

LOG OF DEEP BORINGS

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS GEOLOGY & SOILS SECTION

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Well # MW-1

WELL DATA

PROJECT Air Force Site
Amargosa Creek

FLOOD CONTROL NO. _____
PROJECT NO. Y 504940A
OWNERS NO. _____
D.W.R. NO. _____

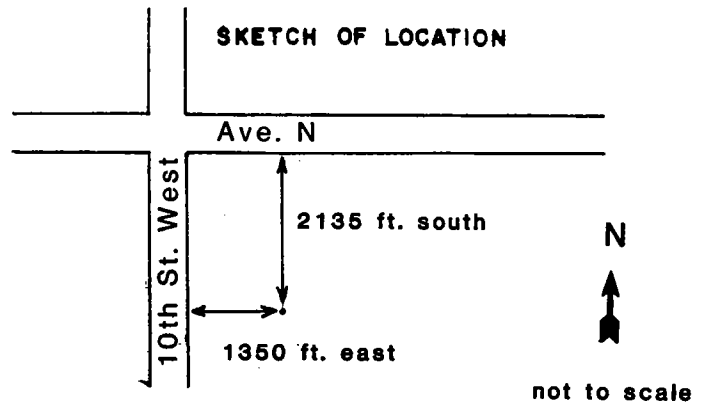
LOCATION AND DESCRIPTION

City of Palmdale

1350 ft. east of centerline of
10th Street West

2135 ft. south of centerline of Ave. N

SKETCH OF LOCATION



ELEVATION OF GROUND AT WELL 2606' U.S.G.S. DATUM

ELEVATION OF REFERENCE POINT 2606' U.S.G.S. DATUM

USE OF WELL Monitoring Well

DRILLING METHOD Rotary Wash/E-Z Mud

DRILLER Bud Mattis

DATE DRILLED 6/11/90 - 7/30/90

SIZE OF HOLE 6½" Bit

DEPTH OF HOLE 800'

SIZE OF CASING 2"

DEPTH OF CASING 800'

TYPE OF CASING PVC Flush Joint, Sched. 40

PERFORATIONS 355' to 695'

GRAVEL PACK Yes - Pea Gravel

TREMES _____

PUMP TYPE _____

POWER USED _____

YIELD _____

DRAWDOWN _____

LITHOLOGIC LOG BY S.L., L.L., K.L.

INTERVAL _____

ELECTRIC LOG BY D.C., K.L., L.L.

INTERVAL _____

REMARKS

Casing between surface and 695', Perforation interval between 355' and 695' below
ground level. Backfilled with pea gravel.

PWS-0190-0051

RECORDED BY _____

DATE _____

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MW-1</u>	Page <u>3</u> of <u>9</u>
REMARKS					DESCRIPTION	
Drill knocking at 101' Time delay, 4-5' Drill hit rock Mud thicker due to clay knocking @ 120' More @ 122' and 123' SPT Sample @ 141'				100	<u>Gravel zone 1' thick?</u> <u>Silty sand</u> , sand fine to coarse, ang. granules 5%, poorly sorted. <u>Silty sand</u> , reddish in color.	
				110	<u>Silty sand</u> <u>Silty sand</u> , reddish in color. <u>Silt</u> , reddish brown.	
				120	<u>Silty sand</u> , silt 30%. <u>Gravelly zone</u> . As above, sandy silt with scattered granules.	
				130	As above less silty.	
				140	<u>Silt</u> , reddish. <u>Silty sand</u> ,	
				150	<u>Silty sand</u> Interbeds of reddish sandy silt. <u>Silt</u> , reddish. <u>Silt</u> , reddish with minor sand.	
				160	As above. As above <u>Silty sand</u> , sand fine to coarse, poorly sorted more silty.	
				170	<u>Gravelly sand</u> , with granules.	
				180	<u>Sandy silt</u> <u>Silt</u>	
				190	Gravelly Silt As above more sandy	
Knocking @ 180'				200	<u>Silty sandy</u> , sand fine to coarse.	

PWS-0190-0053

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MW-1</u>	Page <u>4</u> of <u>9</u>
REMARKS					DESCRIPTION	
Knocking @ 220' and 221'				200	Silty sand, sand fine to coarse. more silty	
Slight knocking				210	Silty sand, sand fine to coarse, silt variable %, poorly sorted. more silty	
Stopped @ 3:30 am on 6/12/90 9:00 am Started drilling @ 9:00 am on 6/13/90 Hard drilling @ 243-246'. 9:36 am 10:03 am				220	Gravelly, cobbles present. Sandy Silty sand, sand coarse. Sandy	
10:30 am 10:45 am				230	More silty Silty sand	
11:10 am				240	Sandy Sand, with some silt.	
				250	Becoming more silty.	
				260		
				270	More sandy Silty sand, with occasional granules, most sand fine to medium.	
				280	Becoming coarser, higher % of coarse sand and granules in sample.	
				290		

PWS-0190-0054

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>M-1</u>	Page <u>5</u> of <u>9</u>
REMARKS					DESCRIPTION	
3:20 pm				300	Silty sand, sand fine to coarse with minor granules, poorly sorted.	
				310		
3:50 pm				320	As above.	
6/14/90 8:30 am				330	As above, coarse sand more abundant.	
Hard drilling				340	As above.	
Progressing slow				350	Silty sand, sand fine to coarse with minor granules, poorly sorted, granules very angular - may be crushed gravel?	
9:05 am				360	As above, coarse sand less abundant between 362' and 368'.	
9:20 am				370	Silty sand, sand fine to coarse, poorly sorted, angular granules 5% possibly crushed gravel, sand grains angular to subangular.	
				380		
Drill knocking @ 372' to 380'				390	As above.	
				400	As above, sand fine to medium, coarse sand less abundant.	
Occasional knocking					Silty sand, sand fine to coarse, ang. to subang., poorly sorted, ang. granules 5%.	

PWS-0190-0055

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MW-1</u>	Page <u>6</u> of <u>9</u>
REMARKS					DESCRIPTION	
Started at 1:00 pm on 6/18/90. Had to redrill 140' of caving.				400	<u>Silty sand</u> , sand coarse, abundant silt.	
				410	Increase in silt content, lumps of silt increasing, sand is coarser and highly weathered.	
Knocking @ 421'.				420	<u>Silty sand</u> , sand coarse, abundant silt.	
Knocking @ 430'.				430		
				440	<u>Silty sand</u> , interbeds of silt.	
				450	More silty, probably silty sand to sandy silt.	
					<u>Sandy silt</u> , increase in silt content.	
Engine breakdown @ 4:33 pm @ 460' on 6/18/90.				460	<u>Silty sand</u> , sand fine to medium with minor coarse granules, poorly sorted, subang.-ang. <u>Sandy Silt</u>	
Resumed drilling @ 7:00 am on 7/24.					Sandier	
Harder drilling.				470	<u>Silty sand</u> , sand very fine grained. <u>Silty sand</u> , sand coarse, clasts of totally weathered material, very soft, thin layers of clayey silt/silty clay @ 470-475'.	
Knocking @ 478' 479'.				480	<u>Clayey sandy silt</u> , reddish.	
Mud coming up through rods. Circulation reversed.					<u>Silt</u>	
				490	<u>Silty sand</u> , sand medium to coarse, totally weathered sand of granitic composition white and red color, some interbeds of silt. @ 490' gravelly, high % of highly weathered granitics and mafic bedrock fragments.	
Marsh funnel 72 sec.					Sand, with gravel.	
				500	Gravelly. with silt and sand.	

PWS-0190-0056

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MW-1</u>	Page <u>7</u> of <u>9</u>
REMARKS					DESCRIPTION	
<p>Stopped drilling @ 4:00 pm on 7/24/90.</p>				500	Silty sand, sand fine grained. Increased gravel content, fragments of granitics and metamorphic rocks, very soft.	
				510	Significant % of gravel.	
				520	<u>Silt</u>	
					<u>Silty sand</u> , sand fine to medium.	
					<u>Silty sand</u> , sand fine to medium with gravel.	
					<u>Gravelly sand</u>	
				530		
<p>Started drilling @ 1:55 pm on 7/25/90.</p>					As above.	
				540	<u>Sandy silt</u> , with minor clay, sand fine to medium, thin layer of silty material.	
					@ 544' <u>Silty sand</u> , sand fine to coarse, poorly sorted, angular to subangular.	
					Less silty	
				550		
					<u>Silty sand</u>	
				560	<u>Silty sand</u>	
					As above, more abundant quartz and black mafic lithic grains 1-1½mm, angular.	
					As above, siltier.	
<p>Knocking @ 564'.</p>					As above, common chips 2-3 mm of light granitics and dark mafic/meta, highly weathered.	
				570	Less abundant chips.	
					<u>Silty sand</u> , sand fine to coarse, poorly sorted, ang. to subang.	
				580	More abundant chips, light colored 2-4 mm, ang.	
					As above, siltier, few coarse sand fine to medium.	
					<u>Silty sand</u> , sand fine to coarse, less silt poorly graded, ang. to subang. almost no chips.	
				590	As above.	
<p>Knocking @ 590'.</p>					Slightly less silty, common chips 2-3 mm ang., light colored grains granitic? highly weathered.	
					As above, few chips.	
<p>Stopped drilling @ 4:10 pm on 7/25/90</p>					PWS-0190-0057	

DPW		Sample	Blows	Graphic	Depth	WELL NUMBER	MW-1	Page 8 of 9
REMARKS						DESCRIPTION		
7/26/90	9:15 am				600	Silty sand, sand fine to coarse, angular, chips of dark colored mafic fragments and some light colored granitics fragments.		
					610	As above, fewer chips.		
	10:05 am							
	10:17 am				620	Silty sand, sand fine to coarse, poorly sorted, angular. No dark or light colored chips. Occasional cuttings of clay/silt in the form of plates about 1/4" to 1/2" in diameter.		
Smaller amt. of sample being returned this interval?					630			
fine grained								
	10:55 am							
	11:07 am				640	As above, more clayey silt plates being returned. Some clayey silt layers.		
More abundant sample returned.								
fast drilling					650	As above, more clay/silt plates. Estimate about 30% of sample.		
	11:35 am							
	11:45 am				660	Silty sand, sand fine to coarse, poorly sorted, angular, clayey silt plates 10 to 15% of sample.		
Valve leak @ 675'. Had to stop operation.					670	Zone of clayey silt plates.		
	12:15 pm							
	12:37 pm							
Resumed drilling.						Silty sand, fine to coarse sand with some bedrock granules, buff white and red in color, poorly sorted, angular.		
	12:52 pm							
	1:00 pm				680	As above.		
6 foot lag time.								
					690	Abundant clayey silt plates. Layer probable at this depth.		
Fast drilling 695'-700'.						PWS-0190-0058		
	1:40 pm					As above, with abundant clay silt plates 20% in this interval.		

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MW-1</u>	Page <u>9</u> of <u>9</u>
REMARKS					DESCRIPTION	
1:52 pm				700	Silty sand, sand fine. Absence of coarse sand and granules. Clayey silt plates $\frac{1}{4}$ to $\frac{1}{2}$ " in diameter common, 15%.	
				710		
Stopped drilling at 2:30 pm on 7/26/90.				720	Silty sand, sand fine to coarse, granules, poorly sorted, angular, clayey silt plates 10% of sample.	
11:10 am 7/30/90				730	Sandy silt, sand fine grained. Absence of coarse sand and granules. Clayey silt plates 10-15%. @ 728' becoming coarser grained.	
11:25 am				740		
12:00 pm				750	Sandy silt, sand fine, some clayey silt plates.	
				760	Becoming coarser and grading into a silty sand. Sand fine to medium grained. Occasional granules of dark bedrock - probably schists.	
12:25 pm				770	Sandy silt, absence of coarse sand and granules.	
1:25 pm				780		
				790	Silty sand, sand fine to coarse, coarse sand and granules 10% of sample. Bulk of coarse grains clear-white-red quartz and white and black bedrock fragments.	
2:00 pm						
2:17 pm					As above.	
					Sandy silt, sand fine, absence of coarse sand and granules. Silt plates $\frac{1}{4}$ to $\frac{1}{2}$ " to 15 to 20% of sample.	
2:55 pm						
3:15 pm						
Stopped drilling @ 3:35 pm on 7/30/90					PWS-0190-0059	
					Increasing sand content. Grading to a silty sand.	
				800	Bottom of hole 800 feet	

LOG OF DEEP BORINGS

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS GEOLOGY & SOILS SECTION

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Well # MW-2

WELL DATA

PROJECT Air Force Site
Amargosa Creek

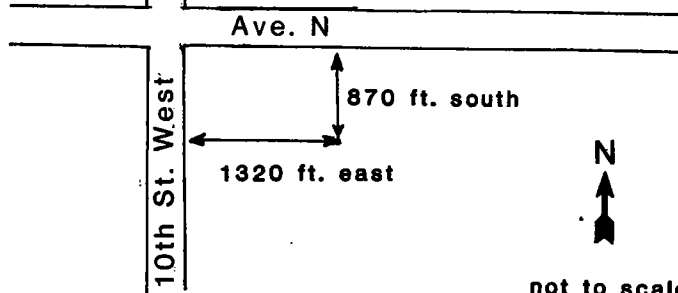
FLOOD CONTROL NO. _____
PROJECT NO. Y504940A
OWNERS NO. _____
D.W.R. NO. _____

LOCATION AND DESCRIPTION

City of Palmdale
1320 ft. east of centerline
of 10th Street West

870 ft. south of centerline of Ave. N

SKETCH OF LOCATION



ELEVATION OF GROUND AT WELL 2594' U.S.G.S. DATUM

ELEVATION OF REFERENCE POINT 2594' U.S.G.S. DATUM

USE OF WELL Observation Well

DRILLING METHOD Rotary Wash, E-Z Mud

DRILLER Bud Mattis

DATE DRILLED 8/7/90 - 8/14/90

SIZE OF HOLE 6½" Bit

DEPTH OF HOLE 660'

SIZE OF CASING 2"

DEPTH OF CASING 615'

TYPE OF CASING PVC Flush Joint, Sched. 40

PERFORATIONS 425-615'

GRAVEL PACK Yes - Pea Gravel

TREMES _____

PUMP TYPE _____

POWER USED _____

YIELD _____

DRAWDOWN _____

LITHOLOGIC LOG BY S.L./L.L.

INTERVAL _____

ELECTRIC LOG BY D.C./S.L./L.L.

INTERVAL _____

REMARKS

Perforation zone between 425' and 615', 10' perforated interval alternates with
10' unperforated interval.

PWS-0190-0060

RECORDED BY _____

DATE _____

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MW-2</u>	Page <u>2</u> of <u>8</u>
REMARKS					DESCRIPTION	
Began drilling @ 8:00 am on 8/7/90.				0	Silty sand, mod. yellow brown, sand fine to coarse, ang.-subang. grains, poorly sorted, silt 15-20%.	
				10	As above, 3% angular granules 1/8 to 1/4" in diameter, mostly quartz with minor mica schists. Grains becoming reddish brown in color.	
8:39 am				20	As above.	
					As above, silt 10-15%, ang. granules 5%.	
				30	Silty sand, granules 5-10%, angular.	
					As above, with more silt, granules 3%, silt 30-35%.	
					As above, slightly less silty - 25%.	
9:02 am					As above, silt 20%, ang. granules 3-5%.	
9:08 am				40	Silty sand, silt 15%, granules 3%.	
					Silty sand, yellowish brown, more silt, silt 40%, sand fine to medium.	
				50	Getting less silty, 30%.	
					Silty sand, silt 30-35%.	
					As above, silt 50%.	
9:41 am				60	Silty sand, silt 20%, poorly sorted, sand fine to coarse, ang. to subang., abundant quartz grains, coarse, angular.	
9:45 am					As above, with silt clumps, silt 25%.	
				70	Silty sand, silt 20%, few ang. schists granules.	
					As above, silt 15-20%.	
10:16 am				80	As above, with abundant silt clumps, silt 25%.	
10:22 am					As above, with few silt clumps, silt 15-20%, grans 3%,	
Knocking 84-86'.					Silty sand, slightly siltier, silt 20-25%, grans 3%, ang. quartz and schists, quartz is fresh, some reddish silt clumps.	
Knocking 88-94'				90	More abundant clumps of reddish silt, silt 25-30%.	
					Silty sand, silt 15-20%, grans ang. 5% quartz mainly, less silty, silt 10%, grans 3%.	
10:54 am				100	Sandy silt, reddish brown, silt 60-70%.	

PWS-0190-0061

A-27

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>M-2</u>	Page <u>3</u> of <u>8</u>
REMARKS					DESCRIPTION	
11:01 am				100	Sandy silt, reddish brown, silt 60-70%.	
Knocking @ 109' and deeper.				110	Silty sand, silt 40-50%. Silty sand, silt 40%, common ang. quartz grans. As above, yellow brown, silt 30%.	
11:42 am				120	Silty sand, silt 20-25%, grans, quartz, ang. 3%. As above, also highly weathered light colored chips 1/8-1/4".	
11:52 am				130	As above, silt 15-20%.	
Knocking				140	Silty sand, reddish brown, silt 25-30%.	
12:31 pm				150	As above, silt 30-40%.	
12:40 pm				160	Silty sand, getting sandier, silt 20%. As above, getting siltier, silt 25%. Silty sand, silt 30-35%.	
Intermittent knocking.				170	Sandy silt, silt 50-60%, reddish brown, sand is poorly sorted, fine to coarse, ang. to subang. @ 150' Silty sand, mod. yellow brown, silt 20%.	
1:20 pm				180	As above, silt 15-30%, common highly weathered light-colored chips. Granules, 5% fresh quartz to 1/8" and highly weathered light-colored chips.	
1:27 pm				190	Sandy silt, reddish, silt 60%, some highly weathered whitish chips. As above, silt 70-90%.	
2:15 pm				200	Getting sandier, silt 50-60%, whitish chips common, 3%. As above, silt 50%, reddish, sand moderately sorted, mostly fine to medium. @ 176' Silty sand, silt 30%, poorly sorted, sand fine to coarse, ang. to subang.	
2:24 pm					Alternating zones of silty sand and sandy silt, weathered white chips common in interbedded layers.	

