EVAPORATION BASIN REPORT

SUNDESERT NUCLEAR PLANT
SAN DIEGO GAS & ELECTRIC COMPANY
SAN DIEGO, CALIFORNIA

JUNE 1976

STONE & WEBSTER ENGINEERING CORPORATIO
BOSTON, MASSACHUSETTS

DUPLICATION TAB

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earthquake would produce a maximum horizontal acceleration at the site of 0.35 g (35 percent of the acceleration due to gravity).

3.4 FAULTING

Based on detailed geologic field mapping, extensive trenching, and downhole geophysical logging of 51 borings drilled to an average depth of 500 feet, it has been shown that faulting within the Blythe site area is confined solely to the bedrock-basement complex. Pliocene to Holocene sediments are essentially flat-lying and unfaulted throughout the site area. Correlations of downhole geophysical logs indicate that seven lithologically and geophysically distinct subsurface zones are readily traceable across the site. No evidence was found for tectonic disruption of the subsurface deposits. The nearest capable fault is located 18 miles west of the plant site and has a maximum length of 8 miles.

3.5 SURFACE HYDROLOGY

The Blythe site is located within the Colorado River drainage basin, which encompasses portions of Wyoming, Utah, Colorado, New Mexico, Arizona, Nevada, and California. The flow of the Colorado River is almost completely controlled by storage

facilities constructed and operated by the U.S. Bureau of Reclamation and the U.S. Army Corps of Engineers. In the site area, the mean annual flow of the Colorado River is approximately six million acre-feet. Since this flow is controlled, the floodplain east of the site is not subject to inundation due to any foreseeable hydrological event.

Figure 3-4 shows the topography of the site area and the boundaries of the site watershed. Figure 3-5 is an air photo mosaic of the site area. The site watershed receives about 4 inches of precipitation per year, usually as intense rainfall during thunderstorms. Most of the runoff from the western part of the watershed flows towards the large, well-established washes north and south of the site, and, therefore, only a portion of the overland flow is directed toward the site. Alternative methods for diverting the overland flow around the station and the evaporation basin include combinations of dikes and/or channels to be located west of each facility. Design of runoff diversion and erosion control systems is in progress and will be presented in the Environmental Impact Report.

3.6 GROUNDWATER HYDROLOGY

Groundwater in the lower Colorado River region is found in the broad intermontane basins and beneath the floodplain of the Colorado River. The basins have ephemeral surface drainage, and the groundwater in the basins is recharged principally by infiltration of runoff during infrequent storms. As shown in Figure 3–2, groundwater in McCoy Wash, Chuckwalla Valley, and Milpitas Wash flows toward the Colorado River flood plain. The aquifer beneath the Colorado River flood plain is the major source of groundwater in the site vicinity. The river and adjacent irrigation networks recharge this aquifer. Groundwater beneath the floodplain and immediately adjacent areas flows generally toward the south in the direction of the river flow (see Figure 3–2).

Figure 3–6 shows the irrigation system and water well locations in the Palo Verde Valley. There is a concentration of wells on Palo Verde Mesa approximately 10 miles north of the preferred site. In 1973, these wells withdrew approximately 26,000 acre-feet of groundwater for irrigation of citrus orchards. The nearest domestic well is three miles southeast of the site in the town of Palo Verde.

The hydrogeology of the site and surrounding area is illustrated in Figure 3–7 and Figure 3–8. The cross sections are based on information obtained from the geologic literature, well logs, field mapping, and 51 borings drilled to an average depth of 500 feet in the plant area. The hydrogeologic units are listed below and are discussed in order of ascending stratigraphic position.

Deposit	Age
Basement (Kmv)	Cretaceous
Bedrock Volcanics (Tv)	mid-Tertiary
Bedrock Fanglomerate (Tf)	Miocene to Pliocene
Bouse Formation (Tb)	Pliocene
Alluvial Deposits of (QTc) - QTfa the Colorado River QTrb and its Tributaries Qre Qrd	Plio-Pleistocene
Surficial Deposits (Qal, Qf)	Holocene

The basement consists of Cretaceous granites and metamorphics (Kmv) which are intruded by Tertiary volcanics (Tv). The volcanics vary in composition from basalt to rhyolite and occur as plugs, flows, dikes, breccias, and local tuff deposits. The granites, metamorphics and volcanics form the floor of the valley and act as an impermeable barrier to the downward migration of groundwater.

Unconformably overlying and interbedded with the volcanics are fanglomerates (Tf). These are alluvial fans of Miocene-Pliocene age, comprised of well-cemented, well-stratified, poorly sorted sand and gravel. The fanglomerates yield little or no water to wells except where interstitial cement has been leached in the upper zone. Transmissivity values derived from two pumping tests in the fanglomerate were less than 100 gallons per day per foot (gpd/ft) and 12,000 gpd/ft. Metzger, et al.[2] Regionally, artesian conditions prevail throughout most of the fanglomerates where confined by the Bouse Formation.

The marine Bouse Formation (Tb) rests unconformably on the fanglomerates. The Bouse Formation averages 500 feet in thickness and consists of a basal marl overlain by an interbedded sequence of sand, silt, and clay. Together, the basal marl and lower part of the interbedded unit form an aquitard, which

confines the groundwater stored in the underlying fanglomerate. The upper part of the interbedded unit is comprised of fine sand which stores and transmits enough water to be considered an aquifer. Water well data in Parker Valley indicate transmissivities as high as 50,000 gpd/ft in the upper zone.

Overlying the Bouse Formation are alluvial deposits of the Colorado River and its tributaries (QTfa, QTrb, Qrd, Qre). These units are grouped as QTc in Figure 3-7. Unit QTfa is an alluvial fan deposit composed of moderately to well-consolidated, crudely stratified coarse sand and angular to subrounded clasts of volcanic rocks.

Unit QTfa is overlain by fluvial deposits of the Colorado River. The QTrb deposits are two distinct subunits or facies, separated by an erosional unconformity. QTrb1 is composed of a thick sequence of silt and clay and probably represents backwater deposits of the Colorado River. QTrb2 consists of light brown to red silty sand and attains a thickness of 250 feet immediately east of the plant site.

Intermediate age fluvial deposits (Qrd) are composed of red-brown to brown sand, silt, and lesser amounts of clay with minor lenses of sub-angular to rounded pebbles. The deposit is well-bedded,

well-sorted, moderately consolidated, and in places partially indurated by calcium carbonate. Qrd deposits are extensively exposed along the bluff of the Palo Verde Mesa and occur up to 200 feet above the present flood plain.

Unit Qre is a gray to light brown medium sand with minor pebble gravel. The sand is unconsolidated, well-sorted, well rounded, and cross-bedded. The gravels contain predominantly well-rounded clasts of foreign rock types. This unit was deposited as the Colorado River degraded from an earlier, higher depositional level.

The alluvial deposits (QTfa through Qre) are quite extensive throughout the region, underlying the mesas flanking the flood plain and comprising over 400 feet of fill near the middle of Palo Verde Valley. These units constitute the principal aquifer in the region, with transmissivity values ranging from 64,000 gpd/ft in the less permeable zones to 1,700,000 gpd/ft in the coarse sand and gravel layers.

Holocene surficial deposits, consisting of young alluvial fan deposits (Qf) and fluvial deposits (Qal), are exposed over much of the site area. The Qf deposits consist of poorly consolidated to unconsolidated mixtures of fine to coarse sand, with lesser

amounts of angular to well rounded pebbles, cobbles, silt, and clay. The Qal deposits consist of silt, sand, and the gravel of modern channels and floodplains of the Colorado River and its tributaries. The Qf and Qal deposits do not constitute significant groundwater units.

An analysis of water level and geological data obtained from test borings drilled approximately 500 feet deep and water level data from six piezometers drilled approximately 300 feet deep indicates that the groundwater in the Blythe site area is stored under water table conditions in the alluvial deposits of the Colorado River and upper part of the Bouse Formation. The boring locations and static water table elevations are shown in Figure 3-9 along with groundwater elevations below the flood plain east of the site. The groundwater contours under the site are generally consistent with the regional contour configuration beneath the floodplain. Several observation wells installed early in the program became clogged and thus do not indicate true groundwater levels. This condition is evidenced by the anomalous groundwater elevations in Figure 3-9 and by field infiltration tests performed on these wells. The data indicate that water table elevations vary less than 10 feet across the site area, from 234.1 feet in B-DH-13 to 224.8 feet in B-DH-26. Beneath the preferred site, the groundwater table slopes gently toward the

south-southwest, and at the evaporation basin location it slopes toward the south-southeast. The slope of the groundwater table is approximately 1.5 to 2 feet per mile in these areas. The water level data indicate that the site area is recharged from the north by flow beneath Palo Verde Mesa and possibly from the southwest by infiltration of runoff from the Palo Verde Mountains. Depths to groundwater range from 140 to 150 feet at the station location, 85 to 95 feet at the evaporation basin, and 7 to 10 feet beneath the flood plain.

A well pumping test was conducted at the Blythe site location during April 1976. A 12-inch diameter louvered well screen was installed from El 108 to El 8 feet, and gravel packed from El 258 to El 2 feet. The well screen penetrates units QTrb , QTfa, and the upper, sandy portion of unit Tb. The well was pumped at a rate of 820 gallons per minute (gal/min) for a 97-hour period, during which groundwater levels were measured in three piezometers (100 to 300 feet from the test well) and four borings (600 to 1,500 feet from the test well). The radius of influence stabilized at a distance of 500 to 1,200 feet. Water samples were obtained at daily intervals from the pump discharge for analysis of water quality. Preliminary analysis of the pumping test data indicates a transmissivity range of 100,000 to 200,000 gallons gpd/ft and a storage coefficient in the order of

1×10^{-3}. For the approximately 220-foot saturated thickness of the aquifer, the transmissivity value corresponds to a coefficient of hydraulic conductivity (permeability) of .042 to .088 feet per minute (ft/min) or .021 to 0.45 centimeter per second (cm/sec).

3.7 WATER QUALITY

According to Metzger, et al[2], the Colorado River near the site contains total dissolved solids concentrations ranging from 650 to 800 milligrams per liter (mg/l). Irrigation runoff collected by the Palo Verde Outfall Drain is higher in total dissolved solids with concentrations in the order of 2,000 mg/l. Table 3-1 is a composite analysis of water from the Palo Verde Outfall Drain at the proposed plant intake structure location (see Figure 3-3).

Metzger, et al[2] distinguished three zones of groundwater quality beneath the Colorado River flood plain: a shallow zone; a principal gravel zone; and a deep zone.

The shallow zone generally extends less than 30 feet below the water table. The total dissolved solids of groundwater range between 600 to 6,000 mg/l. In the Blythe area and in parts of

Cibola Valley, groundwater in the shallow zone is similar in composition to the Colorado River and is a source of water for some domestic and stock wells. However, in the southern part of Palo Verde Valley, the groundwater salinity ranges from 3,000 to 15,000 mg/l total dissolved solids.

