during the history of its development.

HYDROLOGIC REGIME

Occurrence and Movement of Ground Water

Ground water occurs throughout the entire study area. It fills the void spaces or pores between the sediment grains that underlie the area. The size of the pores determines the amount of water that can be stored in a given volume of sediment, and is termed porosity. The degree of interconnection between individual pores determines the ability for the water to move from pore to pore. This property is termed permeability. Fine-grained sediments such as silts and clays have relatively high porosities, but low permeabilities; whereas, coarser-grained sediments such as sands and gravel have lower porosities, but higher permeabilities.

Inflow or recharge to the ground-water system occurs from natural or artificial (man caused) sources. The natural sources of recharge include deep percolation of precipitation and from infiltration of surface water along tributaries of the Boise River (such as Dry and Spring Creeks). Artificial recharge occurs through infiltration of unconsumed irrigation water from the Boise River system. The Farmers Union Canal is the main canal that delivers surface water to the Dry Creek area. Since water is continuously applied to crops throughout the irrigation season, recharge from this source provides a significant portion of inflow to the ground-water system in these areas.

Outflow or discharge from the ground-water system also occurs by both natural and artificial means. Natural discharge may occur where the land surface and water table intersect, causing springs or seeps to issue. Several of these occur in the higher elevations surrounding the study area and discharge intermittently throughout the year. Natural discharge also occurs as underflow leaving the study area to the southwest. Some of the underflow leaving the area discharges into the Boise River, immediately to the south of the study area and contributes to its base flow. Artificial discharge occurs through pumpage from wells. This type of discharge undoubtedly accounts for a major portion of the water leaving the ground-water system.

In spring of 1989, IDWR inventoried 101 wells in the Dry Creek area and measured depth to water in most of them. Some of the wells were re-measured in summer and fall of that year. Figure 2 shows

the locations of the wells that were inventoried. Pertinent information about the wells that are referred to in this report are included in Table 1. From the water-level data, the elevation of the potentiometric surface was constructed for the area and is shown on Figure 8. The potentiometric surface is an imaginary surface coinciding with the hydraulic head in the aquifer system. The water level in a well defines the elevation of the potentiometric surface at that point.

The potentiometric surface map of the area indicates the direction and slope of the ground-water system, since ground water moves from areas of higher elevation to areas of lower elevation. As can be seen, the predominant direction of movement is from northeast to southwest. The slope of the potentiometric surface ranges from about 100 feet per mile (ft/mi) in the northeast portion of the study area to about 40 ft/mi in the remaining portion of the study area. Several factors are responsible for this significant change in slope, but the main ones probably include: 1) lateral variations in sediment composition and associated permeabilities; 2) recharge from irrigation water in the southwestern portion of the study area causing artificial rising of the potentiometric surface; 3) locally concentrated pumpage causing the potentiometric surface to be artificially subdued in areas (example: the northwest quarter of Section 11, Township 1 North, Range 4 East).

Water-Level Fluctuations

Fluctuations in the potentiometric surface in an area are indicative of changes in the amount of ground water held in storage. These changes occur within an annual cycle and over time.

Annual variations in storage are due to the timing and magnitude of seasonal recharge and discharge events. In areas where natural recharge is the dominant annual event, the potentiometric surface begins to rise during spring snowmelt and peaks in early summer, and then declines until the following year's snowmelt. The foothills along the northern and eastern margins of the study area follow this annual trend. In areas where artificial recharge from unconsumed surface water occurs, the natural trend is greatly modified. As irrigation water is applied in late spring, the potentiometric surface continues to rise throughout the irrigation season and peaks in late fall, and then follows the normal decline. Ground-water withdrawal generally increases during the irrigation season and can greatly subdue the recharge events depending upon the magnitude of pumpage in an area.

Long-term changes in storage are due to cumulative differences in the amounts of annual recharge and discharge. During extended periods of drought, the amount of ground water in storage declines, whereas, during periods of above-normal precipitation, storage

Table 1. Records of selected wells

Elevation: Estimated from USGS topographic maps and field surveys (datum is National Geodetic Vertical Datum of 1929).

Depth to water: Measured by IDWR during spring 1989. Negative values indicate above land surface.

Use of water: H - Domestic; I - Irrigation; P - Public supply; S - Stock; U - Unused.

