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WATER LEVEL MEASUREMENTS IN 52 SHALLOW BOREHOLES IN THE SAN FRANCISCO BAY REGION

by

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Abstract

Water-level measurements have been read in 52 cased boreholes in the San Francisco bay region. These measurements are compared to water-table depths determined by P-wave velocity. A velocity in excess of 1200 m/s is taken as the depth of the upper surface of the water table. This method works best in saturated alluvium, and fails in dry rock because of P-wave velocities greater than 1200 m/s.

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Introduction

This report discusses the results from two different methods of measuring water table depths in different geologic units surrounding San Francisco Bay. The first method used in measuring water table depth is by compressional (P-wave) velocity determination. The second method is by measuring with a steel tape the standing water level in the bore hole. Through these measurements information is gained about the relative position of water level and water table in a group of cased bore holes. The water level measurements by these two methods have been made at 52 bore holes in the San Francisco Bay region. These holes were part of a group of 59 holes which were used originally for measurement of shear and compressional wave velocities and were drilled to 30 meters and cased (Gibbs et al., 1975, 1976, 1977).

In October, 1976 the author measured the water levels by steel tape and compared these measurements with the depths determined by the P-wave velocity method. This latter method is described in the section of this report entitled Water-Table Data Collection.

Geology and Hole Locations

The classification of the geologic units in which the holes were drilled is identified in Professional Paper 941-A, Borcherdt (Editor), 1975. The 52 holes have been grouped into three of these units: 1) Bay Muds, 2) Alluvium, 3) Bedrock (see Table A, this report, for site name and number).

Each hole has been surveyed by Brunton compass, hand level and tied to local fixed reference points. Sketch maps are prepared for access and

relocating purposes. Holes No. 1, 15, 18 and 22 were not surveyed in detail, but instead those portions of the identifying 7 1/2' quadrangles are substituted.

Field Procedures

Drilling. Rotary drilling was used to establish the 59 vertical holes for shear wave analysis over a three year period. The holes were drilled to a full 30 meters and flushed with clear water. Solid plastic casing was set and pea gravel was used to backfill around the casing. The holes are identified by number and name (see Table A) and are tabulated below by drilling number and completion dates:

Holes by Number	Drilling Completed
1-12	11-13-1974
13-35	5- 1-1975
36-59	1-12-1976

Several field procedures are routinely performed during the drilling operation. Geologic samples are taken by:

1. Shelby tube and "Pitcher" core barrel.
2. Standard penetration tests are made in soils and weathered bedrock.
3. Drill cuttings are continuously monitored by on site geologist.
4. When possible, a notation of water table contact is made, usually measured in upper levels of hand augered starter holes, e.g., site No. 41, Southern Pacific (rarely deeper than 4 meters when rotary drilling commences).

Water Level Measuring Techniques. Measurements to water level are made at each site by using two different tapes. At first a weighted cloth tape is used to identify the water surface by lowering it into the hole

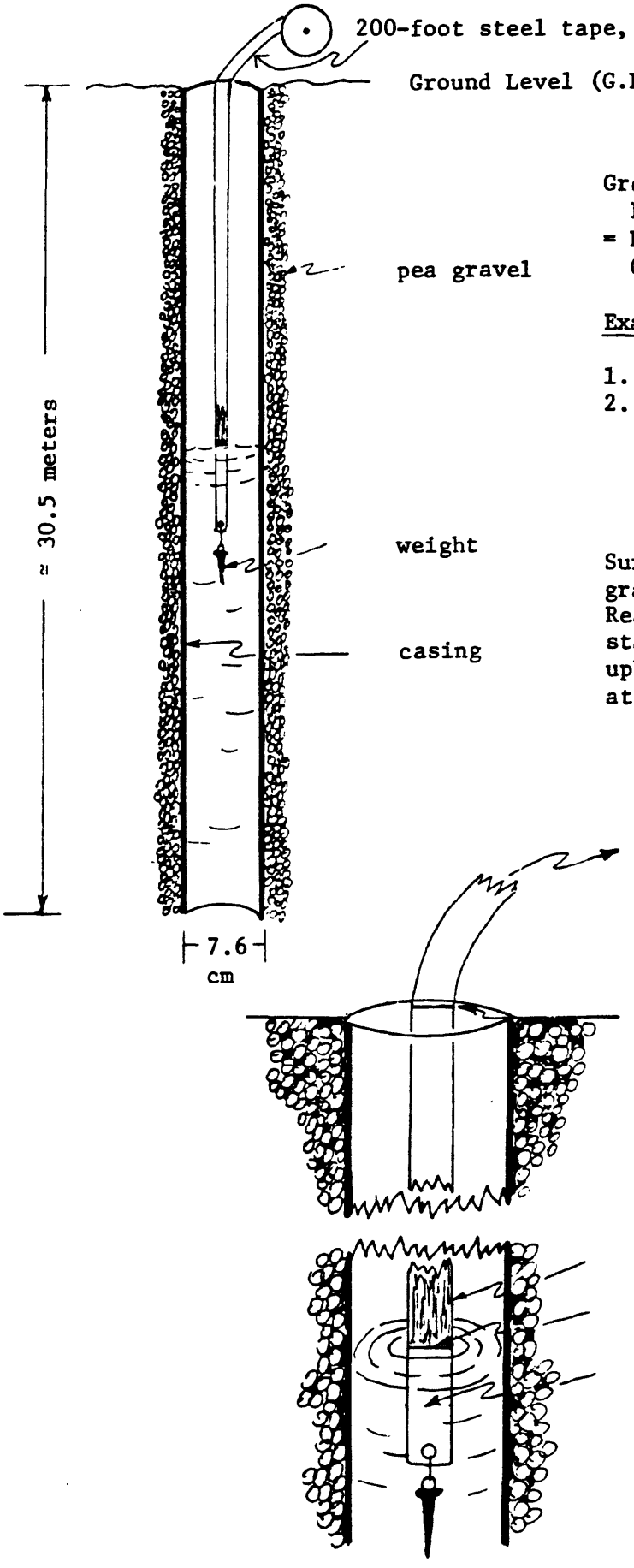
and listening for water contact. This provides a rough calibration measurement to determine the hole depth to which the chalked end of the steel tape should be lowered. The weighted and chalked steel tape, graduated into hundredths of a foot, is gradually lowered into the premeasured water zone and a precise reading is taken, using the casing lip at the ground surface as a reference point (see Figure 2). The same weight is used on the tape to insure identical volume displacement, and each hole is allowed to reach "equilibrium" from surface ripples, before attempting the final reading.

General Discussion

Water level measurements have been made in 52 widely dispersed, non-perforated, cased holes in the San Francisco region. All the holes are located in a region (see Plate 1, in pocket) approximately 2,000 square kilometers in area, and ranging in altitude from sea level to 810 meters. Webster's, D. A., 1973, Map 530-F in pocket is introduced as the base map for locating the 52 holes. The depth zones (A-D) on Webster's map of water table depth were determined from data obtained from more than one thousand shallow bore holes drilled in the San Francisco region to accommodate foundation engineering studies. Over 70% of the shear-wave sites were beyond these zones on Webster's map, and thus water table data were not compared. Water level depths determined by taping were not expected to be equal to water table depths determined by P-wave velocity method, for reasons discussed later in this report.

Bedrock and Alluvium

In interpreting P-wave velocity change as an indicator of water table depth, the geologic unit in which the velocity is measured is a very important consideration. It appears that a velocity in the range of 1350-1600 M/S is optimum for recognizing a water table horizon in saturated alluvium (see Table A). The same P-wave boundary denoting a water table in bedrock is more



Readings (1 and 2)

Ground Level (G.L.) minus Water Level (W.L.)
= Depth to Water
G.L. - W.L. = Depth to Water

Example: Hole No. 21

1. G.L. = 51.50 ft (uphole tape reading)
2. W.L. = 2.00 (downhole, chalk/W.L.)

49.50 ft, or 15.1 meters

Surface reading made on steel tape, graduated to hundredths of a foot. Reading taken only when tape is stabilized. Tape is read at uphole end, then rewound and read at chalk/water contact "line."

Figure 1 Water Level Measuring Technique

TABLE A

Measured water levels and water table determined from P-wave measurements with dates and locations.*

1	2	3	4	5	6	7
BAY MUD Site No. and Name	Site Elevation (Meters)	Township * and Range	Depth to water level when logged	Depth to water table from break in P-wave velocity	Measured (taped) depth to water level, Oct. 1976	Remarks M = Meters S = Seconds
58 Audubon School	0.6M	T4SR4W	1.5M	5 May 76 20.0M, 1500 M/S	4.2M	Taped depth to bottom, Oct. 1976 16.4M
36 Bridgeway	0.6M	T5SR4W	NR	26 Mar76 11.0M, 1510 M/S	3.6M	
50 KGEI	0.6M	T4SR3W	1.5M	23 Apr76 20.0M, 1470 M/S	1.7M	
ALLUVIUM SITES						
13 Alviso	0.6M	T6SR1W	1.3M(?)	2 Jly 76 2.5M, 1560 M/S	0.0M	
25 Oliver Salt Works	0.6M	T3SR2W	2.0M	21 Aug 75 8.0M, 1570 M/S	2.5M	Taped depth to bottom Oct. 1976 12.9M
2 Cozzolino	70.3M	T5SR5W	1.0M	16 Aug 75 2.0-2.5M 15 00 M/S	1.1M	Taped depth to bottom Oct. 1976. 14.5M

* Referred to Mt. Diablo Base & Meridian

TABLE A (continued)

1	2	3	4	5	6	7
Alluvium Sites No. & Name (cont'd)	Site elevation (meters)	Township and Range	Depth to water level when logged	Depth to water table from break in P-wave velocity	Measured (taped) depth to water level, Oct. 1976	Remarks
24 Miller School	71.5M	T7SR1W	5.2M	20 Aug 75	9.2M	
27 Mitchell Park	5.8M	T6SR2W	2.8M	25 Aug 75 2.6M,1530 M/S	2.8M	
31 Frenchman's Creek	42.7M	T5SR5W	8.5M	29 Aug 75 10.0M,2260 M/S	9.2M	Taped depth to bottom. Oct. 1976 29.9M
32 Half Moon Bay Terrace	15.2 M	T5SR3W	2.9M	3 Sept 75 5.0M,1650 M/S	5.8M	Taped depth to bottom, Oct. 1976 25.2M
54 Santa Clara Fairgrounds	44.2M	T7SR1E	5.0M	29 Apr 76 18.5M,1690 M/S	4.3M	
16 Lowry Road	3.1M	T4SR2W	3.0M	9 J1y 75 15.0M,1980 M/S	N.R.	
17 Hayward Sink	0.9M	T4SR1W	3.9M	28 J1y 75 15.0M,1960 M/S	N.R.	

TABLE A (continued)

1	2	3	4	5	6	7
Alluvium Sites No. & Name (continued)	Site elevation (meters)	Township and Range	Depth to water level when logged	Depth to water table from break in P-wave velocity	Measured (taped) depth to water level, Oct. 76	Remarks
18 Parkway Towers	15.2M	T4SR1W	16.0M	1 Apr. 75 20.0-22.5M 1630 M/S	N.R.	
21 Montgomery School	33.6M	T7SR1W	10.5M	9 Apr. 75 17.5-20.0M 1830 M/S	15.0M	
37 Windmill	6.1M	T2SR6W	N.R.	29 Mar. 76 7.5M, 1610 M/S	3.2M	Taped depth to bottom, Oct. 1976 30.2M
38 Chain of Lakes	24.4M	T2SR6W	N.R.	30 Mar76 17.5M, 1260 M/S	14.5M	Taped depth, 21.6M Oct. 1976, several P-break suspect gas in sediments
41 Southern Pacific	0.9M	T2SR5W	5.0M	1 Apr. 76 7.0M, 1700 M/S	2.0M	Taped depth to bottom. Oct. 1976 28.2M
43 Quintara	38.2M	T2SR6W	N.R.	8 Apr 76 10.0M, 1280 M/S	12.5M	Taped depth to bottom, Oct. 1976 30.2M
44 Hillview	76.4M	T3SR6W	7.0M	12 Apr76 10.0M, 1210 M/S	5.1M	Taped depth to bottom, Oct. 1976 27.1M

TABLE A (continued)

1	2	3	4	5	6	7
Alluvium Sites No. & Name (continued)	Site elevation (meters)	Township and Range	Depth to water level when logged	Depth to water table from break in P-wave velocity	Measured (taped) depth to water level Oct. 1976	Remarks
45 Avalon	143.0M	T3SR6W	19.0M	13 Apr 76 20.0-22.5M 1690 M/S	13.8M	Taped depth to bottom, Oct. 1976 29.8M
48 Skyline	140.0M	T3SR6W	N.R.	21 Apr 76 4.0M 1210 M/S	3.8M	Taped depth to bottom, Oct. 1976 28.3M
56 Merritt Sand	8.2M	T1SR4W	N.R.	3 May 76 17.0M,1830 M/S	0.5M	Taped depth to bottom, Oct. 1976 28.3M
59 Carmichael School	3.6M	T2SR5W	2.2M	6 May 76 11.0M,1220 M/S	0.1M	
15 Muir School	2.1M	T3SR2W	4.6M	26 Mar 76 22.5M,1770 M/S	N.R.	
55 Oak Avenue	59.5M	T7SR2W	Dry	30 Apr 76 950 M/S	Dry	
14 Blackberry Farm	94.5	T7SR2W	2.8M	11 Apr75 7.5M,1400M/S	7.5M	

TABLE A (continued)

1	2	3	4	5	6	7
Alluvium Sites No. & Name (continued)	Site Elevation	Township and Range	Depth to water level when logged	Depth to water table from break in P-wave velocity	Measured (taped) depth to water level Oct. 1976	Remarks
19 Palo Alto Square	11.3M	T6SR3W	3.6M	18 Apr75 10.0-12.5M 1410 M/S	20.5M	
BEDROCK SITES						
11 North Peak	490.0M	T4SR6W	N.R.	18 Nov 74 5.0M,1260M/S	12.6M	Taped depth to bottom, Oct. 1976 25.5M
12 Sawyer Ridge	346.0M	T4SR5W	N.R.	19 Nov 74 10.0M,3350M/S	10.8M	Taped depth to bottom, Oct. 1976 21.6M
20 Mission Peak	500.0M	T5SR1E	8.0M	3 Apr 75 2.5M,1940M/S	8.2M	Taped depth to bottom, Oct. 1976 29.9M
22 Stevens Creek Quarry	182.0M	T7SR2W	4.6M	14 Apr 75	N.R.	
23 Cal. State Hayward	134.0M	T3SR2W	15.0M	27 Mar 75 10.0M,1380M/S	19.0M	Taped depth to bottom, Oct. 1976 25.8M

TABLE A (continued)

1	2	3	4	5	6	7
Bedrock Sites No. & Name (continued)	Site Elevation	Township and Range	Depth to water level when logged	Depth to water table from break in P-wave velocity	Measured (taped) depth to water level Oct. 1976	Remarks
26 Corte Madera	241.0M	T3SR2W	5.2M	16 Apr75 2.5M,1190M/S	4.9M	
28 Foothill Park	427.0M	T7SR3W	N.R.	26 Aug.75 15.0M,2640M/S	16.9M	
29 Sierra Morena	732.0M	T6SR4W	5.4M	25 Apr 75 12.5-15.0M 2100M/S	N.R.	
30 Pulgas Tunnel	134.0M	T5SR4W	25.5M	21 Apr75 22.5M,2470M/S	25.4M	Taped depth to bottom, Oct. 1976 30.6M
33 Vista Grande	152.0M	T3SR5W	23.0M	30 Apr75 12.5M,1610M/S	16.7M	Taped depth to bottom, Oct. 1976 30.4M
34 Morrison Canyon	303.0M	T4SR1W	1.2M	2 Apr 75 5.0M,1740M/S	0.9M	Taped depth to bottom, Oct. 1976 28.2M
35 Lake Merced Country Club	50.3M	T3SR6W	24.0M	28 Apr 75	25.0M	Artificially watered for "S" wave test. Taped depth to bottom Oct. 1976, 25.5 M

TABLE A (continued)

1	2	3	4	5	6	7
Bedrock Sites No. & Name (continued)	Site Elevation	Township and Range	Depth to water level when logged	Depth to water table from break in P-wave velocity	Measured (taped) depth to water level Oct. 1976	Remarks
39 Prayerbook Cross	91.5M	T2SR6W	N.R.	31 Mar 76 11.0M,2650M/S	18.6M	Taped depth to bottom, Oct. 1976 25.1M
40 Page Mill Basalt	180.0M	T6SR3W	14.0M	1 Apr 76	14.8M	Nearly Dry
46 Twin Peaks	251.0M	T2SR5W	2.5M	19 Apr 76 12.0-15.0M 1020 M/S	3.1M	Taped depth to bottom, Oct. 1976 29.8 M
47 San Bruno Mt.	244.0M	T3SR5W	7.0M	1 Apr 76 7.0-8.0M 1290M/S	8.0M	Taped depth to bottom, Oct. 1976 27.1M
49 Westmoor	143.0M	T3SR6W	13.6M	22 Apr 76	N.R.	
51 Crest Road	171.0M	T5SR4W	10.5M	26 Apr 76 2.5M,1090M/S	12.0M	Taped depth to bottom, Oct. 1976 30.8M
1 Purisima	76.0M	T5SR5W	12.5M	7 Aug 74 12.5M,1780M/S	N.R.	

TABLE A (continued)

1	2	3	4	5	6	7
Bedrock Sites No. & Name (continued)	Site Elevation	Township and Range	Depth to water level when logged	Depth to water table from break in P-wave velocity	Measured (taped) depth to water level, Oct. 1976	Remarks
3 Maryknoll	128.0M	T7SR2W	N.R.	25 Sept. 74 10.0M,1890M/S	9.7M	
4 El Granada	353.0M	T5SR5W	N.R.	26 Nov74 10.0M,3850M/S	10.2M	Taped depth to bottom, Oct. 1976 21.9M
5 Black Mt.	810.M	T7SR3W	N.R.	10 Oct 74 7.5M,1880M/S	12.2M	Taped depth to bottom, Oct. 1976 29.8M
6 Digges Canyon	226.0M	T5SR5W	Dry	11 Oct 74 Dry	Dry	
7 Pise Lookout	560.0M	T5SR4W	N.R.	25 Nov. 74 5.0M,1790M/S	7.3M	Taped depth to bottom, Oct. 1976 23.5M
8 Pulgas Water Temple	108.0M	T5SR4W	N.R.	20 Nov 74 2.5M,1650M/S	6.2M	Taped depth to bottom, Oct. 1976 23.3M
9 Spring Valley Ridge	350.0M	T4SR5W	N.R.	15 Nov 74 7.5M,2360M/S	8.2M	Taped depth to bottom, Oct. 1976 26.8M

TABLE A (continued)

1	2	3	4	5	6	7
Bedrock Sites No. & Name (continued)	Site Elevation	Township and Range	Depth to water level when logged	Depth to water table from break in P-wave velocity	Measured(taped) depth to water level, Oct. 1976	Remarks
10 Vista Point	268.0M	T5SR4W	N.R.	19 Nov 74 10.0M,3300M/S	N.R.	Taped depth to bottom Oct. 1976 25.5M
57 Merritt College	304.0M	T1SR3W	11.5M	4 May 76 15.0M,1690M/S	9.6M	Taped depth to bottom, Oct. 1976 30.2M
52 College of San Mateo	172.0M	T4SR4W	16.0M	27 Apr76 17.5M,3160M/S	15.6M	Taped depth to bottom, Oct. 1976 30.0M
53 Peninsula Country Club	46.0M	T4SR4W	6.5M	28 Apr 76 2.5M,1670M/S	5.9M	Taped depth to bottom, Oct. 1976 23.9M
						N.R. = not recovered

difficult to observe, because even dry rock may have a high P-wave velocity. At 20 bedrock sites, P-wave depths and taped water levels were compared (see Table B). The average velocity was 2085 M/S (6840 feet/second). The average P-wave velocity in saturated alluvium holes was 1545 M/S (5070 feet/second). (See Table C.)

Fetid waters were noted when making water level measurements in Hole No. 59, Carmichael School, and No. 41, Southern Pacific. These foul waters appear to have entered the upper levels of the cased holes, and may have originated in surrounding zones of water leaking from cracked or broken sewer lines. Both of these holes are located in the "South of Market" district of the city and county of San Francisco. Two additional holes (Nos. 44 and 45) were drilled into the same geologic unit, alluvium of the Merced formation. The water column heights rose in both of these holes between the time of P-wave logging and water-level measurement by taping. Whether or not these water column height increases are from artesian pressure is unknown. The water in Hole No. 44 was extremely brackish although its altitude is above any tidal influence.

Water Table Data Collection

Collectively, the three methods of obtaining water table information used in this report are:

1. Depths to water table measured during shear-wave logging. (See Table A.)

2. Seismic P-wave velocity interpretation (Gibbs et al., 1975, 1976, 1977).

3. Direct water level taping by chalked steel tape to water level in non-perforated cased holes. (See Table A and Fig. 2, this report.)

Shown graphically (Fig. 2) are travel-time curves from a typical

Table B

Bedrock Sites: Average P-wave Velocity 2085 M/S

Site	No	P-Wave Velocity	Depths P-Wave	Depths Taped Oct. 1976
North Peak	11	1260 M/S	5.0 M	12.6 M
Sawyer Ridge	12	3350	10.0	10.8
Mission Peak	20	1940	2.5	8.2
Cal State Hayward	23	1380	10.0	19.0
Corte Madera	26	1530	16.0	4.9
Foothill Park	28	2640	15.0	16.9
Pulgas Tunnel	30	2470	22.5	25.4
Vista Grande	33	1610	12.5	16.7
Morrison Canyon	34	1740	5.0	0.9
Prayerbook Cross	39	2650	11.0	18.6
San Bruno Mt.	47	1290	8.0	8.0
Mary Knoll	3	1780	10.0	9.7
El Granada	4	3850	10.0	10.2
Black Mt.	5	1880	7.5	12.2
Pise Lookout	7	1790	5.0	7.3
Pulgas Water Temple	8	1650	2.5	6.2
Spring Valley Ridge	9	2360	7.5	8.2
Merritt College	57	1690	15.0	9.6
College of San Mateo	52	3160	17.5	15.6
Peninsula Country Club	53	1670	2.5	5.9

Table C

Alluvium Sites: Average P-wave velocity 1545 M/S

Site	No.	P-Wave Velocity	Depths P-Wave Depths	Depths Taped Oct. 1976
Mitchell Park	27	1530 M/S	2.6 M	2.8 M
Frenchmans Cr.	31	2260	10.0	9.2
Half Moon Bay Terrace	32	1650	5.0	5.8
Sta. Clara Fairgrounds	54	1690	18.5	4.3
Montgomery School	21	1830	17.5	15.0
Windmill	37	1610	7.5	3.2
Chain of Lakes	39	1260	17.5	14.5
Southern Pacific	41	1700	7.0	2.0
Quintara	43	1280	10.0	12.5
Hillview	44	1210	10.0	5.1
Avalon	45	1690	20.0	13.8
Skyline	48	1210	4.0	3.8
Merritt Sand	56	1830	17.0	0.5
Carmichael School	59	1220	11.0	0.1
Blackberry Farm	14	1400	7.5	7.5
Palo Alto Square	19	1410	10.0	20.5
Oliver Salt Works	25	1570	8.0	2.5
Cozzolino	2	1500	2.0	1.1

coarse-grained alluvium site; Frenchman's Creek, No. 31. The approximate depth of the water table at this site (10 meters) is shown on both the travel-time curve and the corresponding geologic section. The P-waves were generated from two sources at the ground surface, a vertical hammer blow, or a blasting cap (Gibbs et al., 1976). These P-wave arrival times are plotted on travel-time curves and a velocity is determined from the inverse slope of a least squares fit to the data points. The depth to the water-table in alluvium and bay mud is taken as the shallowest depth at which a P-wave velocity greater than 1200 M/S occurs. This water-table depth selection method has been used throughout the report, and is compared with the taped depths referred to and tabulated in Table A.