The principal gravel zone lies within the alluvial deposits of the Colorado River, approximately 100 feet below the floodplain. North of Ripley, groundwater is satisfactory for some domestic and stock uses, containing less than 1,500 mg/l dissolved solids.[2] Near Palo Verde Mesa, most groundwater in the principal gravel zone contains concentrations of dissolved solids exceeding 3,000 mg/l. Here, the salinity apparently increases with depth and distance from the Colorado River. In Cibola Valley, groundwater is moderately saline, generally ranging from 3,000 to 10,000 mg/l.[2]

The deep zone underlies the Colorado River flood plain and extends from the principal gravel zone to bedrock. This zone is a major source of domestic and municipal water in the north and central Palo Verde Valley, especially for the Blythe and Ripley areas. Most wells in this zone produce water that is of better quality than the Colorado River. This suggests that water from the river or piedmont gravel percolates into the deep zone.

South of the site in the southern Palo Verde Valley and Cibola Valley, west of the Colorado River, the only water quality data available indicate mineralized water containing 5,000 to 14,900 mg/l total dissolved solids. This water is unsuitable for most purposes.[2]

Beneath Palo Verde Mesa, water quality is variable. Data from the irrigation wells approximately 10 miles north of the preferred site indicate that groundwater salinity generally increases with depth and distance from the flood plain. Most of the wells within two miles of the flood plain are 150 to 350 feet deep and produce groundwater with dissolved solids concentrations of 700 to 900 mg/l. Farther west, dissolved solids are approximately 1,500 mg/l; however, well 75/21E-1441 did yield water containing 4,550 mg/l dissolved solids. Metzger, et al.[2] Table 3-2 lists available water quality data for some of the wells shown in Figure 3-6.

At the Blythe site, water quality data are available from the well pumping test completed in April 1976 (Section 3.5). Total dissolved solids concentrations of five samples obtained at daily intervals during the 97-hour test ranged from 1,805 to 1,850 mg/l. Table 3-3 is a composite analysis of the five samples.

3.8 FOUNDATION CONDITIONS AT THE EVAPORATION BASIN AREA

Boring B-DH-18 was drilled to a depth of 507 feet at the western edge of the evaporation basin area. The log of this boring is shown in Figure 3-10, and includes summary grain size distributions based upon laboratory sieve analyses. The soils at this location are predominantly sands containing relatively low percentages of silt or clay. Standard penetration tests were performed to a depth of 200 feet in this boring, and the blow counts are shown in the SPT column of the log. The blow counts are uniformly high and, based upon the Gibbs and Holtz correlation[3], indicate relative densities which are generally greater than 90 percent. These relative densities are consistent with those observed at the preferred site and indicate that foundation conditions are excellent in the evaporation basin area.

TABLE 3-1

WATER QUALITY OF THE PALO VERDE OUTFALL DRAIN

Constituent		mg/l
Calcium	(Ca)	160
Magnesium	(Mg)	45
Sodium	(Na)	420
Potassium	(K)	9
Bicarbonate	(HCO3)	320
Sulfate	(SO4)	620
Chloride	(Cl)	425
Nitrate	(NO3)	2
Phosphate	(PO4)	0.1
Silica, Total		21
Total Dissolved Solids		2,020
Suspended Solids		50
pH	8.0	

TABLE 3-2

CHEMICAL ANALYSIS OF GROUNDWATER
IN PALO VERDE AND CIBOLA VALLEYS

EXPLANATORY NOTES:

Well Number:

Wells located according to the Federal Land Classification System (see diagrams)

Geologic Sources:

CA Alluviums of the Colorado River and its tributaries
F Bedrock Fanglomerate

Remarks:

Analysis by the following laboratories:

A U.S. Geological Survey, Albuquerque, N.M.
Ariz. State of Arizona
Calif. State of California
P. Private Laboratory
T U.S. Geological Survey, Tucson, Ariz.
USSAL U.S. Salinity Laboratory
W U.S. Geological Survey, Washington, D.C.
Y U.S. Geological Survey, Yuma, Ariz.

Units:

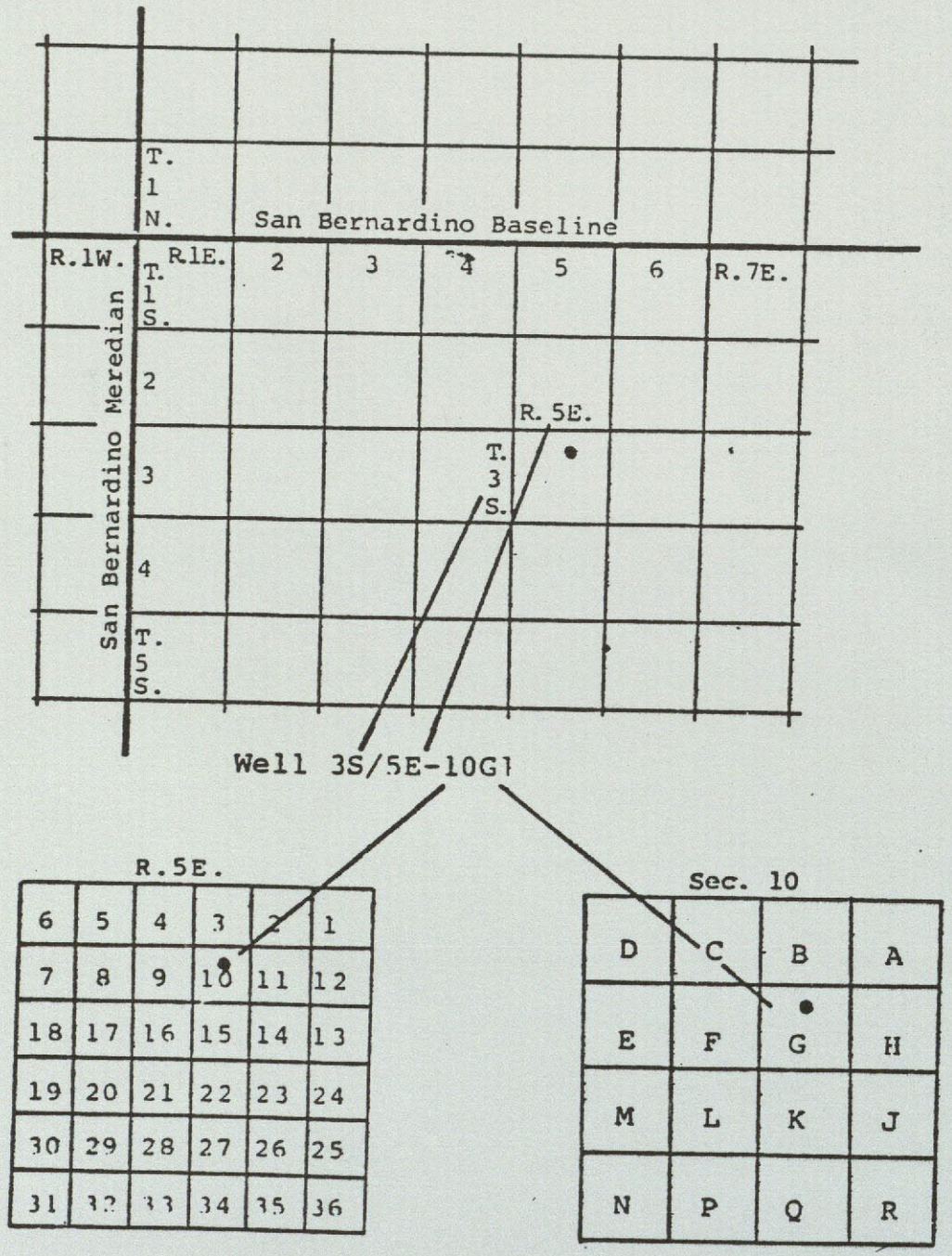
Ft Feet
gpm/ft gallons per minute/foot
mg/l milligrams/liter
°C degrees centigrade

Analyses are in milligrams/liter, except as indicated

TABLE 3-2 (CONT'D)

EXPLANATION FOR TABLE

California Numbering System



Within the smallest division (the 40-acre tract), wells are numbered serially, as indicated by final digit. "Z" indicates unverified location. Lower case s indicates a spring.

TABLE 3-2 (CONT'D)

EXPLANATION FOR TABLE

Arizona Numbering System

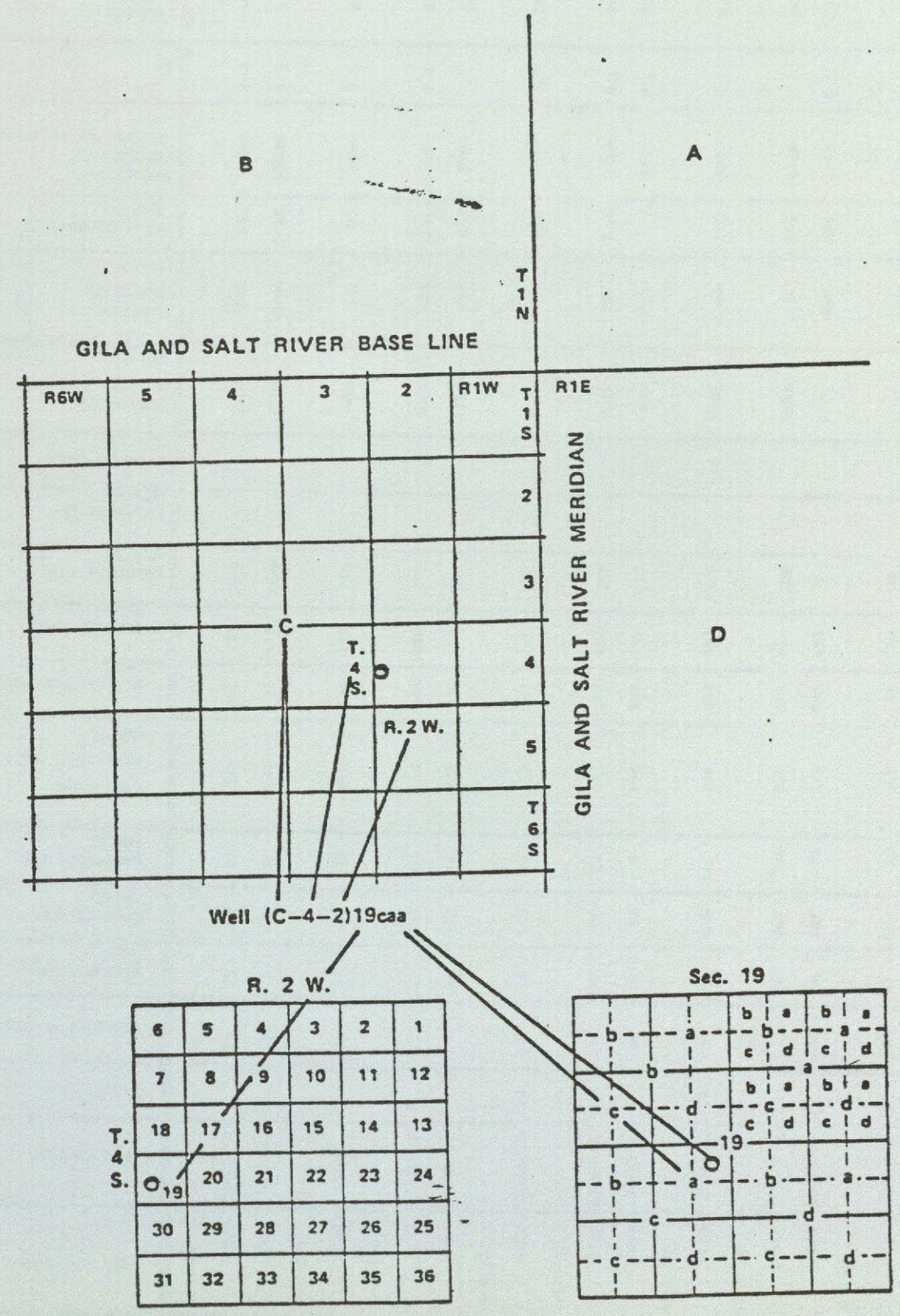


TABLE 3-2 (CONT'D)