Well number	Elevation of land surface (ft)	Well depth (ft)	Depth to first well opening (ft)	Depth to water (ft)	Use of water	Date of well completion
04N-01E-02ACB1	2770	150	61	-2.0	I	07/01/73
02BBC1	2710	185	75	78.7	H	06/09/75
03ACB1	2700	110	106	85.1	H	02/20/74
03BBC1	2620	135	--	36.9	H	03/22/74
03CCC1	2645	405	215	71.8 ¹	P	03/07/91
03CCD1	2645	171	168	67.7	H	09/01/71
03DAD1	2705	250	100	57.2	U	06/01/72
04BBC1	2610	185	98	57.5	H	04/11/66
04CDD1	2620	~300	--	59.1	U/I	--
04DDC1	2635	285	276	61.6	H	11/20/72
09ADA1	2625	165	149	54.2	I	07/12/88
09BCB1	2605	328	208	46.7	P	06/21/80
10AAA1	2677	340	82	87.3	I	10/26/50
10BAB1	2635	~75	--	62.5 ¹	H	--
10BBC1	2625	98	--	53.8	H	09/09/62
10CAC1	2620	305	290	50.1	P	06/01/73
10DDD1	2600	141	128	16.4	H	04/05/69
11BAA1	2805	350	329	227.8	H	02/06/67
11BBB1	2690	203	120	103.3	H	12/11/62
11DCC1	2680	310	145	120.1	H/I	05/10/71
05N-01E-33ADB1	2870	360	326	277.5	H	05/12/82
33CDD2	2630	106	--	57.3	H	06/09/71

Table 1. Records of selected wells -- continued

Well number	Elevation of land surface (ft)	Well depth (ft)	Depth to first well opening (ft)	Depth to water (ft)	Use of water	Date of well completion
05N-01E-33DAB1	2705	250	248	119.1	H/I	02/12/79
33DDA1	2645	100	75	60.3	H/S	02/21/76
34DBB1	2680	175	--	31.2	I	12/15/66
34DCD1	2655	54	8	9.6 ²	H	11/14/56
35ACA1	2720	--	--	--	I	--
35CCB1	2695	235	190	15.2	H	04/23/76