PWS-0190-0062

A-28

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MW-2</u>	Page <u>4</u> of <u>8</u>
REMARKS					DESCRIPTION	
Stopped drilling @ 4:38 on 8/7/90.				200	Silty sand, silt 20-40%.	
					Sandy silt, silt 50-70%, cuttings have light colored grease blobs from Mayhew rig.	
8/8/90 8:35 am				210	Sandy silt, reddish, silt 90%.	
					Silty sand, silt 20-30%, poorly sorted, sand fine to coarse, ang. to subang., silt clumps.	
Much knocking, few cuttings, slow advance @ 222-224' gravel, cobbles? Drilling faster below 224'.					As above.	
				220	Sandy silt, silt 70%.	
10:07 am					As above.	
					Silt, reddish, silt 80-90%.	
10:16 am				230	Silty sand, yellow brown, silt 30-40%, poorly sorted, sand fine to coarse, ang. to subang.	
					Silt, reddish, silt 80%.	
					As above, silt 70-90%.	
					Silty sand, silt 40%.	
Switched back and forth between gears to drill faster.				240	As above, silt 15-40%, common highly weathered whitish chips.	
					Sandy silt, silt 50-60%.	
					As above, silt 50%.	
					As above, silt 80%.	
11:59 am				250	Silty sand, silt 40%.	
					Sandy silt, silt 70-80%.	
12:07 pm					As above, silt 60-70%, scattered highly weathered light colored chips.	
				260	As above.	
Faster drilling 259' to 265'.					Sandy silt, silt 70-80%, no chips.	
					As above, common chips 1/8 to 1/4" diameter, silt forms large clumps 1/2" diameter, reddish brown and gray.	
				270	Getting sandier, silt 60%.	
					Sandy silt, silt 70%, clumps present, abundant whitish chips.	
Stopped @ 280' to change bit.					As above, clumps 80% red-brown, 20% gray, few chips.	
					As above, no chips.	
2:02 pm				280	Getting sandier, silt 50-60%, some weathered whitish chips.	
8/9/90					Silty sand, sand fine to medium.	
					@ 282', Gravelly sand, bedrock frags of granitic rocks and orange feldspar frags.	
Knocking					@ 287-289', interbeds of silty sand.	
				290	Gravelly sand	
					Silty sand, interbeds.	
					Gravelly sand	
9:25 am					Sandy silt, sand fine to very fine.	
				300	Silty sand	

PWS-0190-0063

A-29

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MM-2</u>	Page <u>5</u> of <u>8</u>
REMARKS					DESCRIPTION	
9:45 am				300	Sandy silt	
					Gravelly sand, weathered black fragments.	
					Interbeds of sandy silt.	
				310	Interbedded gravelly sand and silty sands, sand fine to medium, gravel 60%, silt 40%.	
					Silt lenses	
10:24 am					Silty sands, sand fine, reddish, scattered gravel - black fragments.	
10:33 am				320		
Knocking					Gravelly sands, with layers of fine to coarse silty sand.	
				330	Interbedded gravelly sand and silty sand, gravel 40%.	
Intermittent knocking					Increase in gravel content.	
Strong knocking.					Silty sand, sand fine.	
11:10 am						
11:20 am				340	Gravelly sand/sandy gravel, mostly totally weathered clasts of granitics and metamorphic bedrock plus quartz and feldspar.	
				350	Some thin sand silt/silty sand layers.	
11:53 am						
12:02 pm				360	Gravelly sands/sandy gravel.	
					Silty sand, sand fine to coarse.	
				370	Silty sand, with gravel-black fragments, 50-70%.	
					Thin interbeds of silty sand, sand fine to coarse.	
12:45 pm				380	Gravelly sand.	
12:56 pm						
				390		
					Silty sand to sandy silt with scattered gravel, sand fine to coarse.	
1:24 pm				400		

PWS-0190-0064

A-30

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MW-2</u>	Page <u>6</u> of <u>8</u>
REMARKS					DESCRIPTION	
1:57 pm				400	<u>Sandy silt</u> , with scattered gravel, black clasts 10-15%.	
					Increasing sand content.	
				410	<u>Silty gravelly sand</u> , black clasts.	
					Increase in gravel content.	
2:50 pm					<u>Gravelly sand</u> , sand fine to coarse.	
				420	<u>Clayey silt</u> , sand 10%.	
Started drilling @ 10:22 on 8/13/90.					As above, sand 20%.	
					<u>Silty sand</u> , sand fine to coarse, silt and clay 30-40%, poorly sorted, grains ang. to subang., yellow brown.	
Occasional knocking.				430	As above, clay 10%, silt 20%.	
					<u>Silty sand</u>	
11:27 am				440	As above, clay 5-15%, silt 15-20%, granules 3%, granules are quartz and black lithic frags.	
11:58 am					<u>Silty sand</u>	
Stopped to service rig.				450	As above, clay 10%, silt 20-40%.	
				460	<u>Silty sand</u> , few weathered light colored chips.	
12:31 am					<u>Sandy silt</u> , silt 60%, no chips.	
12:40 am					<u>Sandy silt</u> , silt 50-60%, a few whitish chips.	
				470	As above.	
					<u>Silty sand</u>	
					<u>Sandy silt</u> , silt 70%.	
					<u>Sandy silt</u> , silt 70-80%, sand fine to medium,	
					As above, getting sandier, silt 60%, sand fine to coarse.	
1:29 pm				480	<u>Silty sand</u> , silt 40%, clay 5-10%.	
1:35 pm					<u>Silty sand</u> , silt 30-40%.	
					As above.	
					<u>Sandy silt</u> , silt 50-60%.	
				490	As above.	
					<u>Silty sand</u> , silt 40%.	
					As above, abundant highly weathered light colored chips 1/4" in diameter.	
2:26 pm				500	<u>Sandy silt</u> , silt 60%.	

PWS-0190-0065

A-31

LOG OF DEEP BORINGS

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS GEOLOGY & SOILS SECTION

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Well # MW-3

WELL DATA

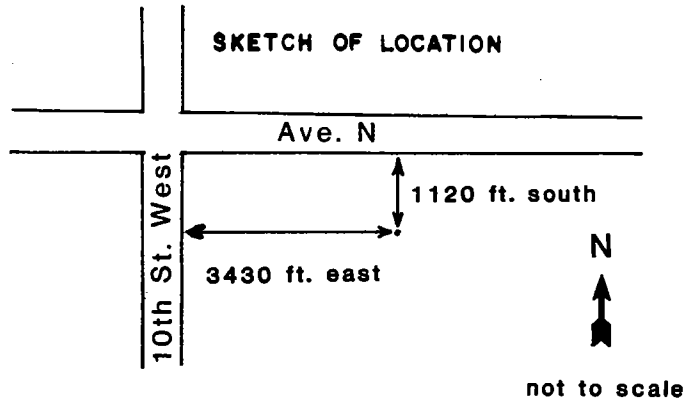
PROJECT Air Force Site
Amargosa Creek

FLOOD CONTROL NO. _____
PROJECT NO. Y504940A
OWNERS NO. _____
D.W.R. NO. _____

LOCATION AND DESCRIPTION
City of Palmdale

3430 ft. east of centerline of
10th Street West

1120 ft. south of centerline of Ave. N



ELEVATION OF GROUND AT WELL 2587' U.S.G.S. DATUM

ELEVATION OF REFERENCE POINT 2587' U.S.G.S. DATUM

USE OF WELL Observation Well

DRILLING METHOD Rotary Wash, E-Z Mud

DRILLER Bud Mattis

DATE DRILLED 8/20/90-8/28/90

SIZE OF HOLE 6½"

DEPTH OF HOLE 660'

SIZE OF CASING 2"

DEPTH OF CASING 641'

TYPE OF CASING PVC Flush Joint, Sched. 40

PERFORATIONS 291'-641'

GRAVEL PACK Yes - Pea Gravel

TREMES _____

PUMP TYPE _____

POWER USED _____

YIELD _____

DRAWDOWN _____

LITHOLOGIC LOG BY K.L./S.L.

INTERVAL _____

ELECTRIC LOG BY D.C./S.L.

INTERVAL _____

REMARKS

Perforation zone between 291' and 641', 10' perforated casing alternating with
drilled 10' blank casing. Blanks have 4 holes ½" diameter every 2 linear feet of
casing.

PWS-0190-0068

RECORDED BY _____

DATE _____

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MW-3</u>	Page <u>2</u> of <u>8</u>
REMARKS					DESCRIPTION	
Started drilling @ 12:50 am on 8/20/90.				0	Sandy silt, yellowish brown, silt 70%, sand medium to coarse, 30%, powdery.	
				10	Sand, light brown, sand fine to very coarse, granules 30%, poorly sorted, sand grains and granules ang. to subang., dominated by clear and opaque quartz and black lithic fragments - schists, some iron staining on grains.	
1:05 pm				20	Becoming fine grained.	
1:25 pm				30	Sandy silt, light brown, sand 40%, silt 50%, granules and gravel 10%, silt plates in cuttings $\frac{1}{4}$ to $\frac{1}{2}$ " in diameter, poorly sorted.	
1:37 pm				40	Silty sand, sand fine to coarse, 50%, silt 30%, granules and gravel 20%, angularity and composition same as 0-20' interval.	
1:45 pm				50		
				60	Silty sand, light brown, sand fine to coarse 50%, silt 30%, granules and gravel 20%, angularity and composition same as 0-20' interval.	
2:05 pm				70	Sandy silt, reddish brown, abundant silt plates. Some gravel fragments dark in color - schists.	
2:48 pm				80	Becoming finer grained.	
Knocking @ 65'				90	Becoming coarser grained.	
3:02 pm				100	Silty sand, light brown, sand fine to coarse 60%, silt 25-30%, granules and gravel 10-15%, angularity and composition same as 0-20' interval.	
3:16 pm						
Knocking @ 89'.						
Stopped drilling @ 3:30 pm on 8/20/90.						

PWS-0190-0069

A-35

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MW-3</u>	Page <u>3</u> of <u>8</u>
REMARKS					DESCRIPTION	
Started drilling @ 7:55 am on 8/21/90.				100	Silty sand, light brown, sand fine to coarse 60%, silt 20%, granules and gravel 20%, poorly sorted, sand grains and granules and gravel angular to subangular, clear to white opaque quartz and black lithic fragments - schists, some grains oxidized to red color, silt clumps are reddish brown.	
				110		
Knocking @ 115'.				120		
8:15 am						
8:20 am				130	As above,	
Drilling interval getting progressively longer. Harder strata?				140	As above,	
8:47 am						
8:52 am				150	As above, increasing silt content, more silt clumps.	
				160	As above,	
9:15 am						
9:24 am				170	As above, increasing silt content to 30%, more silt clumps.	
Knocking @ 175'.				180	As above,	
9:40 am						
9:55 am				190		
SPT sample @ 200'.				200	@ 195' increasing silt content to 30-40%, more silt clumps.	
10:15 am						

PWS-0190-0070

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MW-3</u>	Page <u>4</u> of <u>8</u>
REMARKS					DESCRIPTION	
12:10 pm				200	Silty sand, light brown, sand fine to coarse 60%, silt 20-30%, granules 10-20%, grains and granules angular to subangular, clear to white opaque quartz with black lithic fragments - schists, some grains oxidized to red color, silt clumps common.	
				210	Becoming more silty @ 210-220'.	
12:25 pm				220	Silt content increasing to 30-35%.	
1:08 pm				230	Silt clumps reddish brown becoming more numerous.	
Drilling slower. Progressively harder strata?				240	As above	
1:38 pm				250	Sandy silt, light brown, silt 60-70%, sand and granules 30-40%, poorly sorted, angularity and composition of framework grains same as above.	
1:46 pm				260	Silty sand, same as 200-220' interval.	
				270		
2:11 pm				280	Silty sand, as above.	
2:18 pm				290	Silty sand, as above.	
					Increasing silt content to 30-35%.	
2:48 pm					Some white fragments noted in sample, 1/8 to 1/4" diameter, smears easily between fingers - clay.	
2:57 pm						
3:22 pm				300		

PWS-0190-0071

A-37

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MW-3</u>	Page <u>5</u> of <u>8</u>
REMARKS					DESCRIPTION	
3:28 pm				300	Silty sand, as above.	
					Decreasing sand content.	
				310	Silt/sand, light brown, silt 50%, sand and granules 50%, poorly sorted, grains angular to subangular, numerous silt clumps, framework grains, white opaque and clear quartz and dark lithic fragments - schists, some white clay particles - easily smeared.	
3:53 pm				320		
4:00 pm				330	Increasing silt content - to 60-70% of sample. White clay particles still present.	
Stopped drilling @ 4:26 on 8/21/90.				340	As above in interval 310' to 320'.	
Started drilling @ 11:03 am on 8/22/90.				350	Increasing silt content to 60-70%.	
				360		
11:31 am					Sandy silt, light brown, silt 70%, sand 30%, silt clumps present.	
11:40 am				370		
				380	Silt 60%, sand 40%.	
12:10 pm						
12:17 pm				390	Silt 60-70%, sand 30-40%.	
SPT sample @ 400'.				400		
12:52 pm						

PWS-0190-0072

A-38

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MW-3</u>	Page <u>6</u> of <u>8</u>
REMARKS					DESCRIPTION	
Started drilling @ 9:27 am on 8/23/90.				- 400 -	Silty sand, light brown, sand fine to coarse 60%, silt 40%, poorly sorted, framework grains angular to subangular, opaque white and clear quartz grains and dark lithics - schists.	
				- 410 -	Sandy silt, brown, sand 30-40%, silt 60-70%. Silt content increasing to 70-80%. Abundant reddish brown silt clumps.	
9:57 am				- 420 -	Silty sand, sand 60-70%, silt 30-40%.	
10:08 am				- 430 -	Sandy silt, brown, sand 30-40%, silt 60-70%. Sandy silt, as above.	
10:30 am				- 440 -	Sandy silt, sand 30%, silt 70%.	
10:47 am				- 450 -	As above. Abundant silt clumps, reddish brown.	
11:25 am				- 460 -	Silty sand	
11:36 am				- 470 -	Sandy silt, brown, sand 40-50%, silt 50-60%, white grains easily smeared between fingers - probably unstable minerals, some large white clumps 1/8 to 1/4" in diameter.	
SPT sample @ 480'.				- 480 -	Silty sand, brown, sand fine to coarse, silt 20%, poorly sorted, abundant quartz and black coarse grains and granules, angular to subangular.	
12:23 pm				- 490 -	As above, silt 30-35%. As above, silt and clay 25%. As above, silt 20-30%, common highly weathered white chips 1/8 to 1/4" across.	
Started drilling @ 1:52 on 8/27/90.				- 500 -	As above, silt 30%, fewer chips. As above, no chips, common granules 5%.	
Mechanics serviced rig during the AM.					PWS-0190-0073	
Knocking @ 493'.					A-39	
2:13 pm						

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER <u>MW-3</u>	Page <u>7</u> of <u>8</u>
REMARKS					DESCRIPTION	
2:20 pm				500	Silty sand, silt 20-30%, granules less abundant.	
					As above, common quartz granules, angular, highly weathered white chips.	
				510	As above, silt 30%, fewer quartz grans. and white chips.	
Welder arrived @ 2:45 to work on truck.					As above, silt 20%, abund. quartz grans. and white chips.	
2:40 pm				520	As above, silt 20-30%, fewer granules and chips.	
2:53 pm					As above, silt 35-40%.	
				530	As above, silt 20-30%.	
					As above, common white chips, clay 5%.	
3:15 pm				540	As above, silt 30-35%.	
4:06 pm					As above, silt 40%.	
Operation shut down for welding 3:20 to 4:05.				550	As above, silt 30-40%.	
					As above, silt 30% abund. black granules, weathered, clay plates. 1" thick by .3 by .5" in diameter.	
4:25 pm				560	As above, silt 30-40%, few black granules.	
4:33 pm					Silty sand, silt 40-50%.	
				570	As above, silt 30-40%.	
Stopped drilling @ 4:52 pm on 8/27/90.					As above, silt 20-30%.	
				580	Sandy clayey silt, silt 70%, getting sandier.	
Started drilling @ 7:45 am on 8/28/90.					Silty sand, silt 40-50%.	
				590	Sandy clayey silt, silty clay 60-70%.	
					Silty sand, silt 40%.	
					Sandy clayey silt, silt and clay 70-80%.	
					As above, silt and clay 60-75%.	
				600		

PWS-0190-0074

A-40

DPW	Sample	Blows	Graphic	Depth	WELL NUMBER	Page
REMARKS					DESCRIPTION	8
8:25 am				600	Sandy clayey silt	
					As above, silt 60-80%.	
				610		
					As above, silt 50-60%, getting sandier, with less clay.	
					As above, silt 60-70%.	
8:55 am				620	As above.	
9:04 am					Getting sandier, silt 50-60%.	
Knocking @ 620'.					As above, silt 70%.	
				630	As above, silt 50-60%.	
					Silty sand, silt 40%.	
					Silt/sand, silt 50%.	
					Sandy silt, silt 60-70%.	
9:46 am				640	Increasing silt content to 70-80%.	
9:55 am					Silt content 60-70%.	
				650		
					Sandy silt, silt 60-80%.	
Stopped drilling @ 10:33 on 8/28/90.				660		
					Bottom of Hole 660'	