CHEMICAL ANALYSIS OF GROUNDWATER IN PALO VERDE AND CIBOLA VALLEYS *

WELL LOCATION	DATE SAMPLED	TEMPERATURE (°C)	GEOLOGIC SOURCE	SILICA (SiO_2) (mg/l)	CALCIUM (Ca) (mg/l)	MAGNESIUM (Mg) (mg/l)	SODIUM AND POTASSIUM (Na + K) (mg/l)	BICARBONATE (HCO_3) (mg/l)	SULFATE (SO_4) (mg/l)	CHLORIDE (Cl) (g/l)	FLUORIDE (F) (mg/l)	NITRATE (NO_3) (mg/l)	DISSOLVED SOLIDS (Sum) (mg/l)	HARDNESS AS $CaCO_3$: CALCIUM, MAGNESIUM (mg/l)	HARDNESS AS $CaCO_3$: NON-CARBONATE (mg/l)	SPECIFIC CONDUCTANCE (Micromhos at 25°C)	pH	PERCENT SODIUM	REMARKS
(B-1-23)																			
20bdc	12-21-64		CA	37	318	65	572	240	725	950	1.0		2800	1060	863	4380	7.2	54	Y
31cdc	12-13-62		CA	1	320	154	1920	23	1350	2960			6720	1480	1410	10700	8.2	74	Y
(B-2-22)																			
9cba	2-9-62		CA	17	88	25	162	304	170	175			789	322	72	1330	7.5	52	
(B-3-22)																			
22bbb	4-24-62		CA	21	254	54	735	598	1180	525			3060	855	364	4240	7.6	65	
27bbb	4-24-62		CA	21	170	70	329	548	675	194			1730	710	260	2650	7.1	50	
(B-4-22)																			
2bca	6-18-64	22	CA	19	153	42	163	352	417	132	.5		1100	556	268		7.7	39	Y
(C-1-23)																			
19caa	12-14-61		CA	37	91	10	343	202	190	462			1230	268	102	2250	8.1	74	
30aca	12-14-61		CA	36	40	4	195	267	130	133			672	118		1110	8.0	78	
(C-1-24)																			
36bbb	6-14-63	22	CA	28	353	821	134	372	952	1360		.2	3830	1430	1120	5940	7.3	56	A, Boron-.42
(C-2-23)																			
19adc				38	414	101	829	300	1020	1380			3930	1450	1200	6220	7.7	55	Y
19dcd	11-19-62		CA	36	149	70	299	556	462	265			1560	660	204	2390	8.1	50	
5S/22E-																			
28C1	2-8-62	32	CA	11	255	12	457	22	1020	425			2190	685	667	3160	7.7	59	Y

NOTE:

Metzger, et al. Geohydrology of the Parker-Blythe-Cibola Area, Arizona and California. U.S. Geol. Survey, Prof. Paper 486G, 130 pp., 1973.

TABLE 3-2 (CONT'D)

CHEMICAL ANALYSIS OF GROUNDWATER IN PALO VERDE AND CIBOLA VALLEYS *

WELL LOCATION	DATE SAMPLED	TEMPERATURE (°C)	GEOLOGIC SOURCE	SILICA (SiO_2) (mg/l)	CALCIUM (Ca) (mg/l)	MAGNESIUM (Mg) (mg/l)	SODIUM AND POTASSIUM (Na + K) (mg/l)	BICARBONATE (HCO_3) (mg/l)	SULFATE (SO_4) (mg/l)	CHLORIDE (Cl) (mg/l)	FLUORIDE (F) (mg/l)	NITRATE (NO_3) (mg/l)	DISSOLVED SOLIDS (Sum) (mg/l)	HARDNESS AS $CaCO_3$: CALCIUM, MAGNESIUM (mg/l)	HARDNESS AS $CaCO_3$: NON-CARBONATE (mg/l)	SPECIFIC CONDUCTANCE (Micromhos at 25°C)	pH	PERCENT SODIUM	REMARKS
28C1	10-25-62	32	CA	116	268	9	439	30	972	435			2160	705	674	3090		68	A, Boron-1.2
33J1	3-16-62	31	CA	29	128	2.1	316	58	380	395	2.2	9.7	1290	328	280	2090	7.2	66	A, Boron-.48 Y
	10-26-62		CA	24	122	7.4	302	50	375	395	1.7		1250	335	294	2200	7.35	82	T, boron-1.2 Y
35A1	2-10-66	31	CA	18	68	5	376	122	330	405	1.8		1300	190	90	2160	7.4	76	Y
35M1	1-27-64	31	CA	19	84	2.1	315	82	338	340	1.9		1140	218	151	1940	7.6	79	T, boron-1.3
	2-10-66	31	CA	20	110	1.8	376	80	365	415	1.7		1300	282	217	2150	7.6		
6S/21E-																			
36R1	7-15-54		CA		108	24	927	104	1060	845	4.0		3020	368	283	4700	7.6	85	USSAL
36R2	5-23-61		CA	33	35	8	451	120	404	396	2.4	7.9	1400	120	22	2310	7.7	88	A
6S/22E-																			
1M1	2-9-66		CA	16	20	8.8	230	244	150	161	1.2		709	86		1210	7.7	85	A, boron-.29
2P1	5-14-64		CA	15	21	6	214	201	120	178	1.7	.6	640	76		1150	8.2	85	P, Boron-.34 Y
9P2	6-13-67	32	CA	16	154	9.4	422	34	475	578			1670	430	392	2920	7.5	69	Y
11M1	6-19-64	27	CA	22	108	39	253	224	312	332	1.0		1180	428	244	2060	7.2	56	Y
12E1	10-22-64		CA		106	37	334	238	404	373			1370	415	220	2300		64	USSAL
12F1	1-5-61		CA		100	35	313	255	404	324	.8		1300	395	184		8.0	63	CALIF.
11R1	3-27-67	24	CA	21	138	56	295	288	450	369	.9		1470	575	339	2420	7.7	53	Y
11R2	3-21-67	24	CA	39	124	84	270	436	575	202	.9		1510	655	293	2400	7.5	47	
13Q1	3-23-67	22	CA	22	108	39	138	324	262	135	.5		867	430	164	1450	7.5	41	Y
13Q2	3-23-67	21	CA	20	126	69	358	304	800	208	1.3		1730	600	350	2630	7.7	56	
14L1	3-31-67	24	CA	24	135	59	315	300	500	352	1.0		1540	580	334	2600	7.7	54	Y

NOTE:

Metzger, et al. Geohydrology of the Parker-Blythe-Cibola Area, Arizona and California. U.S. Geol. Survey, Prof. Paper 486G, 130 pp., 1973.

TABLE 3-2 (CONT'D)

CHEMICAL ANALYSIS OF GROUNDWATER IN PALO VERDE AND CIBOLA VALLEYS*

WELL LOCATION	DATE SAMPLED	TEMPERATURE (°C)	GEOLOGIC SOURCE	SILICA (SiO_2) (mg/l)	CALCIUM (Ca) (mg/l)	MAGNESIUM (Mg) (mg/l)	SODIUM AND POTASSIUM (Na + K) (mg/l)	BICARBONATE (HCO_3) (mg/l)	SULFATE (SO_4) (mg/l)	CHLORIDE (Cl) (mg/l)	FLUORIDE (F) (mg/l)	NITRATE (NO_3) (mg/l)	DISSOLVED SOLIDS (Sum) (mg/l)	HARDNESS AS $CaCO_3$: CALCIUM, MAGNESIUM (mg/l)	HARDNESS AS $CaCO_3$: NON-CARBONATE (mg/l)	SPECIFIC CONDUCTANCE (Micromhos at 25°C)	pH	PERCENT SODIUM	REMARKS
14L2	3-31-67	24	CA	22	134	60	319	300	500	358	.9		1540	580	334	2590	7.7	54	
15M1	6-12-63	27	CA	19	35	8.9	251	196	189	222	3.8	.2	822	124		1400	8.1	81	A, Boron-.45
15Q1	9-16-63	33	CA	17	23	.1	257	240	150	183	2.3		752	58		1320	7.9	91	Y
20A1	6-15-67	31	CA	30	55	10	223	76	212	268	1.8		838	180	118	1510	8.0	73	Y
26E1	3-28-67	23	CA	16	135	59	127	240	350	208	.8		1020	580	383	1740	7.8	32	Y
26E2																			
26G1	3-28-67	22	CA	20	159	60	193	332	500	191	.8		1290	645	373	2080	7.7	39	Y
26G2	3-28-67	22	CA	22	146	74	140	248	500	175	1.3		1180	670	466	1930	7.5	31	
28G1	2-9-66	31	CA	18	38	8.5	268	217	220	245	2.9		930	130		1550	7.7	64	T, Boron-.63
31Z1	10-17-17		CA	39	38	64	365	111	324	343		.7	1170	121	30			87	W
32F1	5-23-61		CA	32	24	11	248	116	220	207	2.5	11	813	104	9	1340		83	A
32K1	1954		CA				283	101		296				174	92	1670			USSAL
	5-23-61		CA	24	62	17	324	86	374	330			1180	224	154	1960		76	A, Boron-1.2
32R1	6-11-63	31	CA	22	67	24	427	204	575	301	1.7		1520	266	98	2310	7.6	78	Y
33R1	1960		CA		86	17	341	127	366	391	1.7	1.0	1270	284	180	2150	7.7	72	USSAL
34L1	5-25-61		CA	16	81	26	376	270	354	368	.6	.3	1350	310	88	2220	7.8	72	A
35M1	2-7-62		CA	8	57	20	207	250	181	199			797	224	19	1490	8.0	67	Y
35R1	1960		CA	24	76	28	157	268	170	177	.1		770	306	86	1200	8.0	53	?
35R2	10-23-62		CA	19	79	28	150	259	170	175	.5		752	310	100	1320	7.4	51	Y
6S/23E-29R1	2-7-61	25	CA	20	133	28	117	269	302	114	.4	.5	847	448	228	1290	7.6	35	A

NOTE:

Metzger, et al. Geohydrology of the Parker-Blythe-Cibola Area, Arizona and California. U.S. Geol. Survey, Prof. Paper 486G, 130 pp., 1973.