¹ Measured by C.F. Feast on 3/26/91 prior to aquifer test

² Measured by USGS on 3/11/70

DRY CREEK AREA

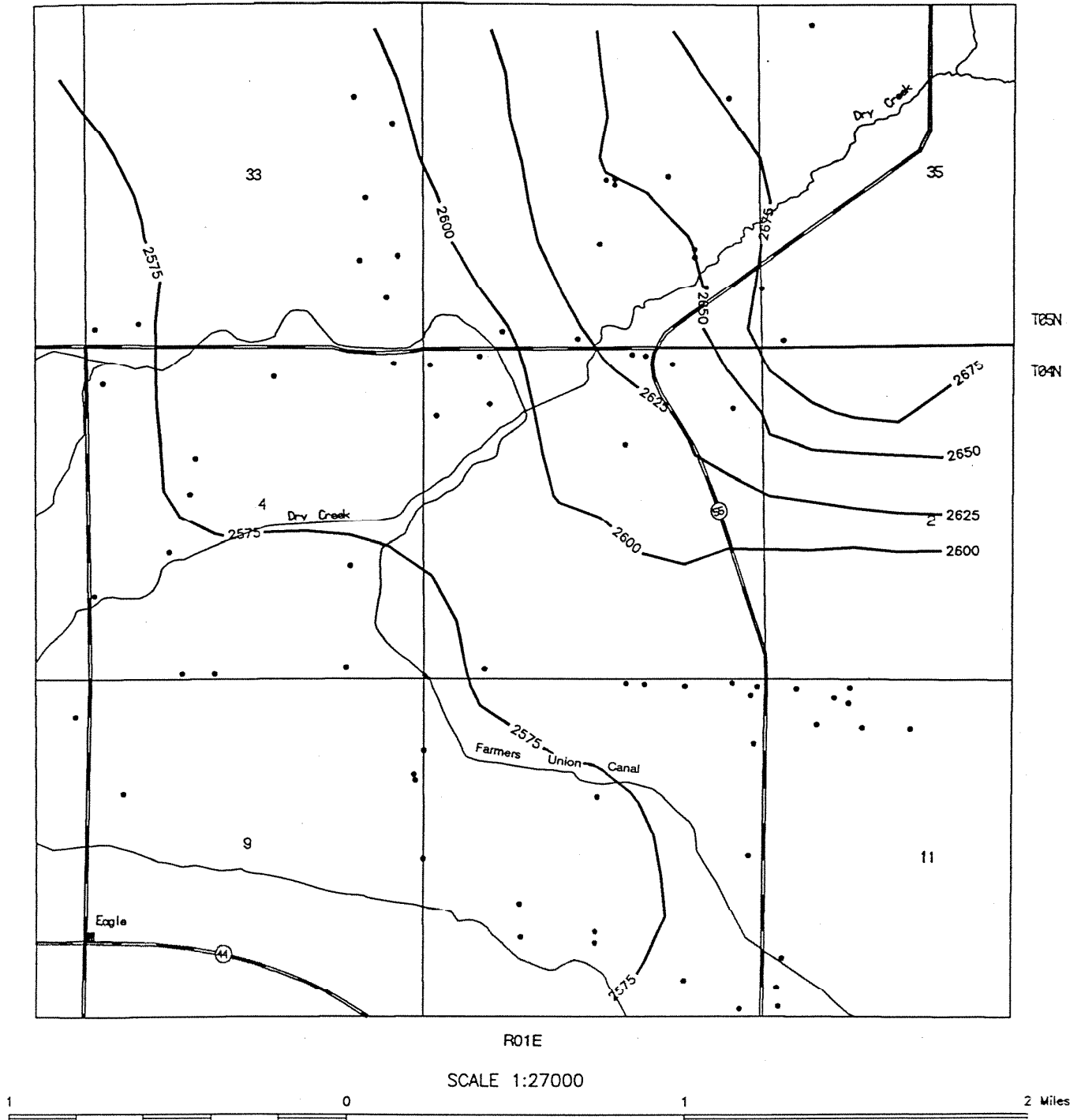


Figure 8. GENERALIZED POTENTIOMETRIC SURFACE MAP, SPRING 1989

increases. As pumpage increases in an area, more water is removed from storage. If the amount of land that is irrigated with surface water is reduced with time, then the amount available for recharge to the ground-water system is also reduced. Each of these factors contributes to long-term changes in storage.

Little data is available on the long-term trends of ground-water storage in the Dry Creek area. Water-level hydrographs of wells 04N-01E-03DAD1 and 05N-01E-34DBB1 are shown on Figure 9. Both wells are monitored by the USGS and are currently the only wells in the study area that have depth to water measured in them regularly.

Of the two wells, 05N-01E-34DBB1 is the only well that has a sufficient period of record to warrant some analysis. Long-term trends in water levels for this well generally follow annual variations in precipitation. During the 1970's, precipitation was generally at or slightly below average as were water levels. Whereas, in early 1980's, precipitation was above average and so were water levels. Since 1987, drought conditions have prevailed and water levels have been on a downward trend. Water levels have only varied about 3 feet from highest trough to lowest trough, suggesting that recharge and discharge have remained relatively constant.

Another source of limited information that indicates what changes in ground-water storage have occurred over time are the differences between two periods of mass water-level measurements. Six wells that were measured in fall 1989 by IDWR had also been measured for Dion's (1972) study in the fall of 1970. Based on this sparsely-distributed data, a water-level change map was constructed and is shown on Figure 10.

As can be seen, the southwest portion of the study area has experienced greater than five feet of water-level decline over the 19 year period. Several factors are probably responsible for the observed declines. Natural recharge has undoubtedly been reduced with the recent drought conditions. Since 1977, the annual amount of water diverted into the Farmers Union Canal has declined by greater than 10 percent from the preceding 27 year period and as result artificial recharge to the ground-water system has also been reduced. Increased pumpage in this area may also be responsible for the observed declines. Several public supply and irrigation wells have been completed in this area during the 19 year time span.

Based on measurements in well 04N-01E-11BBB1, there has been a few feet of rise in water level in this area. Increased development in the Dry Creek area does not appear to have had adverse effects on local water levels during this 19 year period.