Water Table Measurement Problems

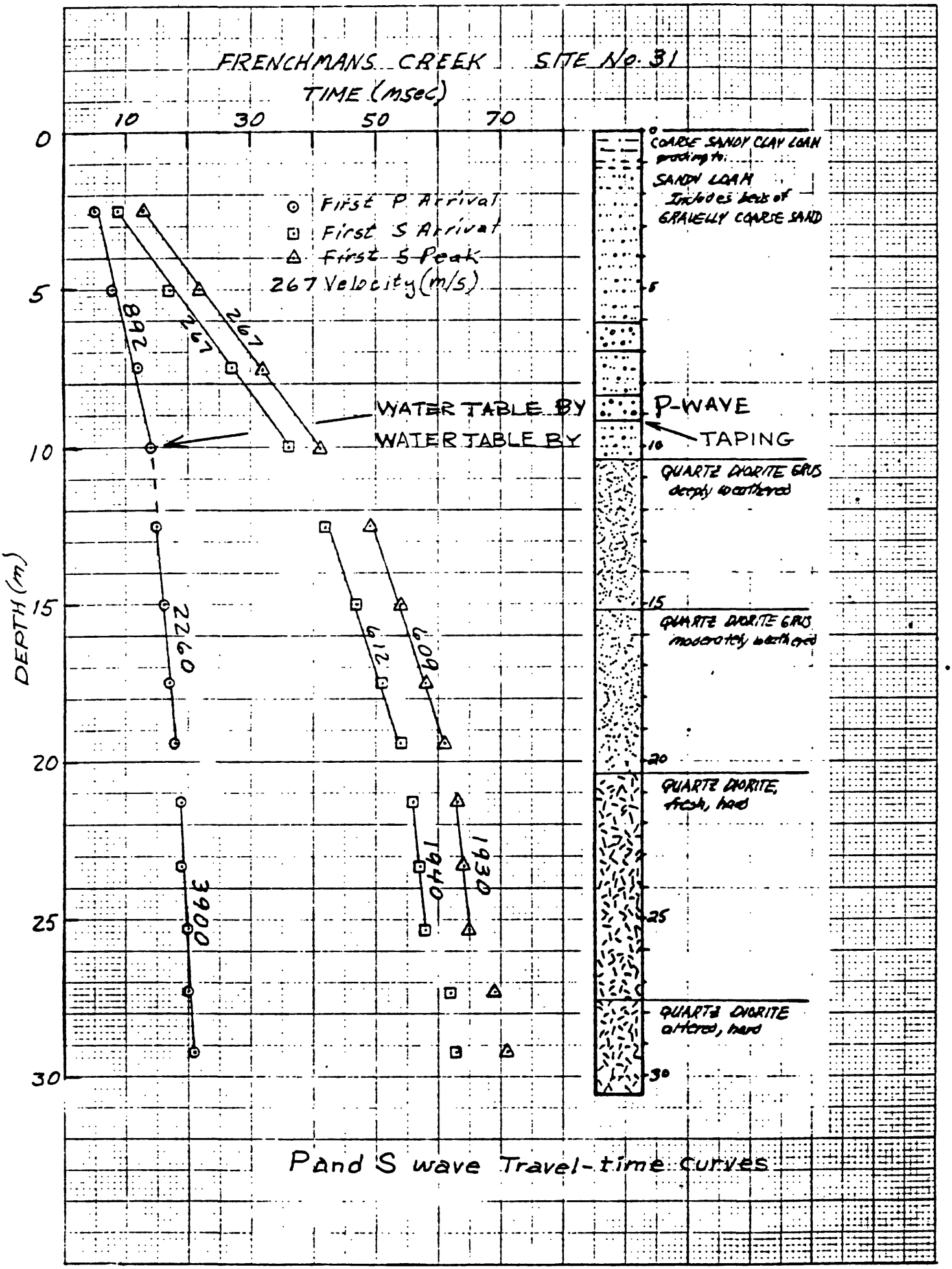
Several problems are inherent in the process of collecting water table data. A few variables which can affect a water-table measurement are listed below.

1. It is not always known if the water table measurement is related to a confined or unconfined aquifer.

   a) Confined aquifer. Ground water in a confined aquifer is overlain by a confining bed isolating it from other aquifers. This ground water is under pressure which forces the well water to rise above the top of the aquifer. Problem: Probably an extra high (toward ground level) measurement.

   b) Unconfined aquifer. Unconfined ground water moves downslope toward area of lowest water-table elevations. Problem: Has water in casing reached equilibrium?

2. A column of water standing in nonperforated casing may be held in the casing by a plug caused by drilling mud settling to the bottom of the hole or by side wall shards knocked off during casing placement.



P and S wave Travel-time curves

Fig. 2

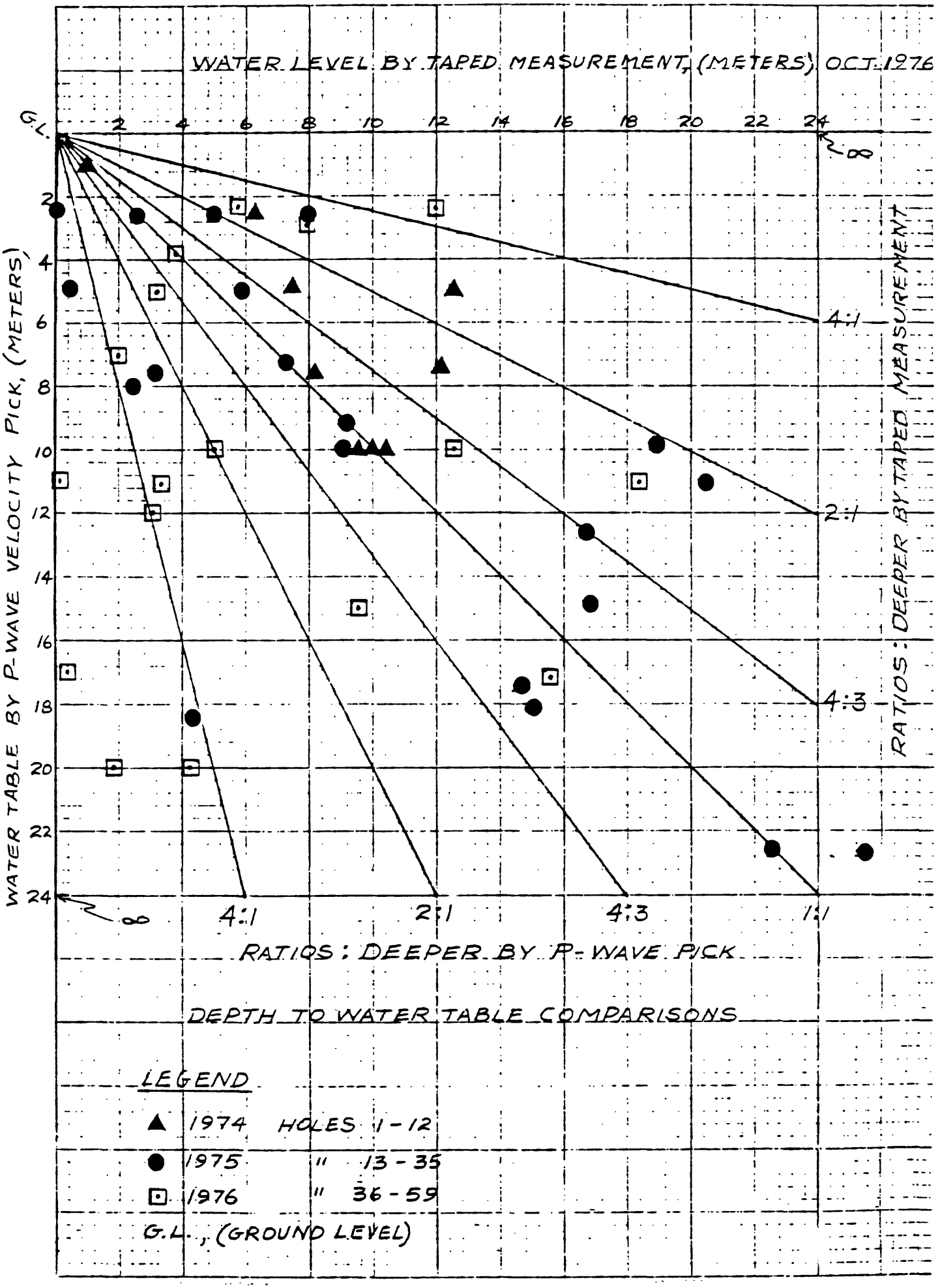


FIG. 3 HOLE EQUILIBRIUM

If this were to occur, a water level reading, no matter how precisely measured, could be incorrectly interpreted as one which relates to the water table. In reality, an observer would be measuring an isolated column of water, captured shortly after the hole flushing, and now temporarily contained by the nonperforated plastic casing.

3. Are cultural (man-made) stresses affecting the measured depth? Examples: A refuse dump nearby could create new hydraulic gradients. Have sewage lines been broken? Has urban/suburban development created new drainage patterns? Does nearby well-pumping over exceed the sustained yield of a ground water basin?

4. How much does the tide influence the water levels in bay mud holes?

5. Has the weather affected the reading?

6. How does the geologic unit in which the hole was drilled affect the water column's equilibrium rate?

7. Have recent rains (Winter 1978) recharged the water table and what are the new water level heights?

8. Are locally occurring artesian pressure systems causing water column height rises?

P-Wave Breaks vs. Taped Depths and Hole Equilibrium History

Comparisons of measured depth to water level by taping and P-wave velocity pick to water table are plotted in Figure 3. The ratios are shown by dividing the graph into eight regions. The ratio values are shown at the end of the line segments, and range from 1:1 (identical measurements, i.e., taped depth equal to P-wave pick) to ∞ . Example: 1975 plot, taped depth = 0, P-wave pick = 2 meters. Accompanying this data is another parameter, hole equilibrium history. Based upon the following facts, the data from thirteen holes were excluded from Fig. 3 and the standard deviation section; six holes could not be relocated, three holes were dry in October, 1976; one hole was

blocked due to cracked or broken casing. At two locations the P-wave velocity data was uninterpretable. For additional individual hole data the reader is referred to Table A.

By dates it appears that the younger the hole, the more widely scattered the two compared depths. This is shown by the following standard deviation (Sx) data.

$$\text{From } S_x = \sqrt{\sum_{i=1}^{N} \frac{\left(X_i - \bar{X}\right)^2}{N}}$$

We have:

X_i = taped measurement (meters) minus P-wave pick to water level.

$\bar{x}$ = mean of x_i's

N = number of points, by years.

Standard Deviation Results:

	N	Sx
1974	9	3.1
1975	20	4.8
1976	17	10.9

These results suggest that the P-wave estimates represent an equilibrium level toward which the water levels in the holes are trending.

Bay Mud Sites

Three Bay Mud Sites were selected for shear wave studies out of a total of 59 holes. These three holes are also classified as saturated, i.e., virtually all interstitial spaces have been filled by liquid. A discussion of their water table measurements follows:

The historic estuarine environment in which the three Bay Mud Sites were drilled creates a natural depositional zone, rich enough in organic

material to form methane gas in the mud (see Whalen et al., 1976). Slow P and S velocities were recorded at the three holes. P-wave values of 770 M/S in the upper 10 to 20 meters, and S wave values of 108 M/S were recorded.

When sediments contain gas, the velocity of the P-wave is reduced so that the P-wave method of picking a depth to water table cannot be used.

Hole No. 58 - Audubon

Initially, the P-wave velocity at this hole is 1070 M/S, and does not attain a velocity denoting water table until it reaches a depth of 15 to 20 meters and a velocity of 1500 M/S. The water level was taped in October 1976 at 4.2 meters, which is 1.7 meters deeper than it was when logged for shear wave velocities in December, 1975. Based on the probability that daily tide fluctuations can affect the taped water column height, future measurements taken over at least one, 24 hour, period should be made to resolve the extent of these changes. At the Audubon hole there is an upper depositional zone of 10 to 15 meters of oyster shells which may contribute to a more rapid water column equilibrium than at either KGEI or Bridgeway Park.

Hole No. 50 - KGEI

Geographically located approximately 4 kms. southeast of Audubon, the KGEI hole has a similar water level to Audubon, but the P-wave velocity does not reach saturated velocity until a depth of 20 meters (see Fig. 4 for these comparisons).

Hole No. 36 - Bridgeway Park

In comparison with the two previous Bay Mud Sites, Bridgeway Park shows the most striking velocity contrast. The velocities (P-wave 427 M/S S-wave 54 M/S) are lower in the upper 11 meters than all the other velocities measured in this survey. The top two meters of this site are artificially filled, which is not enough section to account for the low P & S velocities observed. A probable cause for the low velocities from near surface to

eleven meters is the presence of gas (methane CH_4, Brandt, 1960). It appears (see Fig. 4) that the P-wave velocity break to identify a water table contact should be closer to the surface and faster than was recorded. With gas present, one conclusion reached is that gas mixed with water in a saturated sediment, such as was found at Bridgeway Park, produces lower P & S wave velocities, than are measured in water-saturated, homogenous-sediments, which are free of gas.

Water Level Changes

In Figure 4, the water levels are shown graphically with a solid line representing the level at the time of S-wave measurement and the dashed line representing the level in October 1976. Those bottoms that could not be recovered, as a result of casing obstacles encountered during taping, are left as blank columns. The seismic velocity data at Site No. 42, Mar Vista, were uninterpretable, and were therefore excluded from Table A. For the record, the water level depth in this hole measured 12.9 meters in October, 1976.

Conclusions

Water level measurements have been made in 52 holes in the San Francisco Bay area, and their relations to the water-table have been studied. The data compiled from the different types of measurements represents new water-table data from three geologic units, 1) alluvium, 2) bedrock, 3) bay muds. The P-wave velocity data obtained from saturated alluvium sites most clearly describe a water boundary with a range of velocities from 1200 m/s to 1600(+) m/s. The P-wave velocity method of obtaining a depth to water-table will not work in most bed rock because the initial velocity of the rock in most cases exceeds 1200 m/s.