TABLE 3-2 (CONT'D)

CHEMICAL ANALYSIS OF GROUNDWATER IN PALO VERDE AND CIBOLA VALLEYS*

WELL LOCATION	DATE SAMPLED	TEMPERATURE (°C)	GEOLOGIC SOURCE	SILICA (SiO_2) (mg/l)	CALCIUM (Ca) (mg/l)	MAGNESIUM (Mg) (mg/l)	SODIUM AND POTASSIUM (Na + K) (mg/l)	BICARBONATE (HCO_3) (mg/l)	SULFATE (SO_4) (mg/l)	CHLORIDE (Cl) (mg/l)	FLUORIDE (F) (mg/l)	NITRATE (NO_3) (mg/l)	DISSOLVED SOLIDS (Sum) (mg/l)	HARDNESS AS $CaCO_3$: CALCIUM, MAGNESIUM (mg/l)	HARDNESS AS $CaCO_3$: NON-CARBONATE (mg/l)	SPECIFIC CONDUCTANCE (Micromhos at 25°C)	pH	PERCENT SODIUM	REMARKS
31J1	2-6-62		CA	7	40	11	129	218	100	102			498	146		852	7.9	66	Y
32D1	10-23-62	24	CA	21	143	38	163	338	375	141	.3	.6	1050	514	237	1610	7.5	41	Y, Boron-.14
32J1	9-14-60		CA		46	11	121	223	90	110	.2		491	161		817	7.8	62	Calif.
32M1	1960		CA		44	10	123	218	92	110	1.1		489	151			8.2	63	Calif.
32P1	10-23-62	26	CA	18	104	27	136	264	192	177	.5		787	372	156	1370	7.4	44	Y
32Z1	10-16-17		CA	23	69	22	92	297	81	95			530	263	19			43	W
32Z2	10-16-17		CA	29	76	20	87	297	79	96			535	272	28			41	W
32Z3	10-16-17		CA	29	51	23	108	295	81	92			532	222				52	W
33G1	2-7-62		CA	12	80	17	118	248	155	115			621	271	68	997	7.7	48	Y
33K1	2-7-62		CA	11	63	17	87	230	92	93			478	226	38	874	8.0	46	Y
33M1	2-7-62		CA	11	78	19	122	249	165	115			634	272	68	1010	7.7	49	Y
36N1	2-6-62		CA	13	124	34	128	308	317	102			872	448	196	1320	7.2	38	Y
7S/21E-14B1	2-8-66			24	85	29	893	59	460	1150	6.4		2650	224	176	4490	7.9	90	T
14H1	3-1-66		F	45	150	14	1510	65	800	1990	5.2		4550	430	376	7680	7.5	88	Y
7S/22E-3D1	3-29-67	22	CA	19	47	17	312	236	400	177		2.0	1090	186		1810	7.7	79	Y
3D2	3-30-67	25	CA	22	56	35	461	320	525	335	1.8		1600	284	22	2650	7.7	78	
3H1	3-10-67	23	CA	23	175	91	541	400	700	658	.9		2390	810	482	3900	7.4	59	Y
3H2	3-30-67	23	CA	20	98	55	148	216	400	139	.9		969	470	293	1570	7.4	41	
4P1	10-22-62	28	CA	25	124	46	559	168	700	602			2140	500	362	3790	7.3	71	Y

NOTE:

Metzger, et al. Geohydrology of the Parker-Blythe-Cibola Area, Arizona and California. U.S. Geol. Survey, Prof. Paper 486G, 130 pp., 1973.

TABLE 3-2 (CONT'D)

CHEMICAL ANALYSIS OF GROUNDWATER IN PALO VERDE AND CIBOLA VALLEYS*

WELL LOCATION	DATE SAMPLED	TEMPERATURE (°C)	GEOLOGIC SOURCE	SILICA (SiO_2) (mg/l)	CALCIUM (Ca) (mg/l)	MAGNESIUM (Mg) (mg/l)	SODIUM AND POTASSIUM (Na + K) (mg/l)	BICARBONATE (HCO_3) (mg/l)	SULFATE (SO_4) (mg/l)	CHLORIDE (Cl) (mg/l)	FLUORIDE (F) (mg/l)	NITRATE (NO_3) (mg/l)	DISSOLVED SOLIDS (Sum) (mg/l)	HARDNESS AS $CaCO_3$: CALCIUM, MAGNESIUM (mg/l)	HARDNESS AS $CaCO_3$: NON-CARBONATE (mg/l)	SPECIFIC CONDUCTANCE (Micromhos at 25°C)	pH	PERCENT SODIUM	REMARKS
7B1	2-14-62		CA	11	89	26	96	217	190	115			635	328	150	1040	7.6	39	Y
9S/21E-																			
1M1	2-7-63		CA	19	158	63	1640	572	1250	1740			5160	655	186	8170	7.9	84	
2J1	3-27-62	24	CA	20	510	153	4640	426	4150	5190			14,900	1900	1550	21,100	8.2	84	Y
2J3	3-27-62	24	CA	25	57	24	1540	608	1150	1340			4400	242		6950	7.9	93	Y
2J4	2-15-62		CA	8	98	79	892	571	1080	655			3100	570	102	4820	8.0	77	Y
2P1	5-7-63	24	CA	23	470	165	4560	600	3440	5450			14,400	1850	1360	21,100	7.4	84	Y
2Z1	11-6-17		CA	21	64	27	153	289	214	102			726	271	34			55	W
2Z2	5-11-50		CA		99	29	221	305	355	163			1020	366	116	1540		57	
2Z3	3-9-54		CA		76	24	238	325	338	134	2.8		975	288	22		8.1	63	Calif.
2Z4	3-9-54		CA		202	63	1456	471	1200	1460	1.8		4620	765	377		7.9	80	Calif.
2Z5	3-9-54		CA		178	60	520	395	652	570	1.1		2180	692	366		7.8	61	Calif.
2Z6	10-14-58		CA		164	60	424	432	570	412			1850	655	300			57	Calif.
2Z7	8-2-59		CA		164	33	559	270	860	480	5.0		2240	545	323		8.3	68	Calif.
2Z8	4-6-61		CA		169	54	548	483	508	655			2180	644	248		8.1	64	Calif.
2Z9	3-15-63		CA		138	44	413	359	517	410	1.2		1700	525	231		8.1	62	Calif.
3W1	3-15-63	26	CA	25	190	62	1190	121	850	1660			4040	730	631	6830	7.6	78	Y
3Z1	5-11-50				178	73	3800	180	1740	5010			11,000	744	596	16,800		92	Calif.
11A1	3-27-63	22	CA	21	310	123	3250	504	2550	3750			10,300	1280	856	15,600	7.6	85	Y
11A2	5-8-63	23	CA	21	41	13	1080	524	850	840			3100	156		5060	8.0	94	Y
11K1	3-26-63	21	CA	24	110	43	144	328	317	117			920	452	183	1470	7.7	41	Y

NOTE:

Metzger, et al. Geohydrology of the Parker-Blythe-Cibola Area, Arizona and California. U.S. Geol. Survey, Prof. Paper 486G, 130 pp., 1973.

TABLE 3-2 (CONT'D)

CHEMICAL ANALYSIS OF GROUNDWATER IN PALO VERDE AND CIBOLA VALLEYS*

WELL LOCATION	DATE SAMPLED	TEMPERATURE (°C)	GEOLOGIC SOURCE	SILICA (SiO_2) (mg/l)	CALCIUM (Ca) (mg/l)	MAGNESIUM (Mg) (mg/l)	SODIUM AND POTASSIUM (Na + K) (mg/l)	BICARBONATE (HCO_3) (mg/l)	SULFATE (SO_4) (mg/l)	CHLORIDE (Cl) (mg/l)	FLUORIDE (F) (mg/l)	NITRATE (NO_3) (mg/l)	DISSOLVED SOLIDS (Sum) (mg/l)	HARDNESS AS $CaCO_3$: CALCIUM, MAGNESIUM (mg/l)	HARDNESS AS $CaCO_3$: NON-CARBONATE (mg/l)	SPECIFIC CONDUCTANCE (Micromhos at 25°C)	pH	PERCENT SODIUM	REMARKS
5D1	2-7-62		CA	14	108	26	140	293	225	147			806	378	138	1290	7.8	45	Y
11Q1	2-14-62			12	44	12	167	239	135	133			623	161		1080	7.9	69	Y
34Z1					80	29	183	258	134	250		1.0	856	319	106	1290	7.9	54	Calif.
7S/21E-																			
5E1	2-15-62			16	23	17	125	228	133	124			592	228	41	997	7.8	54	Y
17D1	2-14-62		CA	17	129	36	239	302	375	249			1200	468	220	1880	7.7	53	Y
17E1	2-14-62			13	172	54	321	322	575	345			1640	650	386	2410	7.5	52	Y
18A1	2-14-62		CA	12	120	34	179	218	231	291			976	440	261	1700	7.7	47	Y
21W1	2-15-62			11	36	9	174	242	140	113			604	125		1020	8.1	75	Y
29D1				19	156	37	285	277	342	398	.2	3.0	1380	540	313	2250	7.5	53	A
32W1	2-14-62			15	68	19	88	241	100	97			507	246	98	897	7.8	44	Y
8S/21E-																			
13A1	8-28-63	24	CA	30	29	12	743	271	730	517	8.0	.3	2200	123		3420	8.6	92	A, Boron-1.0
13A1	8-14-63	28	CA	28	256	43	2430	184	1600	3040			7490	815	664	11,700	7.6	87	Y, Zone (395-400)
24A1	2-13-63		CA	23	182	55	223	346	600	181	1.1		1440	680	396	2160	7.6	42	
8S/22E-																			
8D1	2-15-63		CA	22	191	59	172	340	538	180	.9		1330	720	441	1960	7.5	34	
17Z1	11-6-17		CA	20	63	20	146	281	175	101		1.5	665	240	8			57	W
19K1	3-63		CA	24	151	73	120	390	412	130	1.4		110	675	355	1770	7.3	28	
8S/23E-																			
6P1	2-8-62		CA	10	71	18	95	224	129	99			534	250	66	887	7.8	45	Y

NOTE:

Metzger, et al. Geohydrology of the Parker-Blythe-Cibola Area, Arizona and California. U.S. Geol. Survey, Prof. Paper 486G, 130 pp., 1973.