PWS-0190-0075

SUMMARY OF LABORATORY RESULTS
AMARGOSA CREEK - AIR FORCE SITE

Boring No.	Sample		Serial No.	U.S.S. Group Symbol	Gradation		Att. Limits		Lab Compaction		Field Condition		** Perm. (ft./day)
	No.	Depth (ft.)			-4 (%)	-200 (%)	LL (%)	PI (%)	Dry Density (pcf)	Opt. Moist (%)	Dry Density (pcf)	Moist Content (%)	
1	1	5-6½	45040	*SM							110.4	1.3	
	2												
	3												
	4												
	5	20-21	45044	SM-SC	95.5	31.9	23	5					
	6	38-39½	45045	*SM									
	7	38-39	45046	SC	99.3	46.9	30	15			119.5	7.2	Impervious
	8												
	9	68-69	45048	SW-SM	83.7	11.6							
	1												
	2												
	3												
	4	28-29½	45052	*SM							115.8	1.1	

PWS-0190-007

* Classified by field methods
** Percolation tests performed on remolded samples

A-43

A-43

3:AM2

PWS-0190-0077

SUMMARY OF LABORATORY RESULTS
AMARGOSA CREEK - AIR FORCE SITE

Boring No.	Sample		Serial No.	U.S.C. Group Symbol	Gradation		Att. Limits		Lab Compaction		Field Condition		** Perm. (ft/day)
	No.	Depth (ft.)			-4 (%)	-200 (%)	LL (%)	PI (%)	Dry Density (pcf)	Opt. Moist (%)	Dry Density (pcf)	Moist Content (%)	
3	1												
	2												
	3	10-11½	45061	*SM							110.4	1.8	
	4	10-11	45062	SM-SW	94.9	10							
	5												
	6												
	7	25-26	45065	SM	90.0	12.9							
	8	36-37½	45066	*SM							124.1	6.8	Impervious
	9												
	10												
	11	47-48	45069	SM			22	3					
	12												
	13												
											115.8	1.1	

A-144 * Classified by field methods
** Percolation tests performed on remolded samples

3:AM3

PWS-0190-0078

SUMMARY OF LABORATORY RESULTS
AMARGOSA CREEK - AIR FORCE SITE

Boring No.	Sample		Serial No.	U.S.C. Group Symbol	Gradation		Att. Limits		Lab Compaction		Field Condition		** Perm. (ft/day)
	No.	Depth (ft.)			-4 (%)	-200 (%)	LL (%)	PI (%)	Dry Density (pcf)	Opt. Moist (%)	Dry Density (pcf)	Moist Content (%)	
4	1												
	2												
	3												
	4												
	5	32-33½	45076	*SM							124.8	4.9	
	6												
	7	44-45½	45078	*ML							112	2.5	
	8												
5	1												
	2												
	3	10-11½	45082	*SM									
	4	10-11	45083	SM	93	12.9					110.8	2.0	2.1
	5												

A - * Classified by field methods
45 ** Percolation tests performed on remolded samples

SUMMARY OF LABORATORY RESULTS
AMARGOSA CREEK - AIR FORCE SITE

Boring No.	Sample		Serial No.	U.S.C. Group Symbol	Gradation		Att. Limits		Lab Compaction		Field Condition		** Perm. (ft/day)
	No.	Depth (ft.)			-4 (%)	-200 (%)	LL (%)	PI (%)	Dry Density (pcf)	Opt. Moist (%)	Dry Density (pcf)	Moist Content (%)	
5	6												
	7												
	8	39-40½	45086	*SP							108.6	5.4	
	9	40-41	45088	SC	99.5	49.3							
	10												
	11	41-42	45090	CL	99.5	55.2	29	15					
	12												
	13	64-65½	45093	*SW							114.4	1.9	
	14												
	15												
6	1												
	2												
	3												

A-46 * Classified by field methods
** Percolation tests performed on remolded samples

**SUMMARY OF LABORATORY RESULTS
AMARGOSA CREEK - AIR FORCE SITE**

a

Boring No.	Sample		Serial No.	U.S.C. Group Symbol	Gradation		Att. Limits		Lab Compaction		Field Condition		** Perm. (ft/day)
	No.	Depth (ft.)			-4 (%)	-200 (%)	LL (%)	PI (%)	Dry Density (pcf)	Opt. Moist (%)	Dry Density (pcf)	Moist Content (%)	
6	4	29-30½	45098	*SM							109.2	1.1	
	5												
	6	34-35	45100	SM	96.5	32.4							
	7												
	8	66-67½	45102	*SM	93.6	17.9					107	4.9	3.4
	9												
7	1												
	2	29-30½	45105	*SM							99.9	1.6	
	3												
	4	44-45	45107	SM-SP	74.5	8.9							
	5												
	6												
	7												

A-47

* Classified by field methods
** Percolation tests performed on remolded samples

3:AM6

PWS-0190-0081

SUMMARY OF LABORATORY RESULTS
AMARGOSA CREEK - AIR FORCE SITE

Boring No.	Sample		Serial No.	U.S.C. Group Symbol	Gradation		Att. Limits		Lab Compaction		Field Condition		** Perm. (ft/day)
	No.	Depth (ft.)			-4 (%)	-200 (%)	LL (%)	PI (%)	Dry Density (pcf)	Opt. Moist (%)	Dry Density (pcf)	Moist Content (%)	
7	8												
8	1												
	2												
	3	12-13½	45114	SM-SW							105	1.7	14.2
	4	12-13	45115	*SM	92.7	9.4							
	5												
	6												
	7												
	8	26-27½	45118	*SM							106.1	2.1	
	9												
	10												
	11	54-55	45122	CL-ML									
	12												

* Classified by field methods

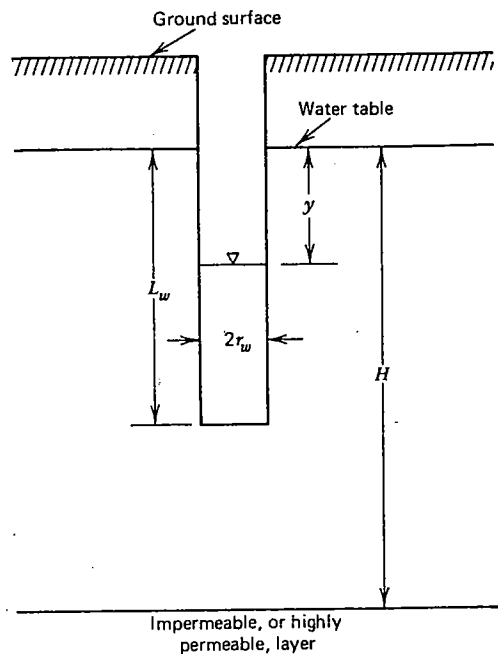
** Percolation tests performed on remolded samples

[illegible]

* Classified by field methods
** Percolation tests performed on remolded samples

PWS-0190-0083

AUGER METHOD



$$K = \frac{C}{864} \frac{dy}{dt}$$

Where:

K: Hydraulic conductivity in m/day

dy/dt: the measured rate of fall in cm/sec

C: factor that can be obtained from the Table

TABLE Values of the Factor C for the Auger Hole Test to Determine Hydraulic Conductivity (after Boast and Kirkham⁶)

L_w/r_{10}	y/L_{10}	$(H - L_w)/L_{10}$ for Impermeable Layer								$H - L_w$	$(H - L_w)/L_{10}$ for Infinitely Permeable Layer			
		0	0.05	0.1	0.2	0.5	1	2	5		5	2	1	0.5
1	1	447	423	404	375	323	286	264	255	254	252	241	213	166
	0.75	469	450	434	408	360	324	303	292	291	289	278	248	198
	0.5	555	537	522	497	449	411	386	380	379	377	359	324	264
2	1	186	176	167	154	134	123	118	116	115	115	113	106	91
	0.75	196	187	180	168	149	138	133	131	131	130	128	121	106
	0.5	234	225	218	207	188	175	169	167	167	166	164	156	139
5	1	51.9	48.6	46.2	42.8	38.7	36.9	36.1		35.8		35.5	34.6	32.4
	0.75	54.8	52.0	49.9	46.8	42.8	41.0	40.2		40.0		39.6	38.6	36.3
	0.5	66.1	63.4	61.3	58.1	53.9	51.9	51.0		50.7		50.3	49.2	46.6
10	1	18.1	16.9	16.1	15.1	14.1	13.6	13.4		13.4		13.3	13.1	12.6
	0.75	19.1	18.1	17.4	16.5	15.5	15.0	14.8		14.8		14.7	14.5	14.0
	0.5	23.3	22.3	21.5	20.6	19.5	19.0	18.8		18.7		18.6	18.4	17.8
20	1	5.91	5.53	5.30	5.06	4.81	4.70	4.66		4.64		4.62	4.58	4.46
	0.75	6.27	5.94	5.73	5.50	5.25	5.15	5.10		5.08		5.07	5.02	4.89
	0.5	7.67	7.34	7.12	6.88	6.60	6.48	6.43		6.41		6.39	6.34	6.19
50	1	1.25	1.18	1.14	1.11	1.07	1.05			1.04			1.03	1.02
	0.75	1.33	1.27	1.23	1.20	1.16	1.14			1.13			1.12	1.11
	0.5	1.64	1.57	1.54	1.50	1.46	1.44			1.43			1.42	1.39
100	1	0.37	0.35	0.34	0.34	0.33	0.32			0.32			0.32	0.31
	0.75	0.40	0.38	0.37	0.36	0.35	0.35			0.35			0.34	0.34
	0.5	0.49	0.47	0.46	0.45	0.44	0.44			0.44			0.43	0.43

Reference: Todd (1980)

PWS-0190-0084

BOUWER AND RICE METHOD

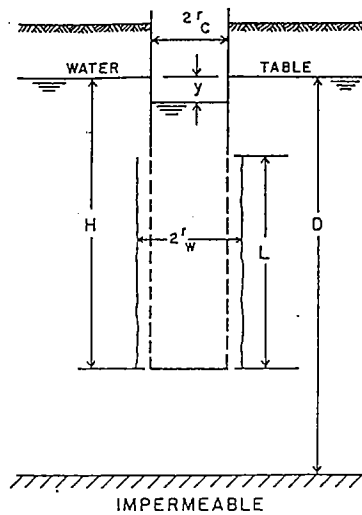


Fig. 1: Geometry and symbols of a partially penetrating, partially perforated well in unconfined aquifer with gravel pack or developed zone around perforated section.

$$K = \frac{r_c^2 \ln (R_e/r_w)}{2L} \frac{1}{t} \ln \frac{y_0}{y_t}$$

K: Hydraulic Conductivity

y: Vertical distance between water level in well and equilibrium water table in aquifer

y₀: y at time 0

y_t: y at time t

r_w: radius of casing and thickness of gravel envelope

R_e: Effective radius over which y is dissipated

L: Length of perforated zone

r_c: radius of casing plus gravel pack

where:

$$\ln R_e/r_w = \left(\frac{1.1}{\ln (H/r_w)} + \frac{C}{L/r_w} \right)^{-1}$$

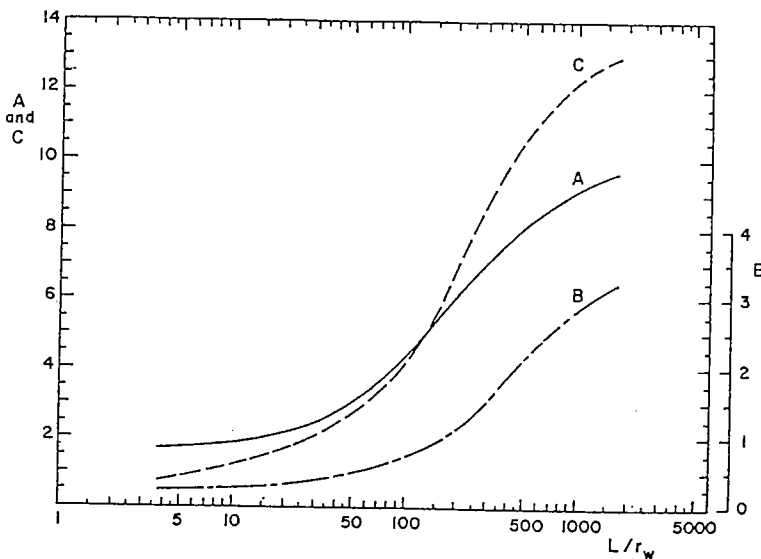


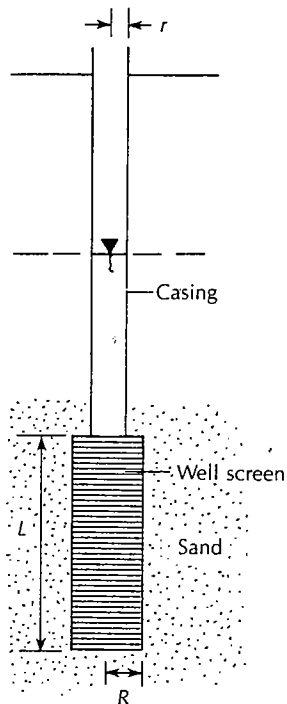
Fig. 3. Curves relating coefficients A, B, and C to L/r_w.

C is obtained from figure 3

Reference: Bouwer and Rice (1976)

PWS-0190-0085

HVORSLEV METHOD



$$K = \frac{r^2 \ln (L/R)}{2LT_0}$$

where

K is hydraulic permeability

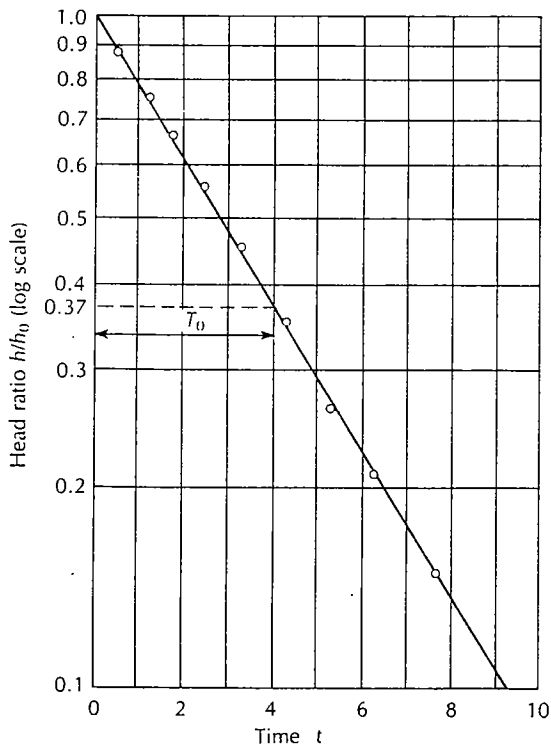
r is the radius of the well casing

R is the radius of the well screen

L is the length of the well screen

T_0 is the time it takes for the water level to rise or fall to 37 percent of the initial change (Figure 6.21)

The data are plotted by computing the ratio h/h_0 and plotting that versus time on semilogarithmic paper, as shown in Figure 6.21. The time-drawdown data should plot on a straight line.



h_0 The height of the water level rises above the static water level immediately upon adding the slug of water.

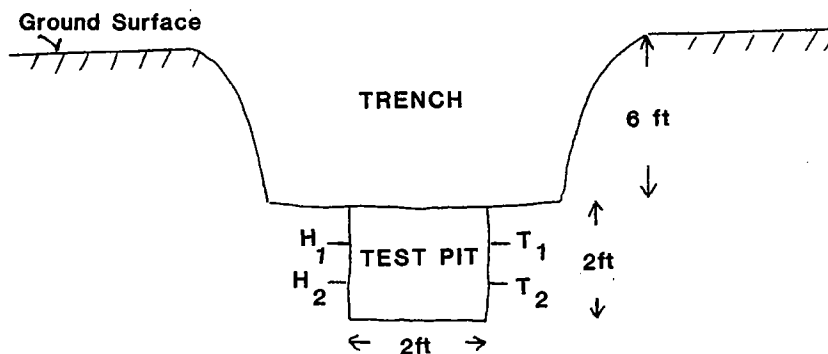
h The height of the water above the static water level at some time, t , after the slug is added.

Plot of head ratio versus time used for Hvorslev method.