A unique pattern of low P and S wave velocities describe the character

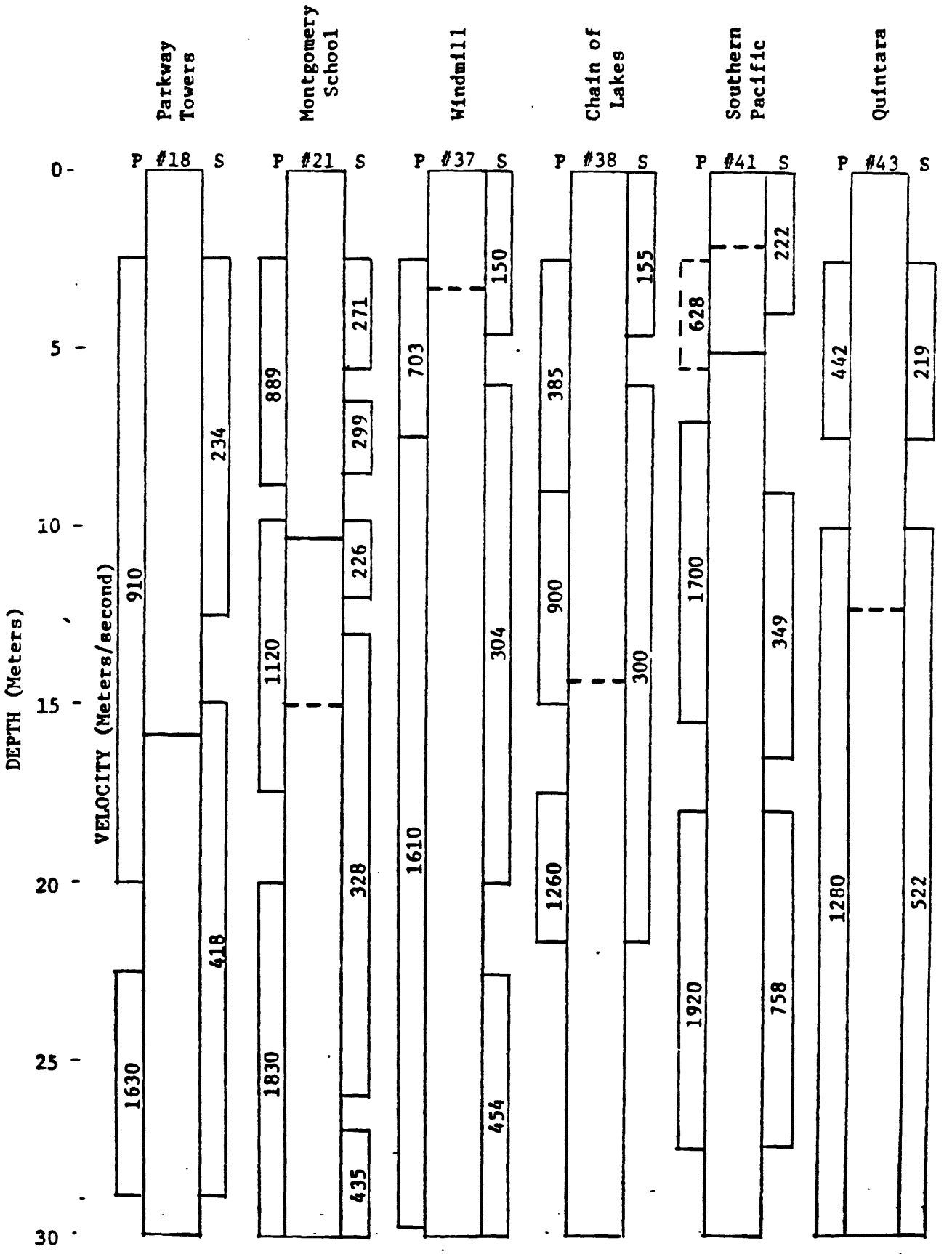


Fig. 4 Velocities (P and S) and Water Level Depths

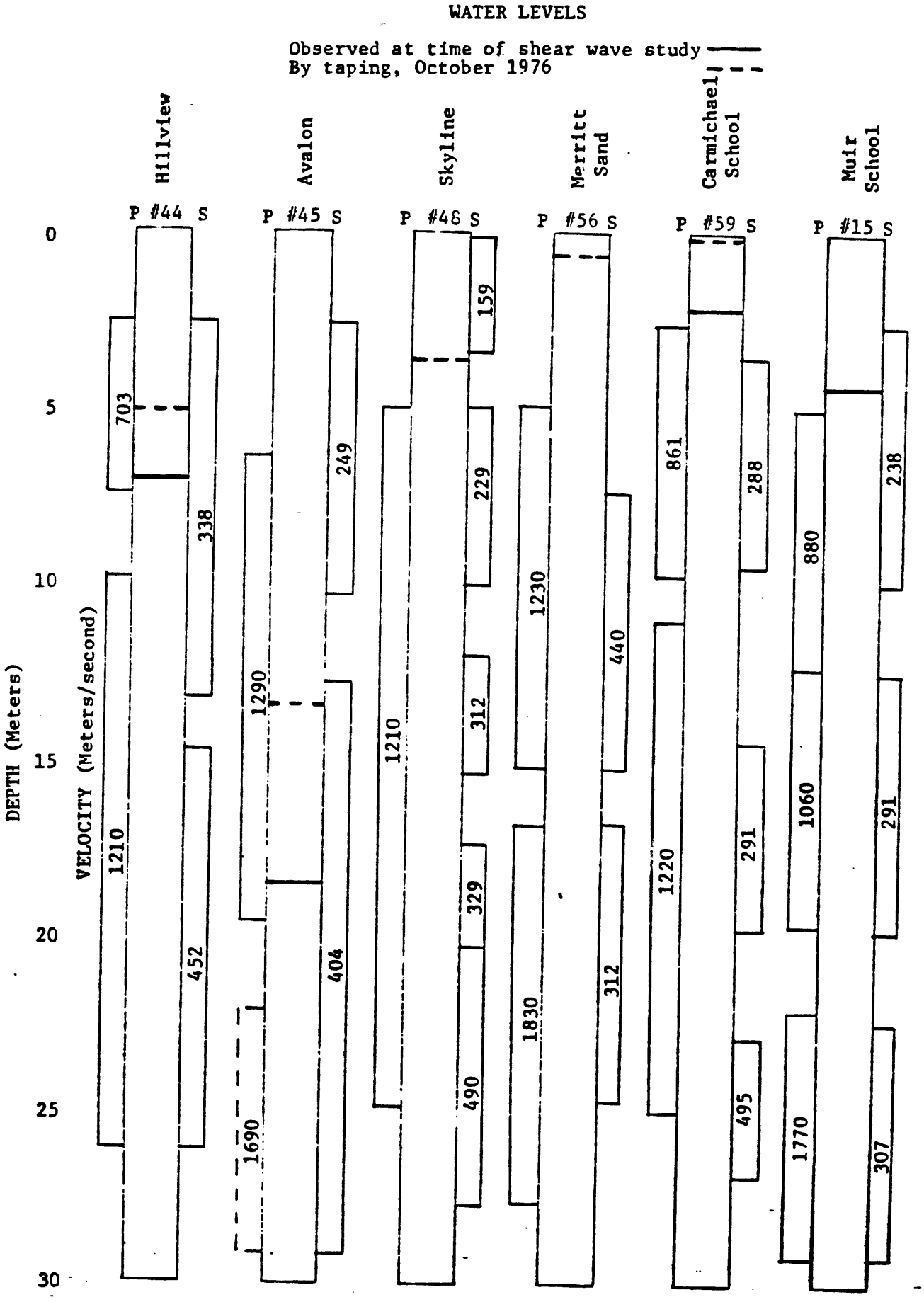


Fig. 4 --Continued

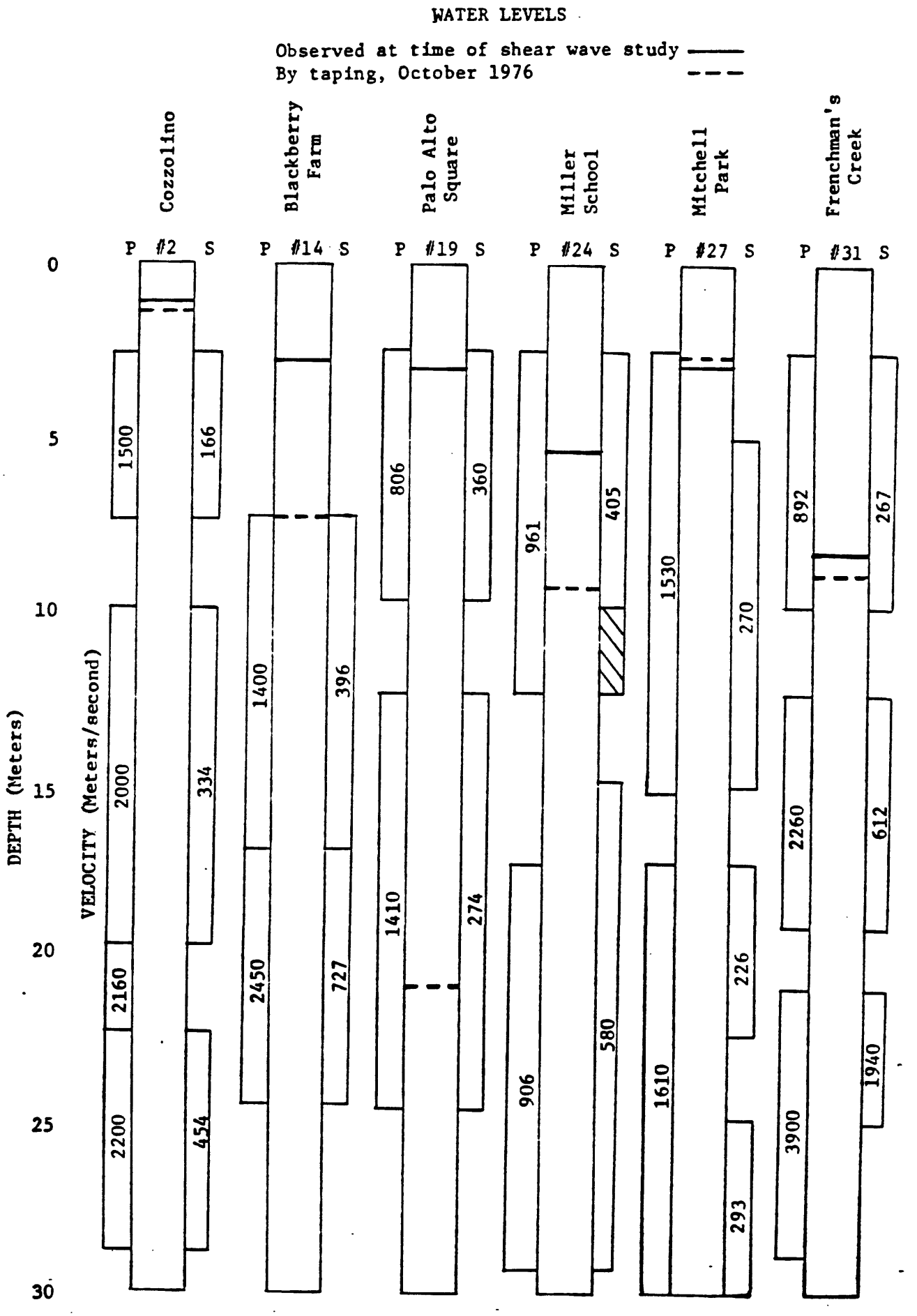


Fig. 4 —Continued

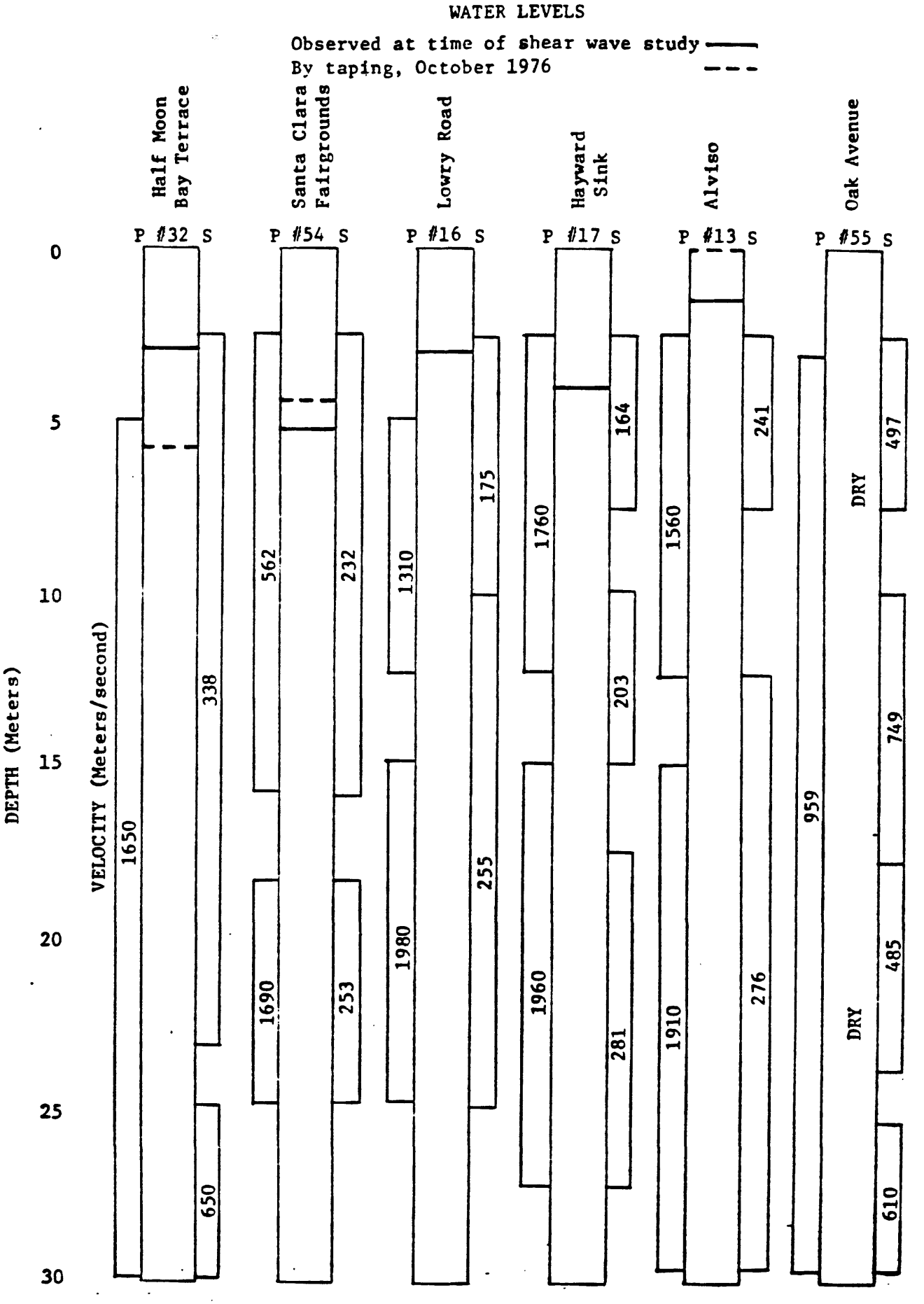


Fig. 4 —Continued

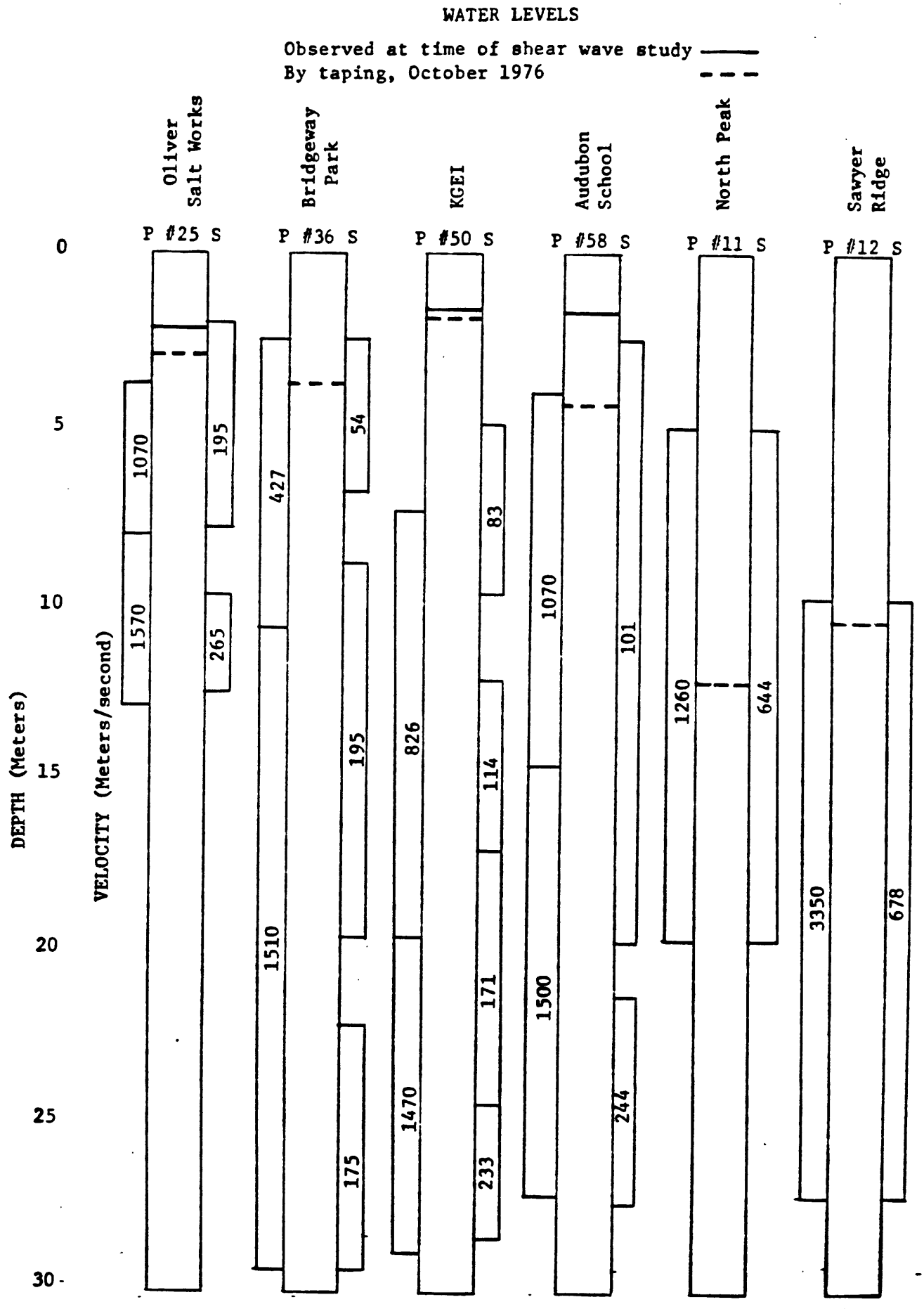


Fig. 4 —Continued

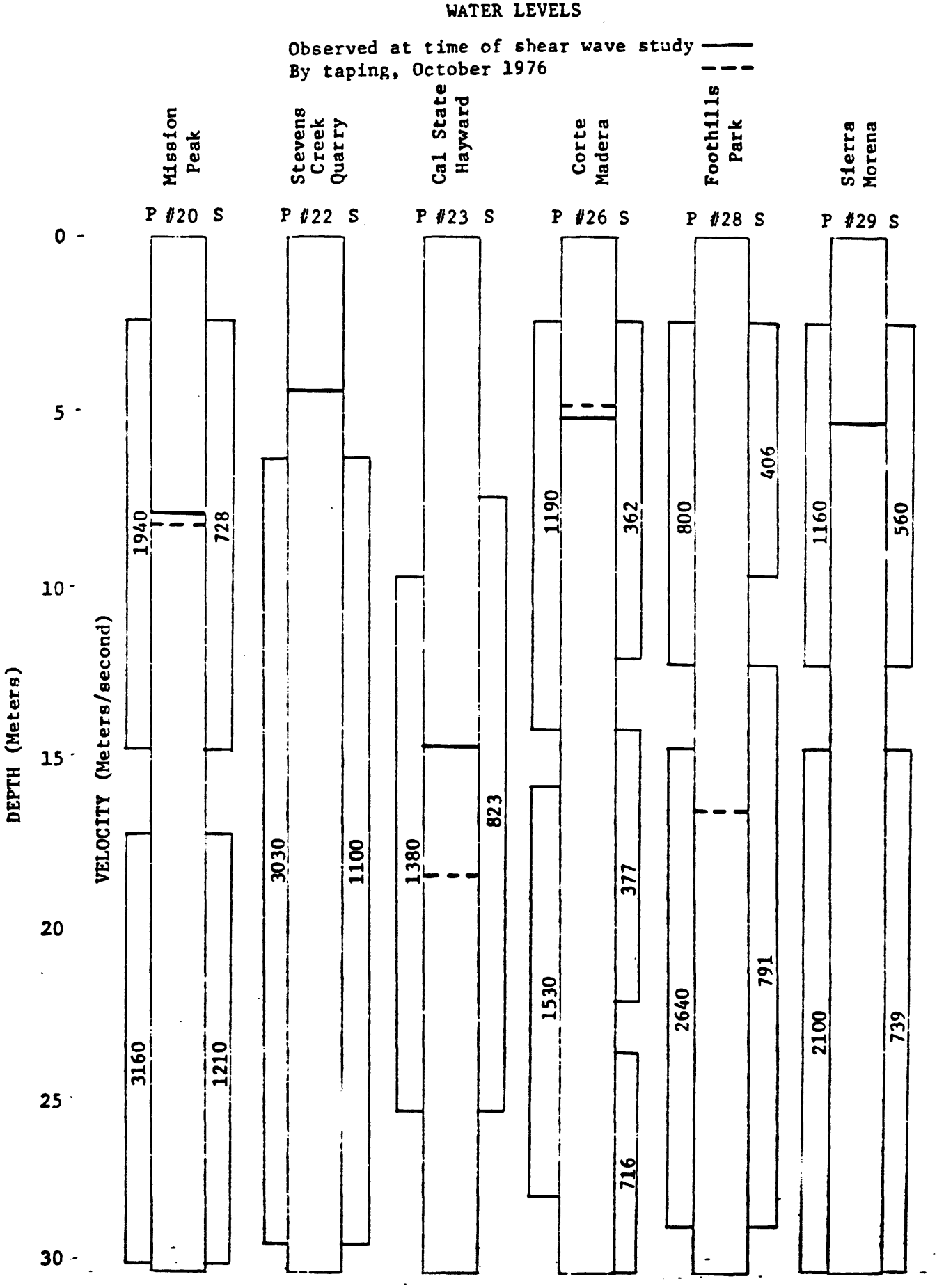


Fig. 4 —Continued

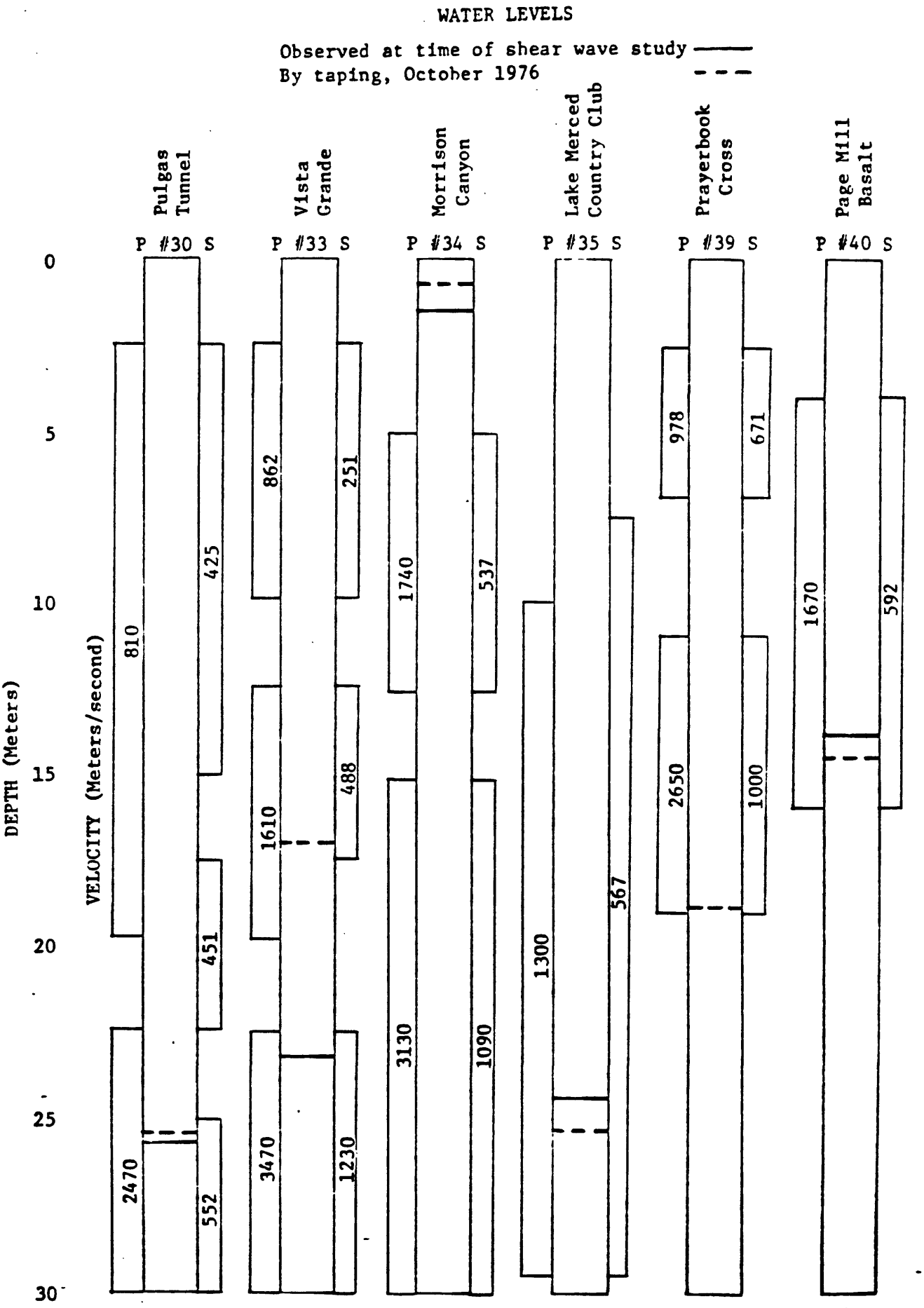


Fig. 4 --Continued

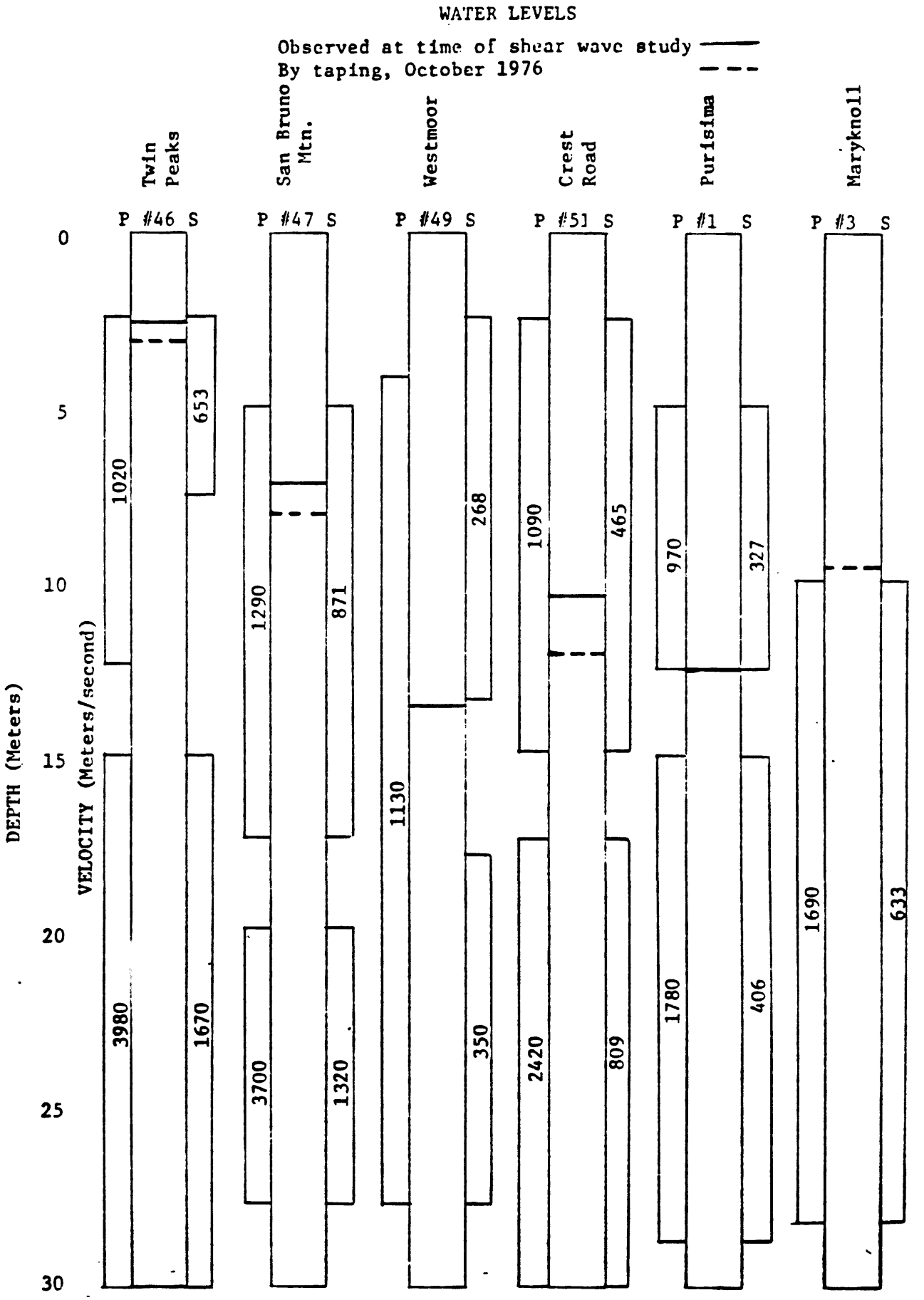


Fig. 4 --Continued

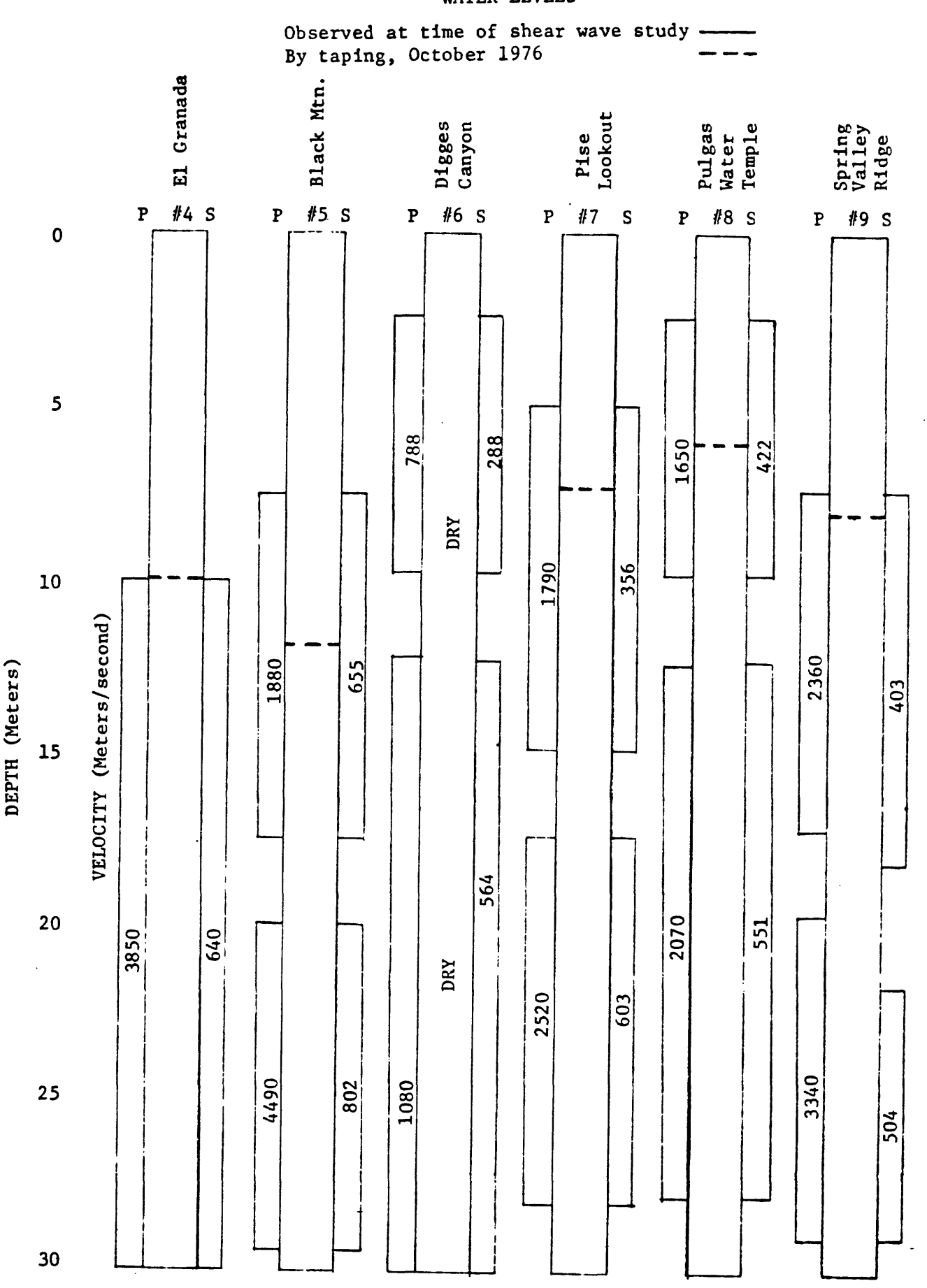


Fig. 4 -Continued

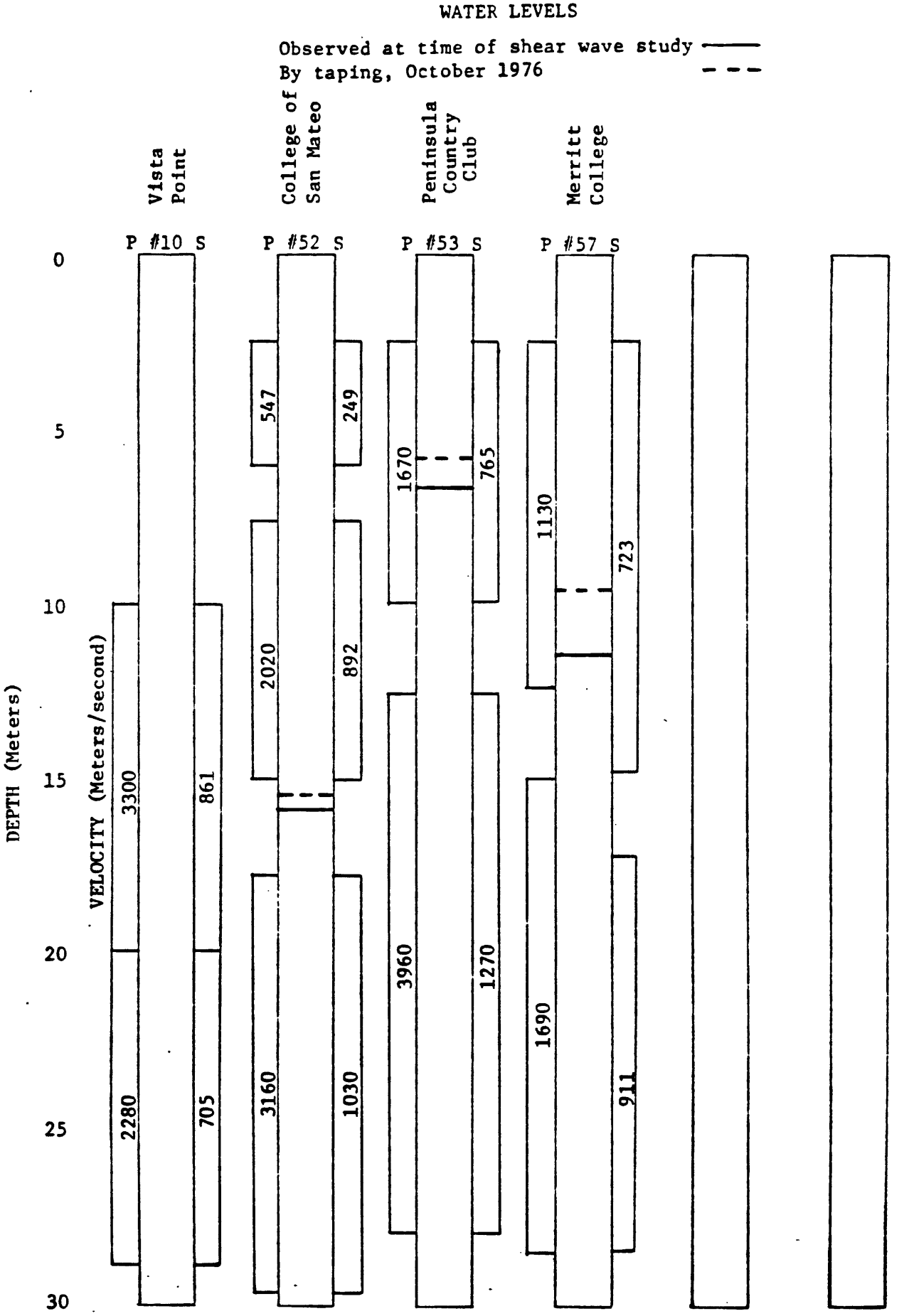


Fig. 4 --Continued

of all three bay mud sites . Based on similar seismic signatures in estuarine localities (Whelan, 1976), a likely reason for the low velocities is the presence of methane gas.