TABLE 3-2 (CONT'D)

CHEMICAL ANALYSIS OF GROUNDWATER IN PALO VERDE AND CIBOLA VALLEYS*

WELL LOCATION	DATE SAMPLED	TEMPERATURE (°C)	GEOLOGIC SOURCE	SILICA (SiO_2) (mg/l)	CALCIUM (Ca) (mg/l)	MAGNESIUM (Mg) (mg/l)	SODIUM AND POTASSIUM (Na + K) (mg/l)	BICARBONATE (HCO_3) (mg/l)	SULFATE (SO_4) (mg/l)	CHLORIDE (Cl) (mg/l)	FLUORIDE (F) (mg/l)	NITRATE (NO_3) (mg/l)	DISSOLVED SOLIDS (Sum) (mg/l)	HARDNESS AS $CaCO_3$: CALCIUM, MAGNESIUM (mg/l)	HARDNESS AS $CaCO_3$: NON-CARBONATE (mg/l)	SPECIFIC CONDUCTANCE (Micromhos at 25°C)	pH	PERCENT SODIUM	REMARKS
23C1	7-24-63		CA	26	780	378	6300	852	4600	8300	.7		20,800	3500	2800	29,500	7.2	80	Y
24D1	5-9-63	22		20	7.8	2.3	370	364	325	135	2.4		1040	29		1670	8.1	96	Y

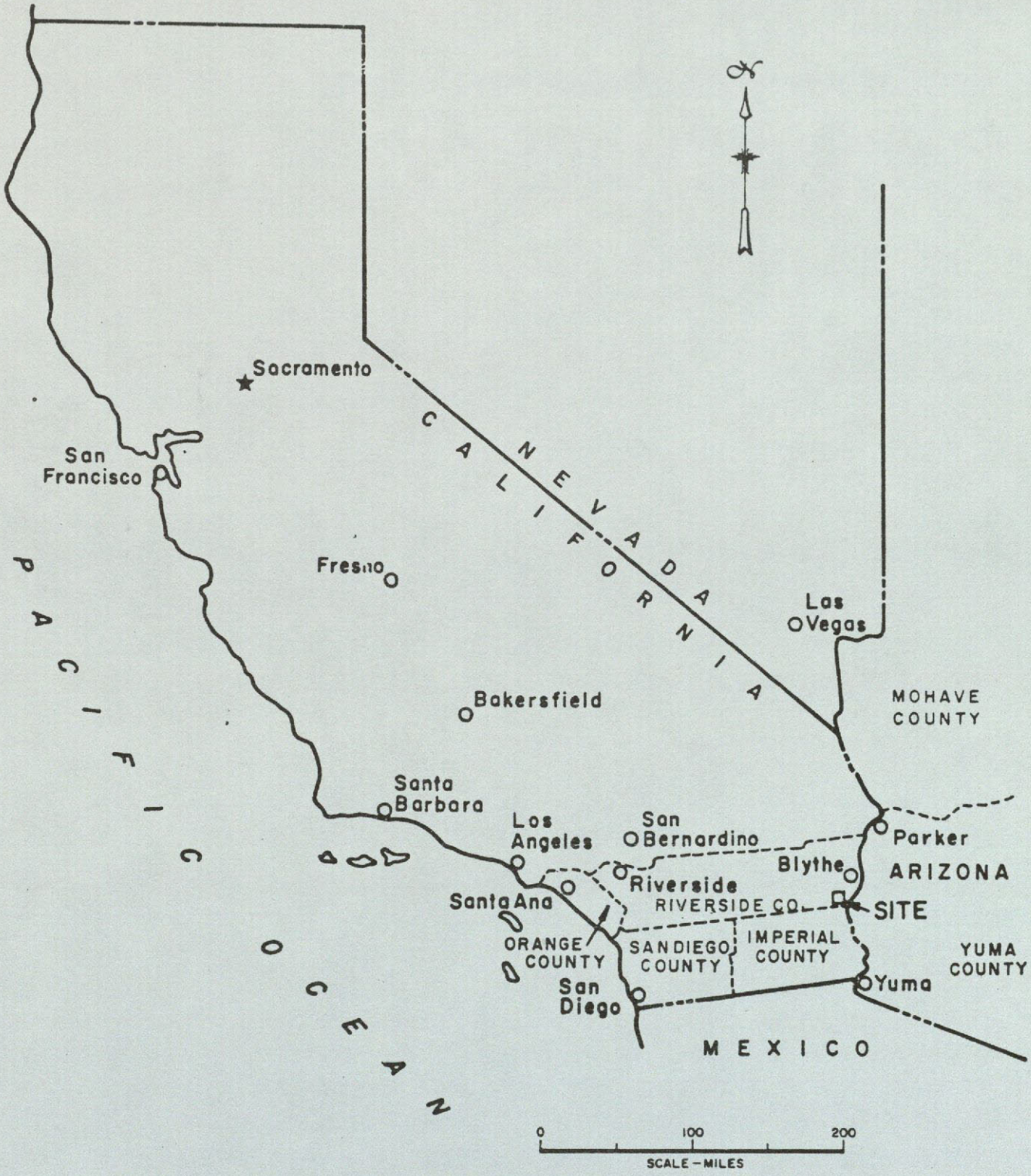
NOTE:

Metzger, et al. Geohydrology of the Parker-Blythe-Cibola Area, Arizona and California. U.S. Geol. Survey, Prof. Paper 486G, 130 pp., 1973.

TABLE 3-3

GROUNDWATER QUALITY BENEATH SUNDESERT NUCLEAR PLANT SITE

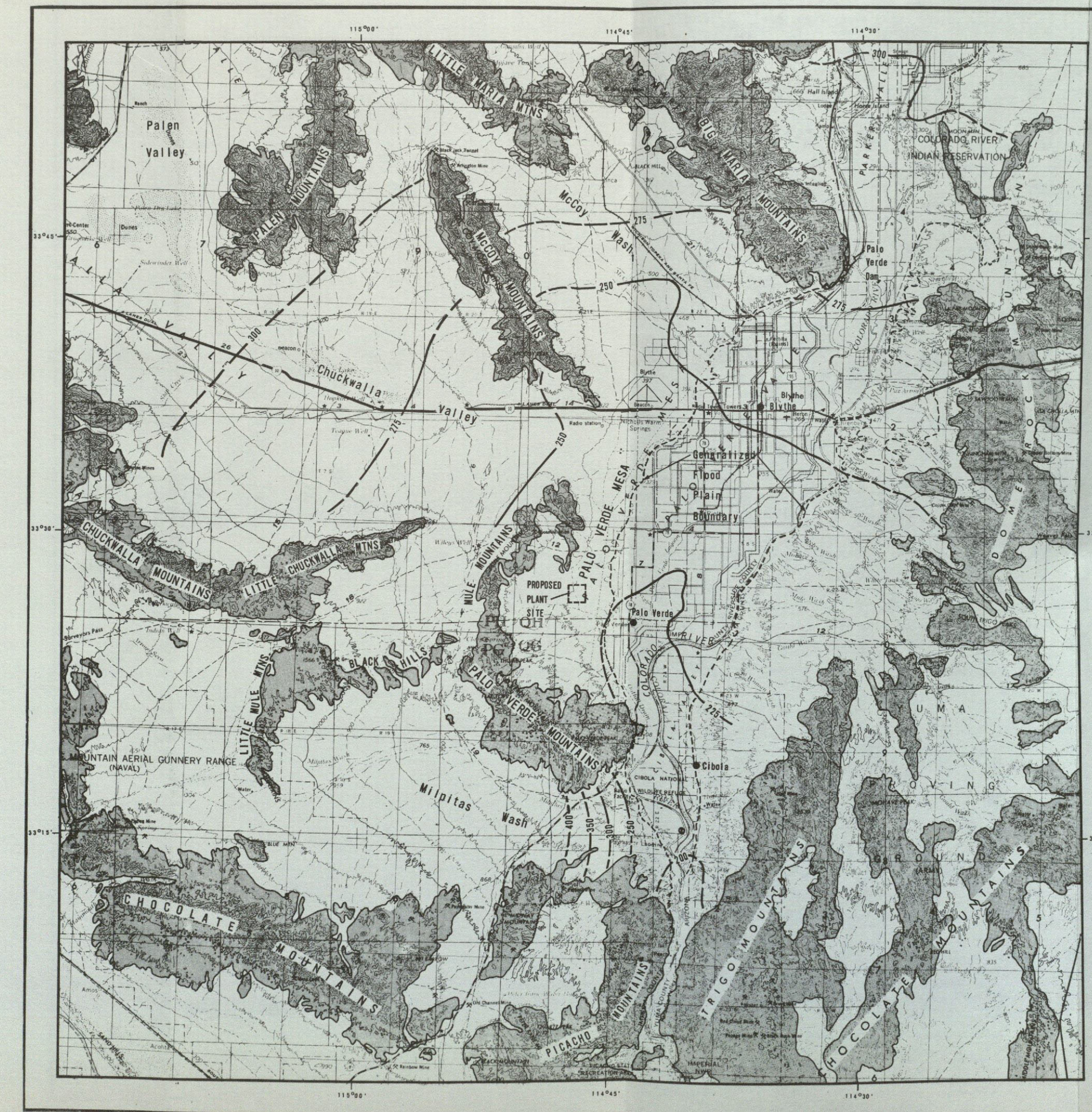
Constituent		mg/l
Calcium	(Ca)	56
Magnesium	(Mg)	5
Sodium	(Na)	580
Potassium	(K)	11
Ammonium	(NH4)	0
Bicarbonate	(HCO3)	140
Sulfate	(SO4)	450
Chloride	(Cl)	604
Nitrate	(NO3)	2
Phosphate	(PO4)	0
Silica		32
Total Hardness	(as CaCO3)	160
Fluoride	(F)	3.8
Boron	(B)	1.4
Iron	(FE)	0.08
Total Dissolved Solids	(TDS)	1,815
Suspended Solids		5
Turbidity	0 JTU	
Color	0 JTU	
pH	7.7	
Conductivity @ 25°C	2900 mhos/cm	



Sundesert Nuclear Plant
UNITS 1 & 2

FIGURE 3-1

GENERAL SITE LOCATION



REGIONAL HYDROGEOLOGIC MAP

EXPLANATION

HOLOCENE TO MIOCENE SEDIMENTS
Alluviums, Eolian Sand, Fans, consolidated Silt and Clays and cemented Fanglomerate

BEDROCK
Sedimentary, Igneous, and Metamorphic rocks

MAP SYMBOLS

GROUNDWATER TABLE CONTOURS

250 — Line of equal water table elevation in feet above mean sea level, dashed where approximate.

RIVER GAGING STATION

NOTE: Base Map from U.S.G.S. Salton Sea 1:250,000 Series.

