GROUNDWATER CONDITIONS IN THE CITY OF SELMA GENERAL PLAN UPDATE 2035 AREA

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prepared for
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GROUNDWATER CONDITIONS IN THE CITY OF SELMA GENERAL PLAN UPDATE 2035 AREA

INTRODUCTION

Quad Knopf (2008) is preparing an Initial Study for the City of Selma General Plan Update for 2035. As part of this study, Kenneth D. Schmidt and Associates (KDSA) prepared this hydrogeologic evaluation of the plan area. The west boundary of the plan area is Armstrong Avenue. The north boundary of the area is Manning Avenue on the west and South Avenue on the east. The east boundary of the area is Bethel Avenue. The south boundary of the area is near Caruthers Avenue for the area west of Highway 99 and Mountain View Avenue farther east. Urban development is predominant in the area bounded by Dinuba Avenue on the north, Leonard Avenue on the west, Saginaw Avenue on the south, and Dockery Avenue on the east. Agricultural lands are predominant in the rest of the plan update area. Water for the City has been pumped from wells owned and operated by the California Water Service Co. (CWS). Water for irrigation is provided by the Consolidated Irrigation District (CID) from the Kings River and by pumpage from private irrigation wells.

EXISTING CONDITIONS

Subsurface Geologic Conditions

Page and LeBlanc (1969) described general groundwater conditions in the Fresno area, which includes Selma. Highly permeable alluvial deposits are present, and these are tapped by numerous water supply wells in the area. Prior to the 1980's, private domestic, city, and irrigation wells tapped deposits within the uppermost 350 feet of the alluvium, which is termed the Quaternary Older Alluvium. Somewhat finer-grained deposits are usually present below a depth of about 350 feet, and these are termed the Tertiary-Quaternary continental deposits. Starting in the 1980's, deeper CWS Selma wells began to be drilled, due to water quality problems with the shallow groundwater. These newer wells tap strata below a depth of 340 feet and above a depth of 650 feet.

As part of this evaluation, two subsurface geologic sections were developed (Figure 1). The first (Section A-A') extends from the northwest to the southeast, generally along Highway 99 (Figure 2). This section extends from a deep City of Fowler well near Parlier Avenue, to the southeast through three deep City wells, to a deep test well and deep supply well that are south of Mountain View Avenue. This section is oriented perpendicular to the inferred dip of the alluvial deposits, and thus the layers of deposits appear to be relatively flat. The color of the deposits above a depth of about 600 to 700 feet along this section is indicated to primarily be brown. Sand and gravel layers are common, and many clay layers are discontinuous along this section. One fairly continuous clay layer averages about 80 feet deep beneath the part of the section north of Nebraska Avenue. Another fairly continuous clay layer averages about 180 feet deep in the same area. A third fairly lat-

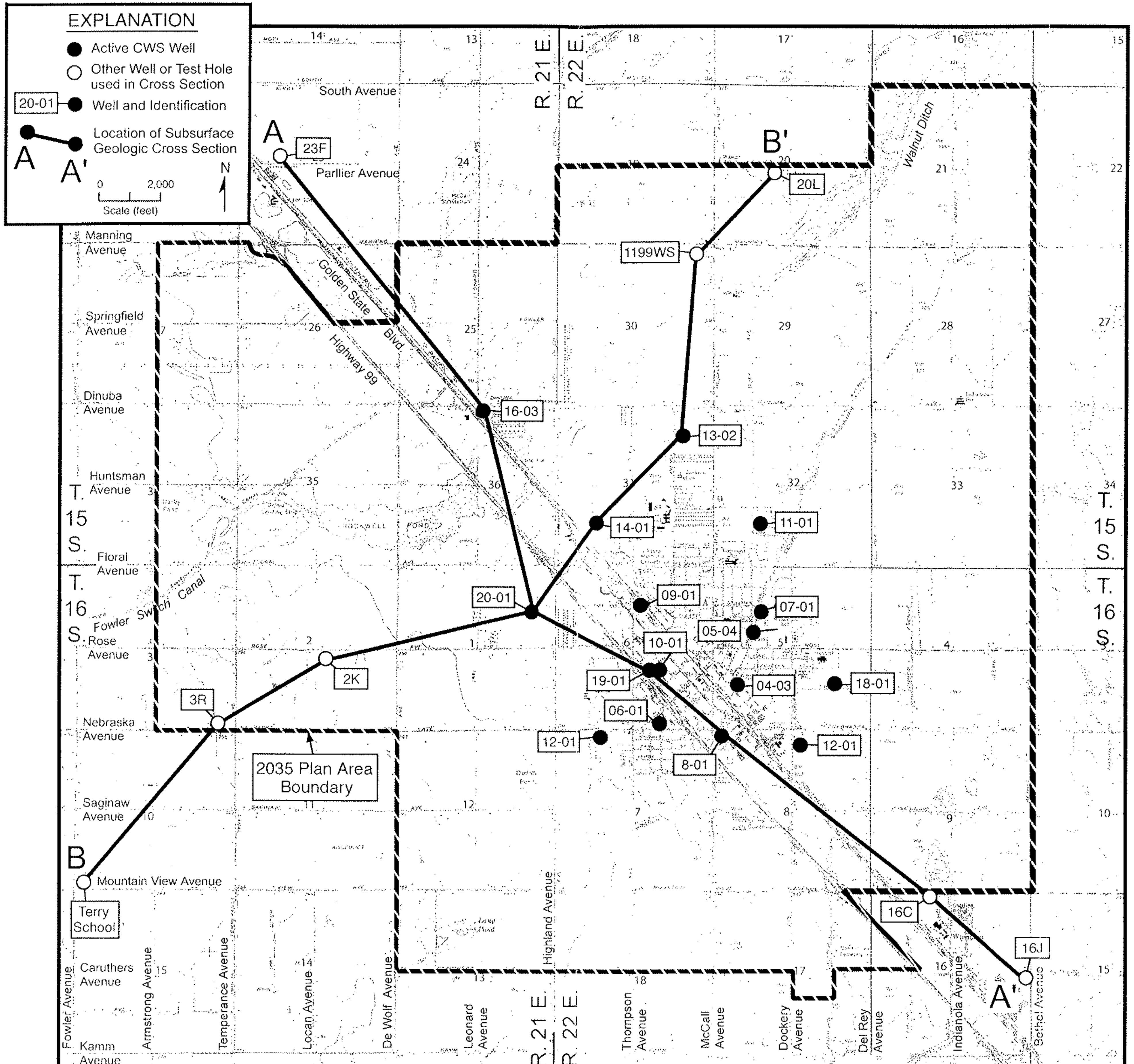

FIGURE 1 - LOCATION OF PLAN UPDATE AREA, ACTIVE CALIFORNIA WATER SERVICE CO. SELMA WELLS, AND SUBSURFACE GEOLOGIC CROSS SECTIONS