Probable plans and suggestions for future water-table measurements are: When the hole is drilled, the water-table measurement should be recorded. Water levels at all holes under study should be repeated by taping in order to evaluate the significance of two years of drought followed by a wet winter in 1978. Water levels in the bay margins should be retaped during flooding and ebbing tides to see if the change in the altitude of the bay affects the water-table.

Acknowledgments

Gratitude for their comments in reviewing this report is extended to J. P. Akers, R. D. Borcherdt, J. F. Gibbs, W. B. Joyner, and R. E. Warrick.

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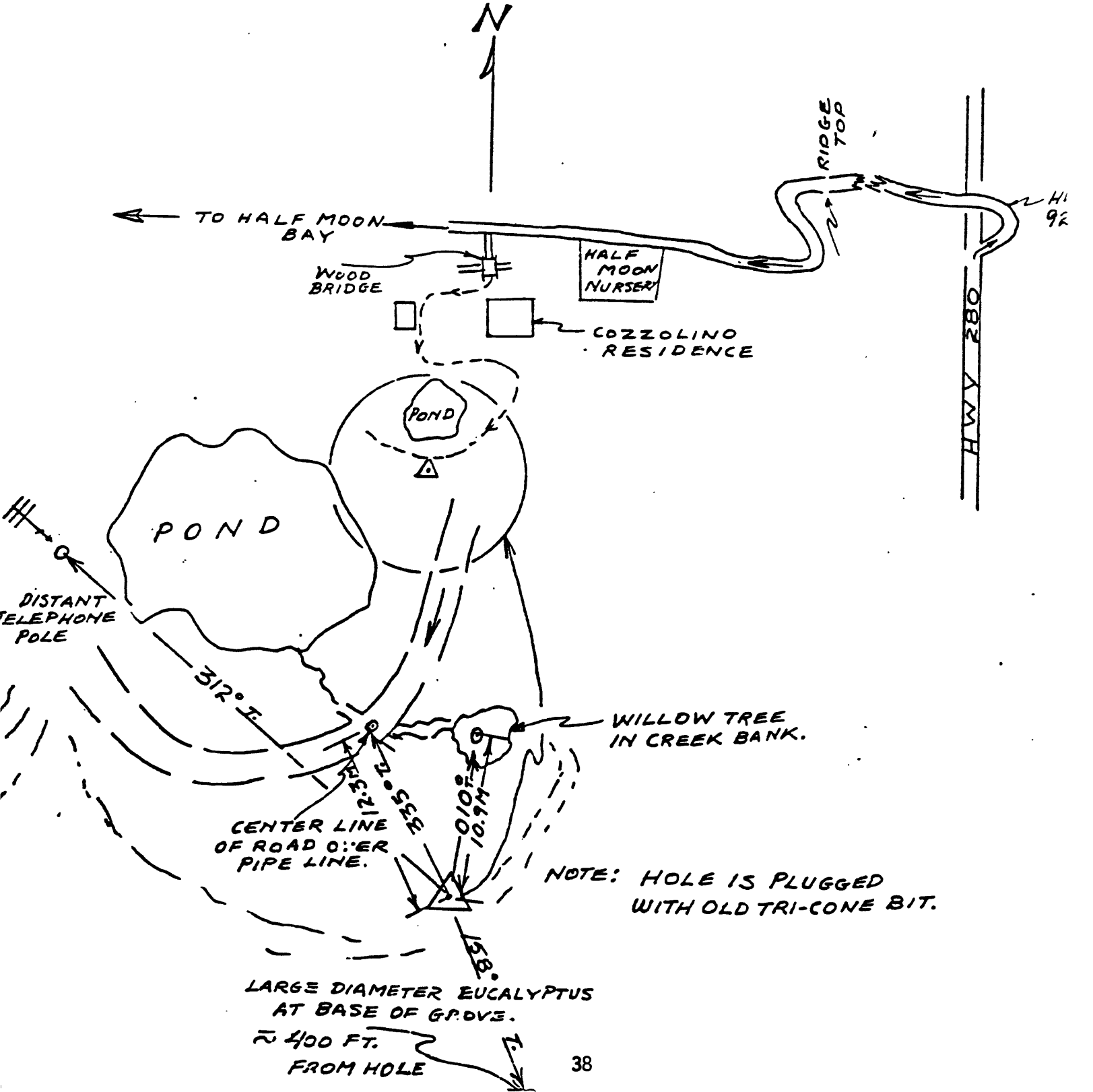
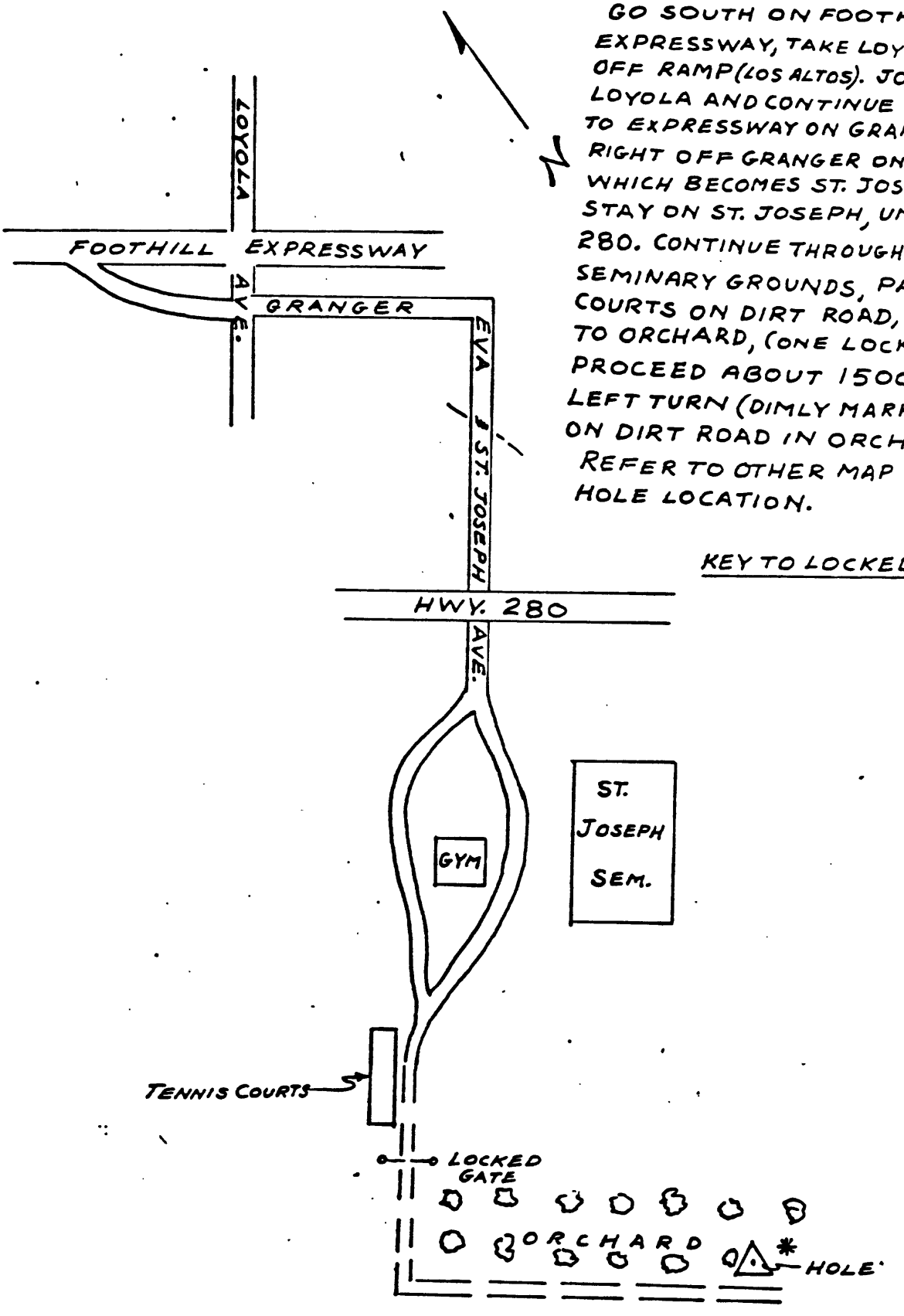
COZZOLINOS SITE NO. 2 △ HALF MOON BAY 7½

DRIVE NORTH ON HWY. 280 TO HALF MOON BAY OFF RAMP, HWY. 92. CONTINUE ON 92 OVER THE RIDGE TOP, DROPPING DOWN INTO AN AGRICULTURAL VALLEY. COZZOLINO'S DRIVEWAY IS ABOUT 0.5 MILES FROM HALF MOON BAY NURSERY. TURN LEFT IN DRIVEWAY, CROSS OVER WOODEN BRIDGE, AND TAKE FIRST RIGHT, (DIRT ROAD) CIRCLING AROUND GROWING GROUNDS. CLIMB UP HILL PAST AN IRRIGATION HOLDING POND, SITE IS IN DEPRESSION ABOVE LEVEL OF POND, AND 2 - 300 FT. BEYOND. IT IS 0.5 MILES FROM MAIN ROAD TO SITE. SEE SKETCH BELOW.



MARYKNOLL SITE NO. 3 CUPERTINO 7½'



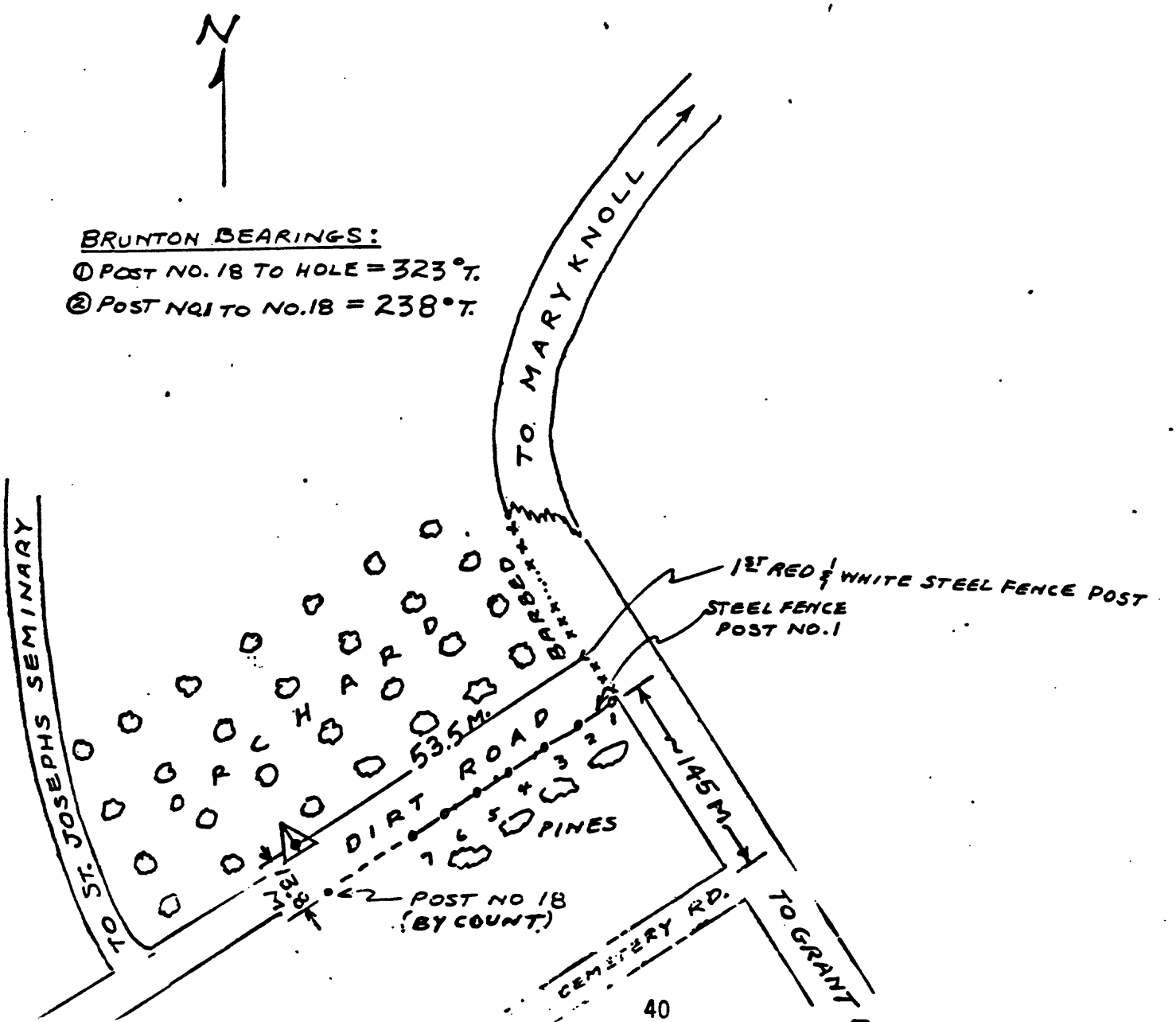
GO SOUTH ON FOOTHILL EXPRESSWAY, TAKE LOYOLA OFF RAMP (LOS ALTOS). JOG ACROSS LOYOLA AND CONTINUE PARALLEL TO EXPRESSWAY ON GRANGER. TURN RIGHT OFF GRANGER ONTO EVA, WHICH BECOMES ST. JOSEPH AVE. STAY ON ST. JOSEPH, UNDER HWY 280. CONTINUE THROUGH ST. JOSE SEMINARY GROUNDS, PAST TENNI COURTS ON DIRT ROAD, PARALLEL TO ORCHARD, (ONE LOCKED GATE, PROCEED ABOUT 1500 FT. TAK LEFT TURN (DIMLY MARKED), STIL ON DIRT ROAD IN ORCHARD. REFER TO OTHER MAP FOR EXAC HOLE LOCATION.

KEY TO LOCKED GATE:

* SEE OTHER MAP FOR DETAILS

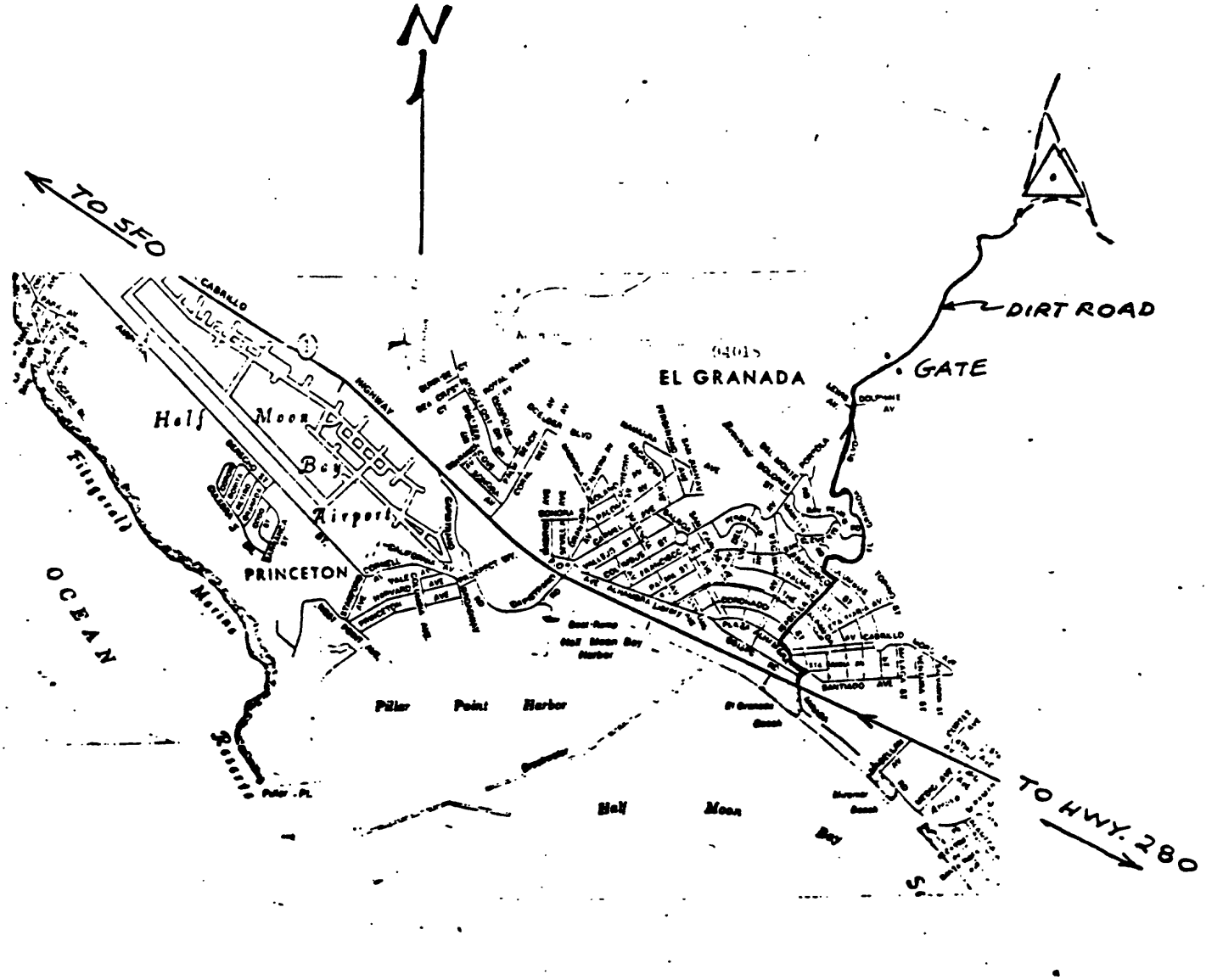
MARYKNOLL SITE NO. 3 △ CUPERTINO 7½'

PROCEED SOUTHERLY ON HWY. 280 TO GRANT RD. TURNOFF; TURN SOUTH, OR RIGHT (TOWARD MONTE VISTA); TAKE FIRST RIGHT, AND CONTINUE TO FIRST ROAD TO LEFT, (TOWARD CEMETERY). DO NOT ENTER, BUT CONTINUE ABOUT 0.09 MILES (145M) ON ORIGINAL ROAD TO FENCELINE ON THE LEFT, RUNNING SOUTHWESTERLY, (ALSO NEXT TO ROW OF PINES). HOLE IS 53.5 METERS (SEE SKETCH) FROM 1ST RED AND WHITE STEEL FENCE POST. SKETCH MAP NOT TO SCALE. DATE OF SURVEY, 30 SEPT. 1975



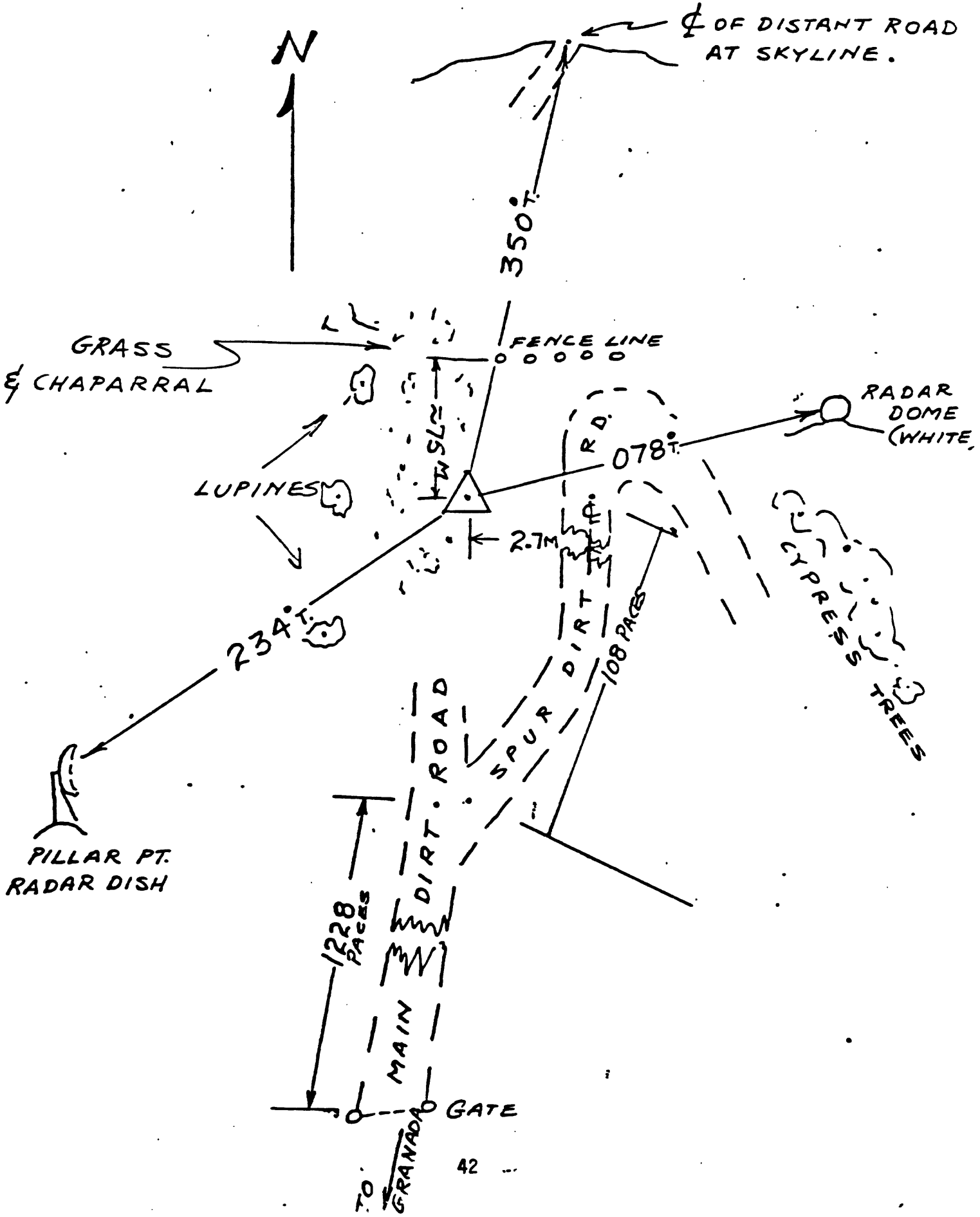
EL GRANADA SITE NO. 4 △ MONTARA MT. 7½'

DRIVE NORTH ON HWY. 280 TO HALF MOON BAY TURN OFF (HWY. 92), CONTINUE ON 92 TO COAST HWY. 1, TURN RT. ON HWY. 1 AND PROCEED NORTH TO EL GRANADA, ABOUT 3.0 MILES. TURN RT. OFF HWY. 1 ON PLAZA ALHAMBRA, THEN LEFT TO ISABELLA. DRIVE 4 BLOCKS ON ISABELLA TO COLUMBUS; TURN LEFT ON COLUMBUS AND RT. AGAIN ON CONTINUATION OF ISABELLA. TAKE A SHARP RT., AFTER LEAVING COLUMBUS ONTO EL GRANADA BLVD., AND CONTINUE, STEEPLY CLIMBING TO THE END OF EL GRANADA. THERE IS A CHAINED AND LOCKED GATE AT END OF PAVED ROAD. SEE SKETCH FOR DETAILS. KEY TO GATE WITH PAUL SMITH AT OLD DOLGER BLDG. IN PRINCETON, OPPOSITE THE SHORE BIRD RESTAURANT. TOTAL MILEAGE TO GATE FROM HWY. 1 AND PLAZA ALHAMBRA INTERSECTION IS 1.4 MILES.