0 5 10 15
MILES

Sundesert Nuclear Plant
UNITS 1 & 2

FIGURE 3-2
REGIONAL HYDROGEOLOGIC MAP

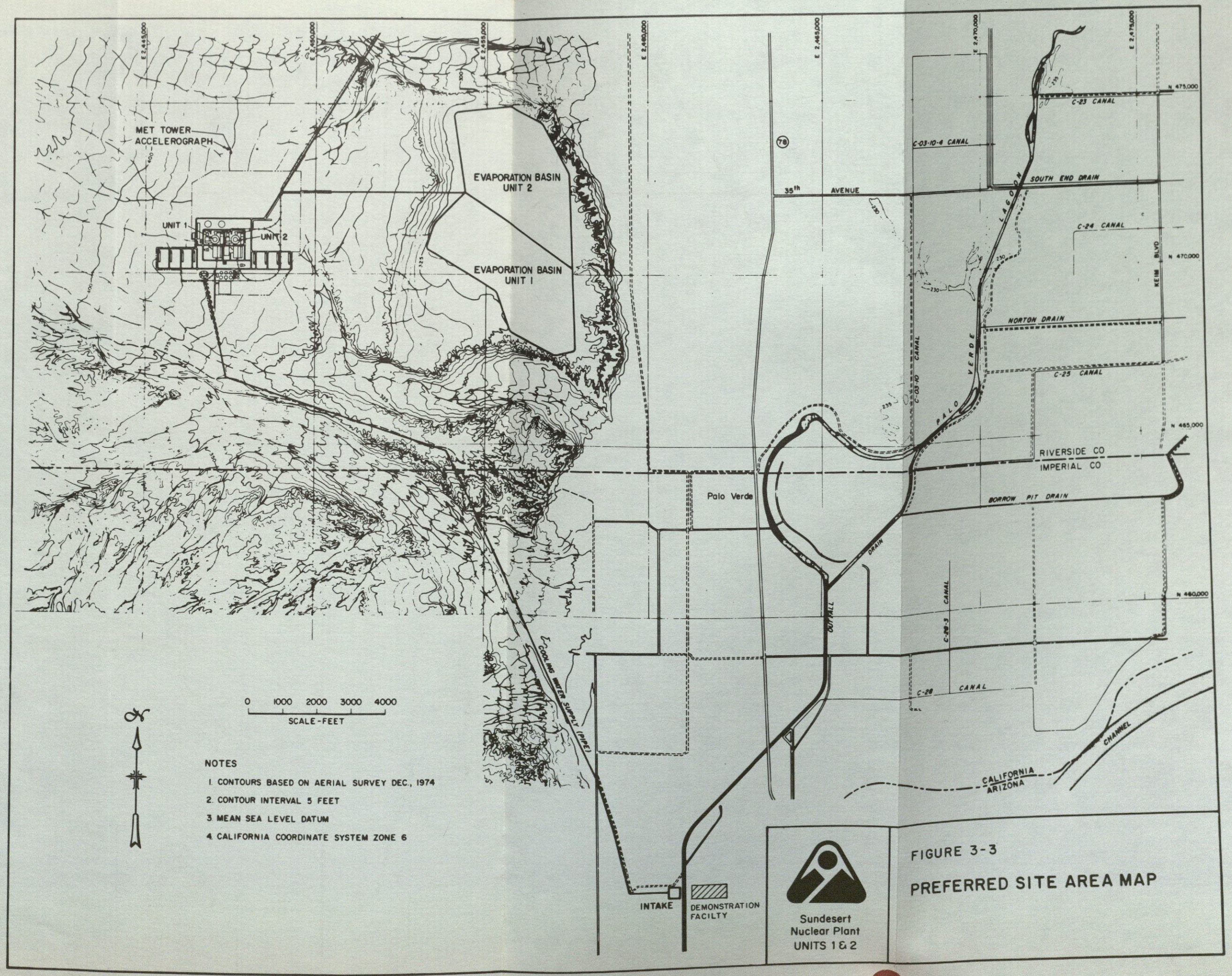


FIGURE 3-3

PREFERRED SITE AREA MAP

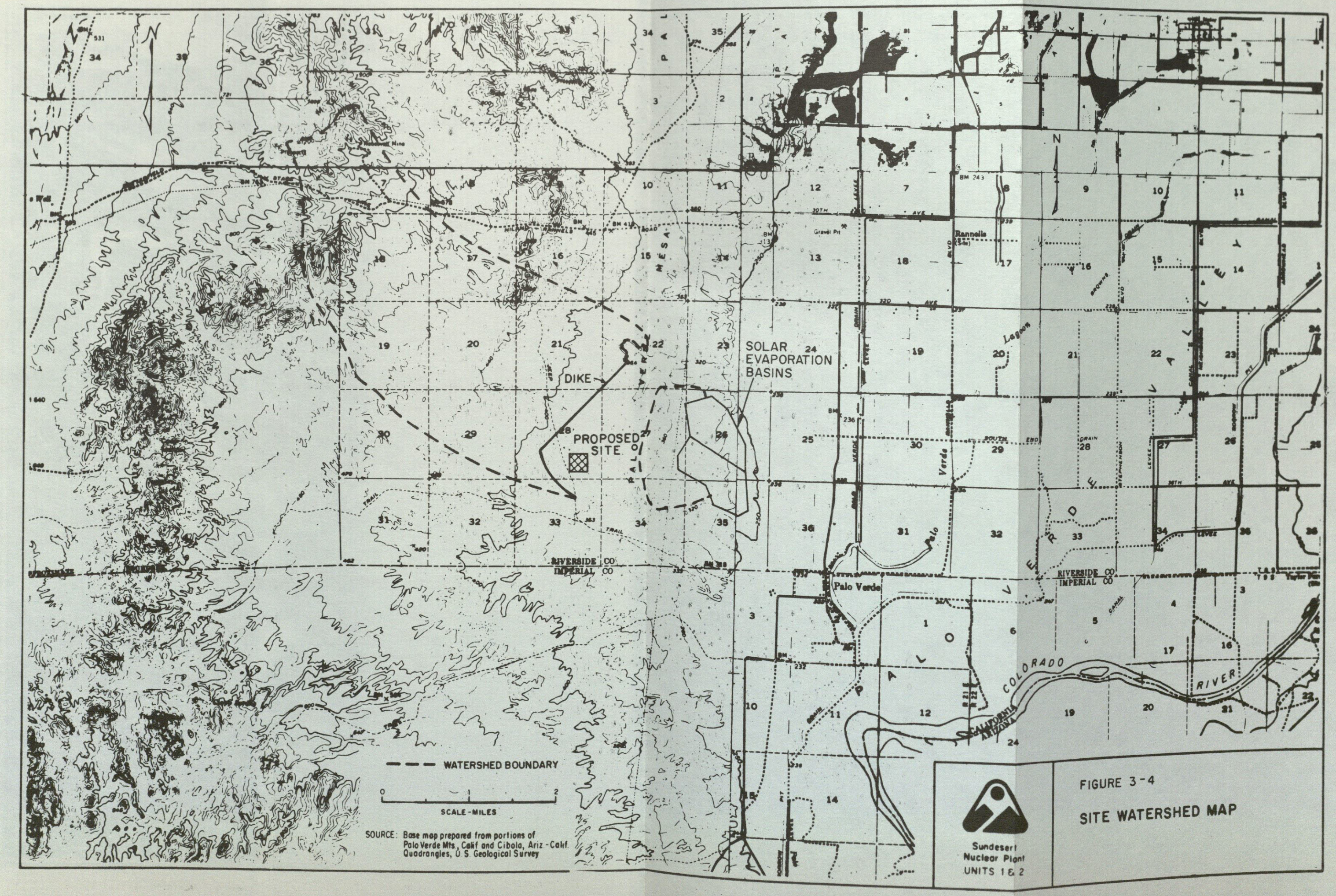


FIGURE 3-4

SITE WATERSHED MAP

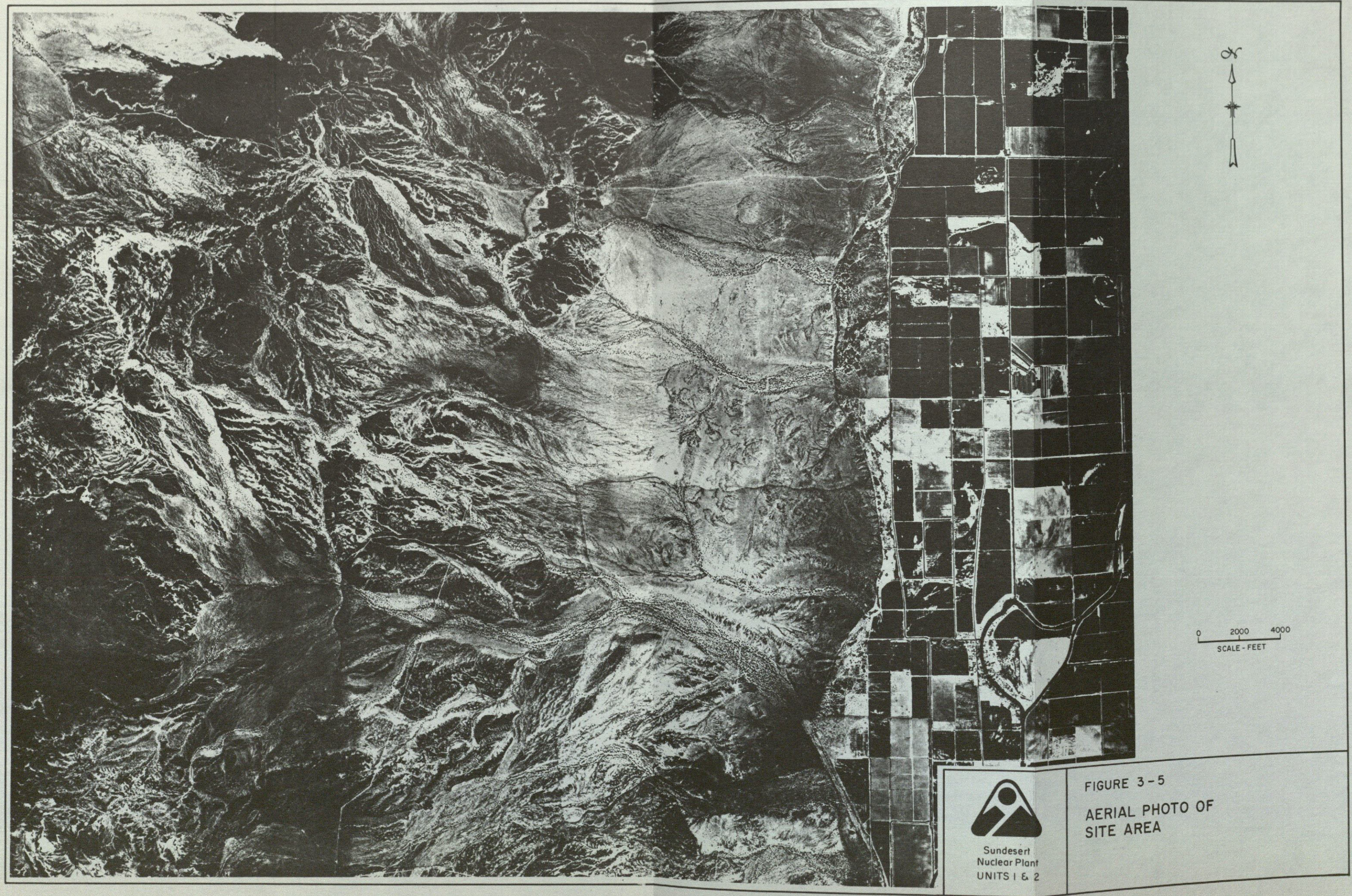


FIGURE 3-5

AERIAL PHOTO OF SITE AREA

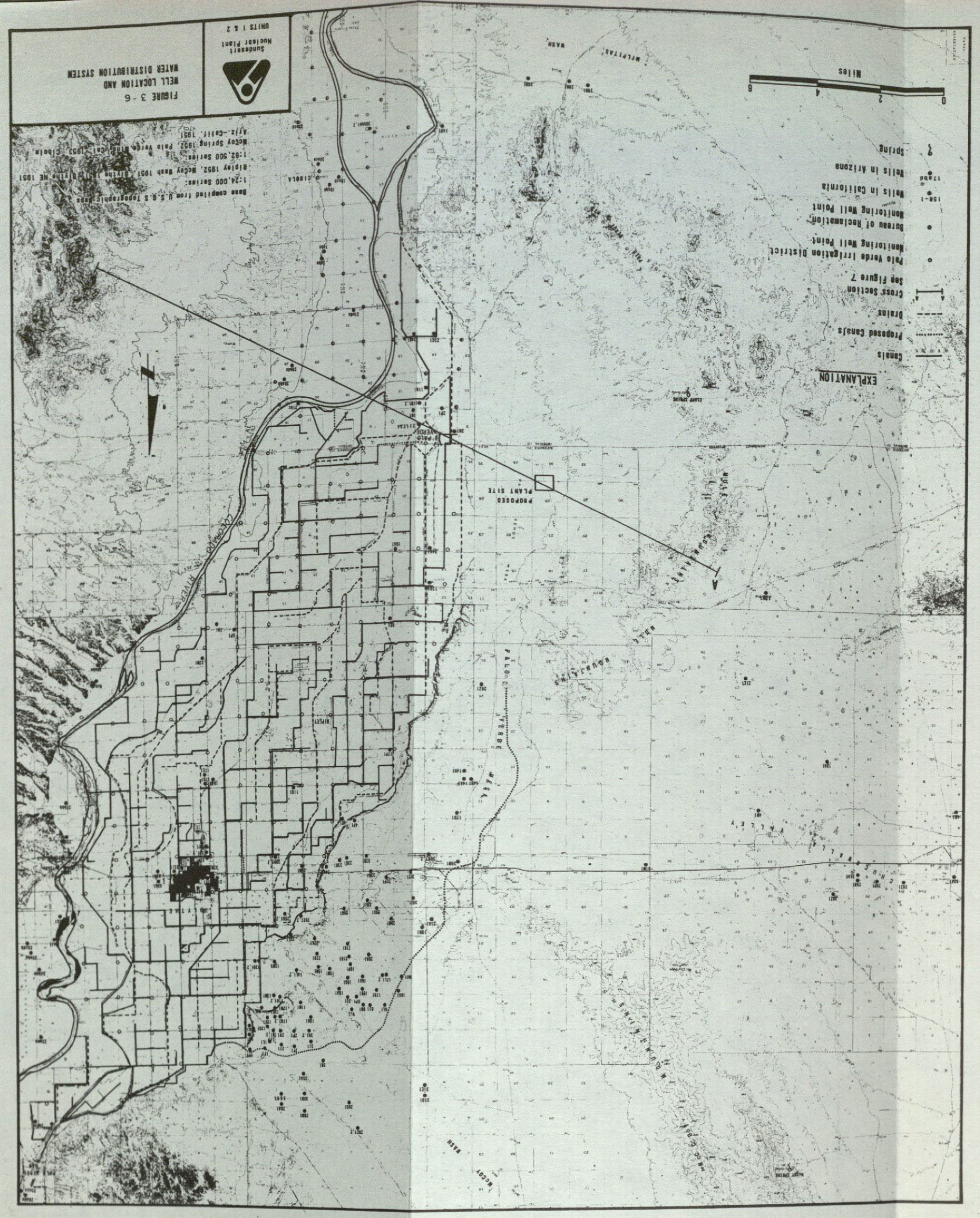


FIGURE 3-6
WELL LOCATION AND
WATER DISTRIBUTION SYSTEM

Southwest