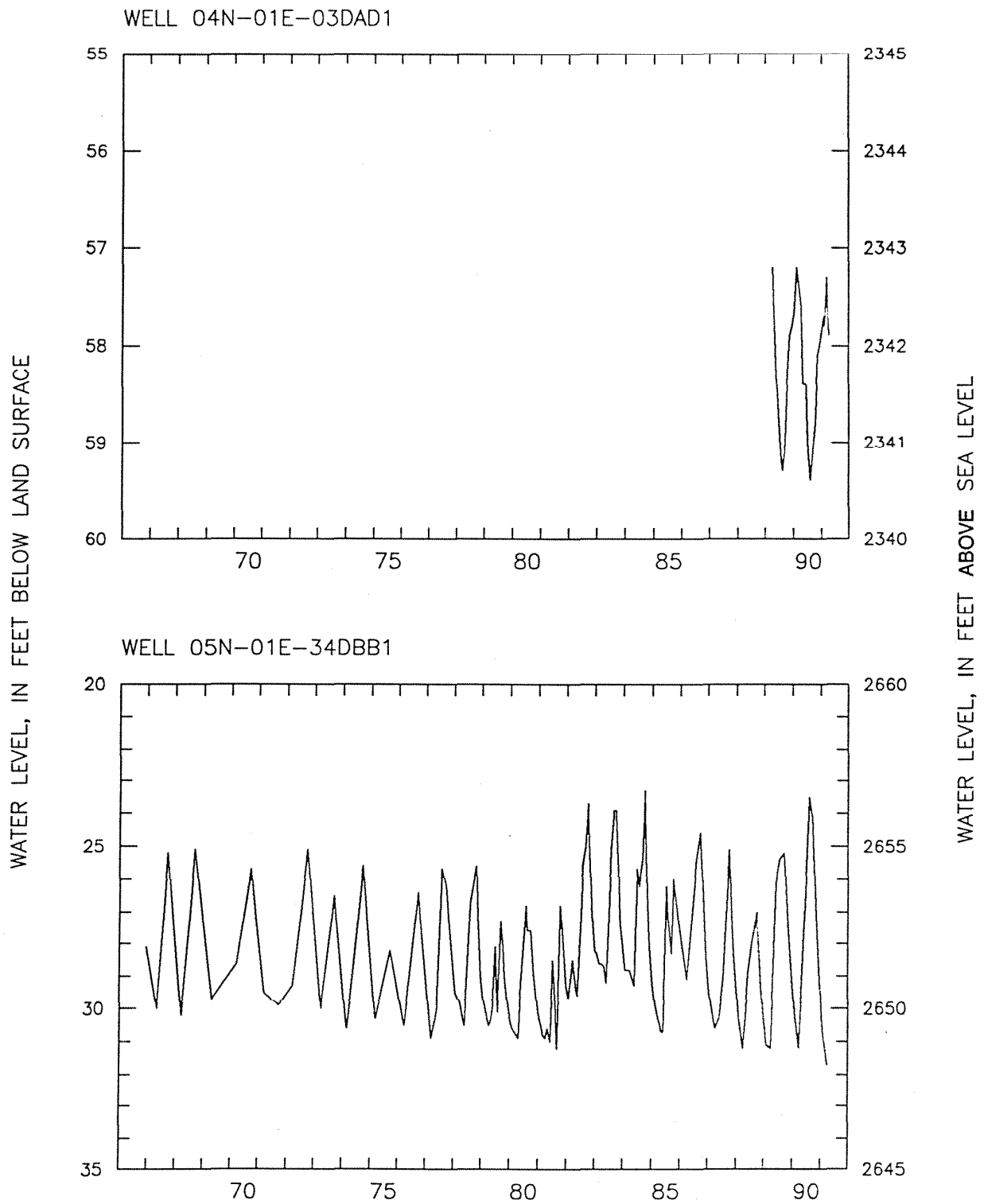


Figure 9. HYDROGRAPHS OF WELLS 04N-01E-03DAD1 AND 05N-01E-34DBB1

DRY CREEK AREA

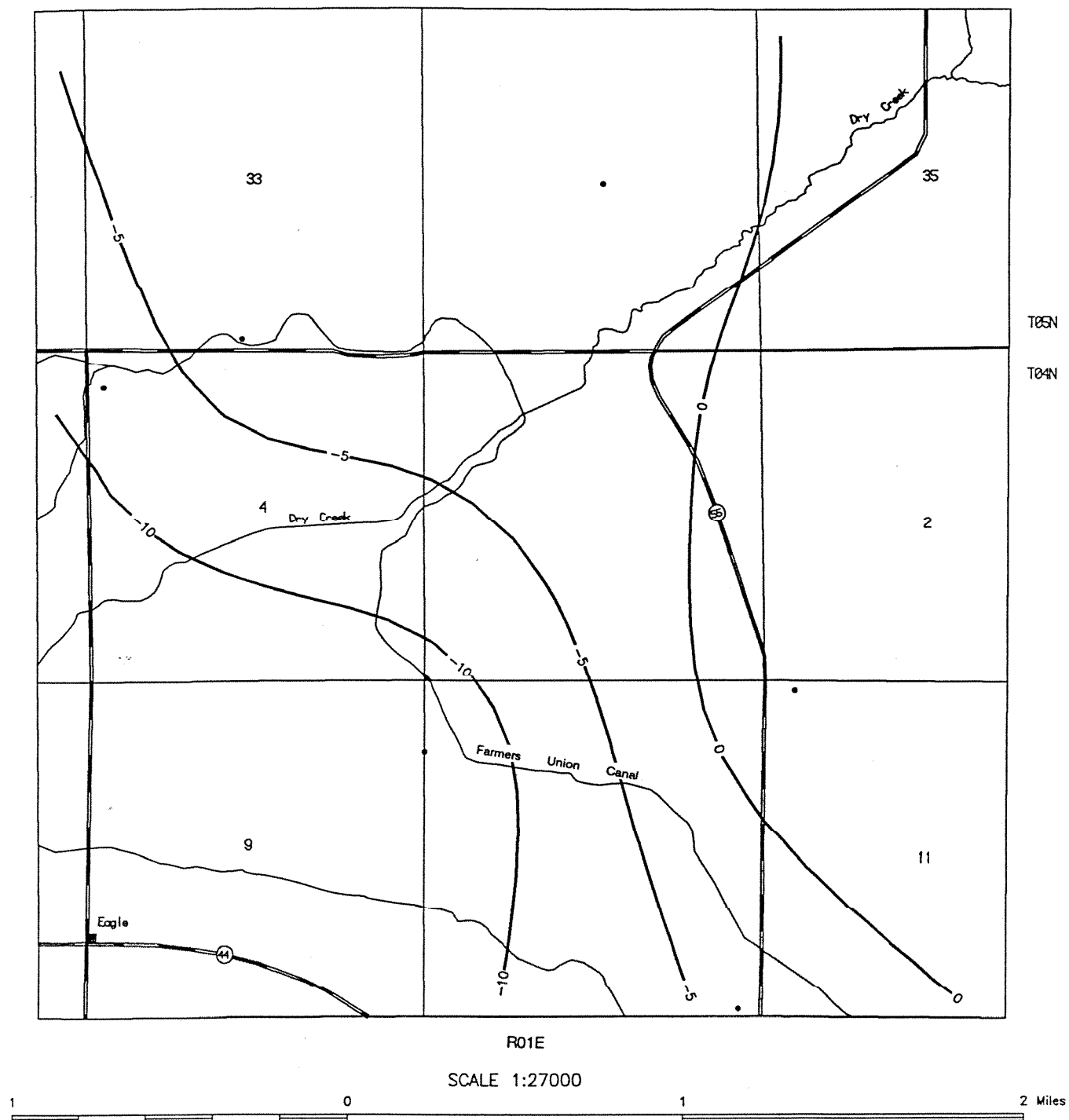


Figure 10. GENERALIZED WATER-LEVEL CHANGE MAP, FALL 1970-89

Ground-Water Hydraulics

Long-Term Aquifer Test

On March 26, 1991, a 30-day aquifer test was initiated at well 04N-01E-03CCC1 in order to determine the effects of pumping this well on the local ground-water system. The well was pumped continuously during the test at an average rate of 743 gallons per minute (gpm). Drawdown was measured in the pumping well along with several wells in the immediate area. A listing of the observed drawdowns in selected wells at the end of pumping is shown on Table 2. A brief summary and interpretation of the test results follows. For a more detailed discussion of the test, refer to the consultants' report (Feast, 1991) cited in the list of references.

Table 2. Observed drawdowns after pumping well 04N-01E-03CCC1 for 30 days

Well number	Distance from pumping well (ft)	Drawdown after 30 days of pumping (ft)	Remarks
04N-01E-03CCC1	--	81.0	--
03CCD1	800	3.84	--
10BAB1	1350	2.47	--
09ADA1	2300	1.04	--
04CDD1	3600	1.03	Wells pumping to the southwest of this well may have contributed to observed drawdown.
03DAD1	4900	--	No measurable effects were observed.
10AAA1	5000	--	No discernable effects were observed, however, measuring device inaccuracy may have contributed to this.

Conventional methods that are used to analyze aquifer tests and determine hydraulic properties of an aquifer system are not able to account for the complexities that were encountered during this test. These complexities include the following: 1) the high degree of stratification (layering) of the water-bearing material which greatly slowed the vertical movement of water to the pumping well and caused drawdown trends to steepen with time as delayed drainage gradually lessened; 2) lateral variations in sediment composition caused the cone of depression to be asymmetrical (that is, the cone was steeper but of less areal extent towards the area of low sand/clay ratio than it was in opposing directions at any given

time); and 3) two weeks into the test, water was diverted into Farmers Union Canal which provided recharge to the ground-water system late in the test.