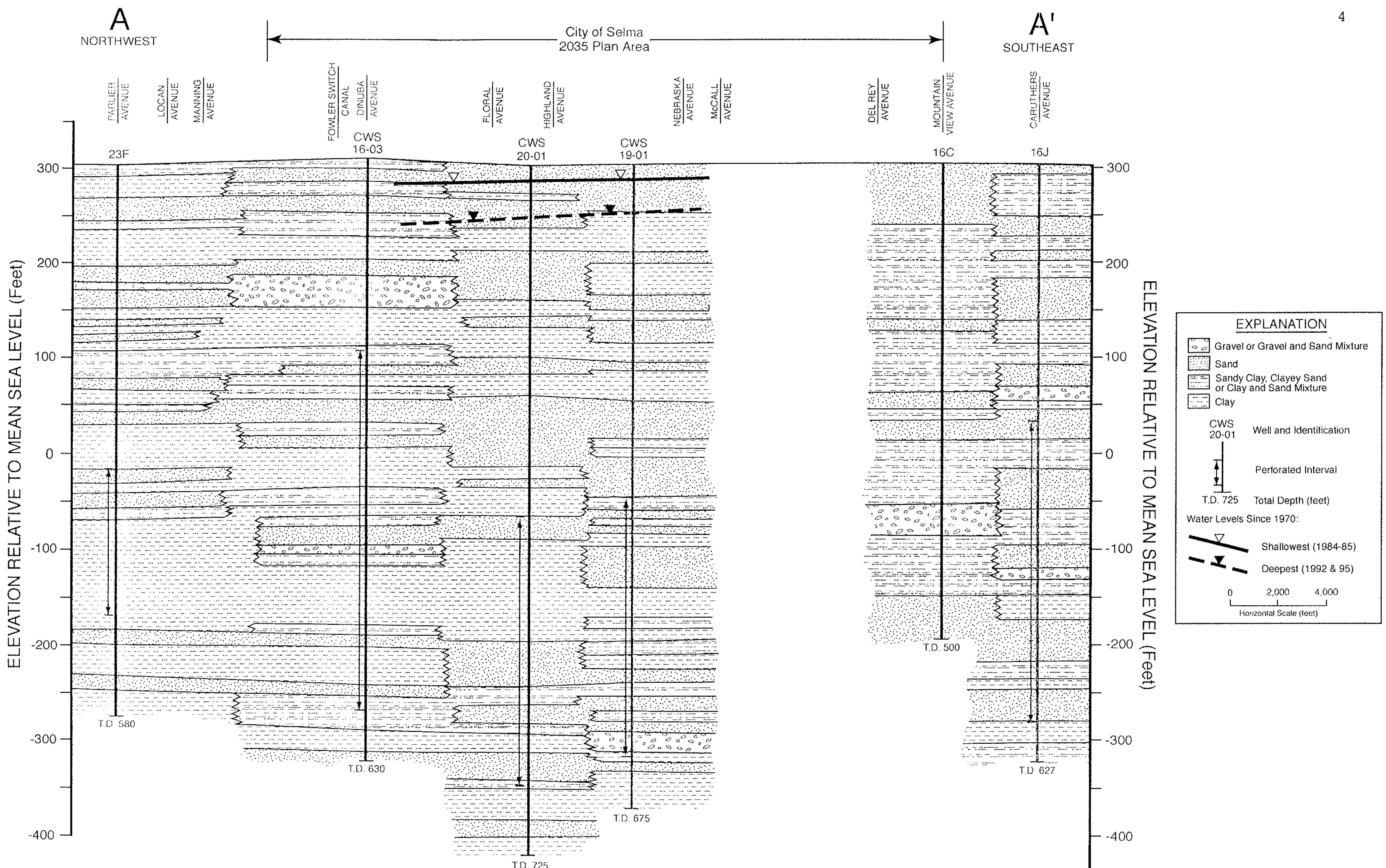

FIGURE 2 - SUBSURFACE GEOLOGIC CROSS SECTION A - A'

erally extensive fine-grained layer is at an average depth of about 300 feet along most of this section. This deep layer is indicated to be important in terms of groundwater quality, which is described in a later part of this report.

Cross Section B-B′ (Figure 3) extends from near Fowler and Mountain View Avenue, to the northeast through two deep CWS wells, thence further north-northeast through a moderately deep water system well, to near Parlier Avenue, east of McCall Avenue. This section is oriented along the inferred dip of the alluvial deposits, and the layers slightly dip to the southwest. Coarse-grained strata are also predominant above a depth of about 350 feet along this section. Apparently continuous clay layers are present at average depths of about 60 feet, 200 feet, and about 350 feet along most of the section. The deepest of these is indicated to be important in terms of groundwater quality. Fine-grained strata appear to be predominant below a depth of about 400 feet along this section. However, enough interbedded sand layers are also present that highly productive wells tapping only deep strata can be developed.

California Water Service Co. Selma Wells

Figure 1 shows the locations of 15 CWS Selma wells. Of these wells, 05-04 has been on standby and 12-01 was temporarily out of service. Table 1 provides construction data for these wells.

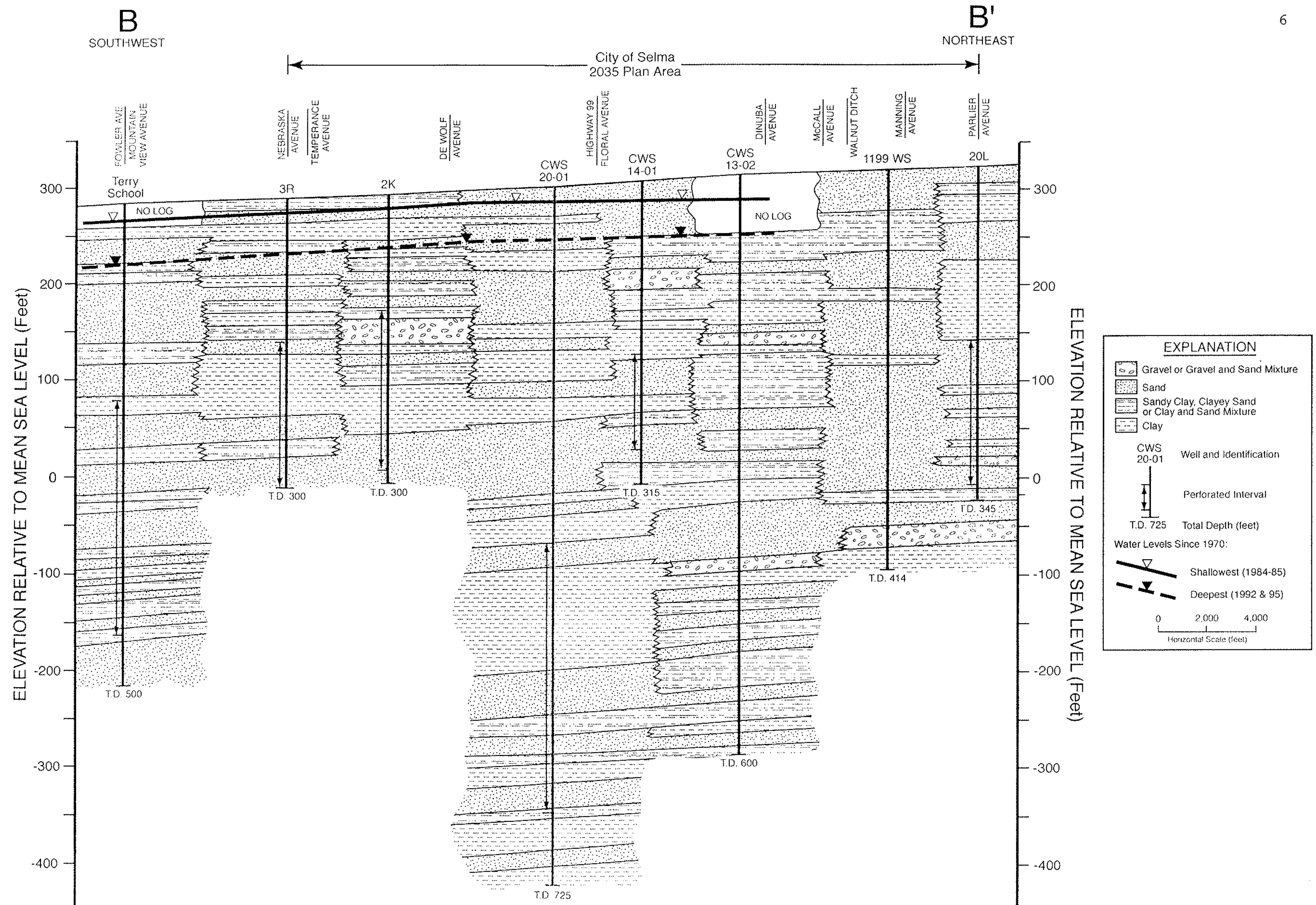

FIGURE 3 - SUBSURFACE GEOLOGIC CROSS SECTION B - B'

TABLE 1-CONSTRUCTION DATA FOR CALIFORNIA WATER SERVICE CO. SELMA WELLS

No.	Date Drilled	Total Depth (feet)	Cased Depth (feet)	Casing Diameter (feet)	Perforated Interval (feet)	Annular Seal (feet)
04-03	1955	264	225	14	O.B.	-
05-04	-	245	229	-	O.B.	-
06-01	1952	296	-	-	O.B.	-
07-01	1930's	211	208	14	O.B.	-
08-01	1934	242	228	12	O.B.	-
09-01	1949	212	172	14	O.B.	-
10-01	1950	330	290	14	O.B.	-
11-01	1956	300	287	16	O.B.	-
12-01	1961	382	376	16	O.B.	-
13-02	1983	600	560	14	340-560	0-300
14-01	1976	315	300	16	179-280	0-61
16-03	1987	602	582		380-582	0-350
17-02						
18-01	1992	610	570	16	340-570	0-320
19-01	1994	675	620	16	350-600	0-330
20-01	1999	725	675	16	375-650	0-350

Wells drilled prior to 1976 were drilled by the cable-tool method. O.B. is open bottom well. Wells in this table that were drilled after 1961 were drilled by the reverse rotary method, and are gravel packed. Data from well completion reports and files of CDOHS.

Wells drilled prior to 1976 were constructed by the cable-tool method, have non-perforated casings, and are open-bottomed. Wells drilled since 1976 were constructed by the reverse rotary method and are gravel packed. CWS Selma wells drilled prior to 1983 ranged from about 210 to 380 feet in depth. Five wells have been constructed since 1983, and these range in cased depth from 560 to 675 feet. These wells have annular seals ranging from 300 to 350 feet in depth.

Other Supply Wells

Most private domestic wells in the area are less than 200 feet deep and most irrigation wells are less than 300 feet deep. Some of the deepest private domestic and irrigation wells in the area range from about 300 to 400 feet in depth. Other relatively deep wells are in the City of Fowler, and for other water system or school wells. These wells range from about 410 to 620 feet deep.