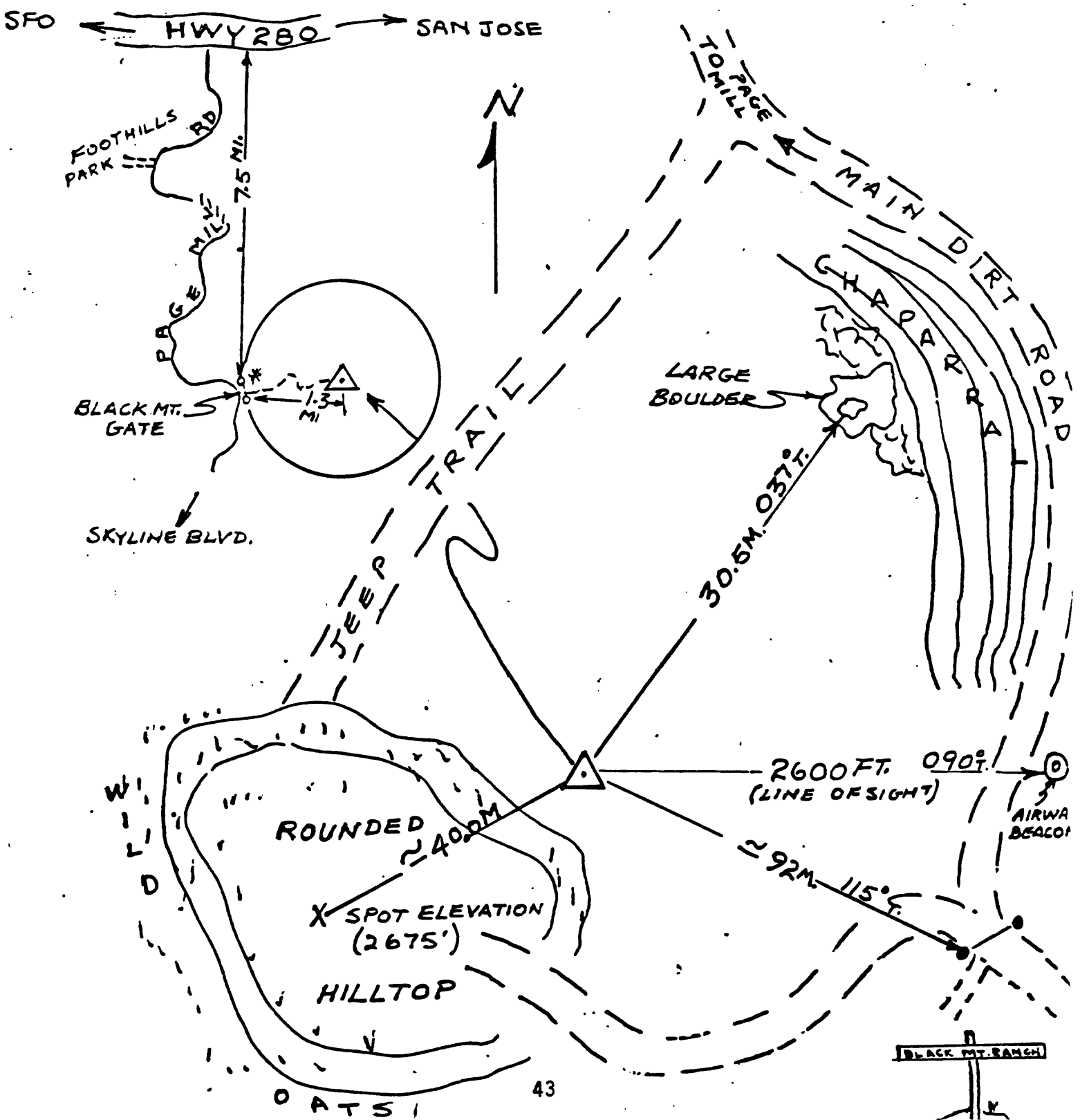
SEE NEXT PAGE FOR DETAILS

SITE NO. 4 EL GRANADA (CONT'D.) △ MONTARA MT 7½'



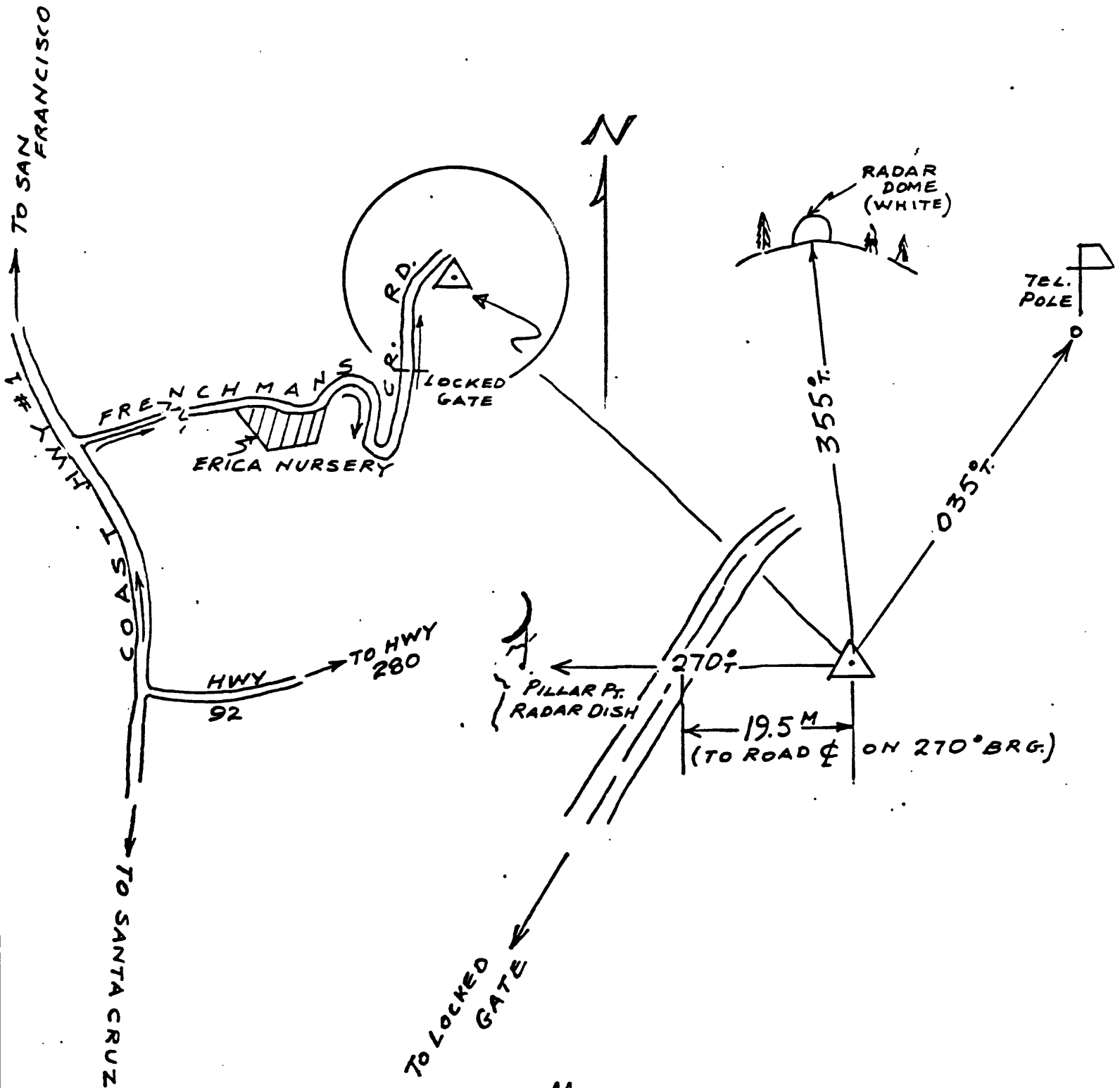
BLACK MT. SITE NO. 5 △ MINDEGO HILL 7½'

DRIVE SOUTH ON JUNIPERO SERRA EXPRESSWAY OR HWY. 280 TO PAGE MILL; TURN RT. OFF EITHER ONE ONTO PAGE MILL AND PROCEED UPHILL IN SKYLINE DIRECTION, APPROXIMATELY 7.5 MILES (FROM HWY. 280) TO BLACK MT. ENTRANCE GATE AT PAGE MILL INTERSECTION. IT IS 1.3 (±0.1) MILES TO SITE FROM THIS GATE. SEE SKETCH BELOW.



DIGGES CANYON SITE NO.6 △ HALF MOON BAY 7½'

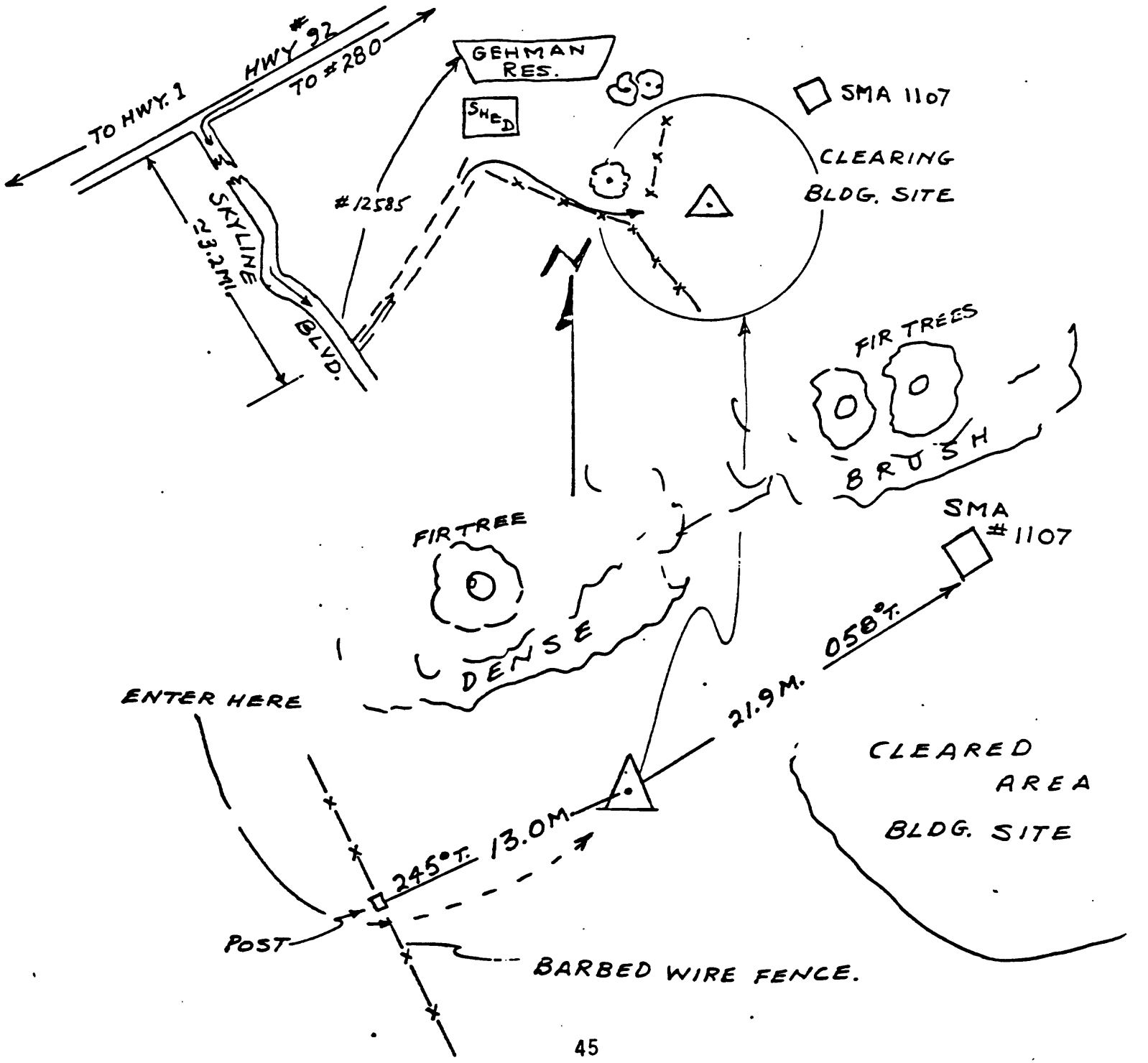
DRIVE NORTH ON HWY. 280 TO HWY. 92. CONTINUE ON 92 TO COAST HIGHWAY 1, TAKE A RIGHT ON 1, DRIVE NORTH TO FRENCHMANS CREEK ROAD, (1.1 MILE). TURN RIGHT AND DRIVE ABOUT 0.9 MILE TO ROAD FORK, KEEP TO THE RIGHT, CONTINUING BEYOND ERICA NURSERY ABOUT 0.8 MILE TO LOCKED GATE, (F.A.A. MAINTAINED). WALK IN TO SITE, ABOUT 0.2 MILE, ON RIGHT SIDE OF ROAD BEYOND TREES, (FIRS) ON THE LEFT. ENTRANCE TO HOLE APPEAR AS A SLIGHT ROAD CUT OFF THE MAIN ROAD. SEE SKETCH BELOW.



PISE LOOKOUT* SITE NO. 7 △ WOODSIDE 7½'
(PISE HILL 2 ON MAP)

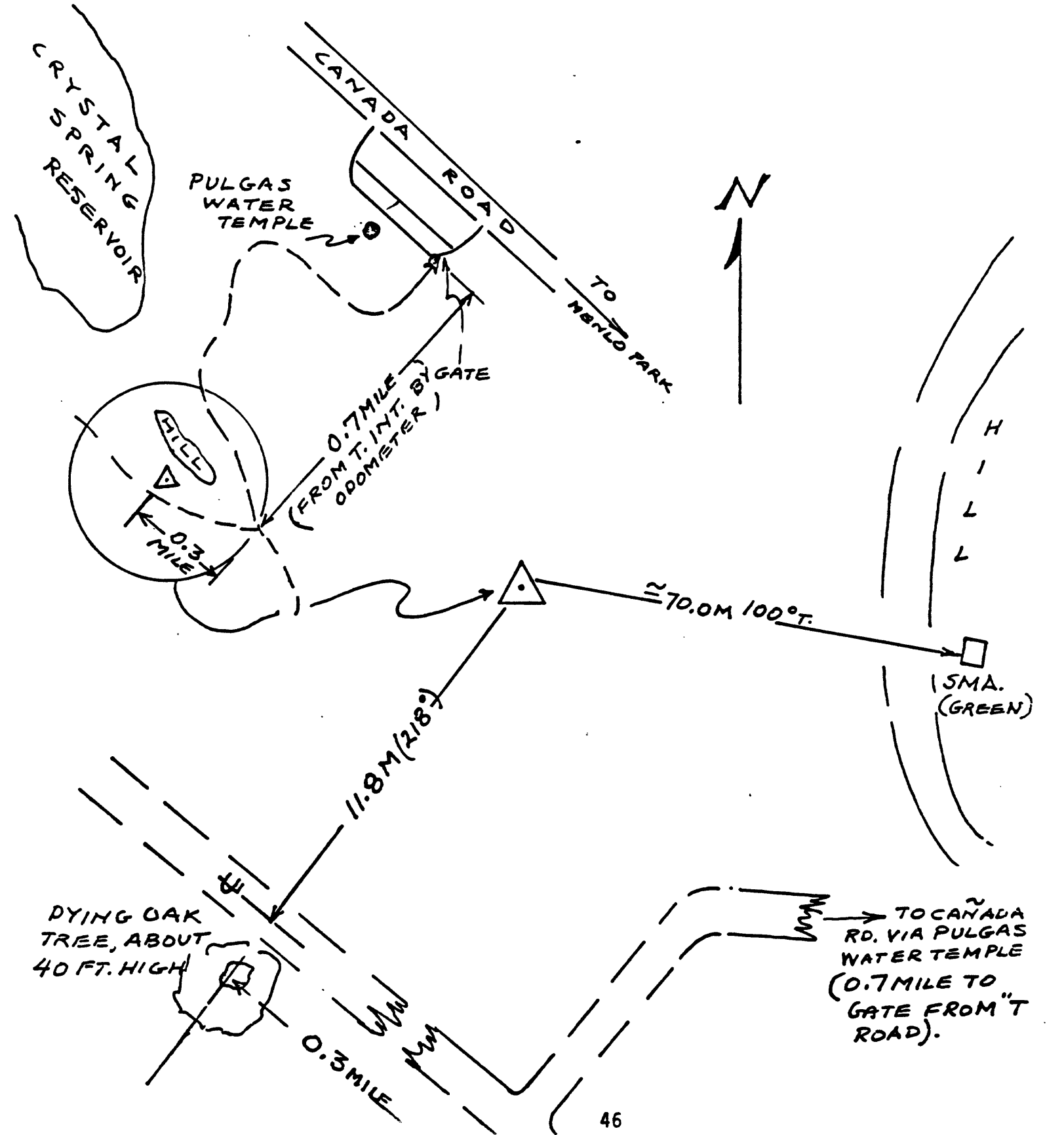
DRIVE NORTH ON HWY. 280 TO HWY. 92, PROCEED TOWARD HALF MOON BAY ON 92 TO CREST OF RIDGE, (SKYLINE BLVD.) TURN LEFT ON SKYLINE AND DRIVE SOUTH ABOUT 3.2 MILES TO DIRT DRIVEWAY ON LEFT, (GATE ABOUT 20 FT. OFF ROAD). USUALLY UNLOCKED. THIS DRIVEWAY IS NORT 0.1 MILE FROM A CHRISTMAS TREE FARM ON OPPOSITE SIDE OF ROAD. SITE IS BEYOND A GROUP OF 3 LARGE FIR TREES, ON THE HILLTOP. SEE SKETCH BELOW.

* NOT TO BE CONFUSED WITH PISE LOOKOUT (BY MAP NAME), WHICH IS ON OPPOSITE SIDE OF SKYLINE BLVD.



PULGAS WATER TEMPLE SITE NO. 8 △ WOODSIDE 7½'

DRIVE ON WOODSIDE ROAD UNDER HWY. 280 TO INTERSECTION OF WOODSIDE ROAD AND CAÑADA ROAD. DRIVE NORTH ON CAÑADA ABOUT 5.0 MILES TO PULGAS WATER TEMPLE. TURN LEFT INTO PARKING AREA KEEPING TO THE LEFT, AND THROUGH GATE. (IF LOCKED, GARDENER IN GENERAL AREA HAS KEY). SEE SKETCH BELOW.

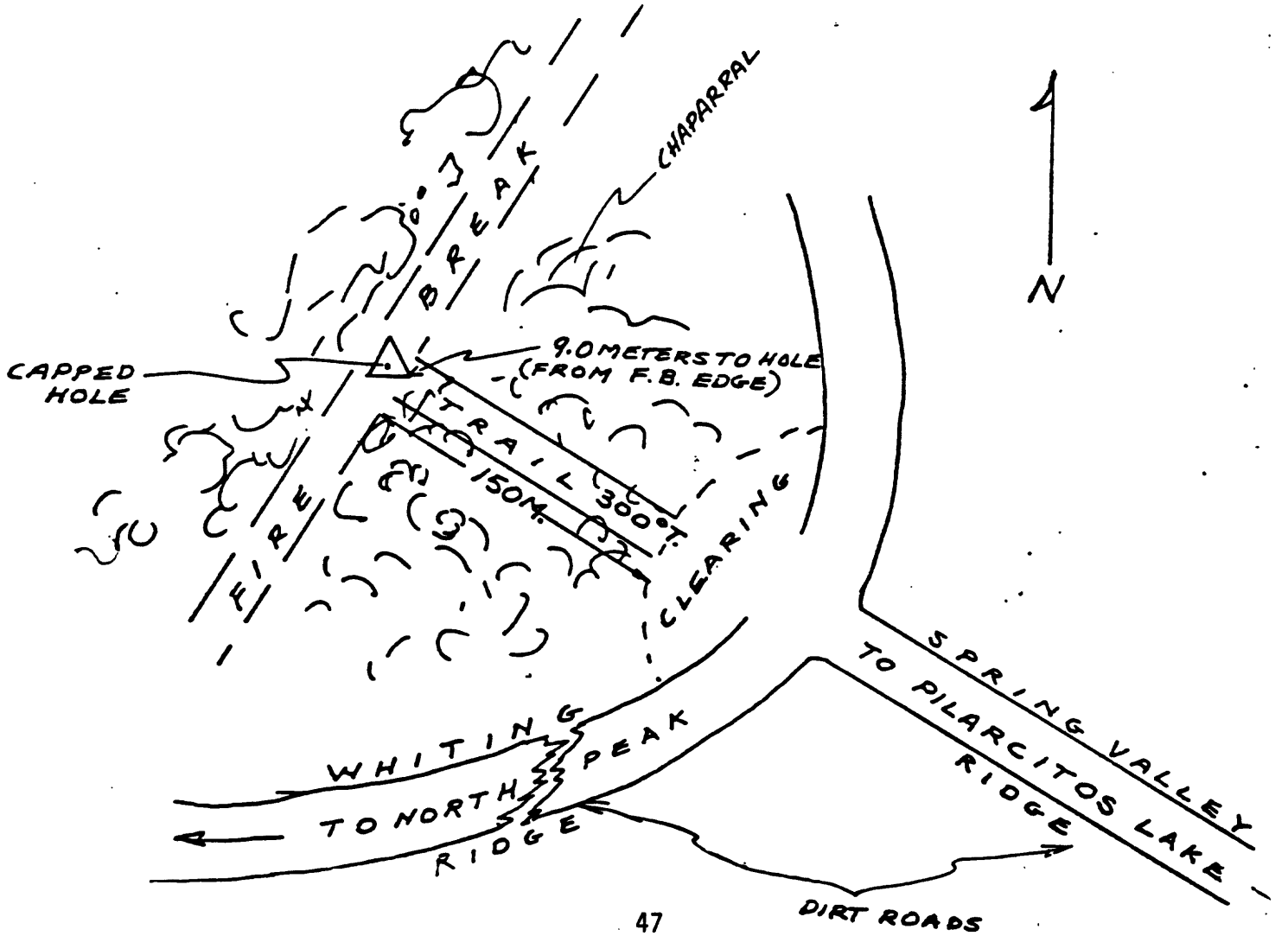


SPRING VALLEY RIDGE △ SITE NO. 9* MONTARA MT. 7½'

* SEE NO. 11 FOR KEY INFO.

SAME ACCESS ROUTE AS TO SITE NO. 11 (NORTH PEAK) WITH THE FOLLOWING EXCEPTIONS: (1) SITE NO. 9 IS LOCATED AT END OF A DIRT ROAD ALONG SAWYER RIDGE AT INTERSECTION TO THE RIGHT. AT THIS INTERSECTION ALONG A BEARING OF 300° T, A DIMLY MARKED (2 TRACK TRAIL) IS FOUND. PROCEED ALONG THIS TRAIL ABOUT 150 M. TO THE EDGE OF A PLOWED FIREBREAK. FROM THE ℄ OF THE TRAIL AND 2° to 5° TO THE LEFT OF A ℄ BEARING, AND 9.0 METERS AT THE APPROXIMATE CENTER OF THE FIREBREAK THE HOLE IS LOCATED. THE TOP OF STEEL PLATE COVERING THE CAPPED HOLE IS 5" BELOW ROUGH GROUND SURFACE. THIS WILL VARY SEASONALLY AS FIREBREAK IS PLOWED.

HOLE IS IN SECT. 19, T4.S R5W.



BRUNTON BEARINGS: 300° to △, FROM ℄ TRAIL, AT CLEARING.