Based on the early-time data acquired from the test (before the effects of the above complexities became significant), the hydraulic properties of the aquifer system were estimated. These data imply that the transmissivity (T) of the aquifer system in the vicinity of the pumped well is between 33000 to 92000 feet squared per day (ft^2/d) or 247,000 to 688,000 gallons per day per square foot (gpd/ft^2). The estimated storage coefficient (S) ranges from 6.4×10^{-4} to 8.4×10^{-2} . The reasons for the large range in S values is probably the result of delayed drainage of the cone of depression and the different depths that the observation wells are completed in the aquifer system. After sufficient time when the effects of the delayed drainage would have lessened, the aquifer system would probably have responded as an unconfined system and as a result have an S in the range of 10^{-2} to 10^{-1} . However, with all the complexities that occurred later in the test this theory can only be evaluated with a more sophisticated numerical model. Lack of data and limited time did not allow this approach to be tested.

Due to the factors that were encountered during this test, the reliability of predicting the long-term effects of pumping well 04N-01E-03CCC1 are extremely limited. However, assuming that steady-state conditions prevailed late in the test (in other words, observed drawdown trends would have remained unchanged with continued pumping), the following predictions were made. By extrapolating these late-time trends five more months into the future and adjusting the pumping rate for the anticipated long-term discharge rate of 1000 gpm, the configuration of the cone of depression was constructed and is shown on Figure 11. As can be seen, the cone is depicted as being symmetrical in shape when in actuality it probably is not. Limited information as to its actual shape required this simplification. As a result, estimated drawdowns may be less than what are shown in the area of low sand/clay ratio and greater in the opposing directions. Because of the uncertainty of what effects the cessation of artificial recharge at the end of the irrigation season would have had on the expanding cone of depression, it was not possible to extend the observed drawdown trends any further in time.

Well Interference versus Well Density

Many of the complaints that IDWR has received in the Dry Creek area concerning declining well yields have been concentrated in the foothills area. This type of problem is commonly related to greater pumping lifts that are caused by declining water levels. The poor water-bearing properties of the material in this area and close proximity of wells to each other probably contributes to this problem, especially late in the irrigation season.