Water Levels

Water levels in eight wells in or near the study area have been regularly measured since 1946. Table 2 provides water-level data for January 11, 2006. The water levels ranged from 46 to 60 feet deep on January 11, 2006 and were shallowest in two wells (T15S/R22E-32N1 and 33R1) in and east of the City. The deepest water levels on January 11, 2006 were in two wells along Fowler Avenue to the west (T15S/R21E-27D1 and T16S/R21E-15D1). Figure 4

TABLE 2-WATER-LEVEL DATA FOR JANUARY 11, 2006

Well Location	Land Surface Elevation (feet)	Depth to Water (feet)	Water-Level Elevation (feet)
T15S/R21E-27D1	302.3	53.9	248.4
-34N1	293.2	48.7	244.5
-35R1	315.0	47.5	267.5
T15S/R22E-32N1	309.0	46.8	262.2
-33R1	317.7	46.1	271.6
T16S/R21E-14A2	288.4	48.2	240.2
-15D1	282.2	59.9	222.3

Data from California Department of Water Resources.

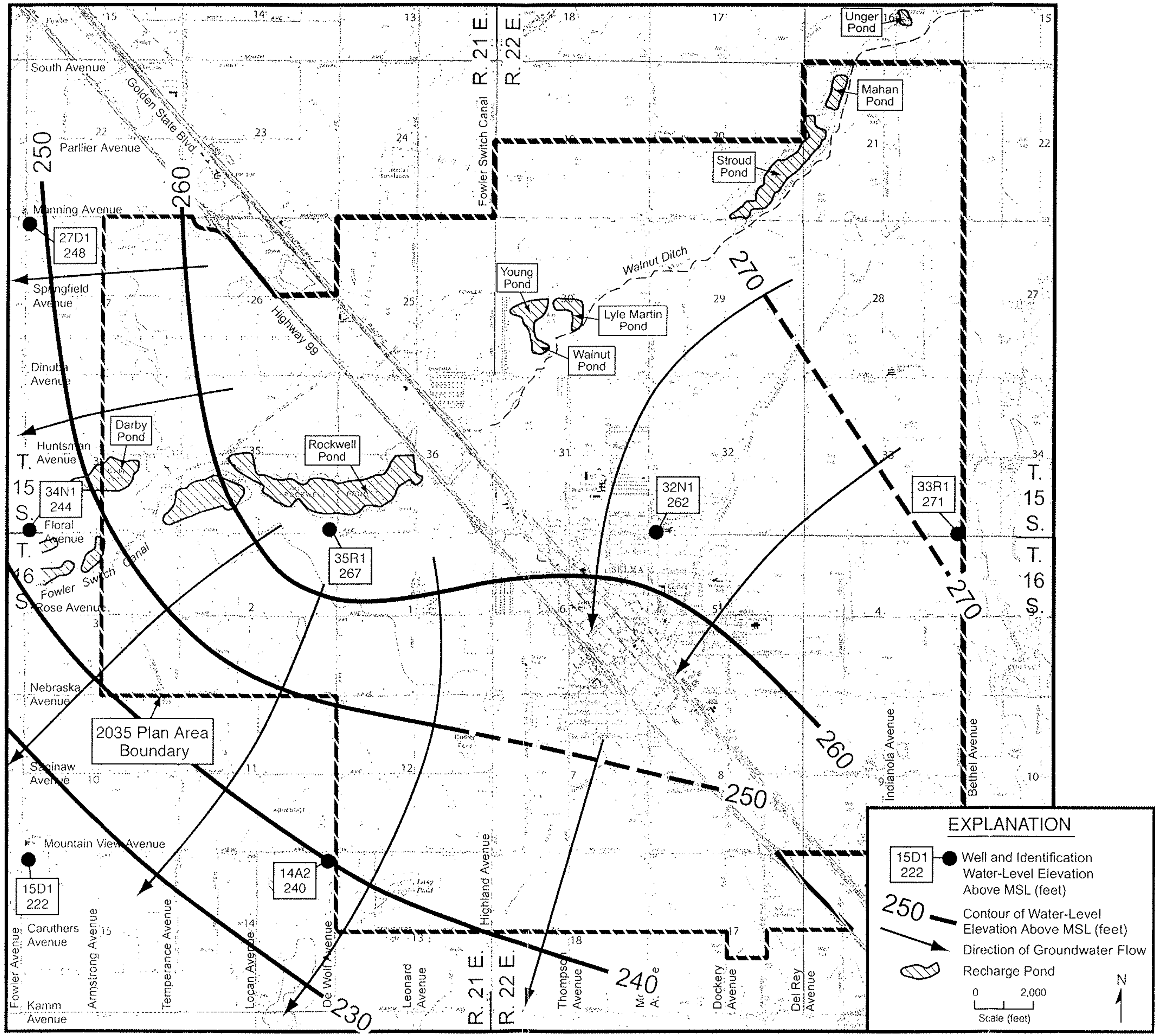

FIGURE 4 - WATER-LEVEL ELEVATIONS AND DIRECTION OF GROUNDWATER FLOW (JANAURY 11, 2006)

shows water-level elevations and the direction of groundwater flow for January 11, 2006. The highest water-level elevation was at Well T15S/R21E-33R1, east of the City, and the lowest was at Well T16S/R21E-15D1, to the southwest near Mountain View and Fowler Avenues. The direction of groundwater flow was generally to the southwest, and the influence of CID pond recharge was apparent, due to the curvature of the contours in the vicinity of these.

Water-level hydrographs were prepared for these eight wells and are provided in Appendix A. Figure 5 shows a water-level hydrograph for Well T15S/R22E-32N1, which is located near Floral and McCall Avenues. Since 1950, depth to water in this well has ranged from about 20 to 55 feet. The shallowest water levels (less than 30 feet deep) were in the 1940's and 1950's, 1969-71, 1973-74, 1980-87, and 1998-99. The deepest water levels (greater than 45 feet) were in 1977-78, 1991-95, and in 2005-06. Water levels in wells in the Selma vicinity rise and fall, largely depending on Kings River water deliveries to the CID. Since 1960, there has been an overall decline in the water levels in Well 32N1 averaging about 0.2 foot per year. Except for two wells near the west boundary of the plan area (T15S/R21E-27D1 and T16S/R21E-15D1), water-levels in the other wells in the plan area with long-term records have fallen an average of 0.3 foot per year since 1960. Water levels in Well 27D1 and 15D1 have fallen an average of 0.5 to 0.6 foot per year since 1960. There have been greater water-level declines