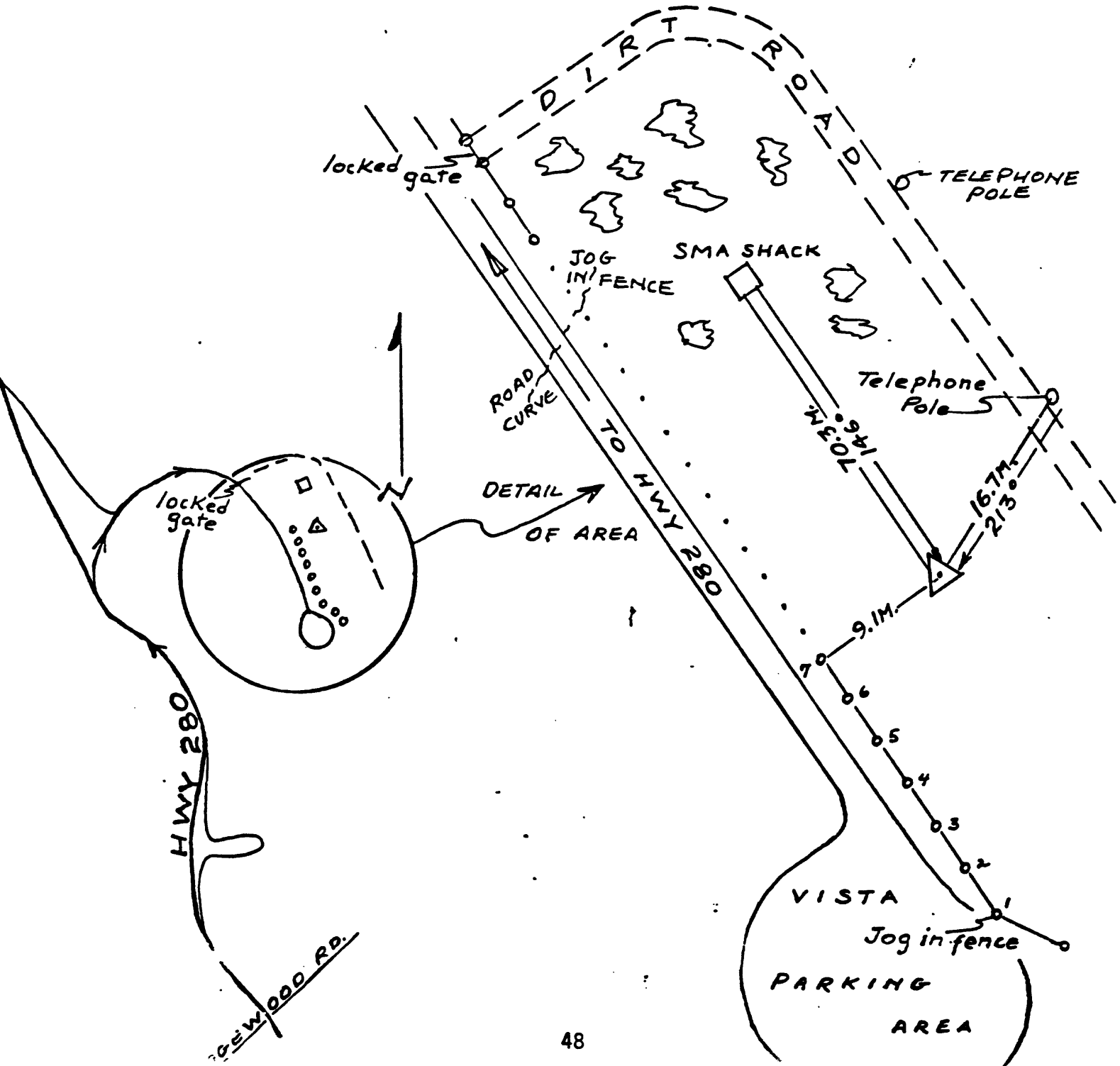
VISTA POINT SITE NO. 10 △ WOODSIDE 7½'

DRIVE NORTH ON HWY. 280 ≈ 1.7 MILES BEYOND EDGEWOOD RD. TAKE THE VISTA (2ND ONE NORTH OF EDGEWOOD) OFF RAMP AND GO 0.35 MILES TO S.F.W.D. LOCKED GATE* (LEFT SIDE). DRIVE THROUGH, TO, AND BEYOND SMA SHACK. SEE SKETCH BELOW.

* ENTRY TO LOCKED GATE :

DATE OF SURVEY OCT. 8, 1975

E.F. ROTH

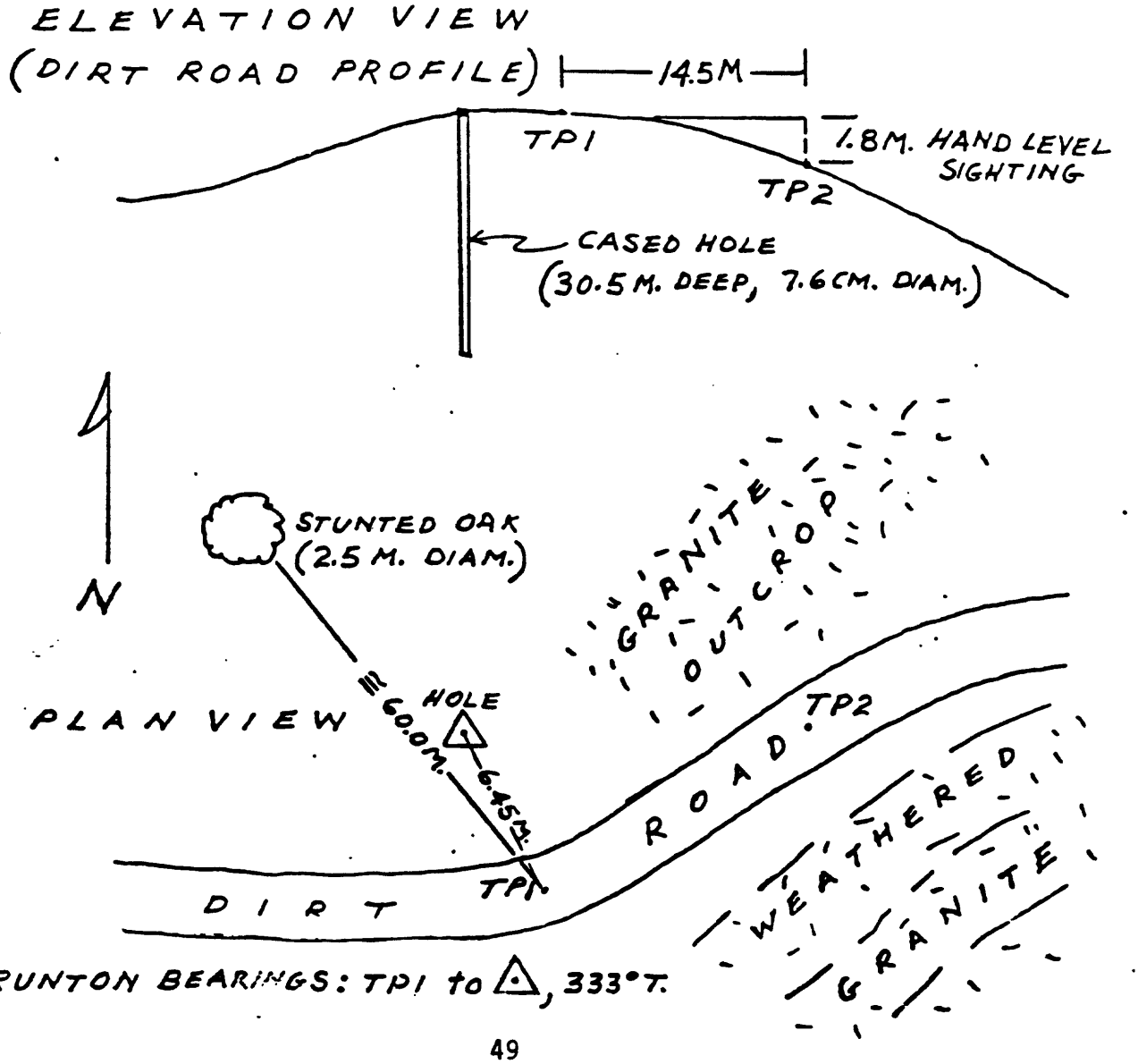


NORTH PEAK SITE NO. 11 △ MONTARA MT.* 7½'

* HOLE IS IN SECT. 25 T4S, R6W

ACCESS ROUTE: KEY OPENS GATE AT SAN ANDREAS LAKE DAM. PROCEED TO PILARCITOS LAKE TURNOFF; AT THIS JUNCTION TAKE FORK TO RIGHT. DROPPING IN ELEVATION TO VIEW OF N.E. FINGER OF PILARCITOS LAKE. PROCEED TO N.W., (AFTER TWO FAIRLY SHARP 180° BENDS IN ROAD) ALONG SPRING VALLEY RIDGE. KEEP TO LEFT AND CONTINUE ALONG WHITING RIDGE INTO SECT. 25, (SEE MONTARA 7½'), DIRECTLY BELOW THE NO. 25 OF SECT. 25, 200 METERS IS THE HOLE AS DEPICTED IN SKETCH BELOW.

THE CASED HOLE IS CAPPED AND COVERED WITH A 25 x 25 CM. STEEL PLATE. DATE OF SURVEY: 1 OCT. 1975, E.F. ROTH.



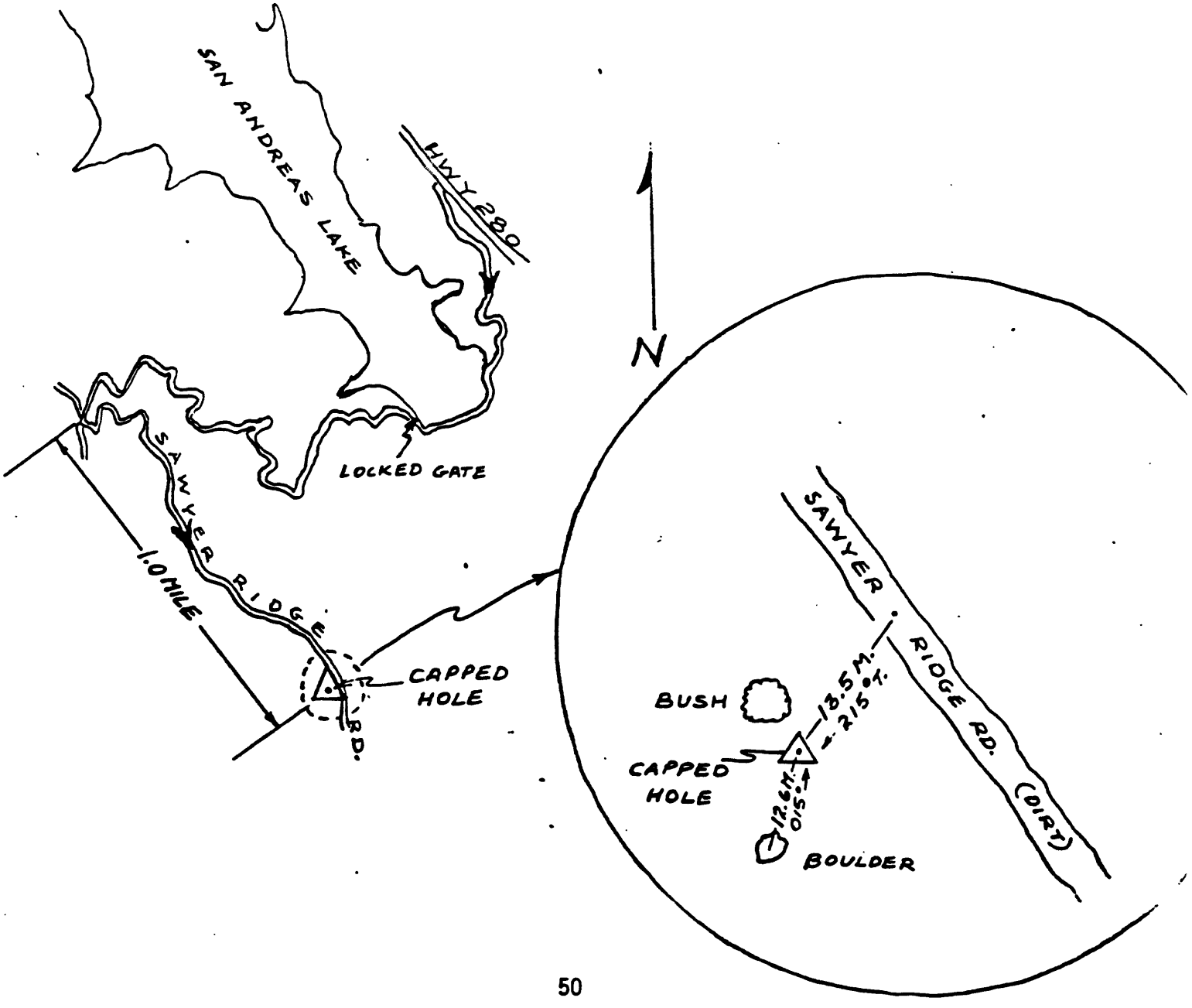
BRUNTON BEARINGS: TP1 to △, 333° T.

SAWYER RIDGE SITE NO. 12 △ MONTARA MT. 7½'

THE HOLE IS LOCATED ONE (1.0) MILE FROM TURNOFF FROM SAN ANDREAS ROAD. FROM ℄ OF SAWYER RIDGE RD. AT 1.0 MILE MARK IT IS 13.5 METERS TO HOLE ON A 215°T BEARING. A TWO BY TWO FOOT WHITE SANDSTONE BOULDER LIES 12.5 METERS FROM HOLE WITH A 015° T. BEARING BACK TO HOLE. A SMALL, 5 FT. DIAMETER BUSH IS LOCATED 4.0 METERS NORTHWEST OF HOLE.

SURVEY DATE: OCT. 3, 1975

E.F. ROTH

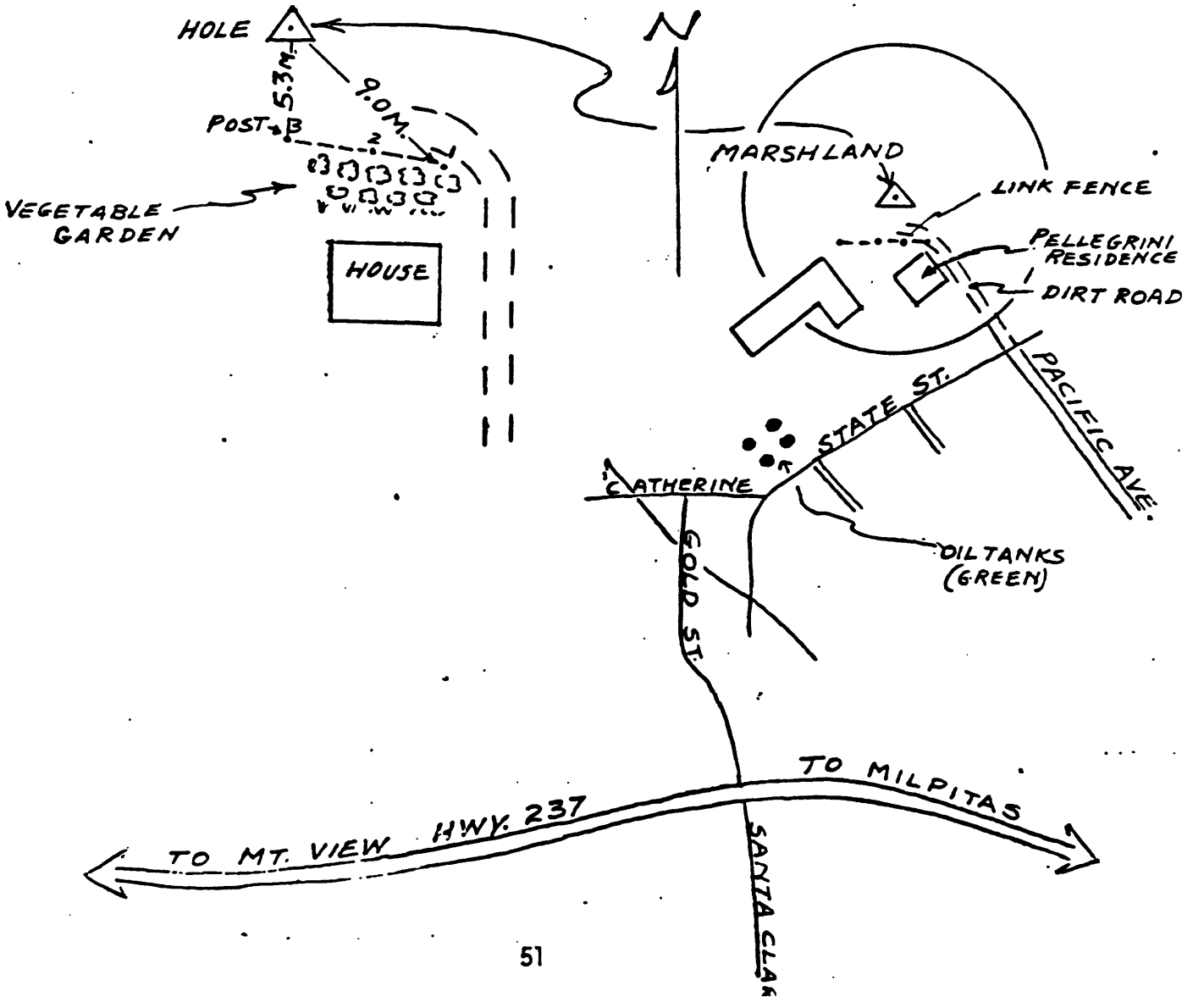


ALVISO SITE NO. 13 △ MILPITAS 7½'

DRIVE SOUTH ON BAYSHORE, (HWY. 101) TO HWY. 237, (FIRST OVERHEAD SOUTH OF MOFFETT FIELD). TAKE HWY. 237 TOWARD MILPITAS ABOUT 3 MILES TO SANTA CLARA AVE. TURN LEFT ON SANTA CLARA, AFTER CROSSING SLOUGH ROAD NAME CHANGES TO GOLD STREET; CONTINUE TO CATHERINE ST. AND TURN RIGHT TO JUNCTION OF STATE ST., PROCEED NORTHEASTERLY ON STATE ST. ABOUT ½ MILE, OR 3 BLOCKS. AT THIRD BLOCK, (PACIFIC AVE.) TURN LEFT ON DIRT ROAD SEE SKETCH BELOW FOR DETAILS.

CONTACT: GENE PELLEGRINI

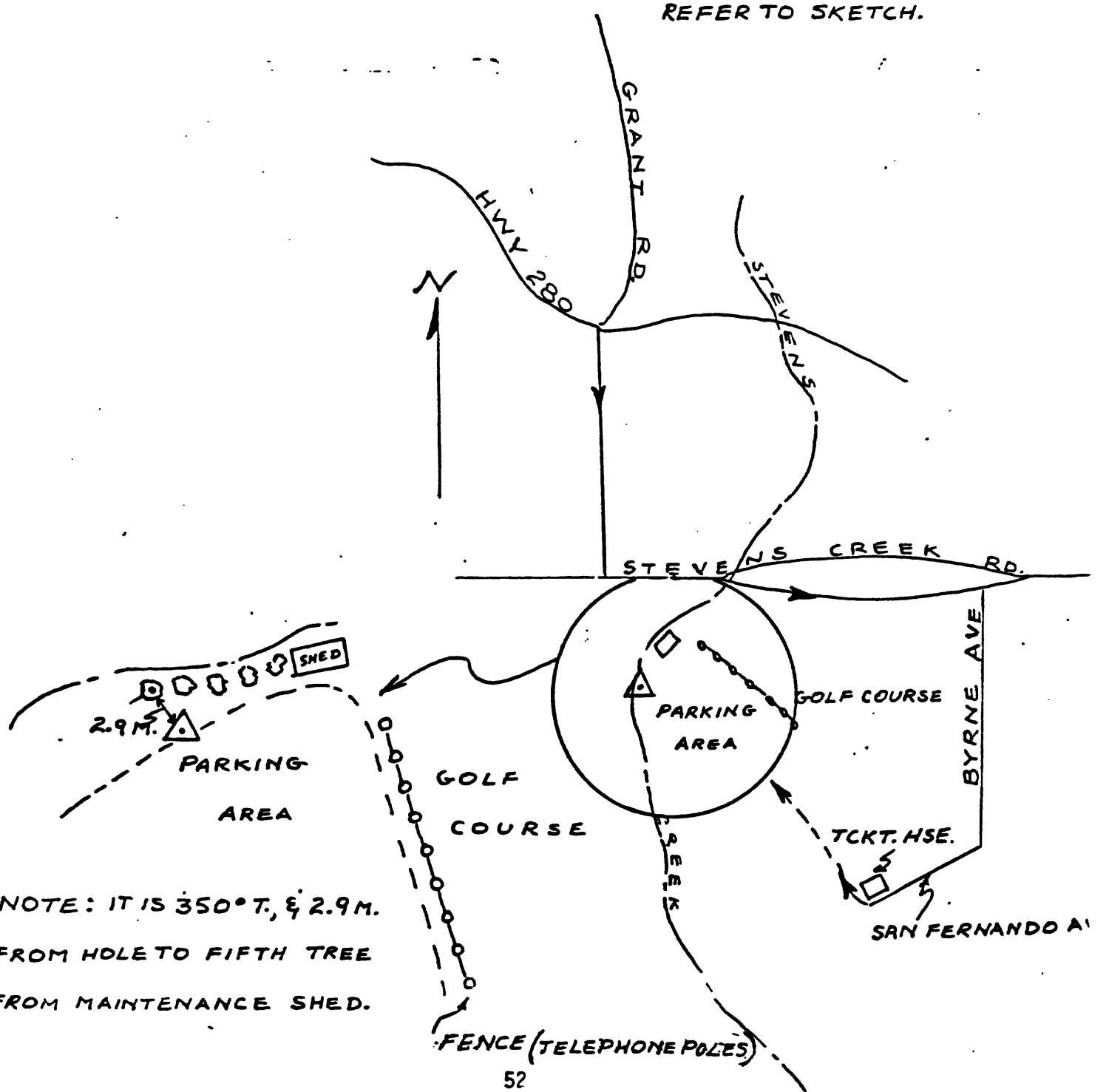
PHONE: (408) 263-6880



BLACK BERRY FARM SITE NO. 14 △ CUPERTINO 7½'

GO SOUTH ON HWY 280 TO GRANT RD. TURNOFF, TAKE SOUTH SEGMENT OF GRANT RD. TO STEVENS CREEK RD., TURN LEFT AND GO ABOUT ¾ MILE. AT THE BOTTOM OF OF A STEEP GRADE, TAKE AN OBLIQUE RIGHT AND PROCEED PARALLEL TO STEVENS CREEK RD. TO BYRNE AVE. TURN RT. AND GO ¾ MILE TO SAN FERNANDO AVE., TURN RT. INTO BLACK BERRY FARM MAIN ENTRANCE; TAKE SHARP RT. AT TICKET HOUSE AND DROP DOWN INTO PARKING LOT, PAST POOLS AND PICNIC AREA.

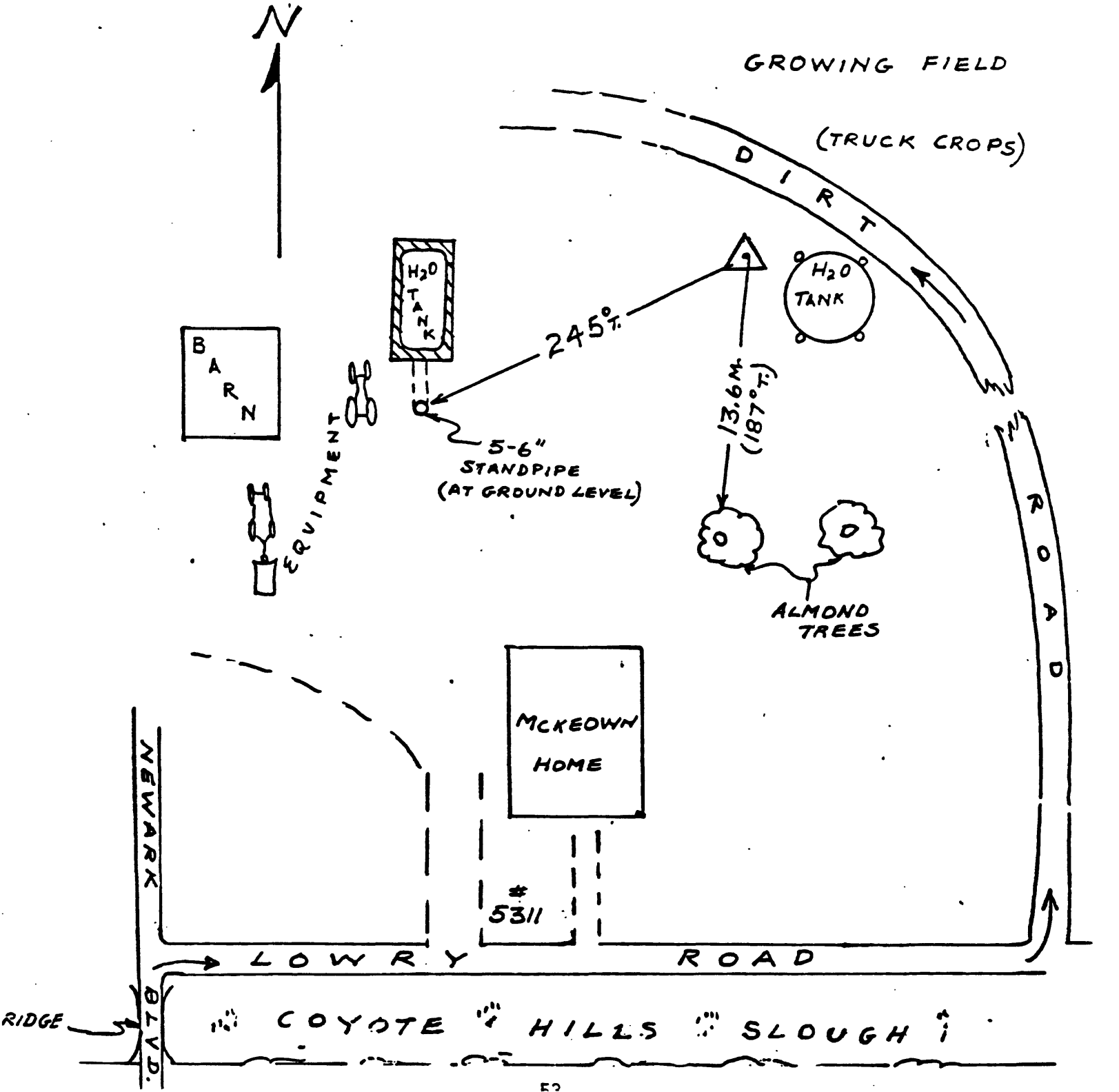
REFER TO SKETCH.