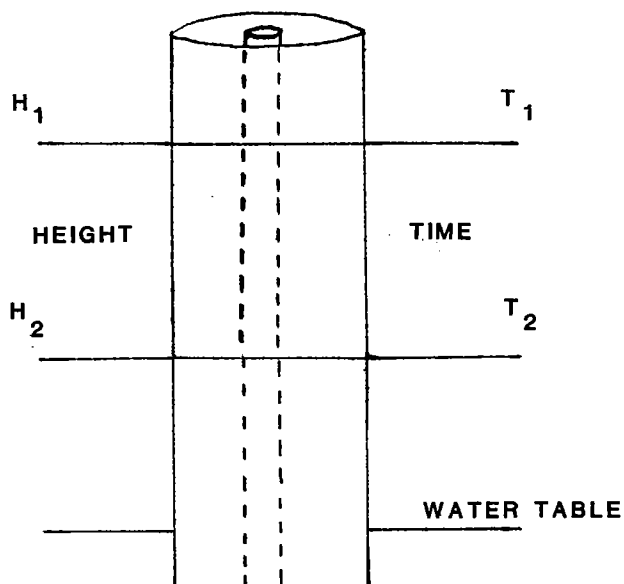
PWS-0190-0086
Reference: Fetter (1988)

PERCOLATION TEST

A) FOR USE IN CALCULATING HYDRAULIC CONDUCTIVITY IN THE TRENCHES



B) FOR USE IN CALCULATING HYDRAULIC CONDUCTIVITY IN THE DEEP BORINGS



BORING DIAMETER: 7"

CASING DIAMETER: 2"

ANNULAR SPACE AROUND 2"

CASING IS PACKED WITH PEA GRAVEL
(POROSITY IS ASSUMED TO BE 40%)

NOTE: Water take is assumed to be through the boring sidewalls above the water table.

$$\text{PERCOLATION RATE } P = Q/A$$

Where:

Q = WATER TAKE BETWEEN TIME T₁ AND T₂

A = AVERAGE SURFACE AREA IN TEST PIT AND BORING BETWEEN TIMES T₁ AND T₂

PWS-0190-0087

WELL PERMEAMETER METHOD

Formula used for the constant-head tests in the shallow borings.

$$k_{20} = 525,600 \frac{\left[\sinh^{-1} \left(\frac{h}{r} \right) - 1 \right] \frac{Q}{2\pi}}{h^2} \left(\frac{\mu_T}{\mu_{20}} \right)$$

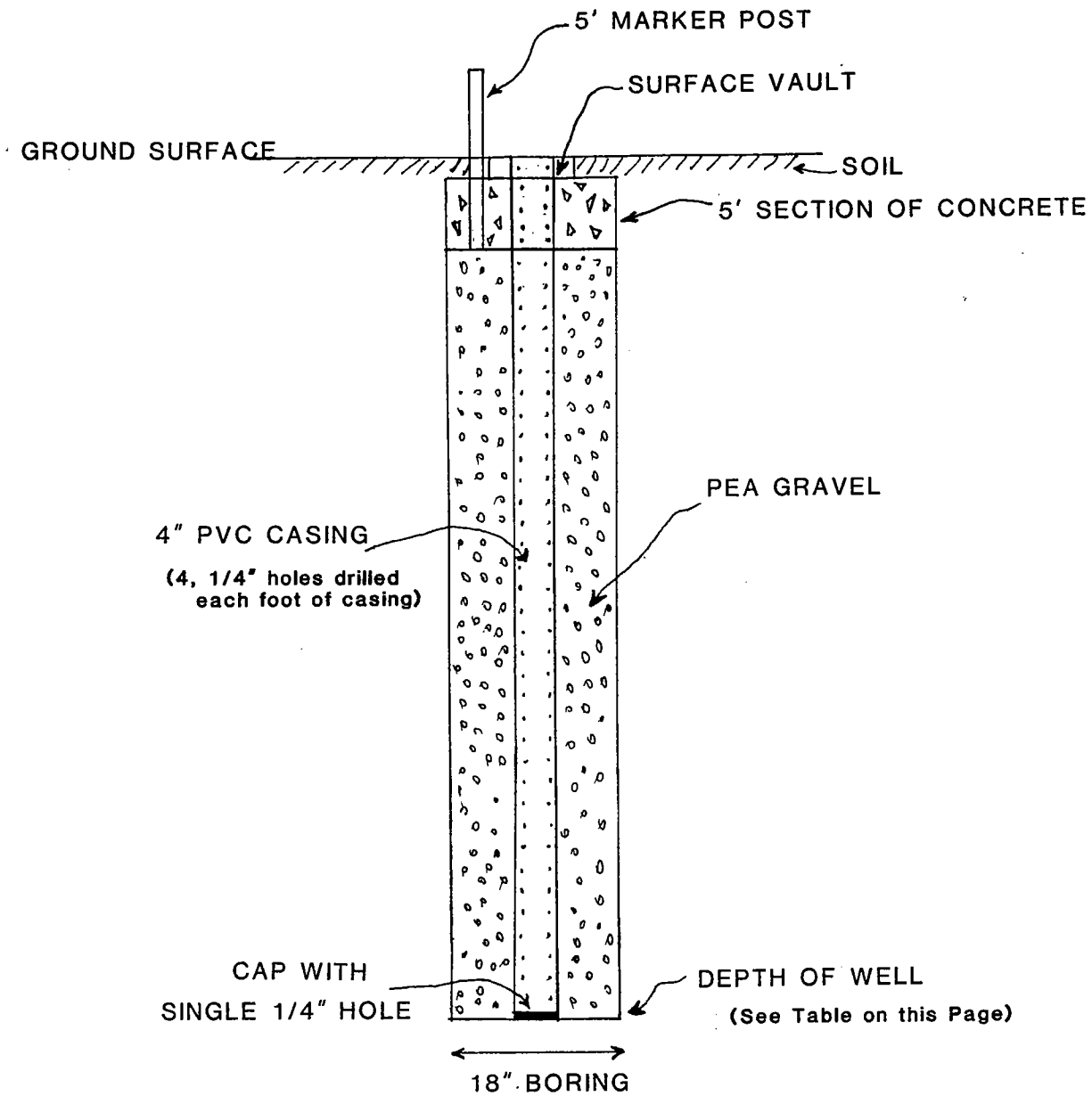
where: k_{20} = coefficient of permeability, feet per year,
 h = height of water in the well, feet,
 r = radius of well, feet,
 Q = discharge rate of water from the well for steady
state condition, cubic feet per minute, (de-
termined experimentally)

μ_T = viscosity of water at temperature T ,
 μ_{20} = viscosity of water at 20° C., and
 T_u = unsaturated distance between the water sur-
face in the well and the water table, feet.

Reference: Earth Manual, 1960

PWS-0190-0088

SCHEMATIC DIAGRAM OF THE SHALLOW WELLS



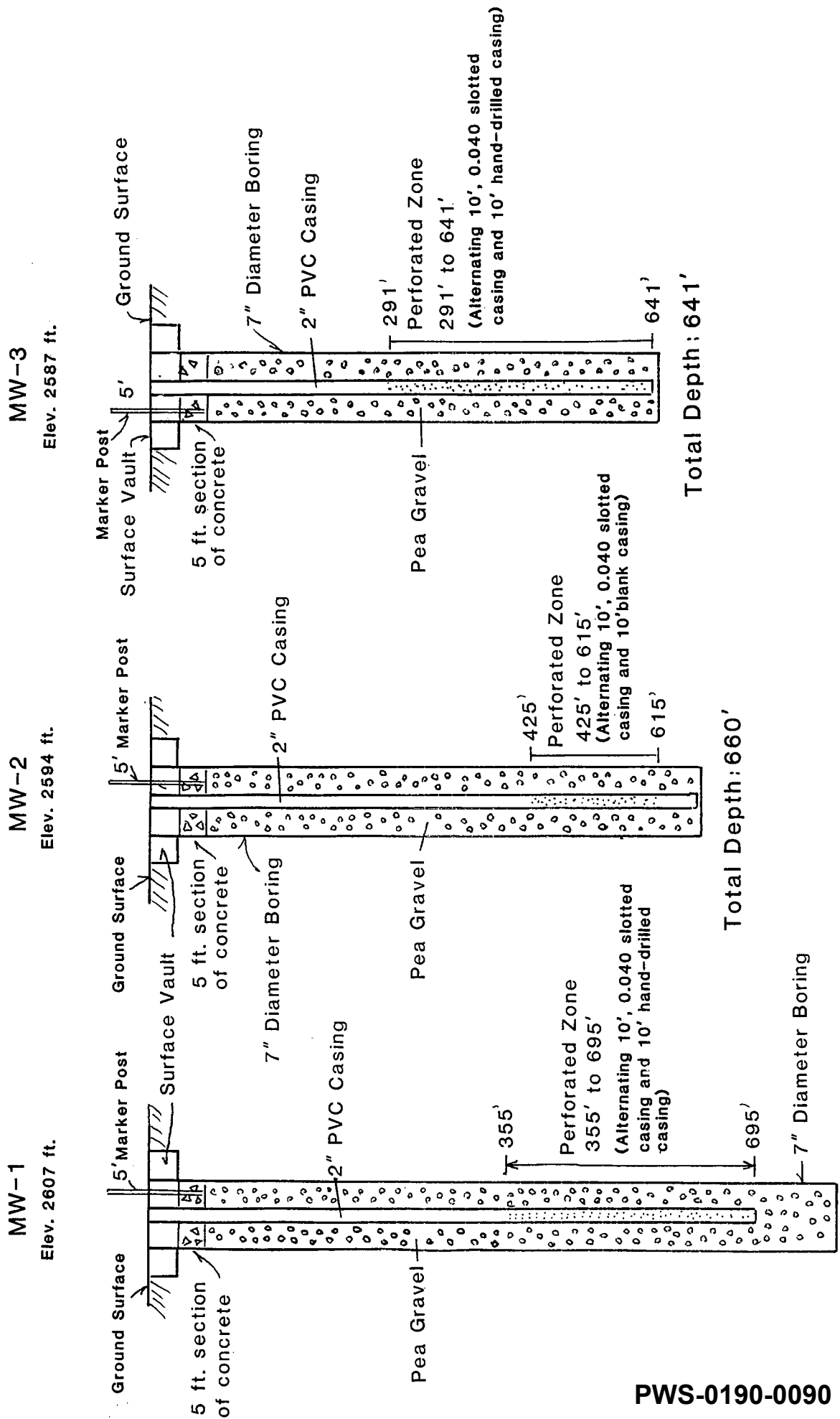
Boring No.	Depth of Boring
B1	69'
B1A	39'
B3	70'
B5A	42'
B7	25'
B8	70'

NOT TO SCALE

A-55

PWS-0190-0089

SCHEMATIC DIAGRAM OF THE DEEP WELLS



NOT TO SCALE

PWS-0190-0090

APPENDIX B

SUBSURFACE INVESTIGATION

The subsurface field investigation consisted of the following:

- a. drilling 11 shallow and 3 deep borings,
- b. electric logging of the deep borings,
- c. performing percolation tests in the borings and in shallow trenches using a variety of methods, and
- d. measuring water levels in the deep borings.

Each of the subsurface investigations is discussed below.

a) Shallow and Deep Borings

Eleven shallow exploratory borings were drilled at the Air Force Site to depths up to 70 feet using a Calweld 18" bucket auger rig (See Plate 1 for boring locations). As the drilling proceeded, a detailed field log of soil stratigraphy was compiled (see attached logs in Appendix A). Soil samples, consisting of bulk and ring type samples, were collected in representative subsurface soils (see laboratory results in Appendix A).

In six of the shallow borings (B-1, B-1A, B-3, B-5A, B-7A and B-8), a 4-inch perforated schedule 40 PVC casing was placed to perform permeability tests. The cased holes were packed with pea gravel.

Three deep exploratory borings were drilled to depths of 640 to 800 feet (see Plate 1 for boring locations). A Mayhew rotary wash rig was used, equipped with a 6½-inch tricone bit. E-Z mud was used as a drilling fluid additive to maintain hole integrity. Due to equipment breakdowns, the drill stem in boring MW-1 was "shut-in" at a depth of 460 feet and had to be blown off at the bit to be recovered. As a result, the hole had to be redrilled at a nearby location.

As the drilling proceeded, a detailed log of soil stratigraphy was compiled (see attached logs in Appendix).

To complete each deep well, a 2-inch diameter, flush joint, schedule 40 PVC casing was placed in the hole to the depth drilled. Centralizers, spaced at 20-foot intervals along the PVC casing, positioned it in the center of the hole. The casing was perforated at pre-selected intervals for monitoring of the static water table.

Perforations consisted of 0.040 inch slotted-type casing and ¼-inch holes drilled in blank stock. After the 2-inch PVC casing was placed, the hole was packed with pea-gravel. The upper 5 feet of the hole was cemented to prevent infiltration of the surface water. A surface vault was installed and the location of the well marked by a 5-foot long, 2-inch diameter steel pipe.

Development of the wells was not uniform. In MW-1, prior to the placement of the PVC casing, the drilling fluid was forced out of the hole by injecting water through the drill stem positioned in the hole. Chlorine bleach was added to the water being injected in order to break down the E-Z mud. In MW-2 and MW-3, development of the wells consisted of injection of chlorinated water through the perforated 2-inch casing after the hole was packed with pea gravel. An additional development effort was later undertaken in the three deep wells. This effort consisted of injecting pressurized and chlorinated water through a 3/4-inch PVC pipe at different depths in the 2-inch PVC well casing.

b) Borehole Electric Logging

Following the drilling of the deep holes and before the wells were cased and developed, the holes were electric logged. The electric logging tools utilized consisted of long and short normal, single point resistance, spontaneous potential and gamma ray logs (see attached logs in Appendix). The datum used in the logs is the ground surface. The drilling fluid in the hole was an E-Z mud additive in fresh water.

c) Percolation Tests

Various percolation tests were performed to determine the hydraulic conductivity of the subsurface soils. Water was supplied by 2000- to 3000-gallon water trucks.

In five of the shallow wells (B-1, B-3, B-5A, B-7A, B-8) constant-head and falling-head permeability tests were performed. The holes were presaturated with at least 10,000 gallons of water before conducting the tests. In the falling-head test the hole was filled with water to within a few feet of the surface and the falling-head was measured as a function of time. The recorded field data was later utilized to determine the hydraulic conductivity of the subsurface soils.

The "well permeameter test" was used as a constant-head test. This test requires a minimum volume of water to be introduced into the boring based on the dimensions of the volume tested. A constant-head was maintained during the testing interval by regulating the metered discharge from the water trucks and continuously monitoring the water level in the boring.

Percolation tests were conducted in two 6-foot deep trenches (TP-1 and TP-2). At the bottom of each trench a 2x2x2 foot pit was hand excavated. Water was added until the pit was filled. During the test the water level was measured and recorded as a function of time. Several cycles of testing were performed. Field data relating the water volume percolated to the average surface area of the pit were used to determine the hydraulic conductivity of the soils. For comparison purposes, soil samples were collected and permeability measurements performed in the soils laboratory.

d) Water Level Measurements

Water level measurements were taken in the three deep wells using an electrical water level indicator. Water level monitoring was performed from October, 1990 to February, 1991, and the data was used in determining the site specific hydraulic gradient for the upper unconfined aquifer.

e) Pumping Test

A pumping test was performed within the unconfined aquifer on wells owned and operated by the El Dorado Mutual Water Company. The wells are located near the intersection of Avenue N-8 and 10th Street West approximately 1700 feet west of MW-1. During the pumping test water was extracted at a rate of approximately 250 gal/min for 143 minutes. Water levels in the well were recorded as a function of time during the drawdown and recovery of the water level. These data were used in determining transmissivity and storativity of the unconfined aquifer.

APPENDIX C

ELECTRIC LOG

LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
GEOLOGY AND SOILS SECTION

PROJECT <u>Air Force Site</u> <u>Amargosa Creek</u> WELL <u>MW-1</u> FIELD _____ COUNTY <u>L.A.</u> STATE <u>CA</u>	PROJECT <u>Air Force Site - Amargosa Creek</u>			
	WELL <u>MW-1</u>			
	FIELD _____			
	COUNTY <u>LOS ANGELES</u> STATE <u>CALIFORNIA</u>			
Location: <u>City of Palmdale</u> <u>1350 ft. east of centerline of</u> <u>10th Street West</u> <u>2135 ft. south of centerline of</u> <u>Ave N</u>				Other Services: <u>G, SP, PR</u> <u>0.4m Normal Res</u> <u>1.6m Normal Res</u>
Sec. _____ Twp _____ Rge _____				
Permanent Datum <u>Ground Surface</u> Elev. <u>2606 ft. (Topo)</u> Log Measured From <u>0 ft.</u> Ft. Above Perm. Datum Drilling Measured From <u>Ground Surface</u>				Elev.: K.B. <u>NA</u> D.F. <u>NA</u> G.L. <u>2606 ft. (Topo)</u>
Date	<u>7/31/90</u>			
Run No.	<u>One</u>			
Depth—Driller	<u>800 ft.</u>			
Depth—Logger	<u>788 ft.</u>			
Btm. Log Inter.	<u>0 ft.</u>			
Top Log Inter.				
Casing—Driller	<u>@</u>	<u>@</u>	<u>@</u>	<u>@</u>
Casing—Logger				
Bit Size	<u>6½ in.</u>			
Type Fluid in Hole	<u>E-Z Mud</u>			
Dens. Visc.		<u> </u>	<u> </u>	<u> </u>
pH Fluid Loss	<u>N/A N/A ml</u>	<u> ml</u>	<u> ml</u>	<u> ml</u>
Source of Sample				
R _u @ Meas. Temp.	<u>N/A @ N/A °F</u>	<u>@ °F</u>	<u>@ °F</u>	<u>@ °F</u>
R _u @ Meas. Temp.	<u>N/A @ N/A °F</u>	<u>@ °F</u>	<u>@ °F</u>	<u>@ °F</u>
R _u @ Meas. Temp.	<u>N/A @ N/A °F</u>	<u>@ °F</u>	<u>@ °F</u>	<u>@ °F</u>
Source R _u R _u	<u>N/A N/A</u>	<u> </u>	<u> </u>	<u> </u>
R _u @ BHT	<u>N/A @ N/A °F</u>	<u>@ °F</u>	<u>@ °F</u>	<u>@ °F</u>
Time Since Circ.				
Time On Bottom				
Max. Rec. Temp.	<u>°F @</u>	<u>°F @</u>	<u>°F @</u>	<u>°F @</u>
Equip. Location	<u> </u>	<u> </u>	<u> </u>	<u> </u>
Recorded By	<u>D.C., K.L., L.L.</u>			
Witnessed By				