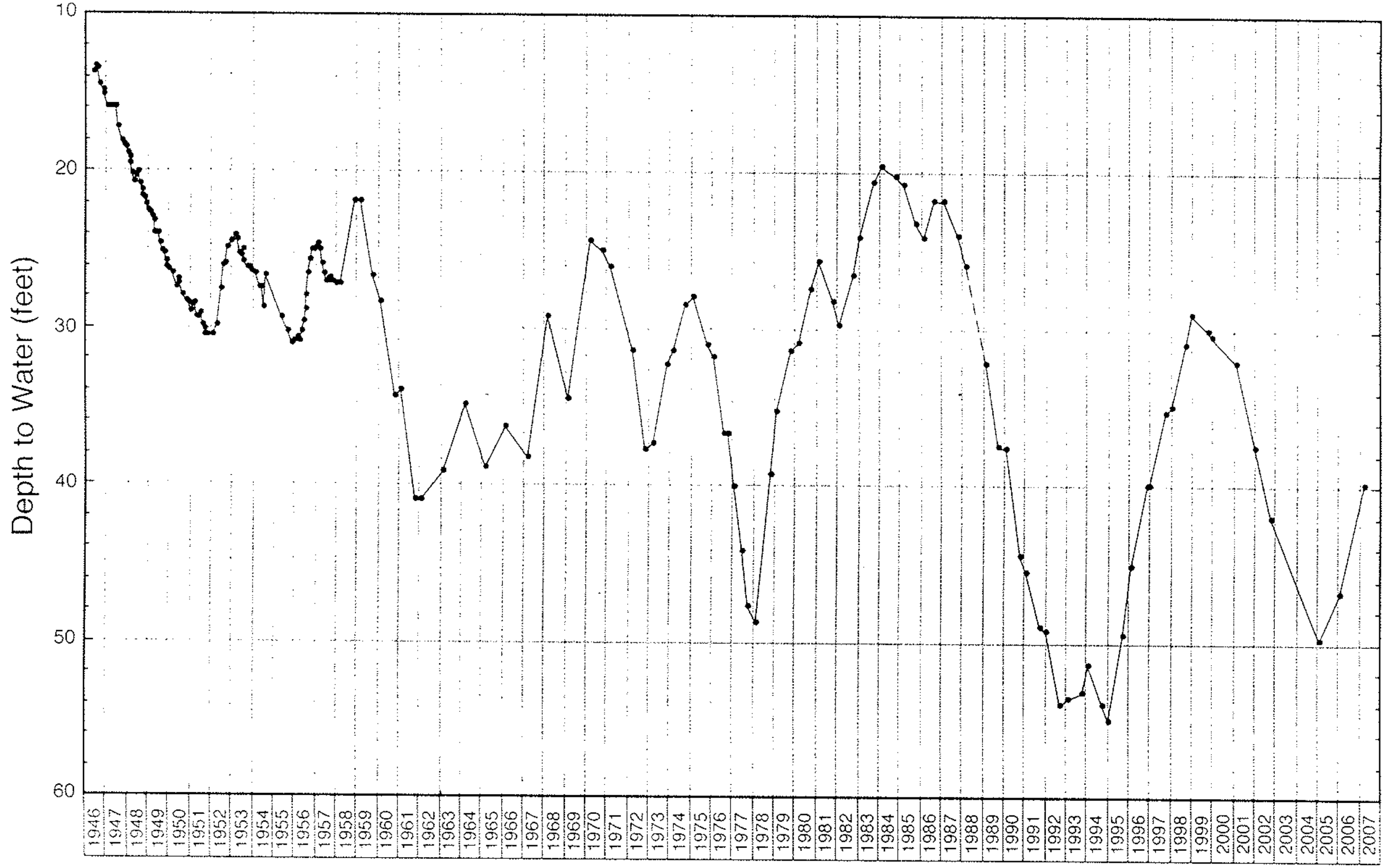

FIGURE 5- LONG-TERM WATER-LEVEL HYDROGRAPH FOR WELL T15S/R22E-32N1

in the area west and southwest of the plan area than farther east. There are a number of CID recharge ponds in the Selma area, and these have been used to recharge the groundwater, along with seepage from canals and deep percolation of applied canal water. According to Summers Engineering (2007), the average rate of water-level decline in the CID has been about 1.5 feet per year.

Well Production

Records of the California Department of Health Services (DOHS) indicate that operational pumping rates for most of the cable-tool drilled CWS Selma wells have ranged from about 500 to 800 gpm. For the deeper gravel packed wells, operational pumping rates have usually ranged from about 700 to 1,200 gpm.

Pumpage

DOHS records indicate that total CWS Selma water system pumpage in 2006 was about 6,300 acre-feet. This was for a total of 6,315 connections serving a population of about 24,000 residents.

There are several industries in the City of Selma that have their own wells for water supply. The annual pumpage from these is estimated to be about 500 acre-feet per year.

Recharge

Summers Engineering, Inc. (2002) described water supplies in the CID. The two main canals are the Fowler Switch Canal, which passes through the plan area near the northwest corner of the City, and the Centerville and Kingsburg (C&K) Canal, which passes through the east and south parts of the City. Canal water deliveries normally begin in April and end in mid-August. The CID conducts recharge to the groundwater by seepage from the canals and dedicated recharge basins. There is typically basin recharge when there are excess flows or flood releases in the Kings River. Plate D-1 of Summers Engineering shows locations of recharge ponds near Selma, and these are shown in Figure 4. Summers Engineering (2007) indicated that pond deliveries in the CID averaged about 31,000 acre-feet per year over the period of record. There is an estimated 20,000 acre-feet per year of canal seepage and pond deliveries during the irrigation season. In addition, Summers Engineering (2007) estimated that deep percolation losses from water applied to irrigated fields in the CID were about 30 percent.

Wastewater Flows

Data from the Selma-Kingsburg-Fowler County Sanitation District (SKFCSD) indicate a wastewater flow from Selma of about 3,000 acre-feet in 2008. The effluent is sent to a series of ponds south of Conejo Avenue, and most of it percolates (about 2,700 acre-feet per year from Selma) to the groundwater, while the remainder evaporates.

Groundwater Overdraft

Based on the water-level hydrographs for the eight wells in the 2035 plan area with long-term records, the average rate of water-level decline since 1960 has been about 0.35 foot per year. Using an estimated average specific yield of 0.15 for the shallow deposits, the amount of groundwater overdraft in the 2035 plan area has averaged about 800 acre-feet per year since 1960.

Groundwater Quality

In general, the quality of groundwater in most of the plan area has been suitable for public supply, except for DBCP and uranium in the shallow groundwater at some locations. Since 1983, new CWS Selma wells have been drilled to depths of at least 600 feet and the shallow groundwater sealed off. Other new water system wells have also been constructed in a similar manner.

Inorganic Constituents

Table 3 shows the results of analyses for selected constituents for water samples collected from shallower CWS Selma wells during 2007-08. Total dissolved solids (TDS) concentrations ranged from 136 to 260 mg/l. The lowest TDS concentrations (175 mg/l or less) were in water from Wells No. 05-03, 07-01, 11-01, and 14-01. The first three of these wells were near the C&K Canal, and the other was near the Walnut Ditch. The waters from this group of wells were of the calcium or calcium-sodium bicarbonate type, and

TABLE 3-CHEMICAL AND RADIOLOGICAL QUALITY OF WATER FROM SHALLOWER CALIFORNIA WATER SERVICE CO. SELMA WELLS

Constituent (mg/l)	No. 04-03	No. 05-03	No. 06-01	No. 07-01
Calcium	34	29	40	31
Magnesium	6	3	4	4
Sodium	21	22	27	18
Carbonate	<1	3	3	4
Bicarbonate	146	116	133	120
Sulfate	17	11	20	15
Chloride	16	12	30	13
Nitrate	13	8	16	11
Fluoride	0.1	<0.1	<0.1	<0.1
pH	8.2	8.1	8.0	8.2
Electrical Conductivity (micromhos/cm @ 25°C)	300	268	381	282
Total Dissolved Solids	220	136	224	172
Arsenic (ppb)	<2	1.9	1.1	<1
Iron	<0.1	<0.1	<0.1	<0.1
Manganese	<0.02	<0.02	<0.02	<0.02
Alpha Activity (pC/l)	8.9	3.6	7.1	6.5
DBCP (ppb)	0.15	0.05	<0.01	0.12
1,2,3-TCP (ppb)	<0.01	<0.01	<0.01	<0.01
Date	07/15/08	01/10/06	10/07/08	04/08/08
Perforated Interval (ft)	225 O.B.	229 O.B.	T.D.296	208 O.B.

Continued:

TABLE 3-CHEMICAL AND RADIOLOGICAL QUALITY OF WATER FROM SHALLOWER CALIFORNIA WATER SERVICE CO. SELMA WELLS (Continued:)

Constituent (mg/l)	No. 08-01	No. 10-01	No. 11-01	No. 14-01
Calcium	36	45	24	27
Magnesium	6	3	1	3
Sodium	23	33	20	21
Carbonate	<1	<1	4	4
Bicarbonate	183	305	93	115
Sulfate	11	29	18	12
Chloride	14	26	9	7
Nitrate	9	29	11	15
Fluoride	0.1	<0.1	<0.1	<0.1
pH	8.1	8.0	8.3	8.2
Electrical Conductivity (micromhos/cm @ 25°C)	300	400	225	263
Total Dissolved Solids	220	260	160	160
Arsenic (ppb)	<2	<2	<1	1.0
Iron	<0.1	<0.1	<0.1	<0.1
Manganese	<0.02	<0.02	<0.02	<0.02
Alpha Activity (pC/l)	5.9	3.1	3.5	5.5
DBCP (ppb)	<0.01	<0.01	<0.01	0.10
1,2,3-TCP (ppb)	<0.01	<0.01	<0.01	<0.01
Date	09/11/07	09/11/07	07/10/07	10/07/08
Perforated Interval (ft)	228 O.B.	290 O.B.	287 O.B.	179-280

Water from Well No. 14-01 is treated for DBCP removal prior to use. Analyses from CDOHS files.

pH values ranged from 8.0 to 8.3. Nitrate concentrations in water from these wells ranged from 8 to 29 mg/l, below the MCL of 45 mg/l. The lowest nitrate concentrations (15 mg or less) were from the wells with the lowest TDS concentrations. Concentrations of iron, manganese, and arsenic in water from these were well below the respective MCLs.

Table 4 shows the results of analyses for inorganic constituents in water samples collected from deeper CWS Selma wells during 2007-08. TDS concentrations ranged from 62 to 132 mg/l. Water from three of these wells (No. 17-02, 19-01, and 20-01) were less than 70 mg/l. The waters were of the sodium or calcium-sodium bicarbonate type and pH values ranged from 8.3 to 8.9. Nitrate concentrations in water from these wells ranged from less than 1 to 11 mg/l. Concentrations of iron and manganese were well below the respective MCLs. Arsenic concentrations ranged from about 2 to 5 ppb, below the MCL of 10 ppb.