NOTE: IT IS 350° T. & 2.9M. FROM HOLE TO FIFTH TREE FROM MAINTENANCE SHED.

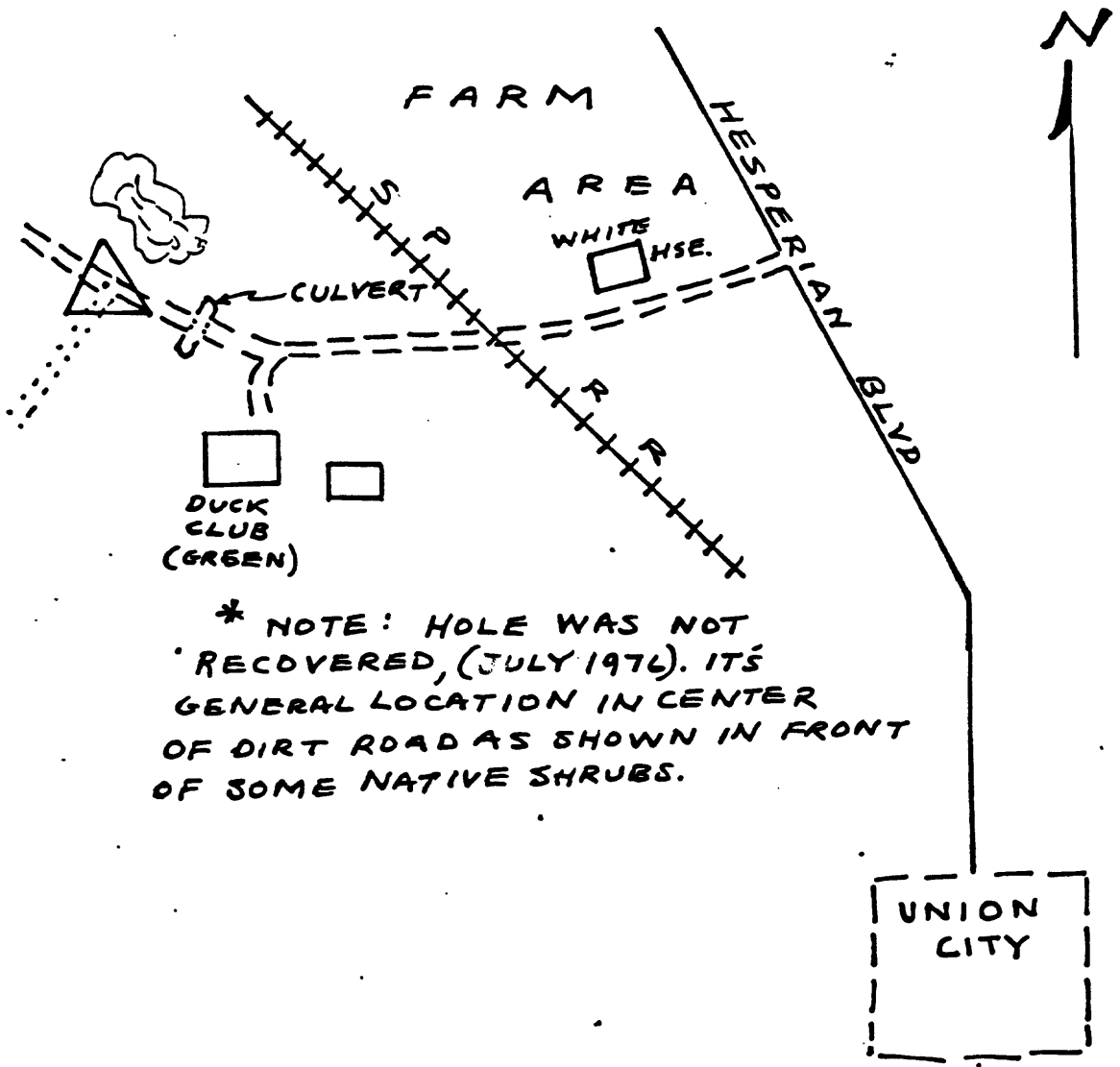
LOWRY RD. SITE NO. 16 △ NEWARK 7½'

DRIVE EAST FROM MENLO PARK ON WILLOW ROAD, (BECOMES DUMBARTON BRIDGE); CROSSING BRIDGE THROUGH TOLL PLAZA ON DUMBARTON RD. TO JARVIS RD., TURN LEFT ON JARVIS AND CONTINUE EASTWARD ABOUT 2.5 MILES TO NEWARK BLVD. TURN LEFT ON NEWARK BLVD. AND PROCEED NORTH ABOUT 3.0 MILES, (CROSSING COYOTE HILLS SLOUGH) TO LOWRY RD; (LOWRY PARALLELS SLOUGH). TURN RT. ON LOWRY RD. AND GO ABOUT 0.45 MILES TO #5311, (LONE 2 STORY RANCH HOUSE) BARNS IN REAR. SEE SKETCH FOR DETAILS.



HAYWARD SINK* SITE NO. 17 NEWARK 7½'

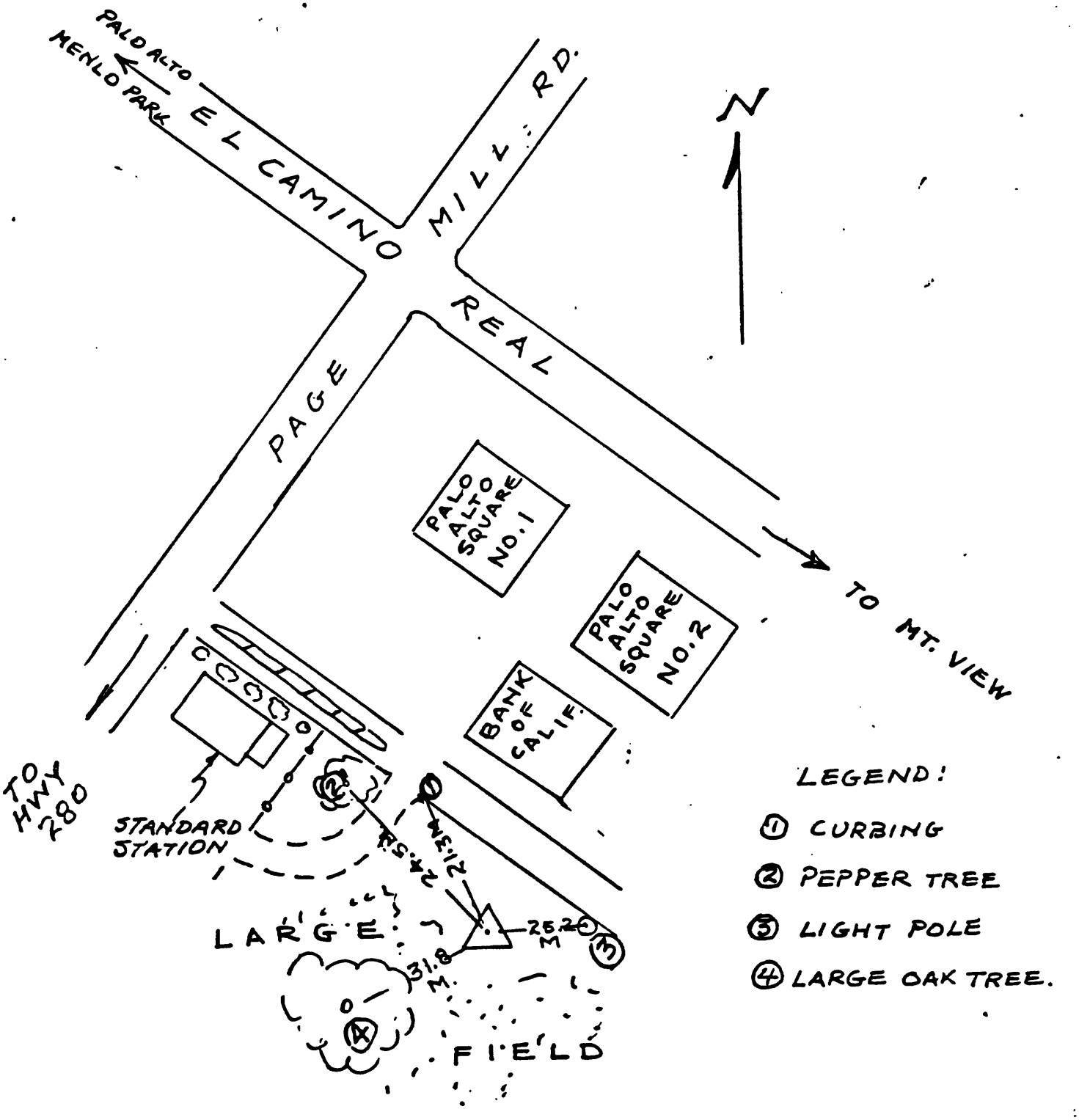
THE MOST DIRECT ROUTE TO SITE IS EAST, ACROSS THE DUMBARTON BRIDGE TO NEWARK BLVD. VIA JARVIS ROAD. TURN LEFT ON NEWARK AT INTERSECTION WITH JARVIS, AND DRIVE NORTH ABOUT 5.0 MILES (THROUGH UNION CITY) ON HESPERIAN BLVD. THE ACCESS ROAD TO SITE IS 1.2 MILES NORTH OF MAIN INTERSECTION IN UNION CITY. TURN LEFT ON DIRT ROAD, OPPOSITE A DRIVE IN THEATRE. PROCEED PAST A WHITE FARM HOUSE AND DRIVE OVER THE S.P.R.R. TRACKS TO GREEN HOUSE AND SHACK, (DUCK CLUB). SEE SKETCH FOR DETAILS.



* NOTE: HOLE WAS NOT RECOVERED, (JULY 1976). ITS GENERAL LOCATION IN CENTER OF DIRT ROAD AS SHOWN IN FRONT OF SOME NATIVE SHRUBS.

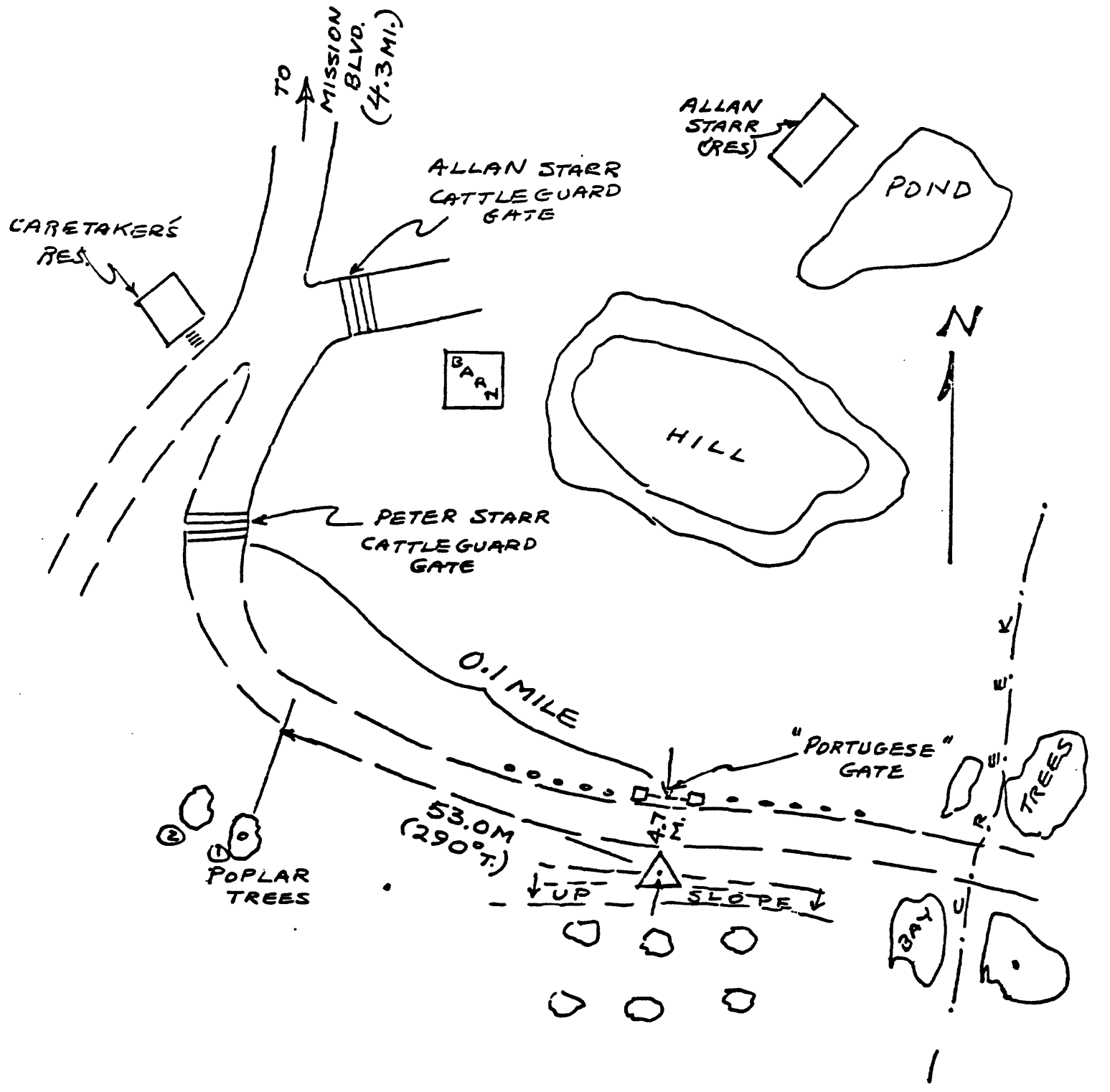
PALO ALTO SQUARE SITE NO. 19 PALO ALTO 7½'

DRIVE SOUTH ON HWY. 101, (BAYSHORE) OR EL CAMINO TO PAGE MILL RD. IN SOUTH PALO ALTO. TURN RT. ON PAGE MILL FROM EL CAMINO DRIVE ABOUT 0.1 MILE TOWARD THE HILLS AN HWY. 280. TO A LEFT TURN HOLDING LANE. TURN LEFT INTO PALO ALTO SQUARE, PARALLELING A STANDARD OIL CO. GAS STATION. DRIVE ABOUT 3—400 FT TO BREAK IN CURBING, (DRIVEWA TURN RT. IN DRIVE AND PARK IN LARGE FIELD.



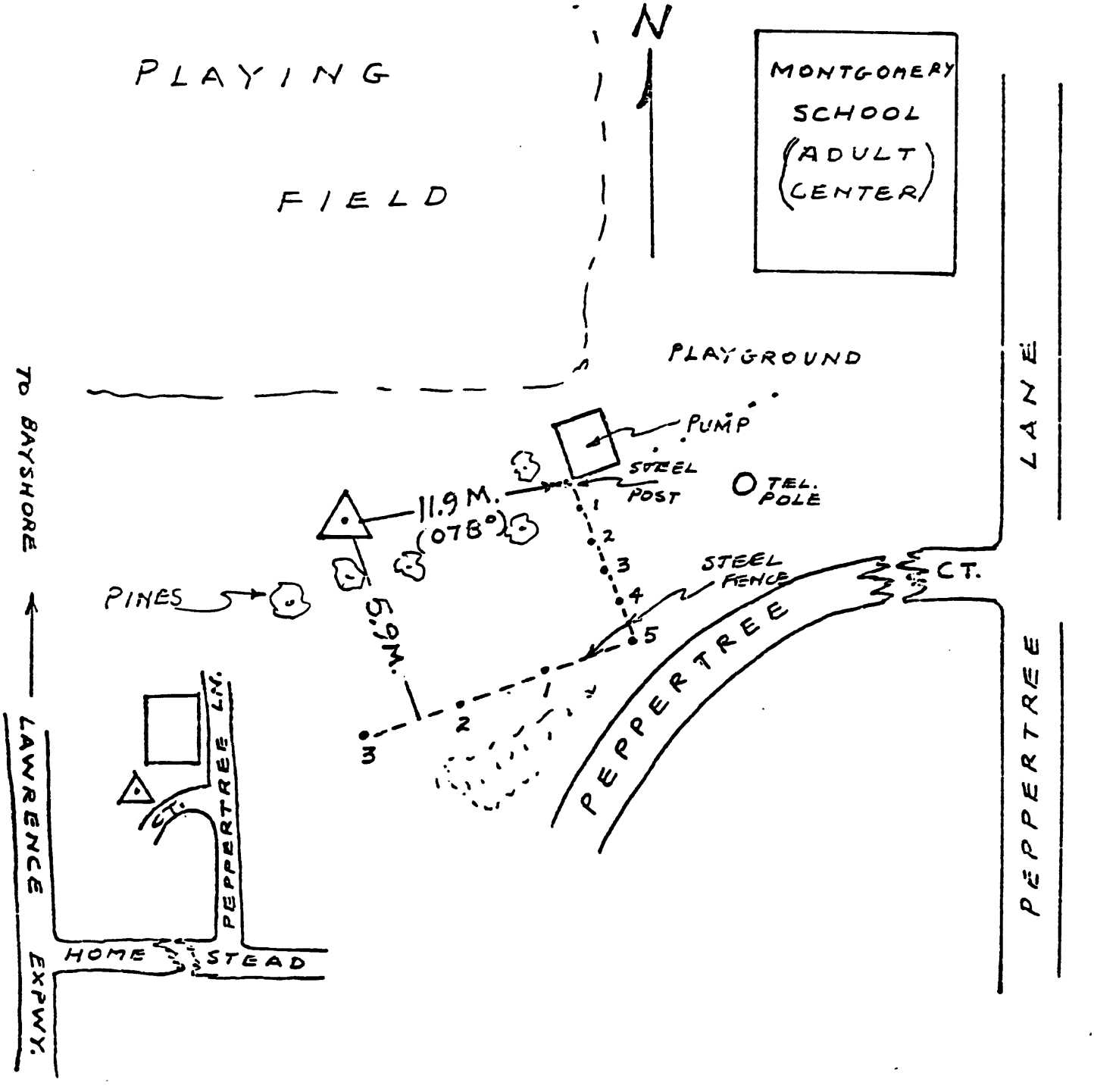
MISSION PEAK SITE NO. 20 LA COSTA VALLEY 7½

DRIVE EAST FROM MENLO PARK ACROSS DUMBARTON BRIDGE TO HWY. 17. TURN RIGHT ON #17 AND CONTINUE TO STEVENSON BLVD. TURN LEFT ON STEVENSON BLVD. AND DRIVE TO MISSION BLVD. (NE BASE OF HILLS). TURN RIGHT ON MISSION AND DRIVE SOUTH ABOUT 2.75 MILES TO MILL CREEK ROAD, (SECOND ROAD AFTER PASSING UNDER HWY. 680 ON MISSION BLVD.) TURN LEFT AND CLIMB ROAD ABOUT 4.5 MILES TO SITE ENTRANCE GATE. SEE SKETCH MAP.



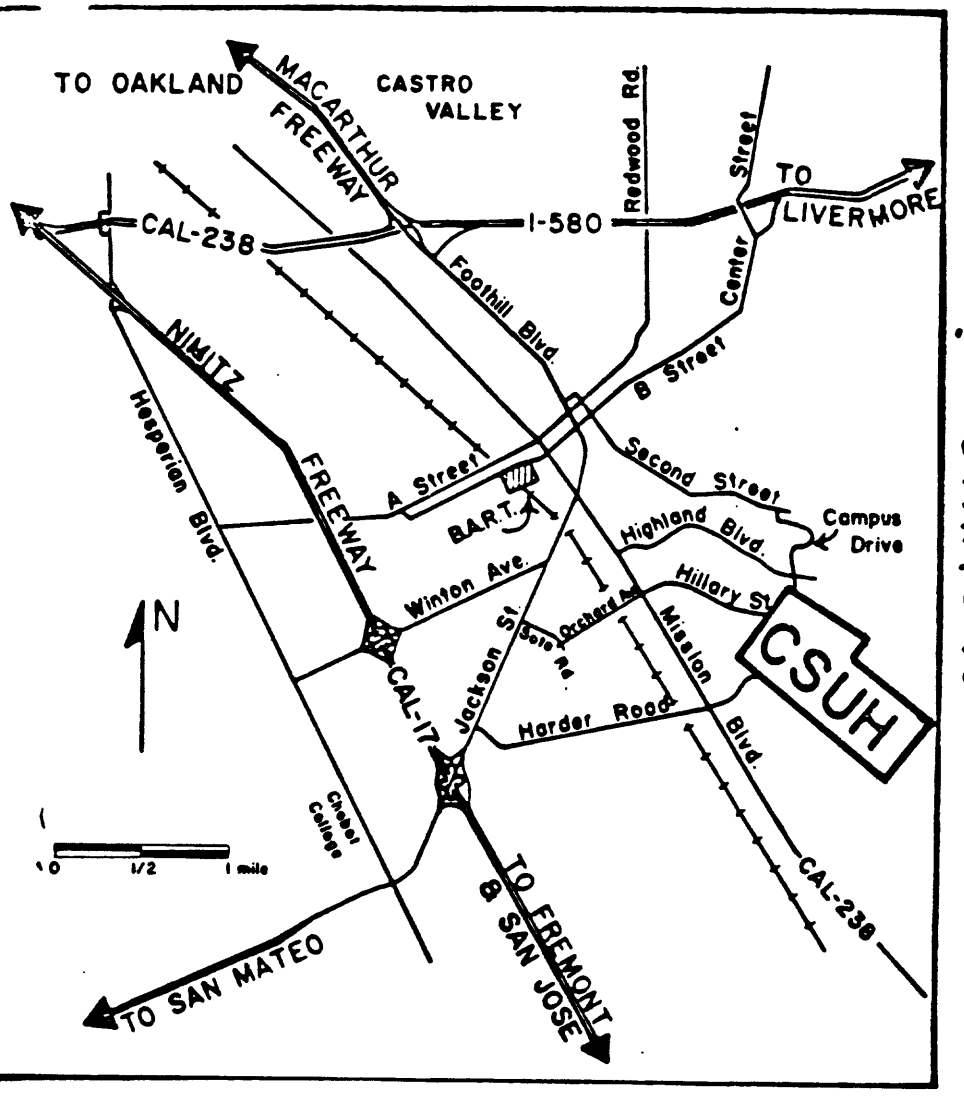
MONTGOMERY SCHOOL* SITE NO. 21. △ SAN JOSE WEST 7½'

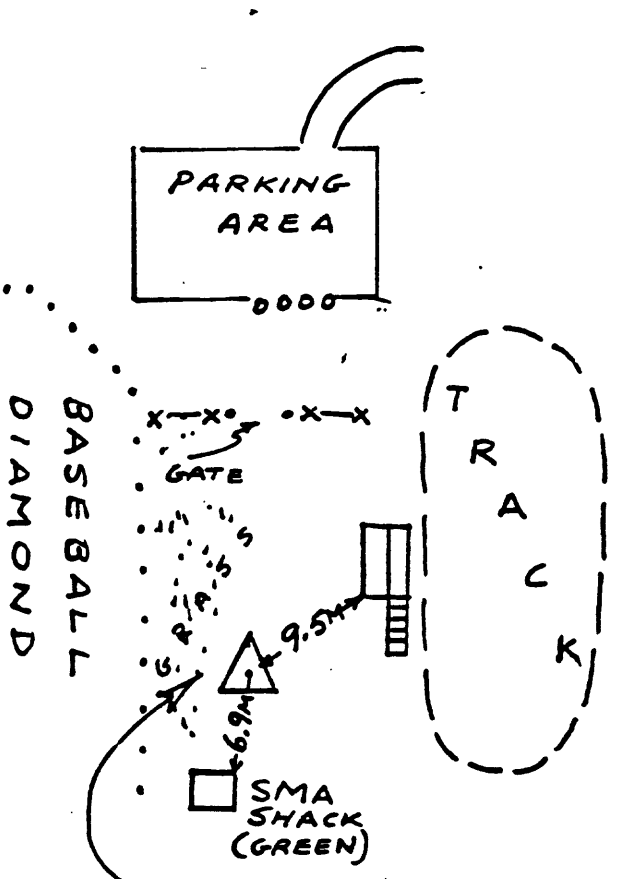
DRIVE SOUTH ON HWY. 101, (BAYSHORE) TO LAWRENCE EXPRESSWAY, TURN RIGHT, (SOUTH) AND CONTINUE FOR ABOUT 2.5 MILES TO HOMESTEAD, TURN LEFT ON HOMESTEAD FOR ABOUT 0.5 MILES TO PEPPER TREE LANE; TAKE A LEFT TO PEPPERTREE COURT, THEN LEFT ON PEPPERTREE CT. TO CURVE IN STREET. SITE IS NEAR BY. NOTE*: SCHOOL HAS BEEN CONVERTED TO THE: "MONTGOMERY ADULT EDUCATION CENTER."