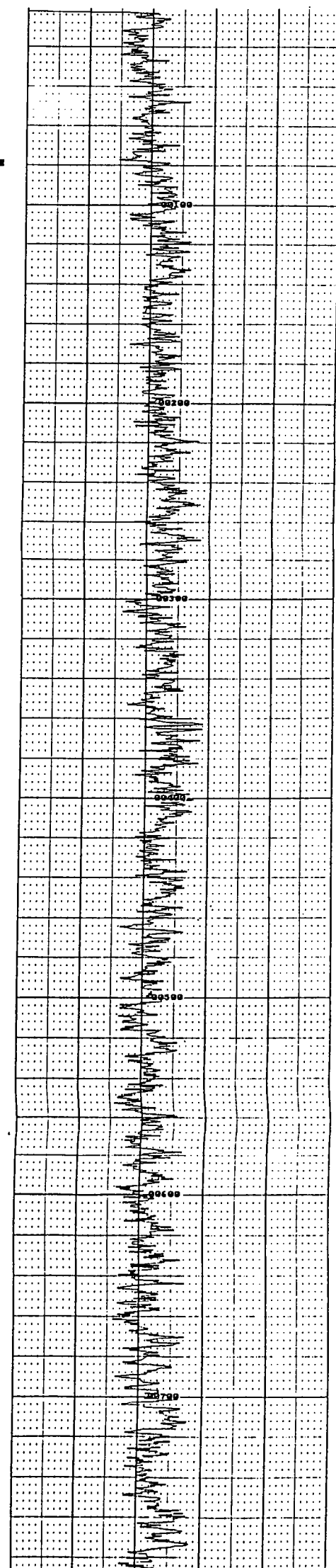
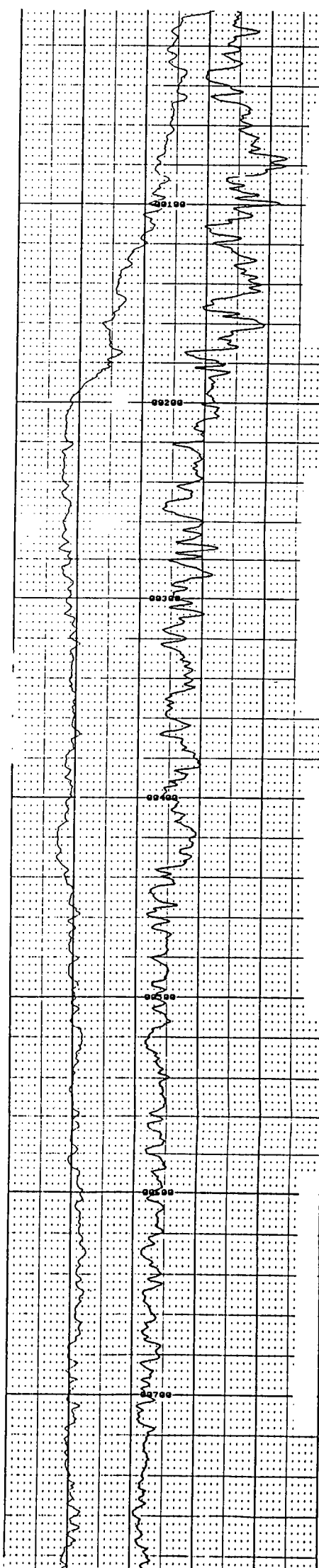
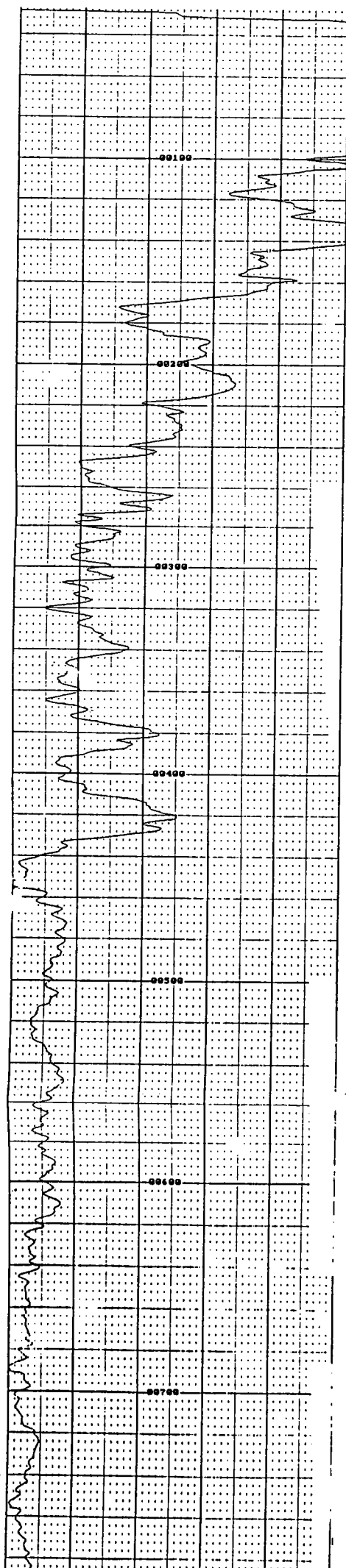
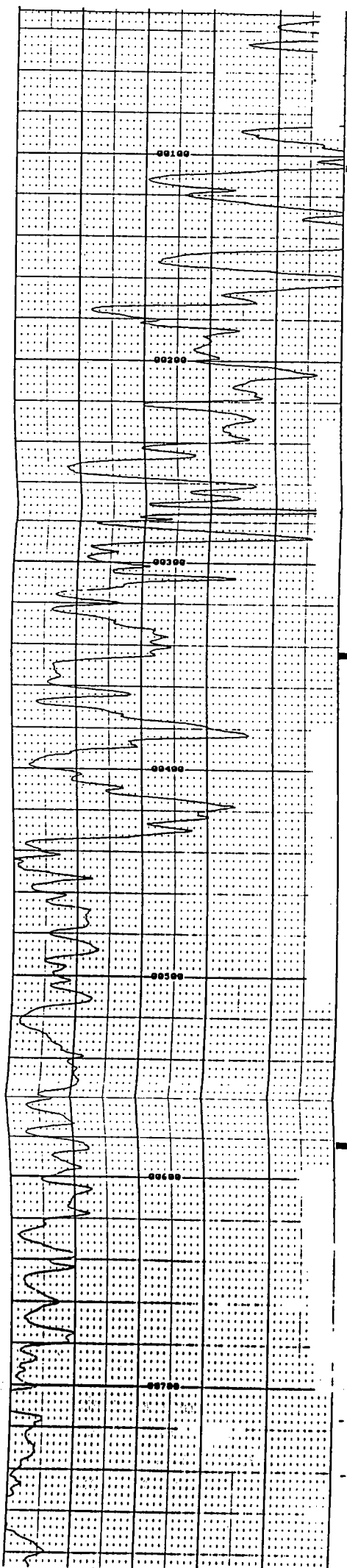
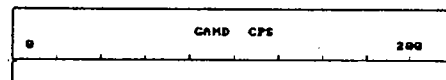
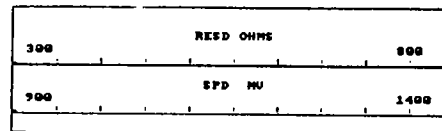
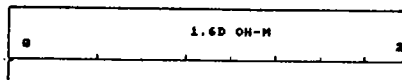
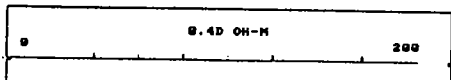
PWS-0190-0096

COMPANY: LA COUNTY
HOLE ID: AFMW-1
LOCATION: AMARGOSA-USAF SITE
DATE: 87-31-98
TIME: 1300
OPERATOR: DC LL
COMMENT1: DATUM G SURFACE
COMMENT2: FLUID--E-Z MUD

COMPANY: LA COUNTY
HOLE ID: AFMW-1
LOCATION: AMARGOSA-USAF SITE
DATE: 87-31-98
TIME: 1830
OPERATOR: DC LL
COMMENT1: DATUM G SURFACE
COMMENT2: FLUID--E-Z MUD

COMPANY: LA COUNTY
HOLE ID: AFMW-1
LOCATION: AMARGOSA-USAF SITE
DATE: 87-31-98
TIME: 1600
OPERATOR: DC LL
COMMENT1: DATUM G SURFACE
COMMENT2: FLUID--E-Z MUD

COMPANY: LA COUNTY
HOLE ID: AFMW-1
LOCATION: AMARGOSA-USAF SITE
DATE: 87-31-98
TIME: 1500
OPERATOR: DC LL
COMMENT1: DATUM G SURFACE
COMMENT2: FLUID--E-Z MUD



ELECTRIC LOG

LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
GEOLOGY AND SOILS SECTION

PROJECT <u>Air Force Site</u> <u>Amargosa Creek</u> WELL <u>MW-2</u> FIELD _____ COUNTY <u>L.A.</u> STATE <u>CA</u>	PROJECT <u>Air Force Site - Amargosa Creek</u>			
	WELL <u>MW-2</u>			
	FIELD _____			
	COUNTY <u>LOS ANGELES</u> STATE <u>CALIFORNIA</u>			
Location: City of Palmdale 1320-ft. east of centerline of 10th Street West 870 ft. south of centerline of Ave N.		Other Services: G, SP, PR 0.4m Normal Res. 1.6m Normal Res.		
Sec. _____ Twp _____ Rge _____				
Permanent Datum <u>Ground Surface</u> Elev. <u>2594 ft. (Topo)</u>		Elev.: K.B. <u>NA</u>		
Log Measured From <u>0 ft.</u> Ft. Above Perm. Datum		D.F. <u>NA</u>		
Drilling Measured From <u>Ground Surface</u>		G.L. <u>2594 ft. (Topo)</u>		
Date	8/15/90			
Run No.	One			
Depth—Driller	660 ft.			
Depth—Logger	636 ft.			
Btm. Log Inter.	636 ft.			
Top Log Inter.	0 ft.			
Casing—Driller	@	@	@	@
Casing—Logger				
Bit Size	6½ in.			
Type Fluid in Hole	E-Z Mud			
Dens. Visc.				
pH Fluid Loss	N/A N/A ml	ml	ml	ml
Source of Sample				
R _u @ Meas. Temp.	N/A @ N/A °F	@ °F	@ °F	@ °F
R _u @ Meas. Temp.	N/A @ N/A °F	@ °F	@ °F	@ °F
R _u @ Meas. Temp.	N/A @ N/A °F	@ °F	@ °F	@ °F
Source R _u R _u	N/A N/A			
R _u @ BHT	N/A @ N/A °F	@ °F	@ °F	@ °F
Time Since Circ.				
Time On Bottom				
Max. Rec. Temp.	°F @	°F @	°F @	°F @
Equip. Location				
Recorded By	D.C., S.L., L.L.			
Witnessed By				

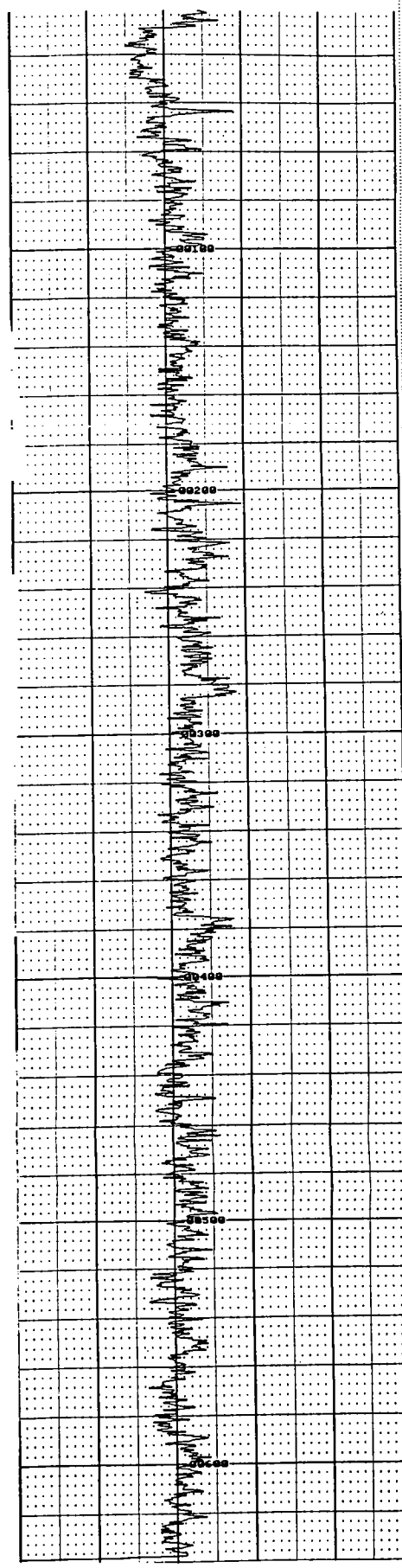
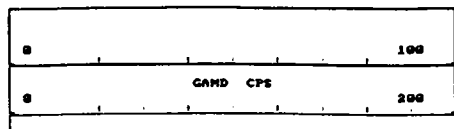
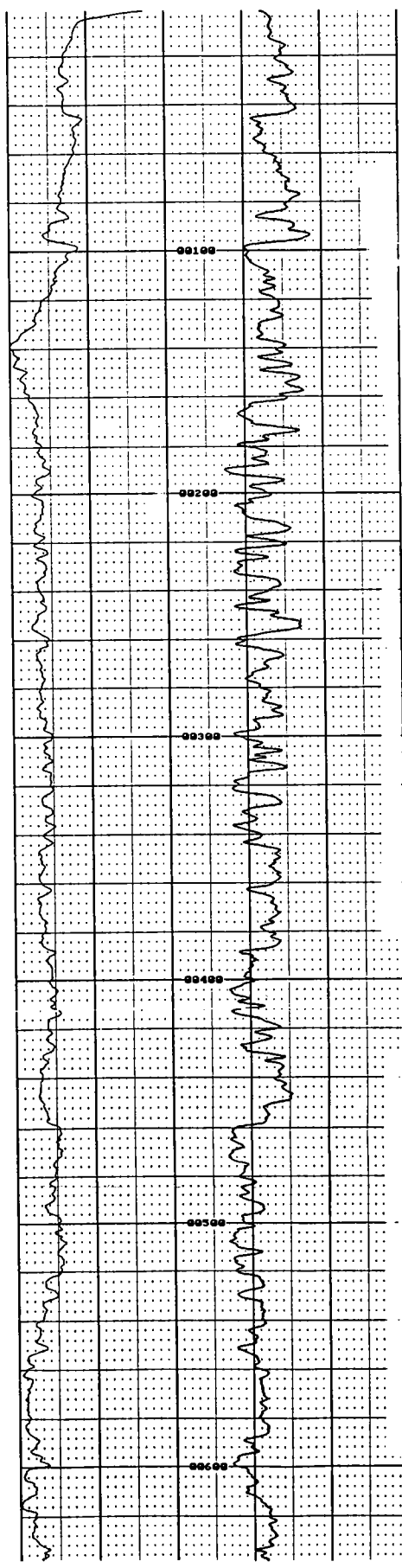
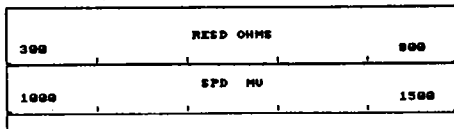
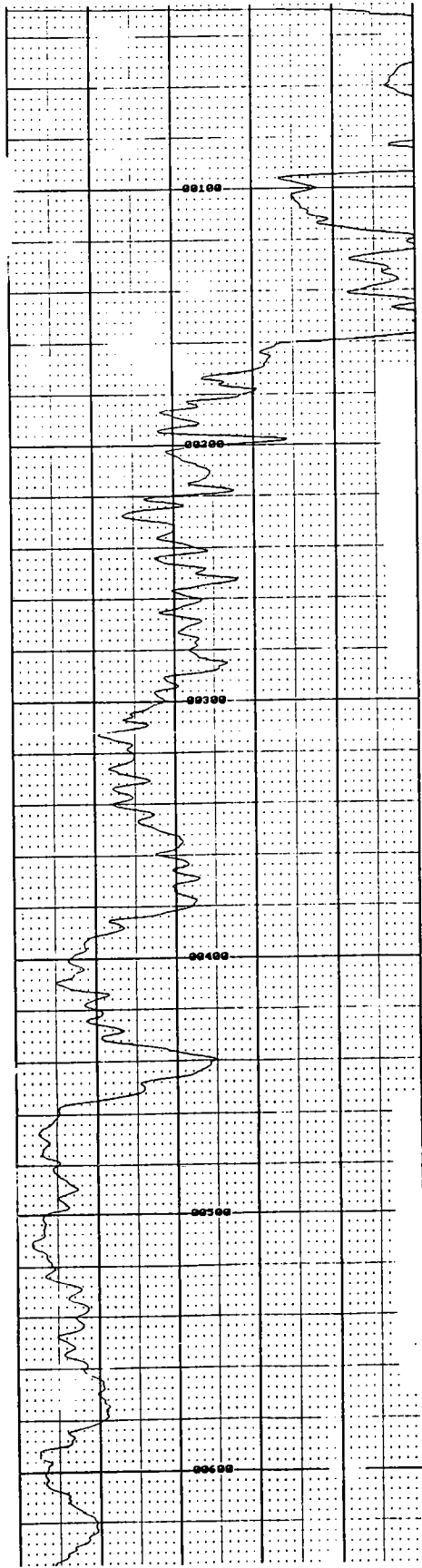
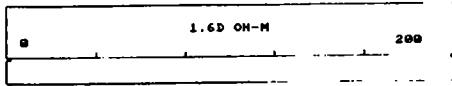
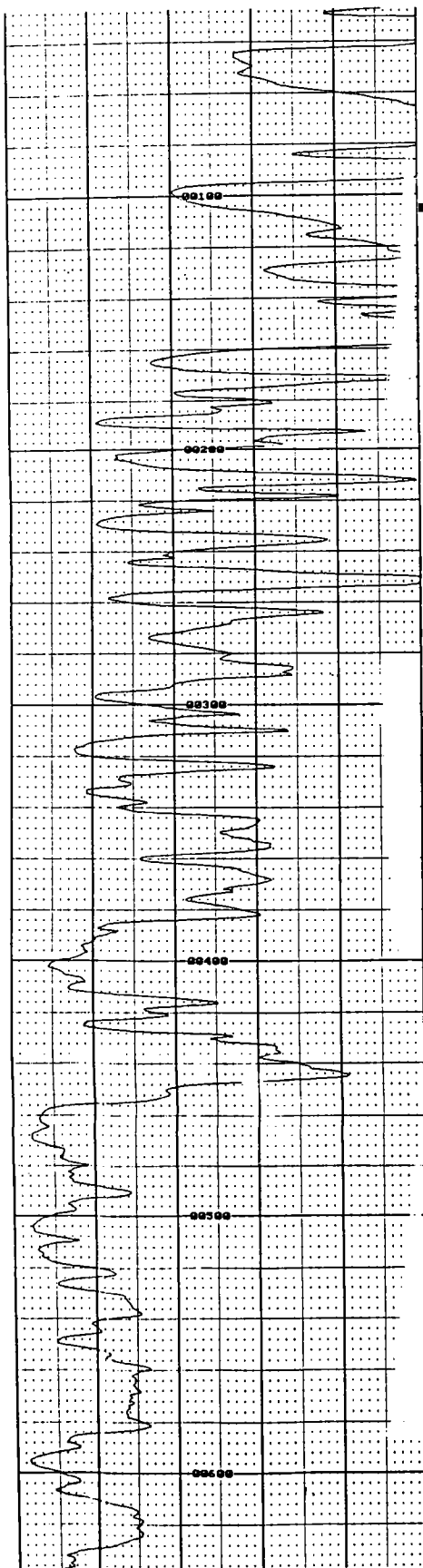
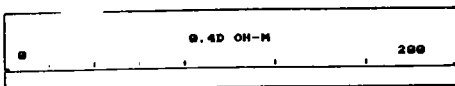
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COMPANY: LA COUNTY
HOLE ID: AFM-2
LOCATION: AMARGOSA-USAF SITE
DATE: 08-15-98
TIME: 0850
OPERATOR: DC SL
COMMENT1: DATUM G SURFACE
COMMENT2: FLUID--E-Z MUD