Radiological Constituents

CWS Selma Well No. 15-01 is now inactive, but produced uranium concentrations near or exceeding the MCL. This well was perforated from 160 to 300 feet in depth. Table 3 indicates that alpha activities in water from the shallower CWS Selma wells ranged from about 3 to 9 picocuries per liter in 2007-08, below the MCL of 15 picocuries per liter. The highest alpha activities were generally

TABLE 4-CHEMICAL ANALYSES OF WATER FROM DEEPER
CALIFORNIA WATER SERVICE CO. SELMA WELLS

Constituent (mg/l)	No. 13-02	No. 16-03	No. 17-02	No. 18-01	No. 19-01	No. 20-01
Calcium	15	13	6	14	8	7
Magnesium	1	<1	<1	<1	<1	<1
Sodium	20	20	15	19	16	17
Carbonate	6	<1	6	7	7	8
Bicarbonate	79	70	67	60	46	54
Sulfate	9	<10	3	6	6	3
Chloride	5	13	2	15	7	3
Nitrate	11	8	<1	7	7	5
Fluoride	<0.1	<0.1	0.1	<0.1	0.1	0.1
pH	8.6	8.3	8.5	8.7	8.9	8.8
Electrical Conductivity (micromhos/cm @ 25°C)	173	160	100	161	133	116
Total Dissolved Solids	132	110	67	98	68	62
Arsenic (ppb)	1.6	<2	2.7	5.3	3.5	3.8
Iron	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	<0.01	<0.01	<0.01	0.01	<0.01	<0.01
Alpha Activity (pC/l)	2.3	<3.0	<3.0	<3.0	<3.0	<3.0
DBCP (ppb)	0.04	0.05	<0.01	0.02	<0.01	<0.01
1,2,3-TCP (ppb)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Date	10/16/07	07/29/08	12/09/08	01/09/07	12/14/07	03/06/07
Perforated Intervals (ft)	340-560	380-582		340-570	350-600	375-650

Analyses from CDOHS. No. 17-01 is a new well, not yet in service.

in wells with the shallowest perforations. Table 4 indicates that alpha activities in water from all of the deeper CWS Selma wells were less than 3 picocuries per liter.

Trace Organics

DBCP was applied in some irrigated lands in the eastern San Joaquin Valley to control nematodies, particularly for vineyards on sandy soils, until it was banned in 1977. CSUF (1994) evaluated the distribution of DBCP in the Kings Basin, which includes the project site. High DBCP concentrations in groundwater usually coincide with sandy topsoils, coarse-grained under-lying alluvium, and vineyards. DBCP in the groundwater has been found to be primarily above a depth of about 250 feet in the Selma area. Tables 3 and 4 also show DBCP concentrations in water from CWS Selma wells in 2007-08. DBCP was detected in water from four of the shallower CWS Selma wells at concentrations ranging from 0.05 to 0.15 ppb, below the MCL of 0.2 ppb. Water from CWS Well 14-01 is treated for DBCP removal. CWS Selma cable-tool wells that draw water from below a depth of about 290 feet appear to normally have had no detectable DBCP concentrations in the pumped water. DBCP concentrations in water from three deeper CWS Selma wells were non-detectable (Table 4). Water from the other three of the deeper wells had DBCP concentrations ranging from 0.02 to 0.05 ppb, below the MCL.

Summary

The quality of groundwater below a depth of about 300 feet and above a depth of about 700 feet beneath the City of Selma plan area appears to be excellent for public supply. Shallower groundwater is generally of suitable quality for irrigation use.

Existing Water Budget

Urban

CDOHS records indicate that pumpage from CWS Selma wells was 6,300 acre feet in 2006, or an average of about 2.6 acre-feet per acre per year for the 2,400 acres in the City limits. There is an additional estimated pumpage of 500 acre-feet per year from several industries in the City of Selma. Information from the SKFCSD indicates a dry weather wastewater influent amount from the City of Selma of 2,600 acre-feet in 2008. The estimated outdoor water use in the City was thus about 3,700 acre-feet per year. Assuming an average irrigation efficiency of 60 percent in the urban area, the consumptive use of applied water in the urban area would be about 2,200 acre-feet per year, or about 0.9 acre-foot per acre per year.

Information on SKFCSD effluent ponds evaporation and percolation is submitted by the SKFCSD to the Regional Water Quality Control Board on an annual basis. Of the City of Selma contribution to wastewater effluent from the SKFCSD WWTF, an estimated 200 acre-feet per year (rounded), has been lost to pond evaporation, when the ponds have been allowed to gradually plug. Thus the total consumptive use for the City of Selma was about 2,400 acre-feet per year, or about 1.0 acre-foot per acre per year. In 2009 the percolation ponds were deep ripped, and after this was completed, the pond water surface area decreased from about 110 acres to 15 acres (Ben Munoz, person communication). Thus infiltration rates from the ponds can be increased and evaporation rates decreased in the future by periodic maintenance. Recharge of storm water in the City hasn't been exactly determined, but is estimated to be less than 100 acre-feet per year.

Rural

Summers Engineering (2007) summarized canal water deliveries in the CID. The CID delivers an average of 239,000 acre-feet per year of water to 95,000 acres in the CID. Assuming that two-thirds of the 9,900 irrigated acres in the plan area were provided canal water by the CID (based on the District-wide average), the canal water delivery to the plan area would average 15,000 acre-feet per year. According to Summers Engineering (2007), the CID recharges an average of about 51,000 acre-feet per year in recharge ponds and canals in the District. An estimated 500 acres of these ponds are in the 2035 plan area. The estimated recharge from the ponds and canals in the plan area averages about 10,000 acre-feet per year.

Aerial photos were reviewed for the 2035 plan area. The part of this area east of Locan Avenue was covered by a photo for August 20, 2004, and the part of the area to the west was covered by a photo of March 30, 2007. The plan area encompasses about 15,200 acres of land. Of the land, a total of about 9,900 acres was irrigated, 3,100 acres were urban, 500 acres were recharge basins, and 1,700 acres were idle land, agricultural residences, and ancillary land in the rural area.

Based on a review of these aerial photos, there were about 8,040 acres of vineyards, 1,540 acres of deciduous orchards, and 400 acres of other irrigated crops in the 2035 plan area (based on the November 2008 preferred alternative map). Using California Department of Water Resources Bulletin 113-3 values for evapotranspiration of applied water by crops, the consumptive use of applied water in the 2035 plan area was 21,000 acre-feet per year. The average consumptive use in the rural area was thus 2.1 acre-feet per acre per year, or about twice the estimated urban consumptive use (including evaporation of the City's share of sewage effluent from SKFCSD ponds). Using an estimated irrigation efficiency of 60 percent, the applied water requirement for irrigation in the plan area would be about 35,000 acre-feet per year. If an average of 15,000 acre-feet per year of irrigation water has been delivered in this area from canals, then the groundwater pumpage for irrigation in this area has averaged about 20,000 acre-feet per year.

In the CID as a whole, canal water deliveries (for irrigation and recharge) have been less than the crop consumptive use and the groundwater outflow to the west. This is demonstrated by the history of water-level declines shown by water-level hydrographs for numerous wells in the District. The larger water-level declines aren't associated with urban areas, rather they are associated with pumpage for agricultural irrigation, both in and west of the CID. Average rates of water-level decline in the City of Selma plan area have been much less than the reported average decline in the CID.

Using an average water-level decline in the 2035 plan area of about 0.35 foot per year since 1960, and a specific yield of about 0.15 for the shallow deposits, the average annual groundwater overdraft in the plan area has been about 800 acre-feet per year.

IMPACTS OF DEVELOPMENT OF PLAN AREA ON GROUNDWATER

Based on the November 2008 preferred alternative 2035 plan area, about 14,700 acres of land would be urban (excludes CID canals and recharge ponds). California Water Service (2006) estimated the water requirement for year 2030 would be about 27,600 acre-feet per year. If groundwater pumpage alone is used to supply the urban demand for the 2035 planning area, the increased pumpage would be about 8,000 acre-feet per year compared to existing conditions. There would be an estimated urban consumptive use of about 15,000 acre-feet per year under full development of the 2035 plan area. This would be about 13,000 acre-feet per year less than the estimated present consumptive use in the plan area. The amount of wastewater generated in the plan area would be about 13,000 acre feet per year. If all of this was exported out of the plan area, there would be an average water deficit of about 15,000 acre-feet per year in the plan area. If the canal water formerly used for irrigation in the 2035 plan area (15,000 acre-feet per year) were used or recharged in the 2035 plan area under full development, then the deficit would be eliminated. If the 10,000 acre-feet of additional wastewater was used or percolated in the plan area, this would reduce the deficit significantly.