DRY CREEK AREA

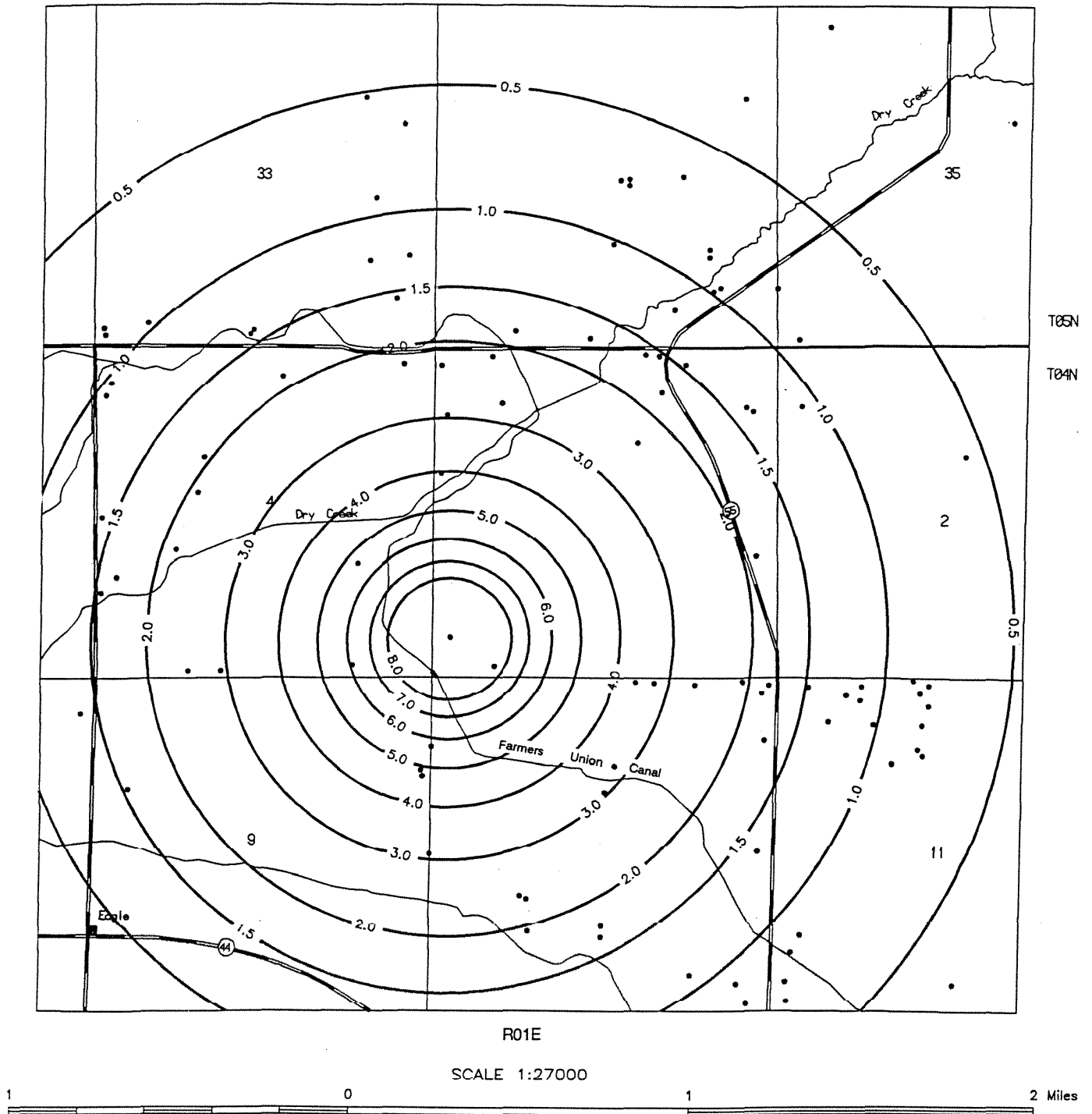


Figure 11. MAP SHOWING ESTIMATED DRAWDOWN FROM PUMPING WELL 04N-01E-03CCC1 AT 1000 GPM FOR 6 MONTHS

A hypothetical analysis of local well interference in this area was performed. According to surveyors' plats of subdivisions in this area, wells appear to be spaced about 250 ft apart from each other on the average. Most lots are thought to have at least one well. Based on well test data from Well Driller's Reports, T appears to average around 1000 ft²/d or 7500 gpd/ft². Since the aquifer system in this area is composed of thin sand stringers interbedded with massive clay layers, it most likely occurs under confined conditions with S ranging around 10⁻⁴.

Based on the above parameters, the cumulative effects of drawdown in a given well from 24 other equally-spaced wells pumping at the same rate are as follows. At the end of the irrigation season (approximately 180 days), each well pumping 1 gpm continuously would result in almost 4 ft of additional drawdown in a given well. During short-term but increased use the following effects were estimated. If each well is pumping 10 gpm continuously for 8 hours, the additional drawdown would be around 16 ft.

This analysis has shown that local well interference in the foothills area can significantly add to the observed well yield declines. Other factors, such as extended periods of below-normal precipitation, faulty well construction, and additional groundwater development in adjacent areas can also contribute to these more localized problems.

Well Construction Practices

Well construction practices vary greatly throughout the study area. The type of construction used to complete a well can greatly affect its life and efficiency. Due to the fine-grained nature of the water-bearing material in the area, the production of sand from wells can be a significant problem. Many wells in the area are completed with a minimum amount of casing. This causes a large portion of the hole to be unsupported and allows sediments to slough into a well. Over time, the yield of a well can decline because of the gradual loss of the amount of open interval in a well. Pumping sand can also cause excessive wear to a pump and require it to be serviced more frequently.

The best method of well construction to use in Dry Creek area to inhibit the sand production includes the following. Factory-wrapped well screen should be selectively set adjacent to each of the principal permeable zones encountered in the well. Blank well casing is then installed between each of the screened intervals. A gravel envelope should be placed in the annulus between the wall of the hole and the wall of casing adjacent to the screen intervals. Finally, the well should be completely developed before the well is put into use. This type of well is initially more expensive, but will be worth it over the long haul with the cost savings from the elimination of sand filters, well cleaning and/or deepening, and pump repairs.

A statistical comparison between well use and selected well characteristics was performed. The results of this analysis are shown on Table 3. The term specific capacity (SC) is defined as the yield of a well in gpm per foot of drawdown. Note the difference between each of the average specific capacities for domestic wells in the two topographic settings. The average SC for the lowlands is about double the value for the foothills. This means the average amount of drawdown in a domestic well located in the foothills is about twice that of a domestic well in the lowlands for a given discharge rate. Also notice the greater SC values for the irrigation and public supply wells in the lowlands than domestic wells in the same area. The reasons for this are probably related to the larger well diameters, greater depth of penetration into the aquifer system and more efficient well construction between the two groups.