COMPANY: LA COUNTY
HOLE ID: AFM-2
LOCATION: AMARGOSA-USAF SITE
DATE: 08-15-98
TIME: 0945
OPERATOR: DC SL
COMMENT1: DATUM G SURFACE
COMMENT2: FLUID--E-Z MUD

COMPANY: LA COUNTY
HOLE ID: AFM-2
LOCATION: AMARGOSA-USAF SITE
DATE: 08-15-98
TIME: 1145
OPERATOR: DC SL
COMMENT1: DATUM G SURFACE
COMMENT2: FLUID--E-Z MUD

COMPANY: LA COUNTY
HOLE ID: AFM-2
LOCATION: AMARGOSA-USAF SITE
DATE: 08-15-98
TIME: 1310
OPERATOR: DC SL
COMMENT1: DATUM G SURFACE
COMMENT2: FLUID--E-Z MUD



ELECTRIC LOG

LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
GEOLOGY AND SOILS SECTION

PROJECT <u>Air Force Site</u> <u>Amargosa Creek</u> WELL <u>MW-3</u> FIELD _____ COUNTY <u>L.A.</u> STATE <u>CA</u>	PROJECT <u>Air Force Site - Amargosa Creek</u>			
	WELL <u>MW-3</u>			
	FIELD _____			
	COUNTY <u>LOS ANGELES</u> STATE <u>CALIFORNIA</u>			
Location: City of Palmdale 3430 ft. east of centerline of 10th Street West 1120 ft. south of centerline of Ave N.				Other Services: G, SP, PR 0.4m Normal Res. 1.6m Normal Res.
Sec. _____ Twp _____ Rge _____				
Permanent Datum <u>Ground Surface</u> Elev. <u>2587 ft. (Topo)</u> Log Measured From <u>0 ft.</u> Ft. Above Perm. Datum Drilling Measured From <u>Ground Surface</u>				Elev.: K.B. <u>NA</u> D.F. <u>NA</u> G.L. <u>2587 ft. (Topo)</u>
Date	8/28/90			
Run No.	One			
Depth—Driller	660 ft.			
Depth—Logger	652 ft.			
Btm. Log Inter.	652 ft.			
Top Log Inter.	0 ft.			
Casing—Driller	@	@	@	@
Casing—Logger				
Bit Size	6½ in.			
Type Fluid in Hole	E-Z Mud			
Dens. Visc.				
pH Fluid Loss	N/A N/A ml	ml	ml	ml
Source of Sample				
R _u @ Meas. Temp.	N/A @ N/A °F	@ °F	@ °F	@ °F
R _w @ Meas. Temp.	N/A @ N/A °F	@ °F	@ °F	@ °F
R _{sp} @ Meas. Temp.	N/A @ N/A °F	@ °F	@ °F	@ °F
Source R _w R _{sp}	N/A N/A			
R _u @ BHT	N/A @ N/A °F	@ °F	@ °F	@ °F
Time Since Circ.				
Time On Bottom				
Max. Rec. Temp.	°F @	°F @	°F @	°F @
Equip. Location				
Recorded By	D.C., S.L.			
Witnessed By				

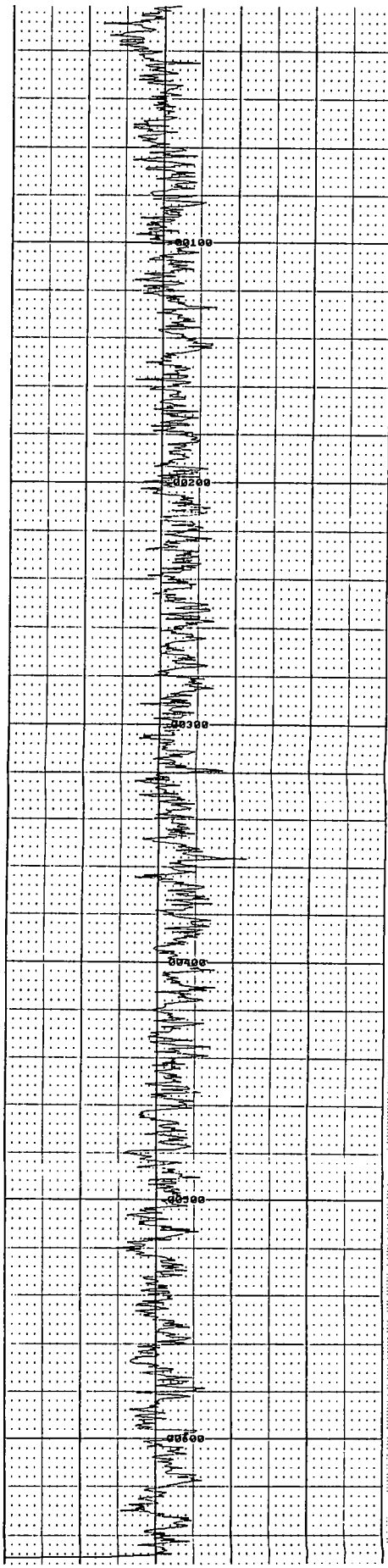
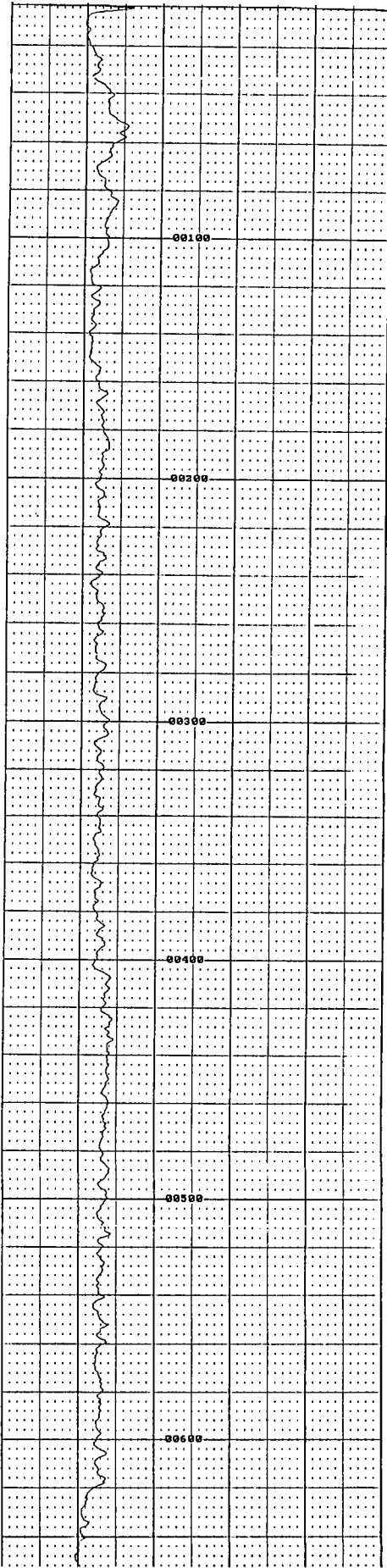
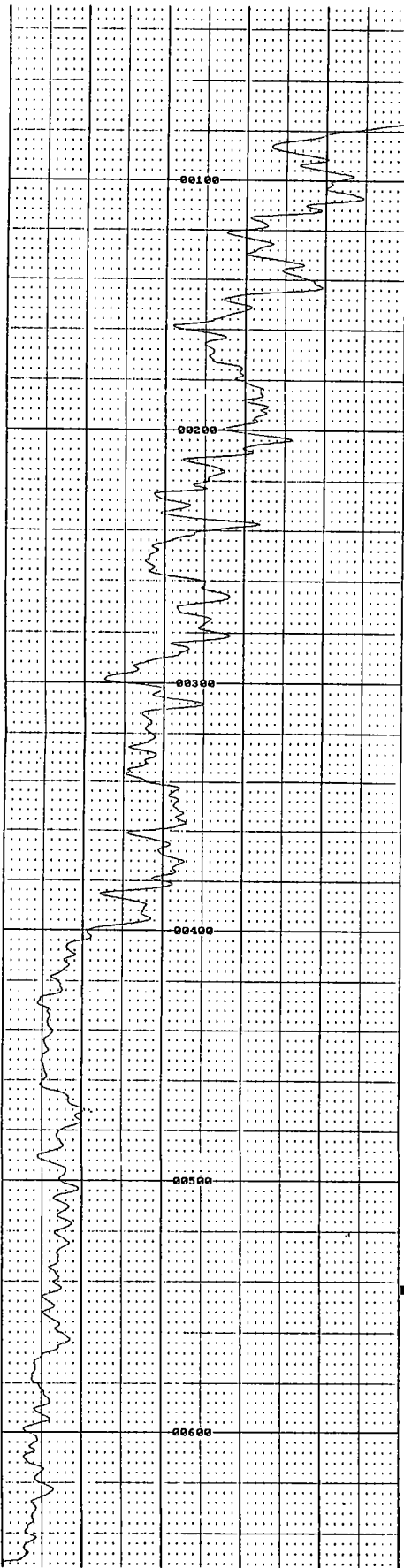
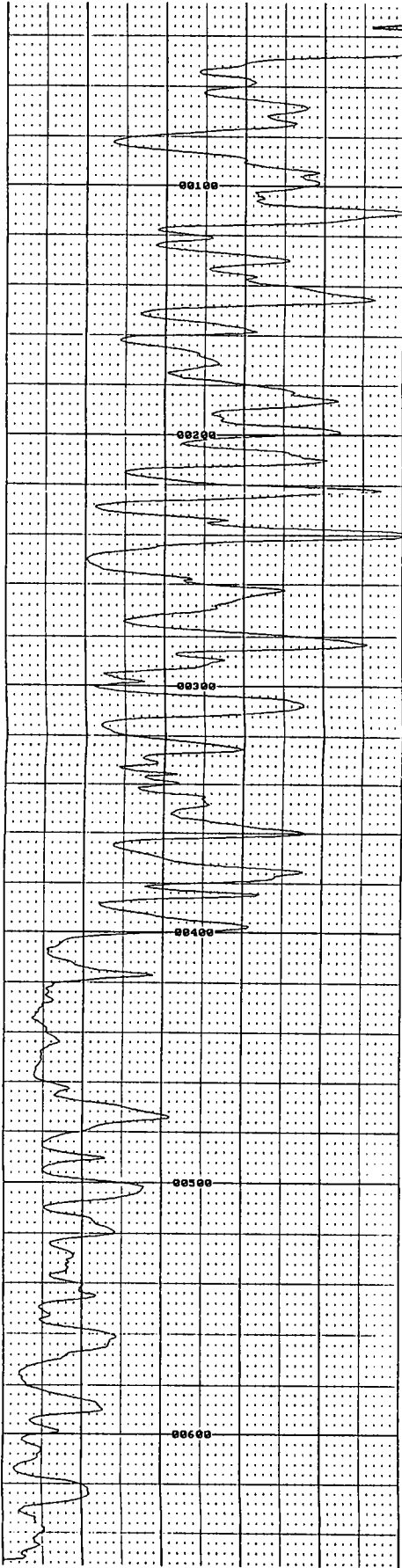
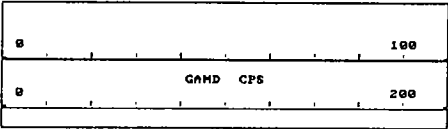
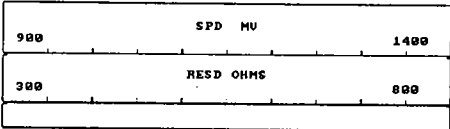
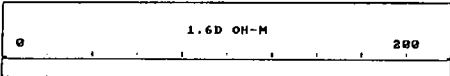
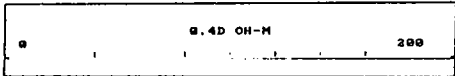
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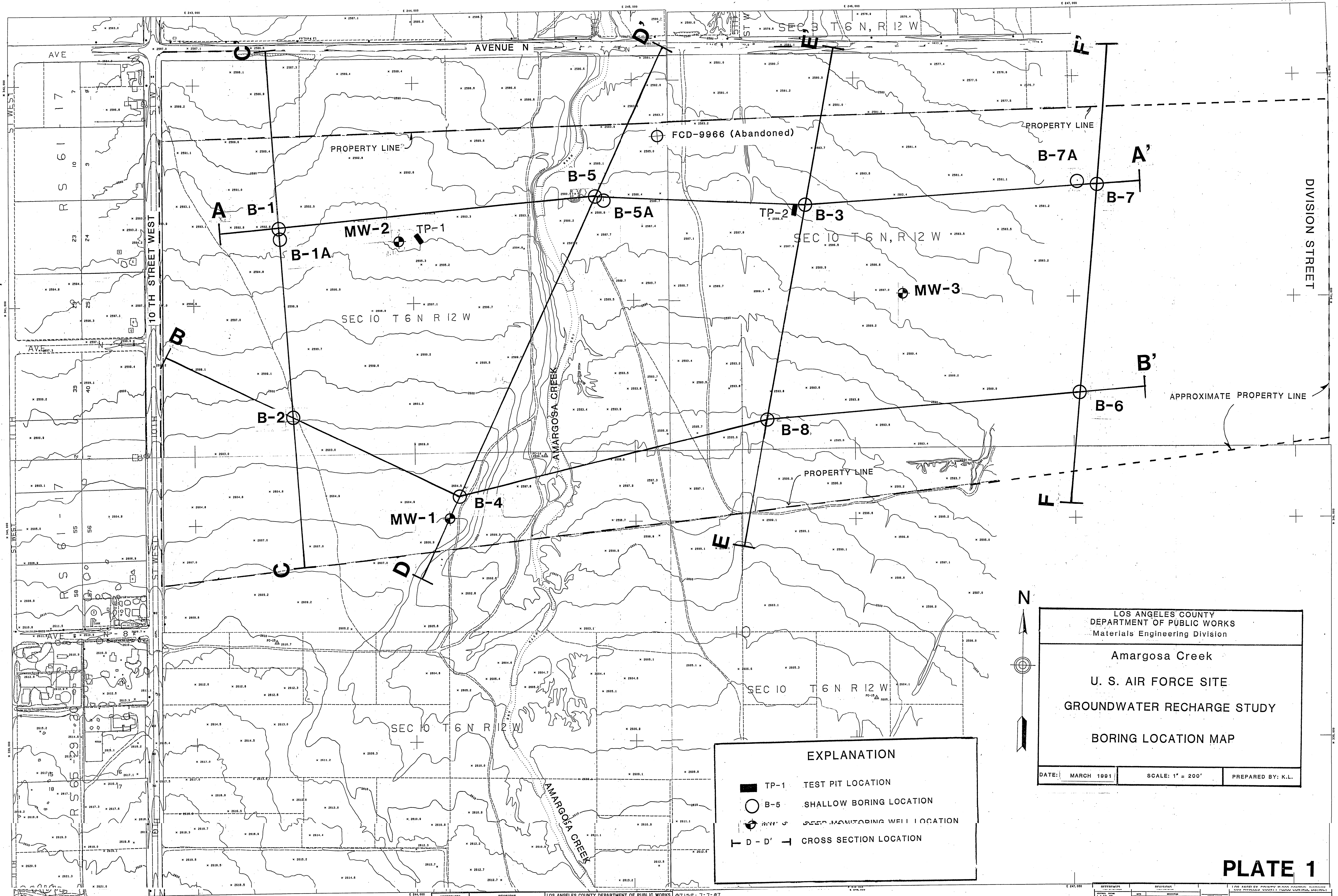
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LOCATION: AMARGOSA-USAF SITE
DATE: 08-28-90
TIME: 1350
OPERATOR: DC SL
COMMENT1: DATUM G SURFACE
COMMENT2: FLUID--E-Z MUD

COMPANY: LA COUNTY
HOLE ID: AFMW-3
LOCATION: AMARGOSA-USAF SITE
DATE: 08-28-90
TIME: 1240
OPERATOR: DC SL
COMMENT1: DATUM G SURFACE
COMMENT2: FLUID--E-Z MUD

COMPANY: LA COUNTY
HOLE ID: AFMW-3
LOCATION: AMARGOSA-USAF SITE
DATE: 08-28-90
TIME: 1430
OPERATOR: DC SL
COMMENT1: DATUM G SURFACE
COMMENT2: FLUID--E-Z MUD