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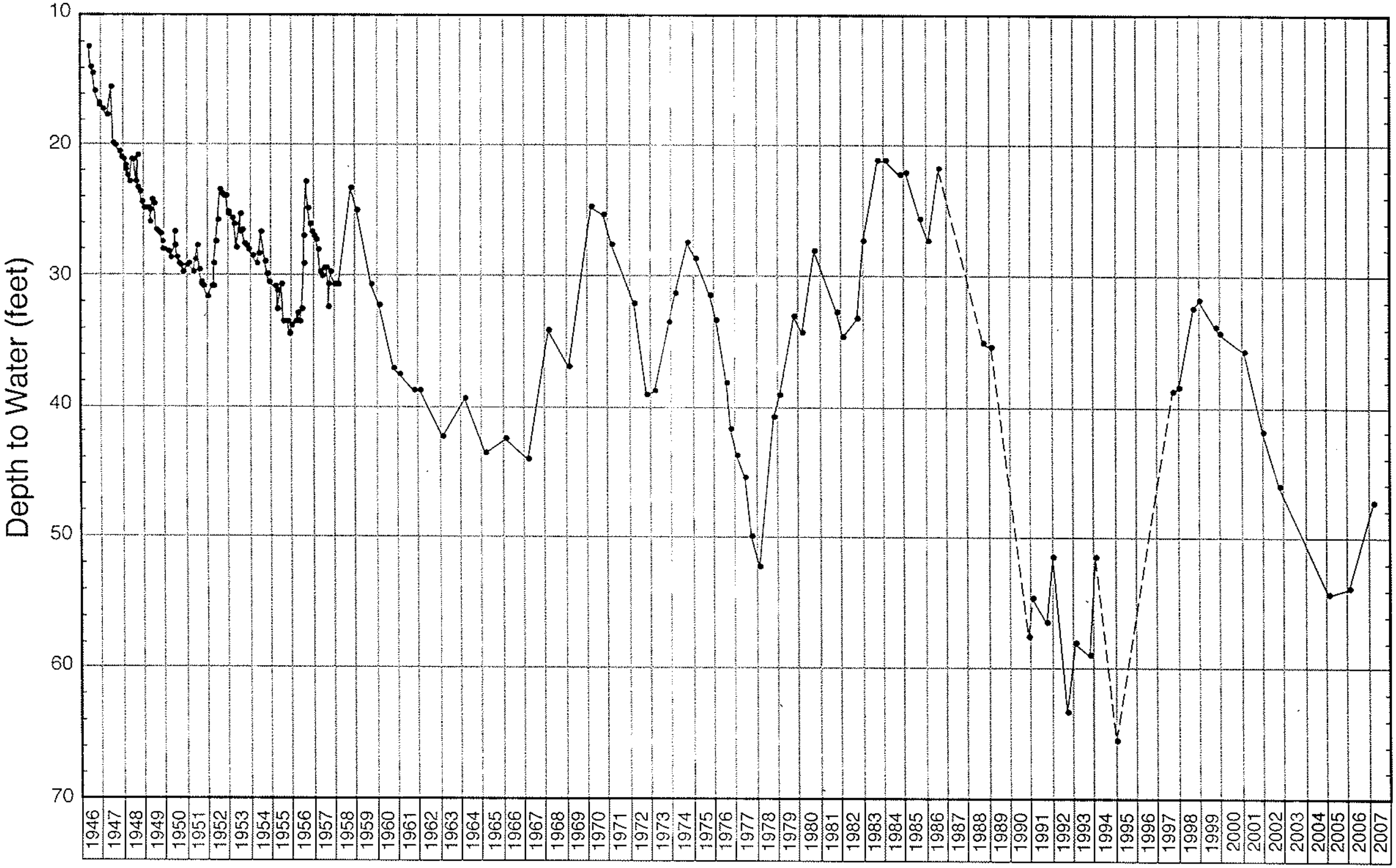
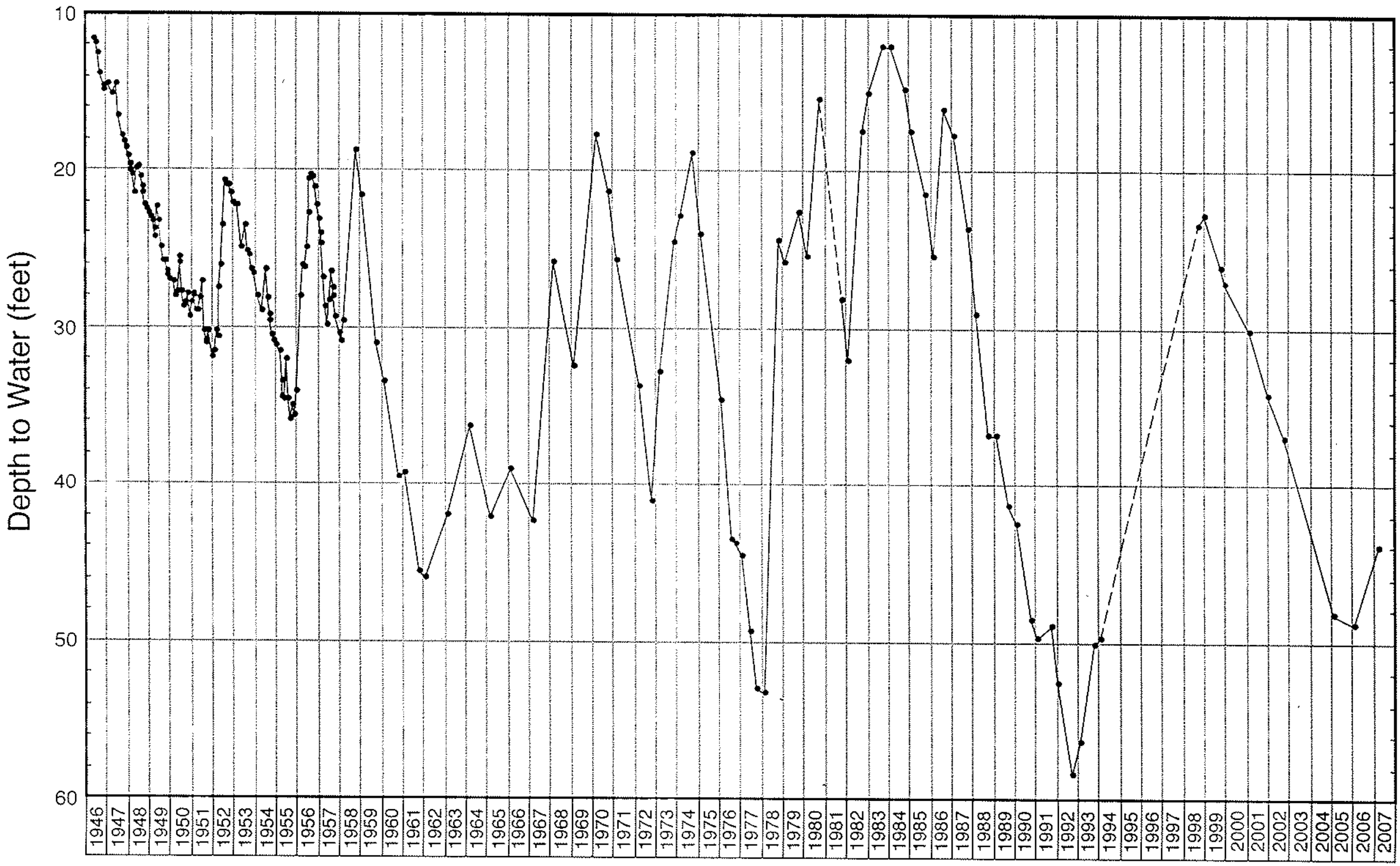
APPENDIX A