Nuclear Plant
UNITS 1 & 2

GENERALIZED HYDROGEOLOGIC CROSS SECTION

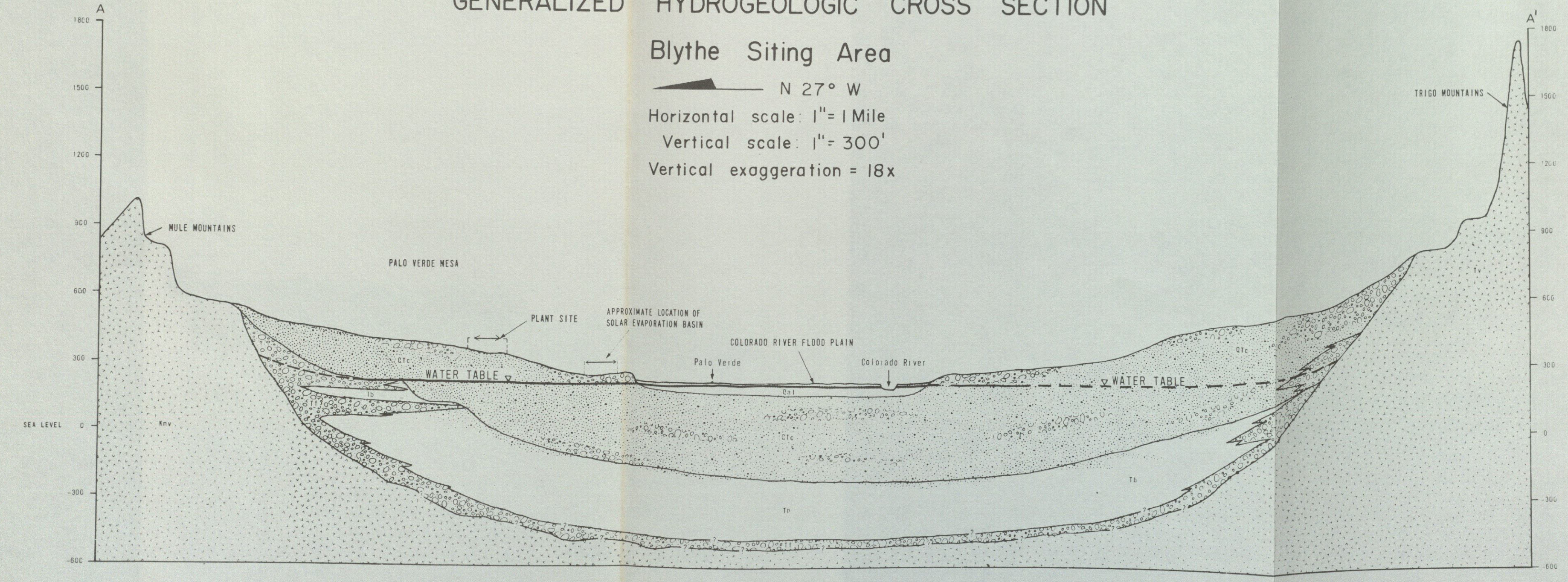
Blythe Siting Area

N 27° W

Horizontal scale: 1" = 1 Mile

Vertical scale: 1" = 300'

Vertical exaggeration = 18x



EXPLANATION

Qal — SURFICIAL DEPOSITS
Unconsolidated silt, sand, clay and gravel

QTc — ALLUVIAL DEPOSITS OF THE COLORADO RIVER AND ITS TRIBUTARIES
Poorly to moderately consolidated sand and gravel with silt and clay