COMPANY: LA COUNTY
HOLE ID: AFMW-3
LOCATION: AMARGOSA-USAF SITE
DATE: 08-28-90
TIME: 1540
OPERATOR: DC SL
COMMENT1: DATUM G SURFACE
COMMENT2: FLUID--E-Z MUD





EXPLANATION

- TP-1 TEST PIT LOCATION
- B-5 SHALLOW BORING LOCATION
- MW-1 MONITORING WELL LOCATION
- D - D' CROSS SECTION LOCATION

LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
Materials Engineering Division

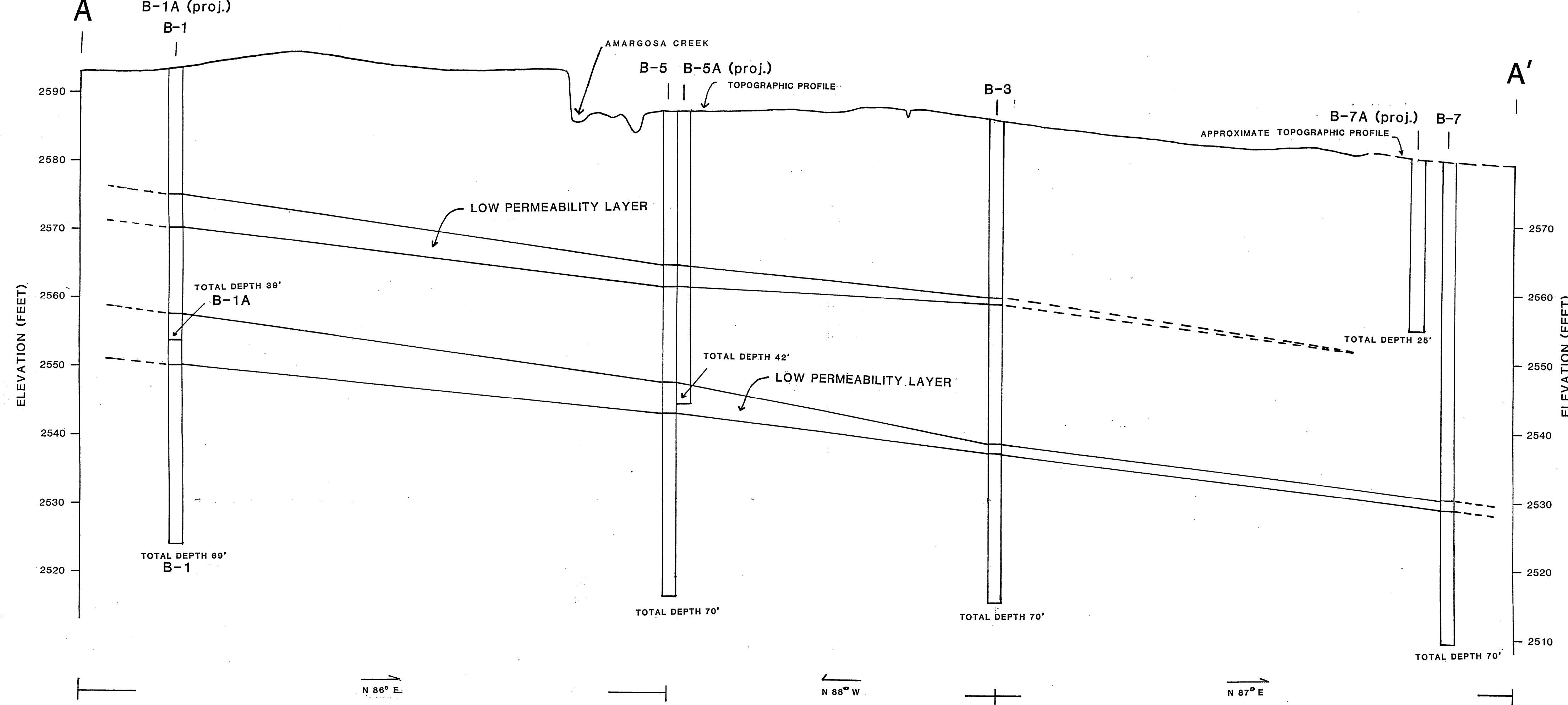
Amargosa Creek
U. S. AIR FORCE SITE
GROUNDWATER RECHARGE STUDY
BORING LOCATION MAP

DATE: MARCH 1991 SCALE: 1" = 200' PREPARED BY: K.L.

PLATE 1





PWS-0190-0102

REFERENCES		REVISIONS		LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS	
AMERICAN AERIAL SURVEYS, INC.	7-22-87	NO.	DESCRIPTION	DATE	BY
AMERICAN AERIAL SURVEYS, INC.	7-22-87	1	ISSUED FOR REVIEW	7-22-87	K.L.
AMERICAN AERIAL SURVEYS, INC.	7-22-87	2	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	3	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	4	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	5	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	6	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	7	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	8	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	9	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	10	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	11	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	12	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	13	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	14	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	15	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	16	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	17	REVISED		
AMERICAN AERIAL SURVEYS, INC.	7-22-87	18	REVISED		
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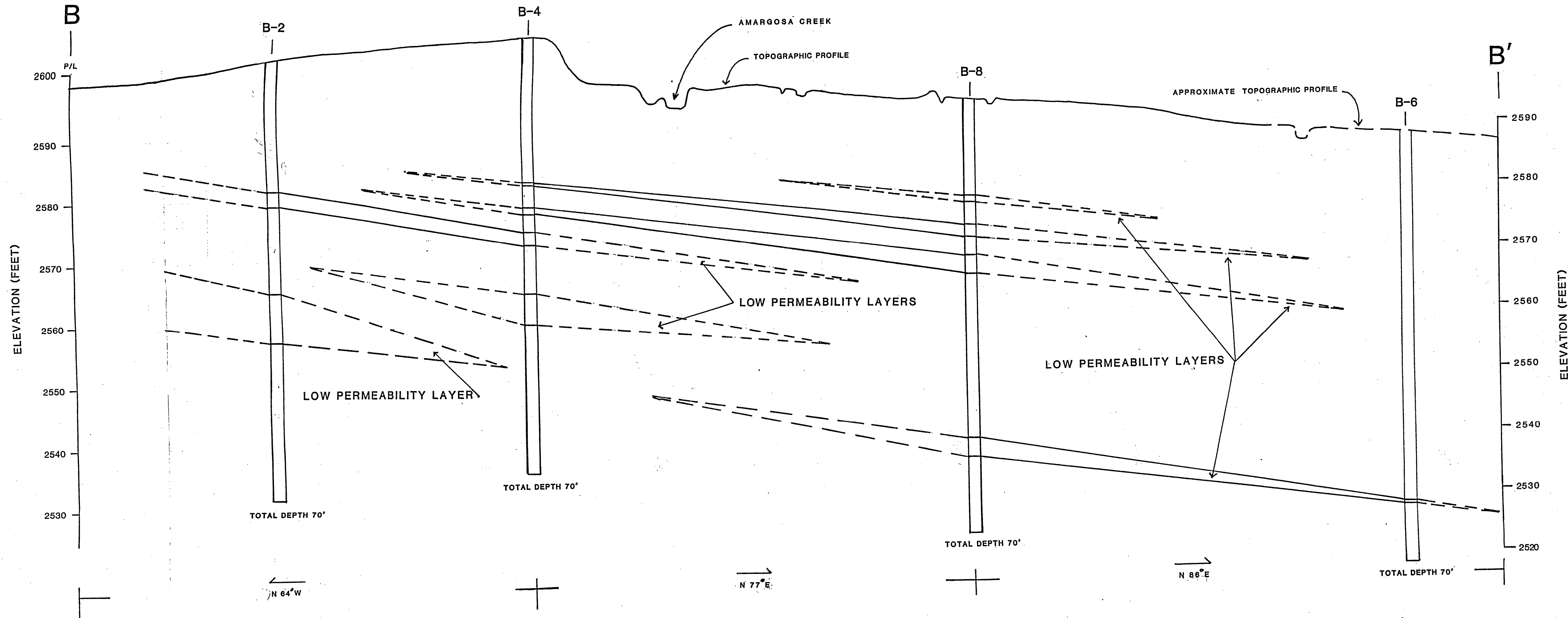
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GROUNDWATER RECHARGE STUDY		
GEOLOGIC CROSS SECTION A-A'		
DATE: MARCH 1991	H. SCALE: 1" = 200' V. SCALE: 1" = 10'	PREPARED BY: S.L.

EXPLANATION

- | | | |
|---|-----|---------------------------------|
|  | B-3 | BORING LOCATION |
|  | | BOUNDARY BETWEEN UNITS |
|  | | INFERRED BOUNDARY BETWEEN UNITS |
|  | P/L | PROPERTY LINE |

FOR LOCATION OF CROSS SECTION SEE PLATE 1

PWS-0190-0103



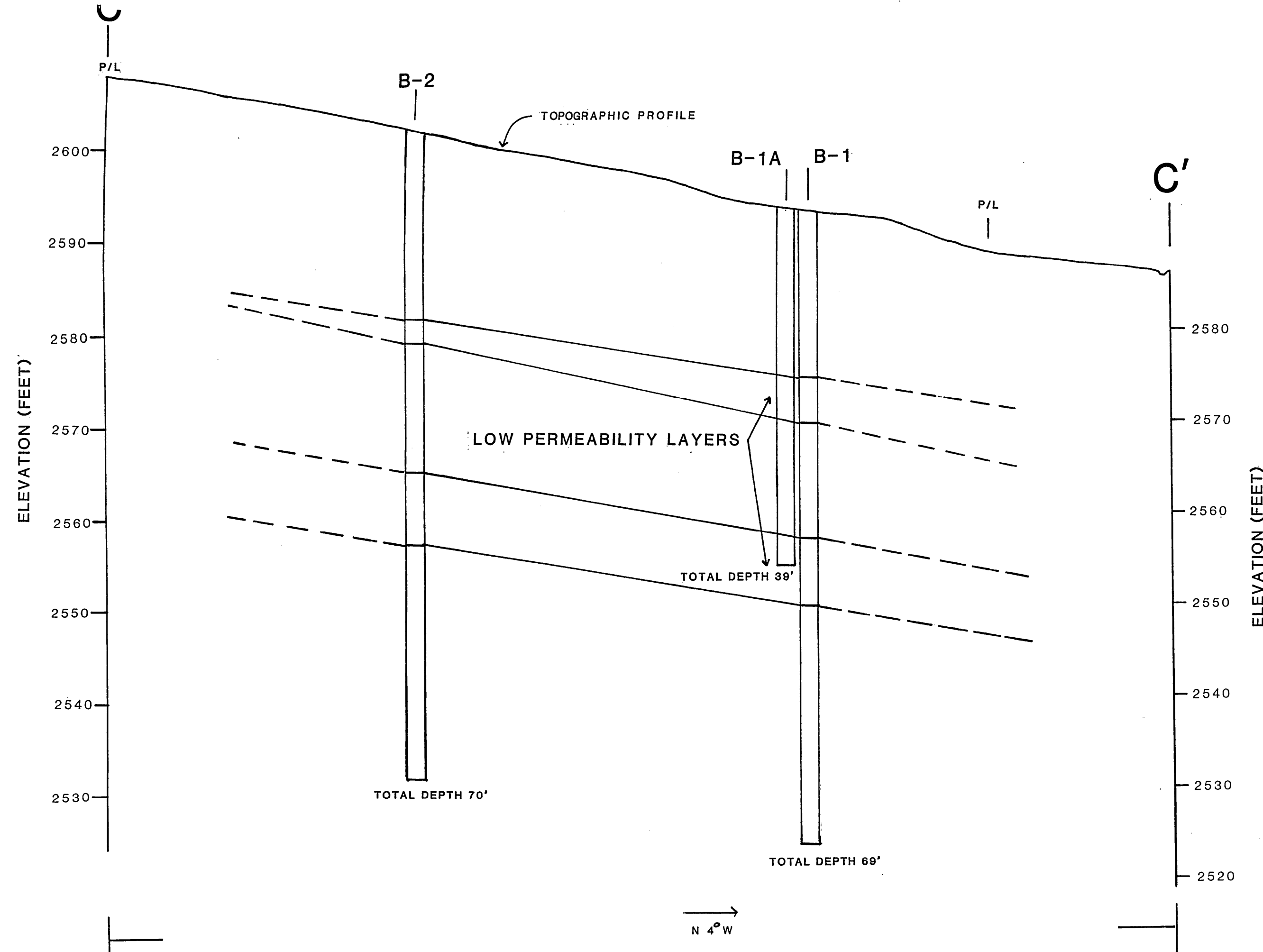
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GROUNDWATER RECHARGE STUDY		
GEOLOGIC CROSS SECTION B-B'		
DATE: MARCH 1991	H. SCALE: 1" = 200' V. SCALE: 1" = 10'	PREPARED BY: S.L.

EXPLANATION		
	B-3	BORING LOCATION
		BOUNDARY BETWEEN UNITS
		INFERRED BOUNDARY BETWEEN UNITS
	P/L	PROPERTY LINE

PWS-0190-0104

FOR LOCATION OF CROSS SECTION SEE PLATE 1

PLATE 3



LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS		
AMARGOSA CREEK U.S. AIR FORCE SITE		
GROUNDWATER RECHARGE STUDY		
GEOLOGIC CROSS SECTION C-C'		
DATE: MARCH 1991	H. SCALE: 1" = 200' V. SCALE: 1" = 10'	PREPARED BY: S.L.

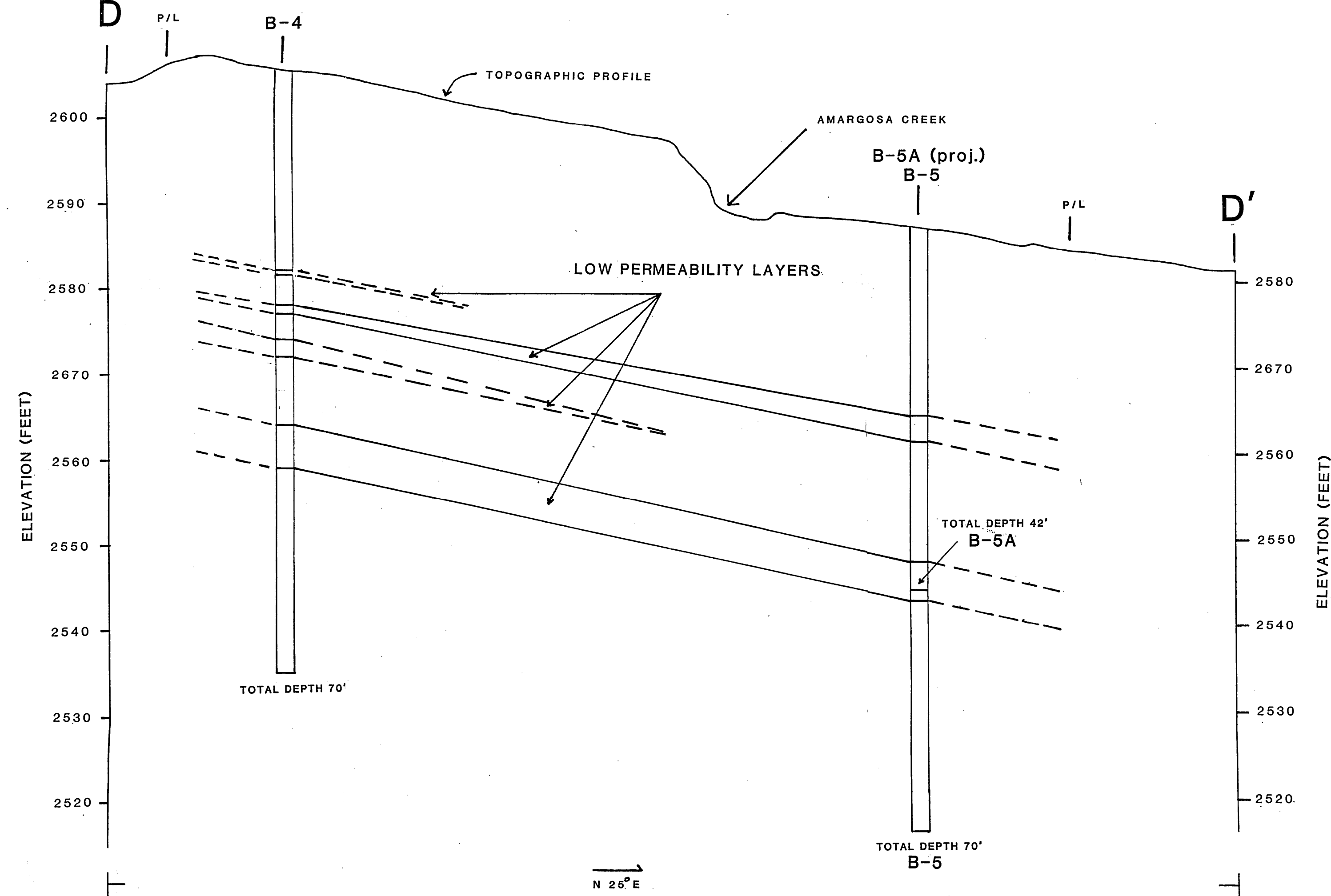
EXPLANATION

- | | | |
|--|-----|---------------------------------|
| | B-3 | BORING LOCATION |
| | | BOUNDARY BETWEEN UNITS |
| | | INFERRED BOUNDARY BETWEEN UNITS |
| | P/L | PROPERTY LINE |