WATER-LEVEL HYDROGRAPHS



LONG-TERM WATER-LEVEL HYDROGRAPH FOR WELL T15S/R21E-27D1



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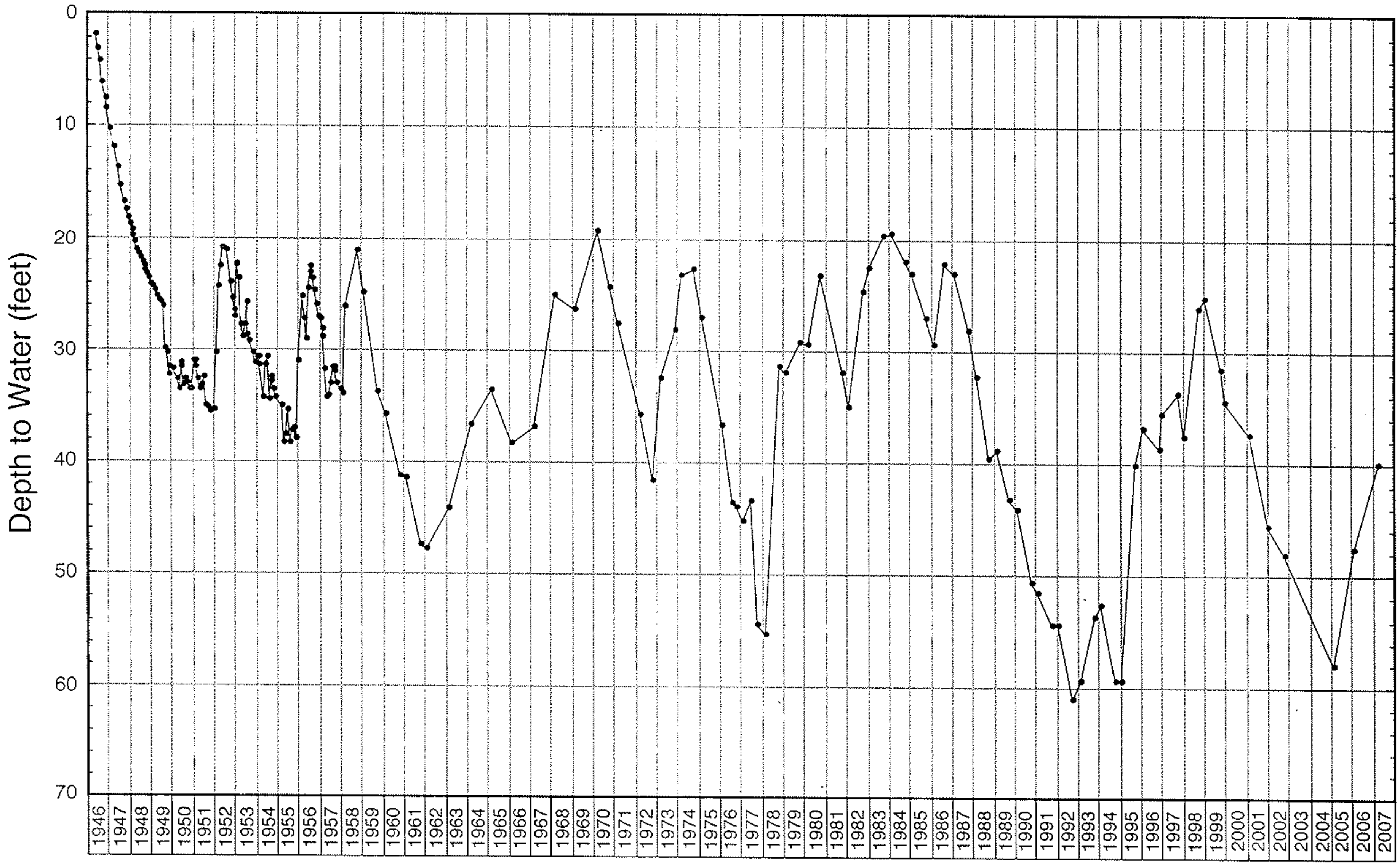

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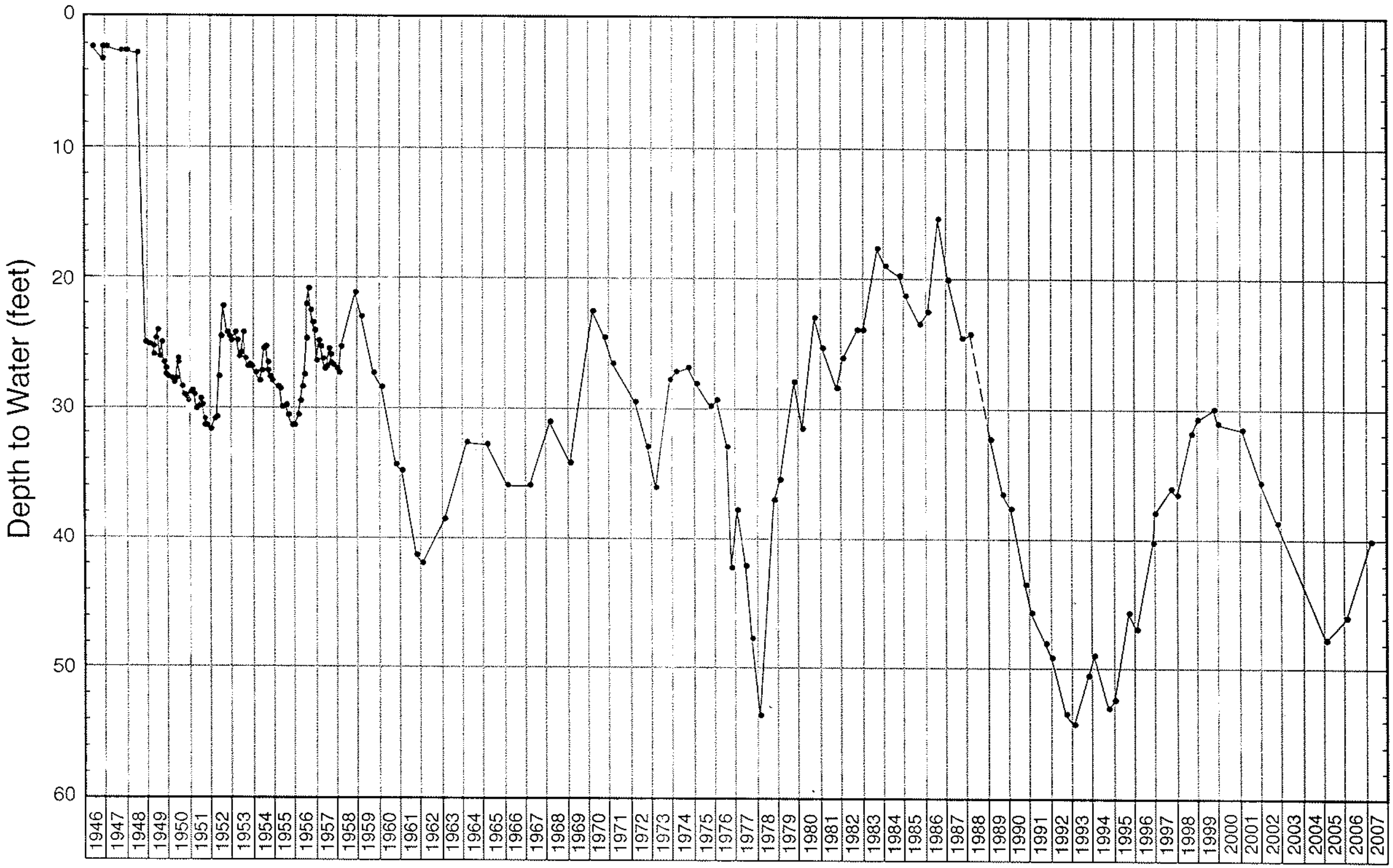