Table 3. Comparison between use of well and selected well characteristics

Use of well and topographic settings	Average water level (ft)	Average total depth (ft)	Average open interval ¹ (ft)	Average yield (gpm)	Average specific capacity (gpm/ft)	Number of wells
Domestic						
Lowlands	50.2	124.9	23.6	30.8	4.4	221
Foothills	129.6	274.7	85.1	27.6	2.1	62
Irrigation						
Lowlands	64.4	188.5	53.4	177.4	10.0	17
Public supply						
Lowlands	58.6	301.1	54.1	340.0	13.9	7

¹ Includes all uncased, perforated, and screened intervals in a well

GROUND-WATER QUALITY

Limited information is available regarding the quality of the ground water in the Dry Creek area. A total of ten samples have been collected and analyzed from eight wells in the study area. The samples were acquired during various studies and/or time periods. One sample was collected during Nace and others' (1957) study, six others were taken for Dion's (1972) study, and the remaining three were obtained during miscellaneous visits to the area. The results of the analyses are shown on Table 4.

Ground water in the study area appears to be a calcium-sodium bicarbonate type. The water ranges from low to slightly mineralized and is moderately hard to very hard. No analyses of dissolved iron were performed on any of the samples. However, due to reports by well owners regarding red iron staining in laundry and plumbing fixtures, iron concentrations probably exceed 0.3 mg/L in some areas. The reasons for the hardness and high iron content in the ground water are probably from naturally occurring factors and are related to the mineral composition of water-bearing material.

The concentrations of most analyzed constituents are within the range of the recommended drinking water standards established by the U.S. Environmental Protection Agency (1976). Fluoride concentrations in well 05N-01E-35ACA1 was the only case where the recommended levels were exceeded. According to EPA, excessive levels of fluoride in drinking water supplies can produce objectionable dental fluorosis.

Table 4. Chemical analyses of water from selected wells
(All constituents reported in mg/L)

Well number	Sample date	Specific conductance (μ mhos/cm)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)
04N-01E-04B8C1	08/13/70	461	43	7.2	50	3.2	270	15	2.0	0.30	9.5
10AAA1	08/21/53	390	32	6.0	38	2.0	190	30	9.0	--	--
10BBC1	06/25/70	363	--	--	--	--	--	--	5.0	--	3.7
10DDD1	07/15/70	236	--	--	--	--	--	--	1.0	--	1.8
11BBB1	06/25/70	367	--	--	--	--	--	--	10	0.90	--
05N-01E-34DBB1	10/07/75	612	65	18	39	4.5	300	91	8.4	0.60	--
34DCD1	06/25/70	652	--	--	--	--	--	--	13	--	4.6
35ACA1	03/25/70	245	--	--	--	--	--	--	--	13	--
	05/31/72	285	4.3	0.10	57	3.2	110	23	4.9	11	--
	09/02/88	283	3.8	0.08	58	3.1	--	24	4.7	8.3	--

CONCLUSIONS

According to available information, it appears that the ground-water resources in the Dry Creek area are not currently over-developed. That is, the current annual discharge rate for the area does not appear to exceed the long-term annual recharge rate. However, the effects of further development of the ground-water system are uncertain and continued monitoring of water levels in the area is essential.

Local declines in the potentiometric surface have occurred, but available data indicate the amount of these declines have been minor in comparison to the saturated thickness of the entire aquifer system. Four consecutive years of drought have undoubtedly reduced the amount of recharge to the area and have caused water levels in wells to be lower. Due to the poor hydraulic properties of the aquifer system in the area of low sand/clay ratio (see Figure 2), well spacing appears to be a major factor in contributing to the declining well yields that have been experienced in this area. Faulty well construction practices have also added to well owners' problems throughout the study area.

RECOMMENDATIONS

The current observation well network in the Dry Creek area is inadequate to monitor the effects of continued development of the ground-water resources in the area. Another observation well should be located in the southwest portion of the study area where development appears to be most concentrated. Well 04N-01E-04CDD1 (see Figure 2) seems like a good candidate. It is an unused irrigation well that is about 300 ft deep. A Well Driller's Report does not appear to exist for the well, so little is currently known about its completion. Therefore, it would be extremely useful to have the well geophysically logged so that the open interval and nature of the water-bearing material can be determined. An arrangement should be made with the well owner, so the well can be used for monitoring for an extended period of time. This well could be added to the IDWR-USGS cooperative observation well network.

As more farm land is used for multi-family subdivisions, the increased demand on the ground-water system in the Dry Creek area is not the only change that would be imposed on it. A reduction in the amount of artificial recharge from unconsumed surface water could also result if surface water irrigation is not continued in these areas. Therefore, if development is allowed to expand, it is crucial that all economically-feasible steps be taken to continue the use of surface water for irrigation. This will also reduce the amount of ground water that is pumped.

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