Tb — BOUSE FORMATION
Poorly to moderately consolidated clay, silt, sand

Tp — TERTIARY FANGLOMERATE
Well consolidated sand, silt and gravel

Kmv, Tv — BASEMENT BEDROCK COMPLEX
Volcanic and metavolcanic rocks

FOR LOCATION OF CROSS SECTION REFER TO FIGURE 6

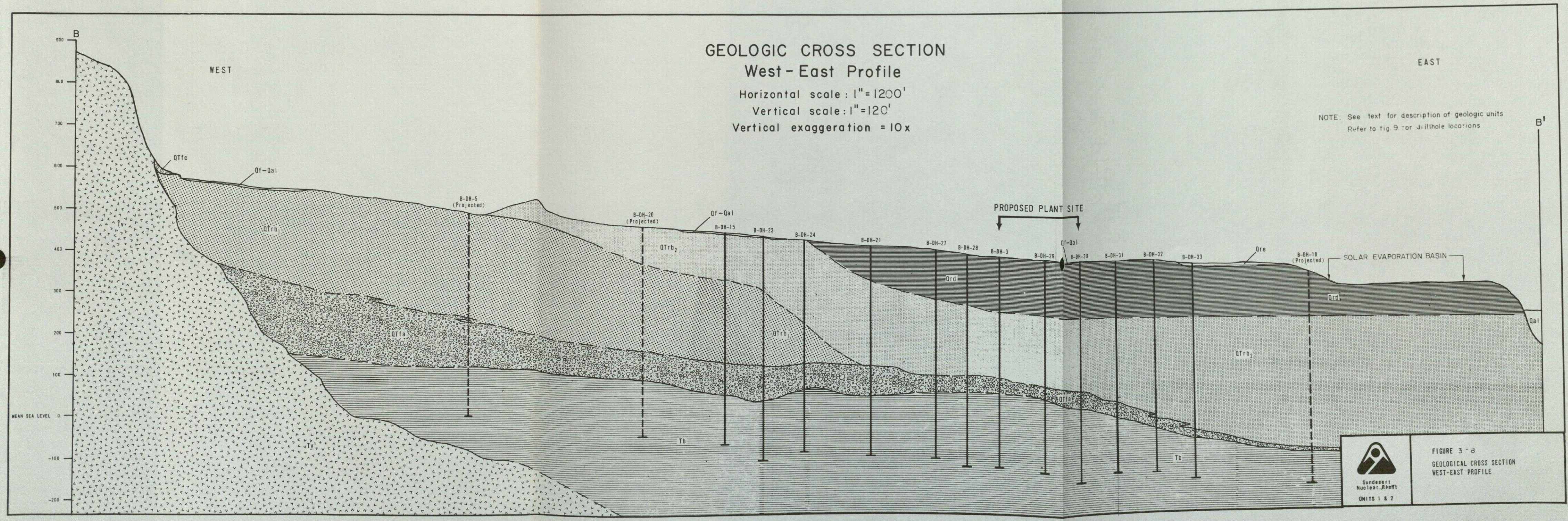
SYMBOLS

Based upon subsurface information

Potentiometric water level

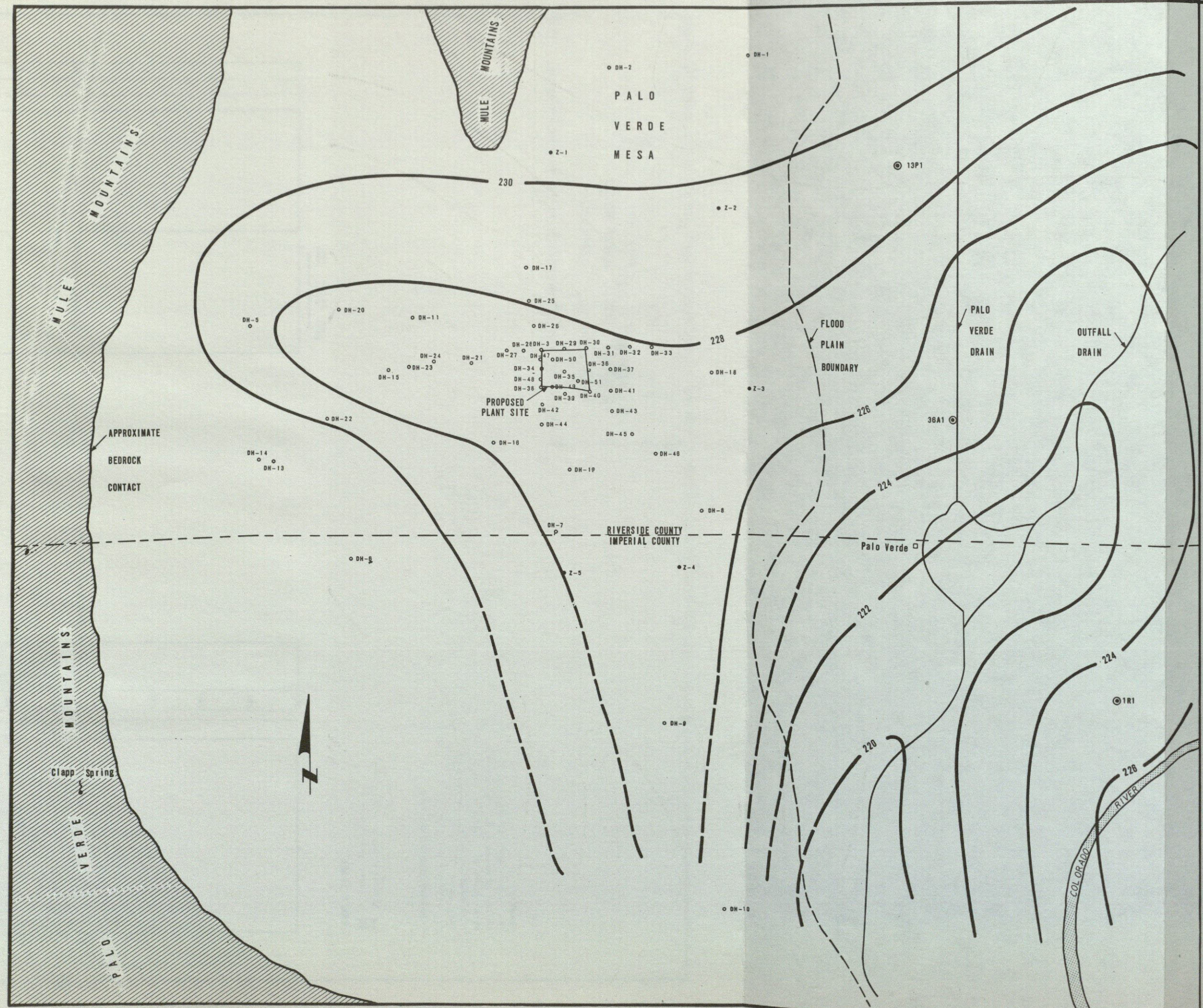
Sundesert Nuclear Plant
UNITS 1 & 2

FIGURE 3-7
GENERALIZED HYDROGEOLOGIC CROSS SECTION



Sundesert Nuclear Plant
UNITS 1 & 2

FIGURE 3-8
GEOLOGICAL CROSS SECTION
WEST-EAST PROFILE



WATER TABLE CONTOUR MAP
Blythe Siting Area

EXPLANATION

DH-NO	LAND SURFACE ELEVATION	WATER TABLE ELEVATION	DATE OF WATER LEVEL MEASUREMENT
1	341.63	230.2	1-12-75
2	421.49	320.0 *	1-12-75
3	383.22	218.9	1-07-75
5	502.31	226.3	1-05-75
6	434.45	220.2	1-12-75
7	357.18	226.0	8-25-74
8	337.41	327.4 *	1-08-75
9	358.33	241.9 *	1-12-75
10	383.98	200.0 *	1-12-75
11	434.33	226.8	1-12-75
12	425.95	228.0	1-12-75
13	481.25	234.1	2-26-75
14	455.05	318.0 *	1-12-75
15	440.95	219.8 *	2-05-75
16	368.35	227.9	1-07-75
17	399.73	228.2	1-12-75
18	319.09	227.1	12-04-74
19	359.01	227.6	2-05-75
20	463.74	362.8 *	1-12-75
21	405.67	226.0	2-05-75
22	454.92	230.5	1-09-75
23	432.15	227.7	1-12-75
24	421.79	229.4	1-12-75
25	383.78	229.6	2-05-75
26	391.43	224.8	1-08-75
27	395.40	227.7	1-09-75
28	389.10	227.5	1-09-75
29	374.70	227.4	1-08-75
30	366.30	227.4	1-09-75
31	384.12	227.1	1-09-75
32	361.68	227.9	1-09-75
33	362.18	228.0	2-05-75
34	380.97	226.0	1-09-75
35	373.60	227.4	2-05-75
36	367.07	227.3	1-09-75
37	363.16	227.3	1-09-75
38	378.78	227.0	1-09-75
39	372.81	227.7	1-08-75
40	365.58	227.3	1-08-75
41	360.04	226.6	1-09-75
42	377.64	187.1 *	1-09-75
43	358.04	227.3	1-09-75
44	376.10	220.8	1-09-75
45	346.92	228.4	1-09-75
46	332.01	220.4	1-09-75
47	382.27	227.3	1-08-75
48	380.47	227.4	1-09-75
49	376.05		
50	378.08	230.1	3-10-75
51	369.75	229.7	3-10-75

Z-NO	LAND SURFACE ELEVATION	WATER TABLE ELEVATION	DATE OF WATER LEVEL MEASUREMENT
1	424.23	233.0	2-11-75
2	328.96	229.8	2-04-75
3	320.78	226.5	2-04-75
4	310.18	227.8	2-04-75
5	431.02	228.0	2-04-75

250 — Line of equal water table elevation in feet above mean sea level. Dashed where approximate.

DH-12 — Drill hole location

Z-4 — Piezometer location

1R1 — Well hydrograph station; data shown in Figure 2.4-26

* — Well not functioning

NOTE: Flood plain data from 1974 water level contour map, Figure 2.4-21

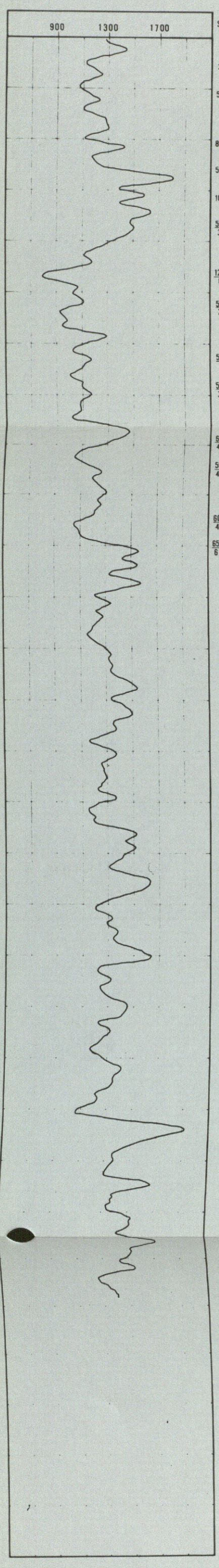
0 3000 6000 9000
FEET

Sundesert Nuclear Plant
UNITS 1 & 2

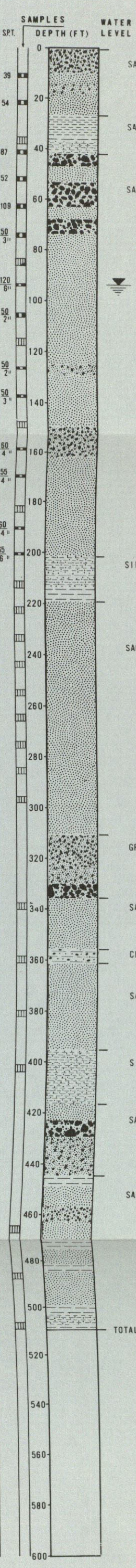
FIGURE 3-9

WATER TABLE CONTOUR MAP

NATURAL GAMMA LOG



LITHOLOGIC DATA



GROUND SURFACE ELEVATION: 319 Ft.

SAND & GRAVELLY SAND (SP) Light brown; subrounded sand, angular to subangular gravel; medium dense to dense; stratified.

SANDY SILT & SILTY SAND (ML&SM) Light brown; medium dense; stratified; occasional lenses of stiff sandy clay; calcareous.

SAND & SANDY GRAVEL (SP&GP) Light brown to gray brown, subrounded fine to medium sand, angular to subangular fine to medium gravel; dense to very dense; highly stratified, occasional clay lenses.

SILTY SAND, CLAYEY SAND & SANDY CLAY (SM, SC & CL) Gray fine sand, medium plastic sandy clay; dense and very stiff; highly stratified; calcareous.

SAND (SP-SM) Light gray-brown; subrounded fine to medium sand, trace of silt; very dense; interbedded with silty sands, slightly gravelly sands and occasional thin clay lenses; calcareous.

GRAVELLY SAND & SANDY GRAVEL (SP&GP) Gray brown; subrounded fine sand, subangular and angular coarse sand and gravel; very dense; stratified; occasional lenses of sandy clay.

SAND (SP) Light gray; subangular fine to medium sand; dense; scattered clay lenses.

CLAY & GRAVELLY SAND (CH&SP) Gray-brown; clay of high plasticity, angular and subangular sand and gravel; very dense; highly stratified; calcareous.

SAND (SP-SM) Light gray-brown; fine to medium sand, trace of silt; very dense; interbedded layers of fine to medium sand and silty fine sand, scattered clay lenses; calcareous.

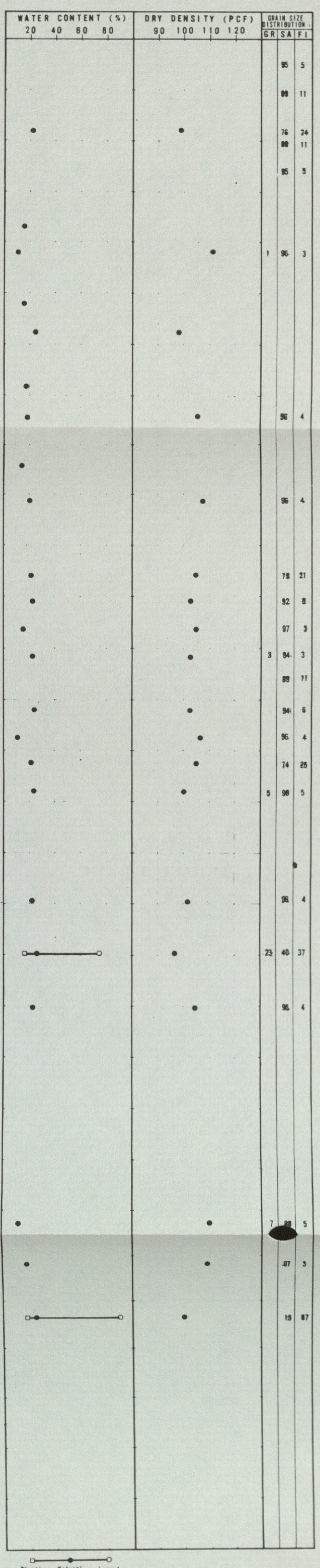
SILTY & CLAYEY SAND (SM&SC) Gray-brown; fine to coarse sand, fines of low plasticity; very dense; interbedded with thin clay lenses; calcareous.

SAND & GRAVEL (SP&GP) Light gray-brown; fine to medium sand, angular and subangular gravel; very dense; highly stratified, interbedded with clay lenses.

SAND & CLAY (SP, CL & CH) Light gray brown and gray, fine to medium sand, clay of medium to high plasticity, occasional gravel; very dense and very stiff; highly stratified; calcareous.

TOTAL DEPTH 507 Ft.

BASIC SOIL PROPERTIES



SAMPLE TYPES

Pitcher Tube Sample.
Standard Split Spoon Sample.

LITHOLOGIC DESCRIPTIONS

Lithologic descriptions were compiled from geologist's field logs, laboratory test data and down hole geophysics. Field logs were prepared in accordance with ASTM: D2488-69. Classifications based on laboratory test data are in accordance with ASTM: D2487-69. Rock descriptions follow procedures outlined in the QUARTERLY OF THE COLORADO SCHOOL OF MINES; Volume 50 No. 1. Descriptions for rotary borings are based upon cuttings samples, geophysical logs and drillers' comments.

Sundesert Nuclear Plant

UNITS 1 & 2

FIGURE 3-10

LOG OF BORING
B-DH-18