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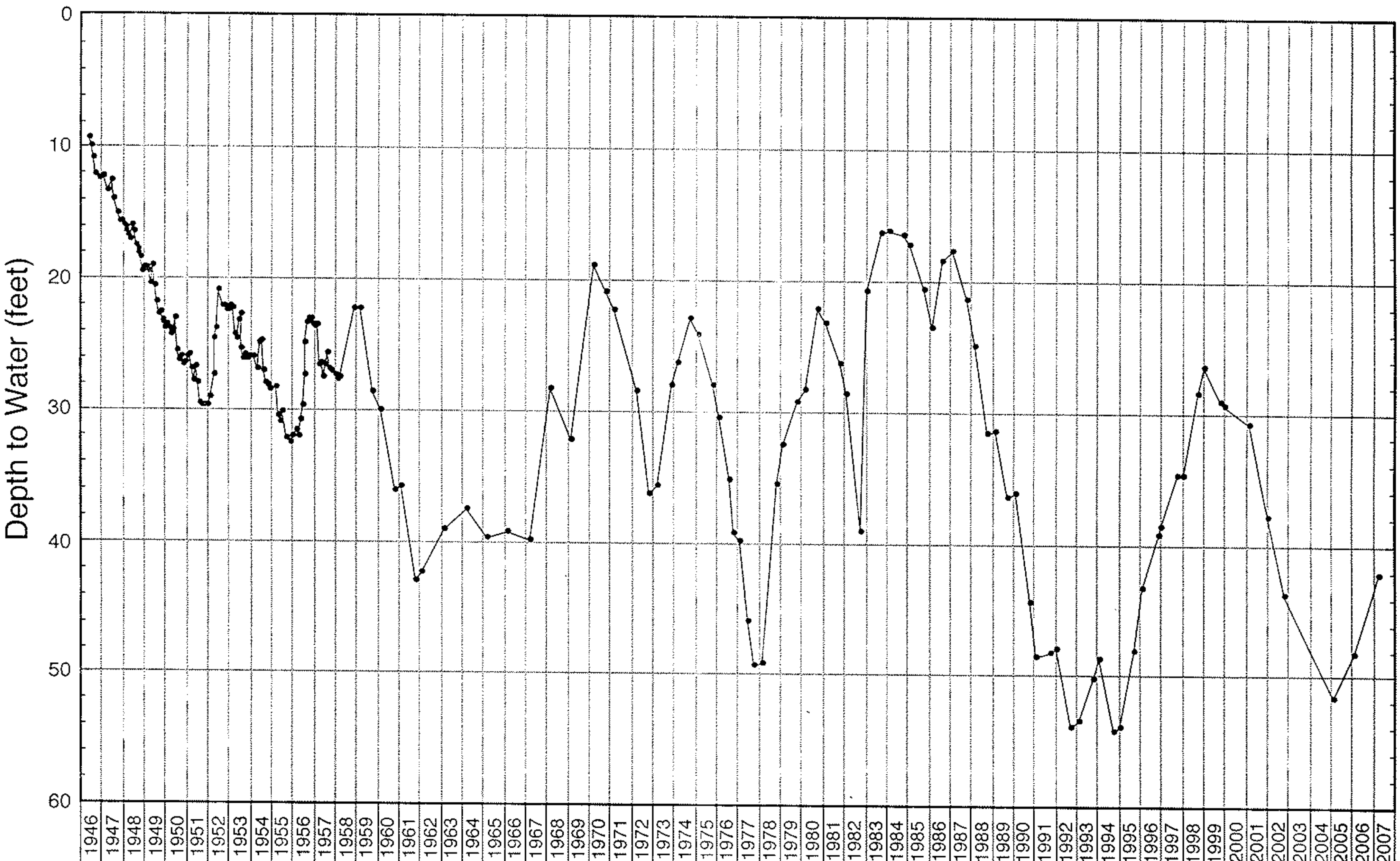
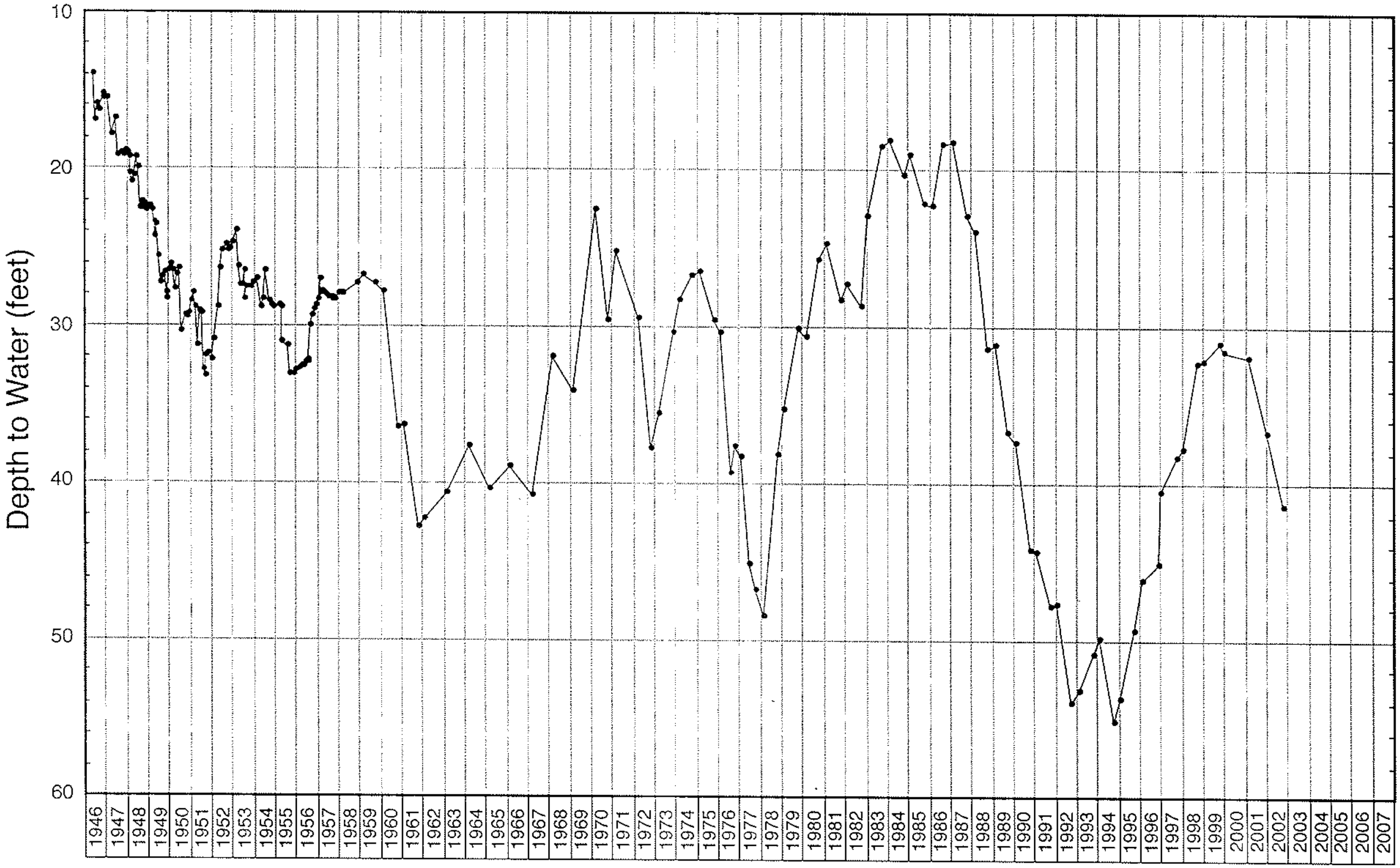
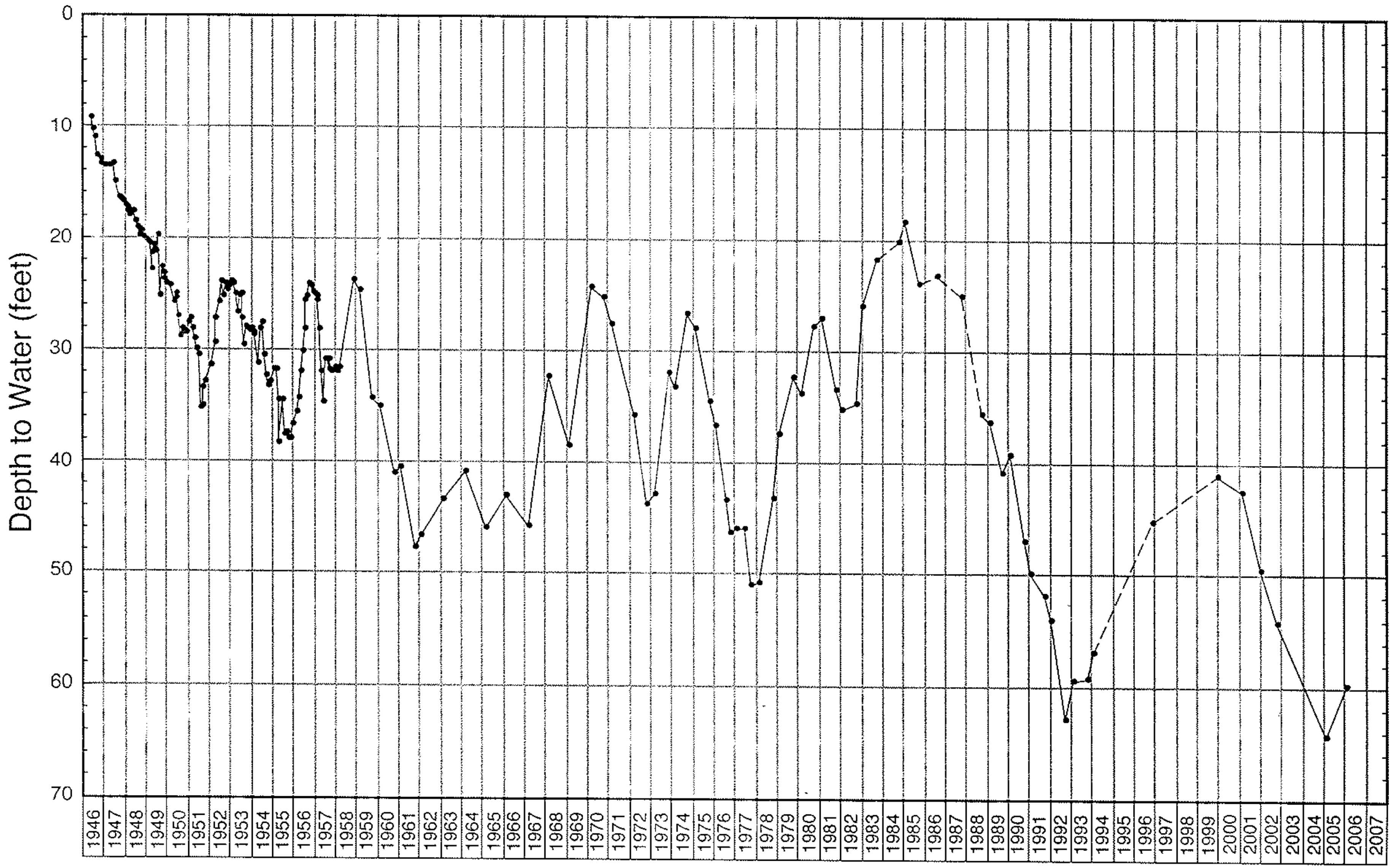


LONG-TERM WATER-LEVEL HYDROGRAPH FOR WELL T16S/R21E-14A2



LONG-TERM WATER-LEVEL HYDROGRAPH FOR WELL T16S/R22E-18A1



LONG-TERM WATER-LEVEL HYDROGRAPH FOR WELL T16S/R21E-15D1