FOR LOCATION OF CROSS SECTION SEE PLATE 1

PLATE 4

PWS-0190-0105



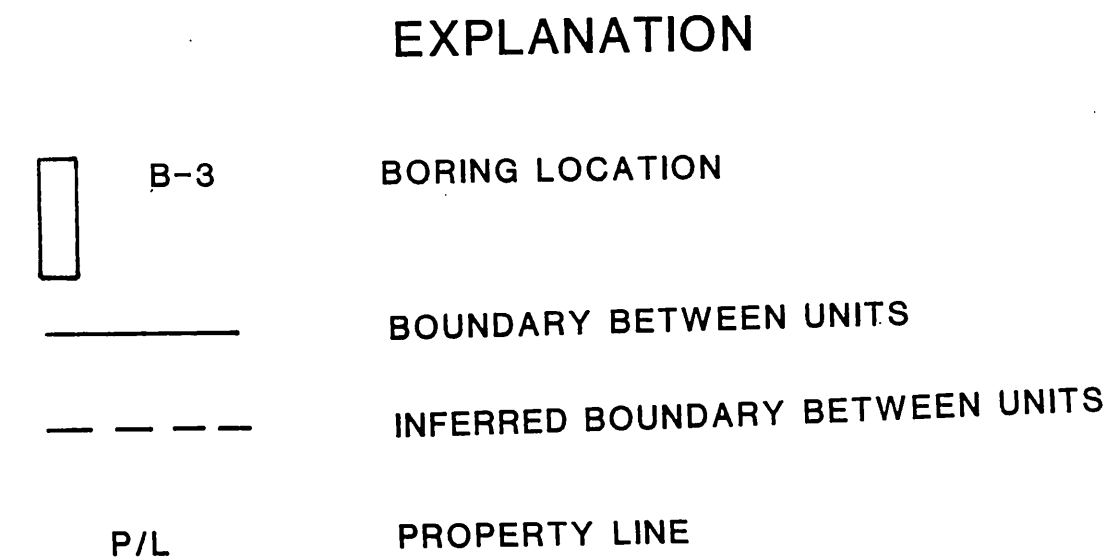
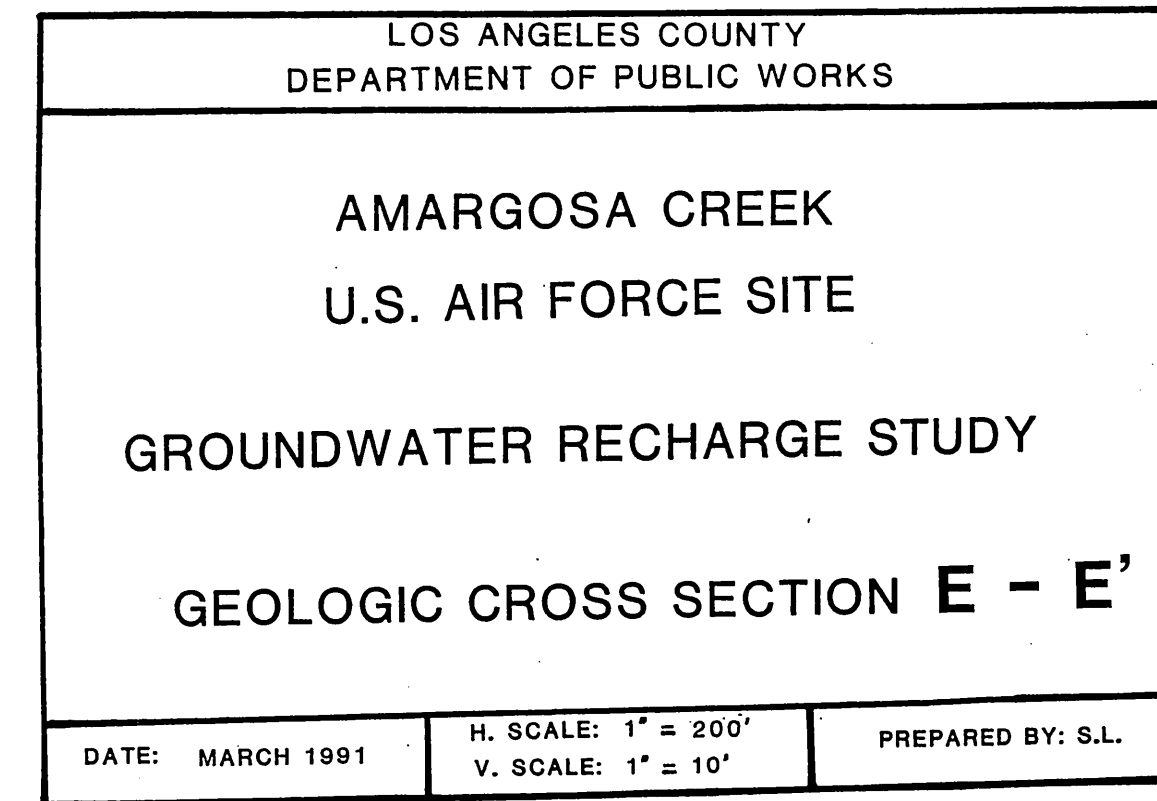
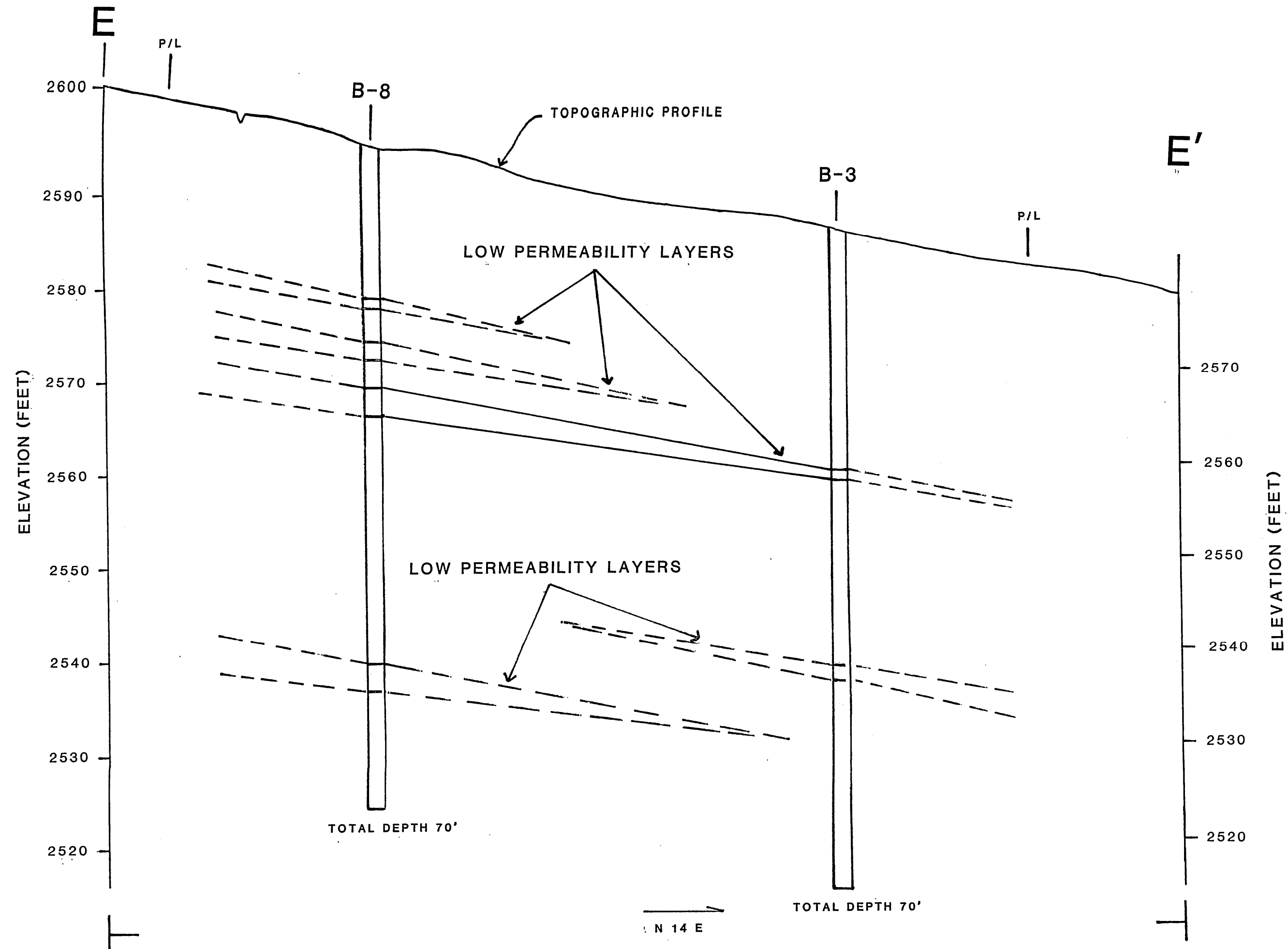
LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS		
AMARGOSA CREEK U.S. AIR FORCE SITE		
GROUNDWATER RECHARGE STUDY		
GEOLOGIC CROSS SECTION D-D'		
DATE: MARCH 1991	H. SCALE: 1" = 200' V. SCALE: 1" = 10'	PREPARED BY: S.L.

EXPLANATION	
	B-3 BORING LOCATION
	BOUNDARY BETWEEN UNITS
	INFERRED BOUNDARY BETWEEN UNITS
	PROPERTY LINE

FOR LOCATION OF CROSS SECTION SEE PLATE 1

PLATE 5

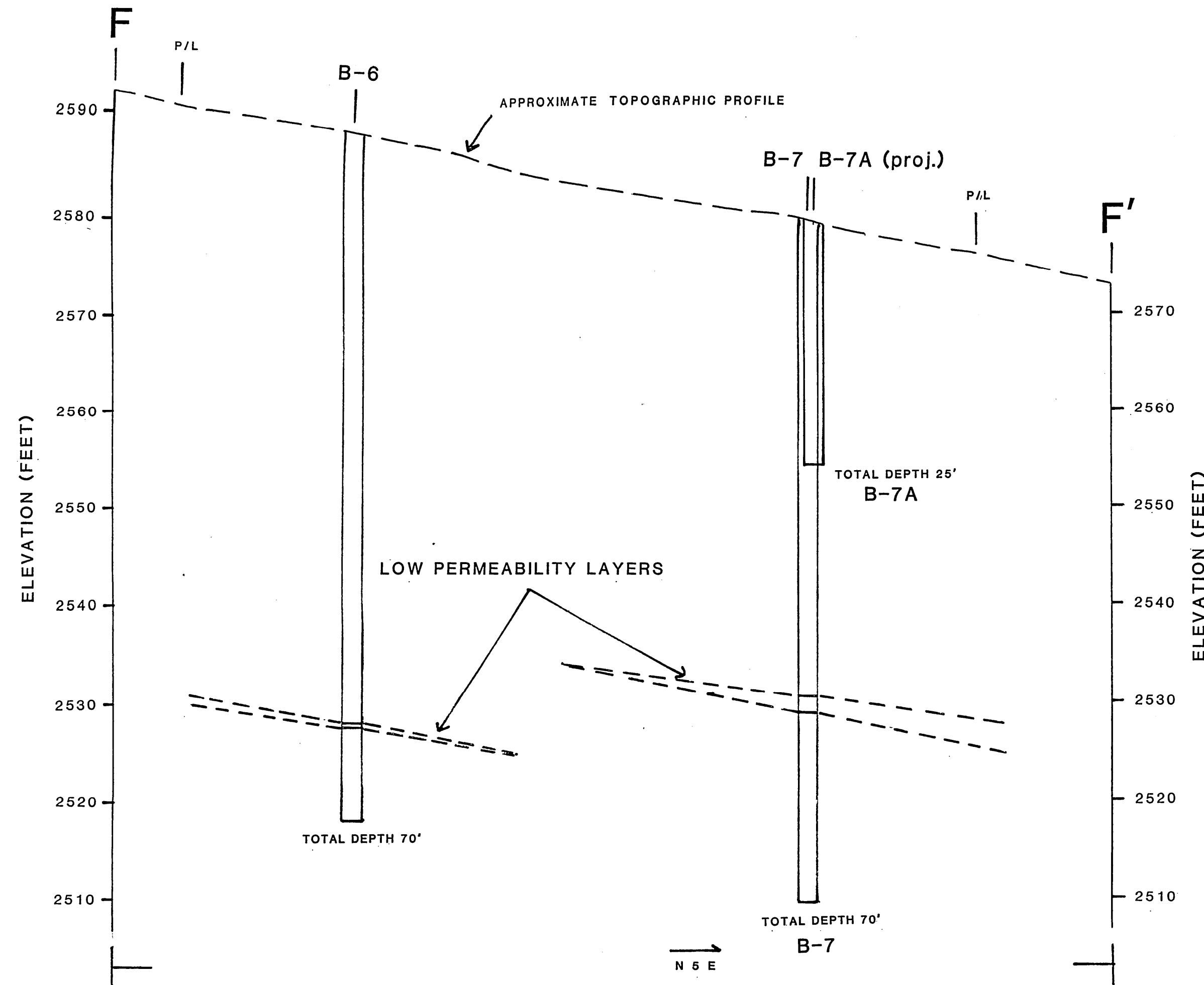
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FOR LOCATION OF CROSS SECTION SEE PLATE 1





PLATE 6

PWS-0190-0107



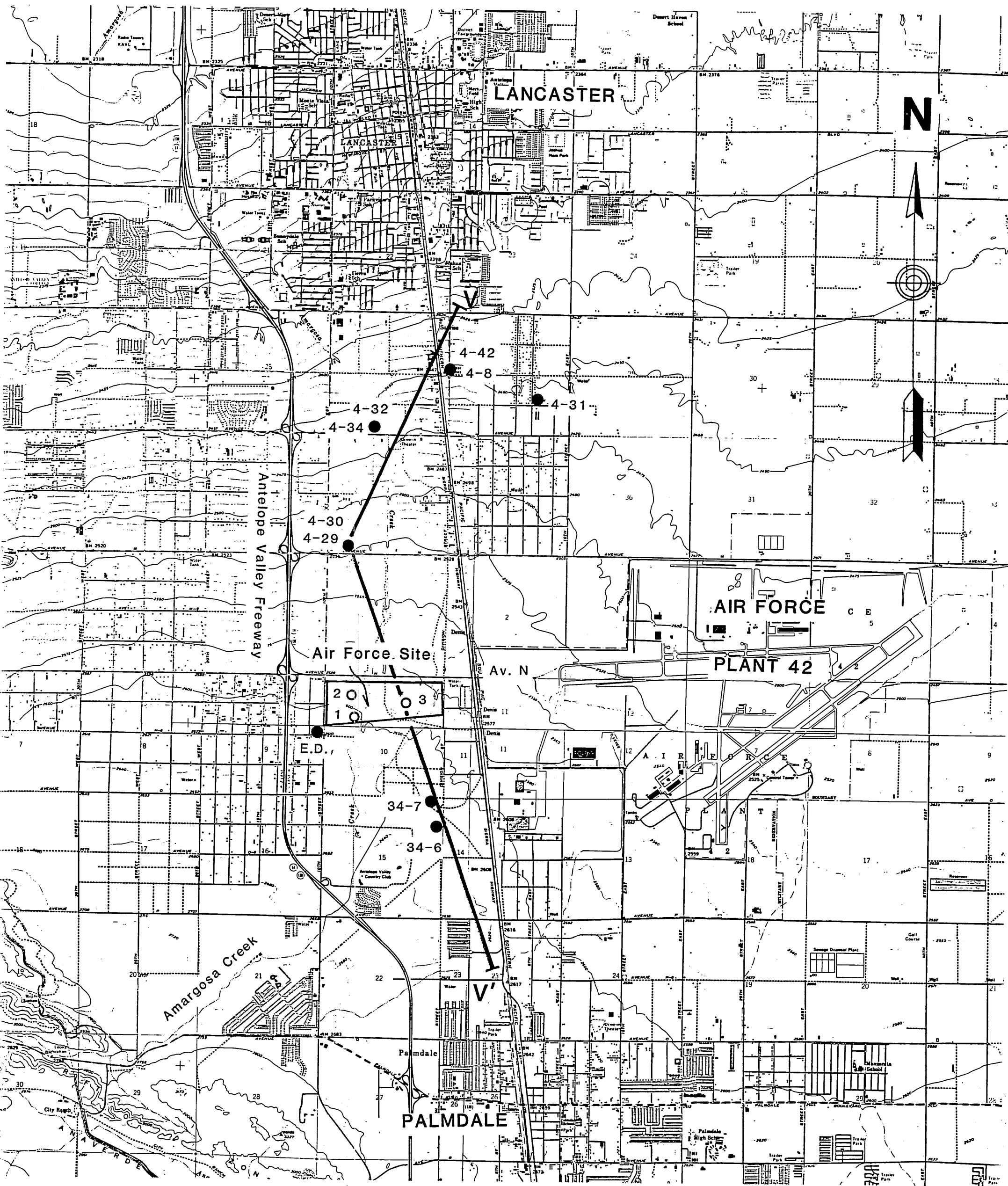
LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS		
AMARGOSA CREEK U.S. AIR FORCE SITE		
GROUNDWATER RECHARGE STUDY		
GEOLOGIC CROSS SECTION F - F'		
DATE: MARCH 1991	H. SCALE: 1" = 200' V. SCALE: 1" = 10'	PREPARED BY: S.L.

EXPLANATION

- | | | |
|---|-----|---------------------------------|
|  | B-3 | BORING LOCATION |
|  | | BOUNDARY BETWEEN UNITS |
|  | | INFERRED BOUNDARY BETWEEN UNITS |
|  | P/L | PROPERTY LINE |

FOR LOCATION OF CROSS SECTION SEE PLATE 1

PLATE 7



EXPLANATION

- 4-42 Waterworks Wells (Wells in close proximity are denoted with one symbol)
- 3 Monitoring Wells (This Study)
- E.D. El Dorado Water Company Wells
- V — V' Geologic Cross Section (See Figure 3)
- 34-7 Not constructed

LOS ANGELES COUNTY
Department of Public Works
Land Development Division

Air Force Site
Well Location Map

Scale 1" = 4000'

MARCH 1991