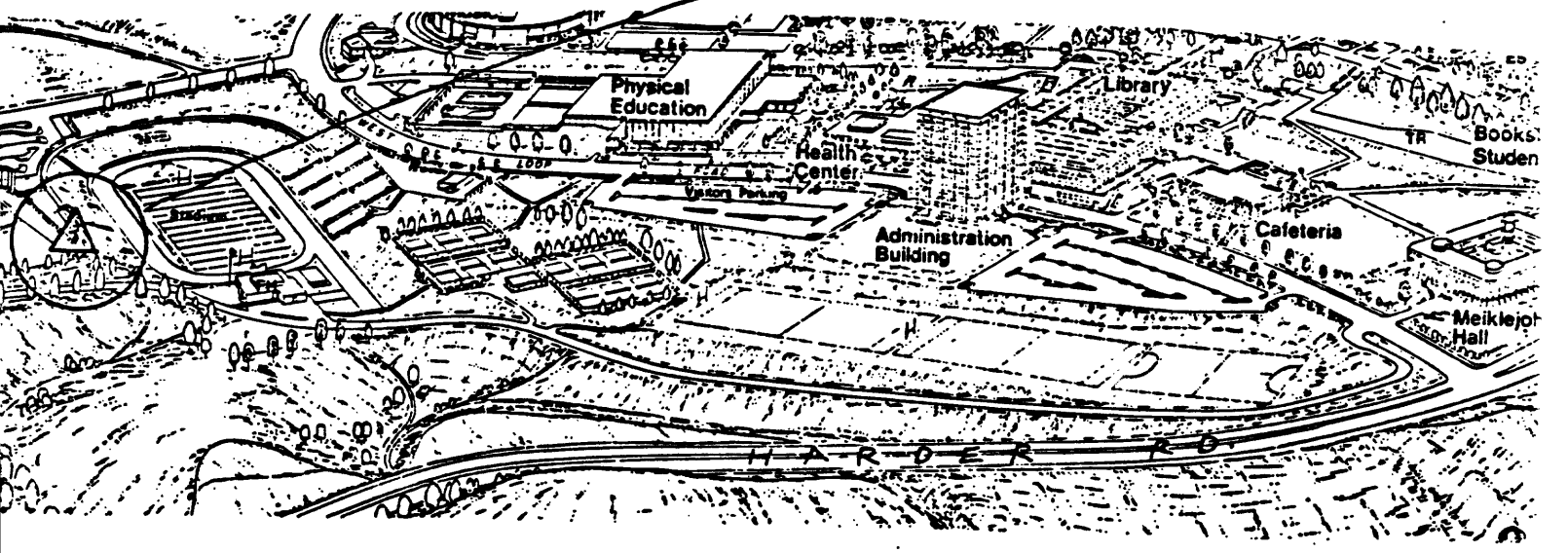


CAL STATE HAYWARD SITE NO. 23 HAYWARD 7½

SEE INSET MAPS FOR ACCESS ROUTE AND SITE LOCATION.

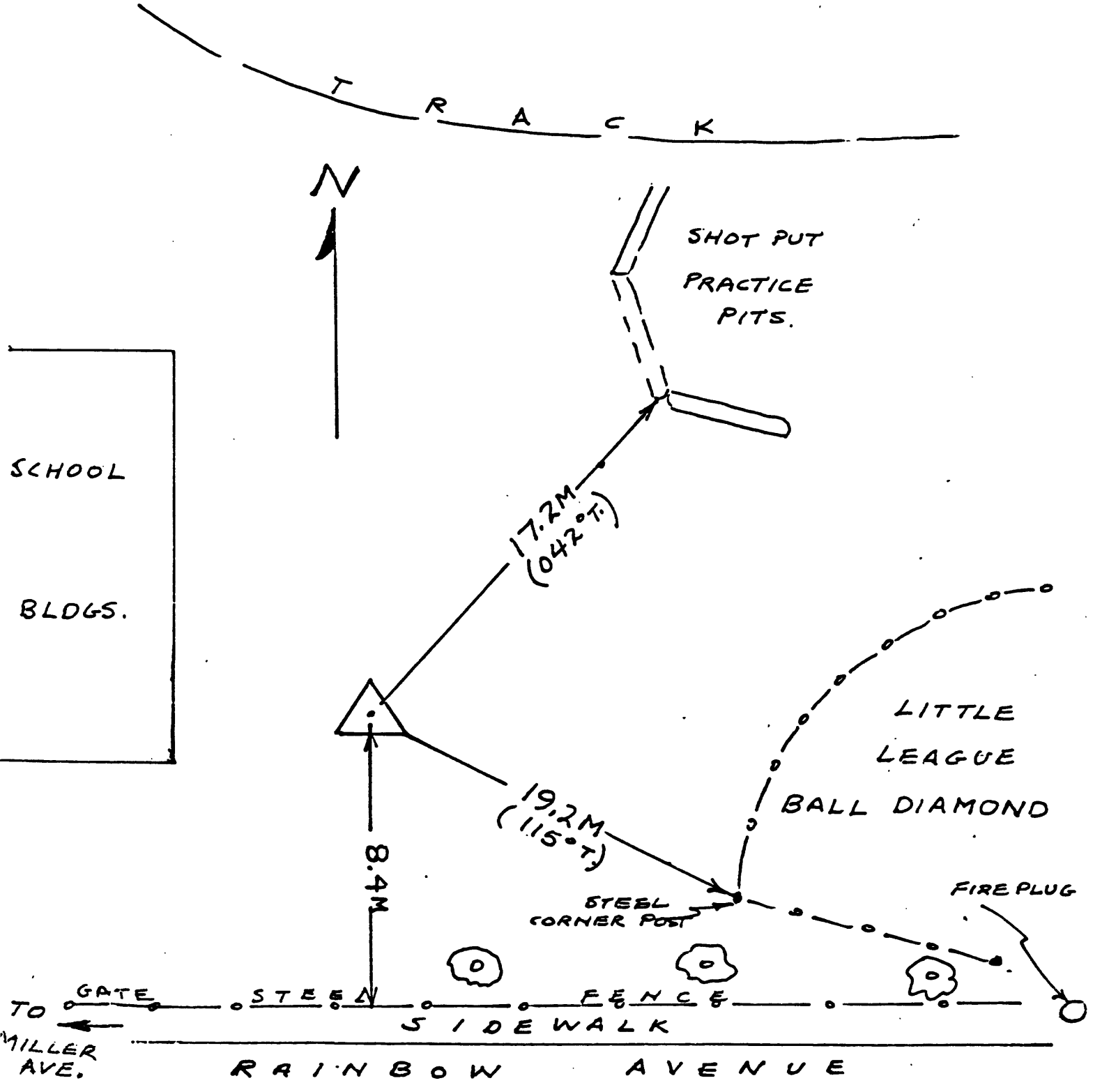






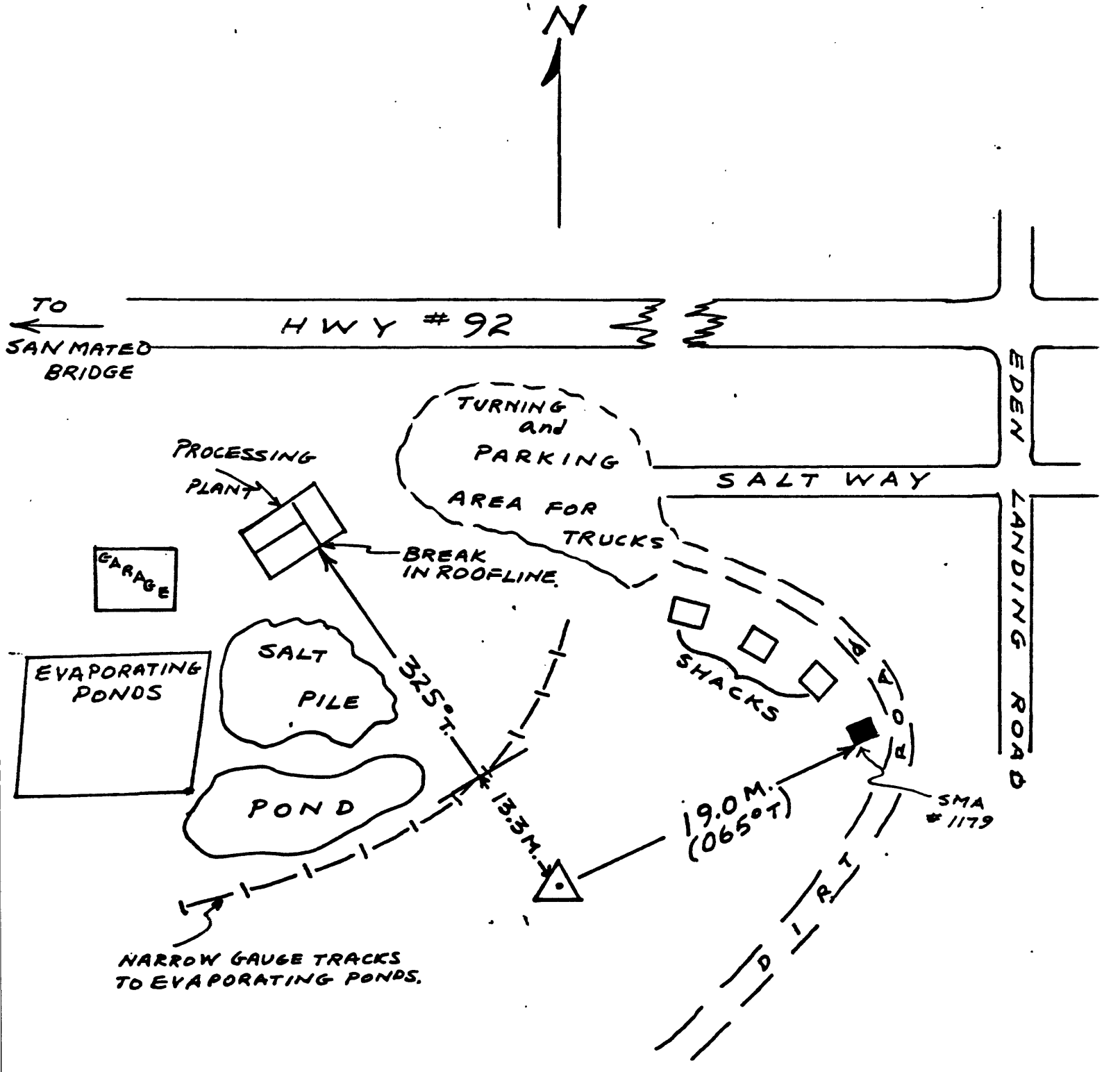
MILLER SCHOOL SITE NO. 24 CUPERTINO 7½'

TRAVEL SOUTHEASTERLY ON HWY. 101, (BAYSHORE) TO MATHILDA AVE IN SUNNYVALE. TURN OFF ON MATHILDA TO THE RIGHT, (SOUTH) AND DRIVE ABOUT 2.6 MILES TO MERGER OF MATHILDA WITH SARATOGA SUNNYVALE ROAD. DRIVE ABOUT 3.5 MILES TO BOLLINGER ROAD, TURN LEFT, CONTI UE ABOUT 7 BLOCKS TO MILLER AVE; TURN RIGHT AND PROCEED 7 BLOC TO RAINBOW AVE; TURN LEFT AND DRIVE TO ATHLETIC FIELD, BEHIND SCH SITE IS JUST OFF RAINBOW IN AREA ADJOINING SHOT PUT PRACTICE AREA. SEE SKETCH BELOW.



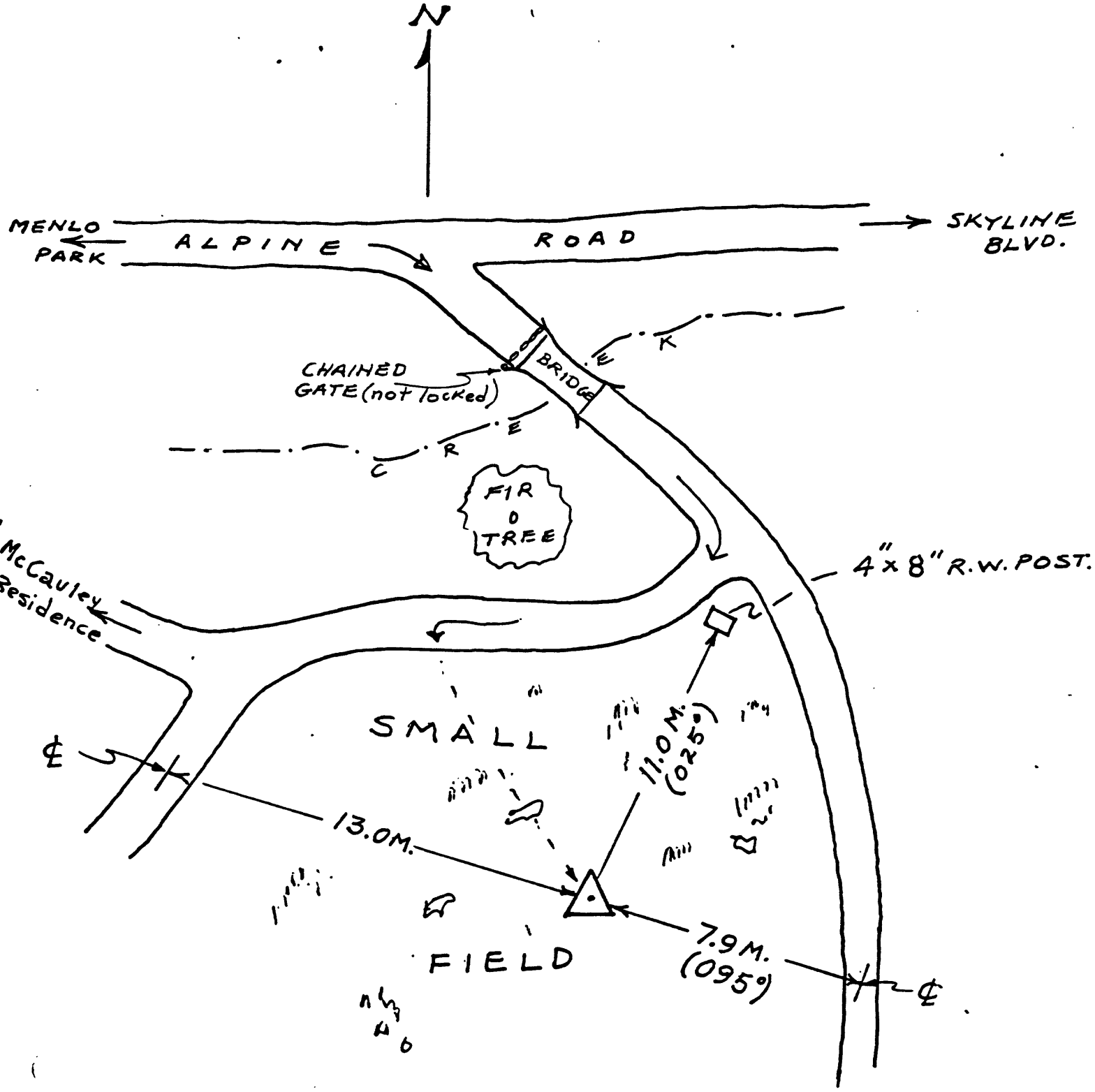
OLIVER SALT WORKS SITE NO. 25 △ REDWOOD PT. 7½'

DRIVE NORTH ON HWY. 101 (BAYSHORE) TO HWY. #92, TAKE 92, SAN MATEO BRIDGE ROUTE ACROSS BAY. JUST BEYOND TOLL PLAZA TAKE A RIGHT ON EDEN LANDING ROAD, THEN ANOTHER RIGHT ON SALT WAY, (BACK TOWARD BAY) TO ITS END. SALT WORKS BUILDINGS ARE LOCATED THERE. SEE SKETCH BELOW.



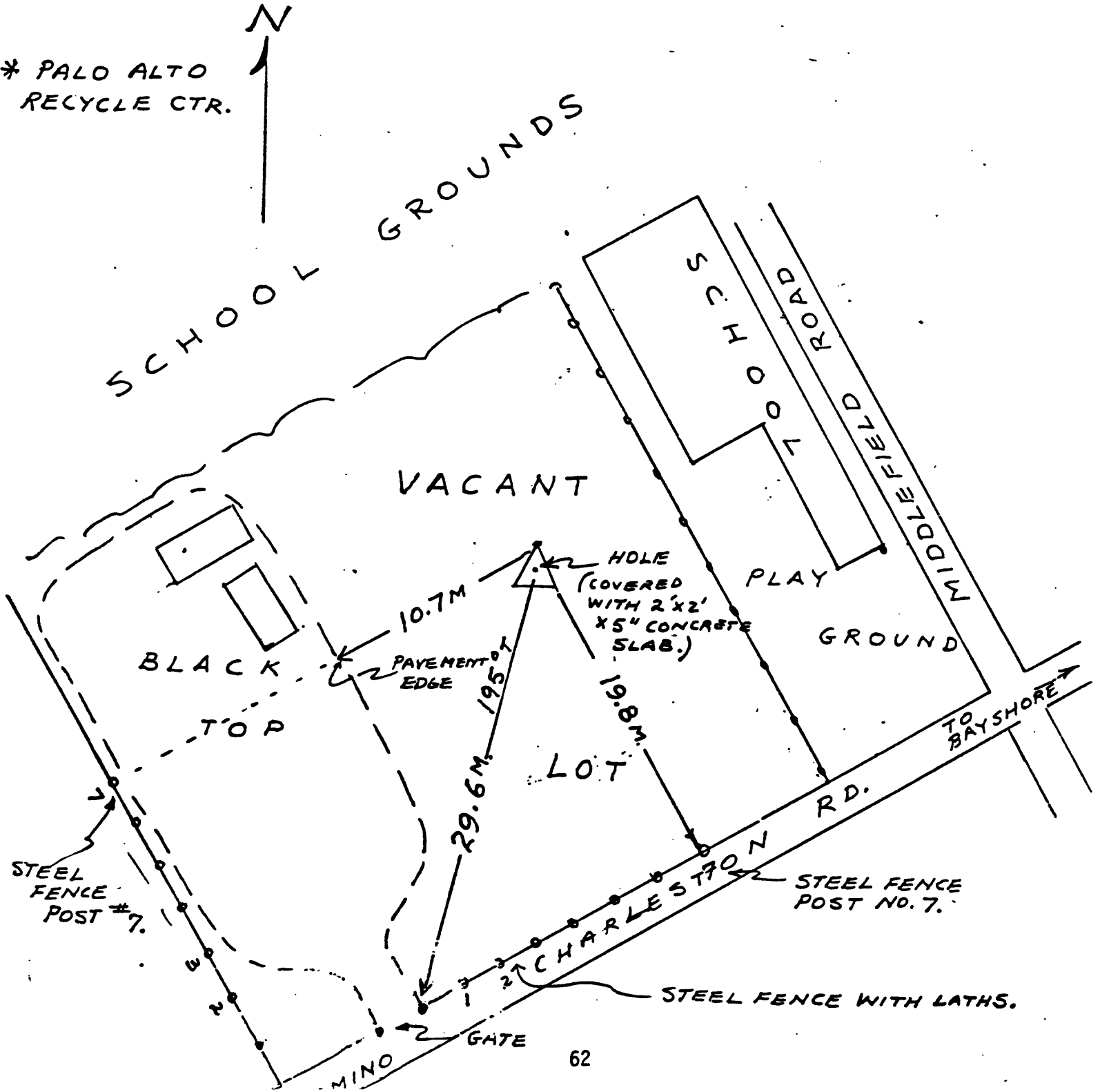
CORTE MADERA SITE NO. 26 △ MINDEGO HILL 7½

DRIVE WEST FROM MENLO PARK ON ALPINE ROAD TO PORTOLA ROAD JUNCTION. CONTINUE ON ALPINE ROAD ABOUT 1.75 MILES TO ENTRANCE DRIVEWAY AND BRIDGE CROSSING CREEK ON THE RIGHT. FROM INTERSECTION OF ALPINE ROAD AND WILLOWBROOK IT IS 0.85 MILES TO THE DRIVEWAY ENTRANCE AND BRIDGE.



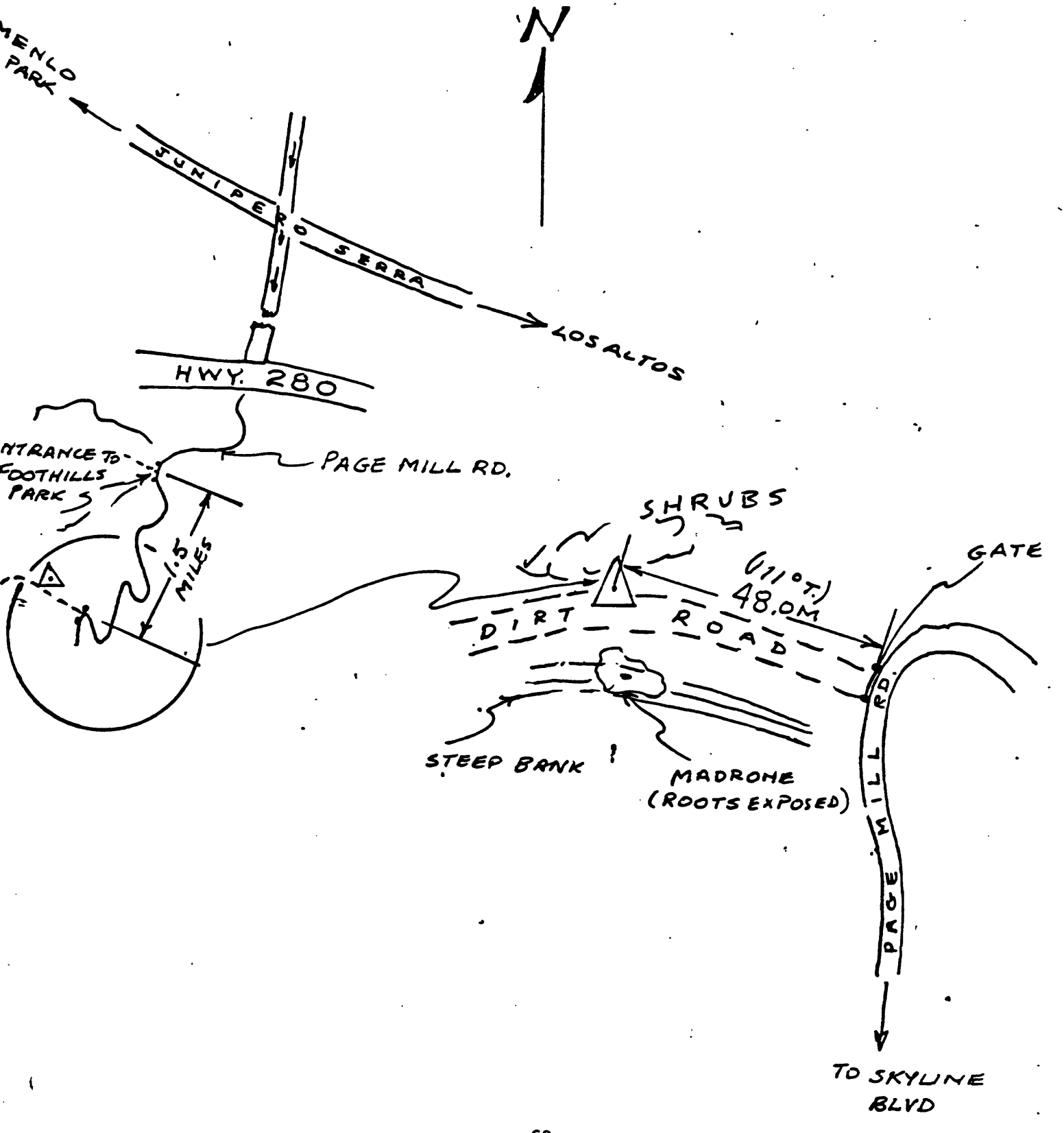
MITCHELL PARK * SITE NO. 27 △ MOUNTAIN VIEW 7½'

DRIVE SOUTH ON BAYSHORE BLVD. (HWY. 101) TO SAN ANTONIO OFF LANE, APPROXIMATELY 4.0 MILES SOUTH FROM HWY. 101 AND WILLOW ROAD IN MENLO PARK. TURN RT. ON SAN ANTONIO & RT. AGAIN ON CHARLESTON RD., ABOUT 0.5 MILES. CONTINUE ON CHARLESTON TO MIDDLEFIELD RD., PROCEED THROUGH INTERSECTION, CROSSING MIDDLEFIELD RD., ABOUT 400FT. TO GATE ON RIGHT, MARKING ENTRANCE TO RE-CYCLE CENTER. SITE IS ABOUT 11.0 METERS OFF EDGE OF BLACK TOP IN VACANT LOT.
SEE SKETCH BELOW.



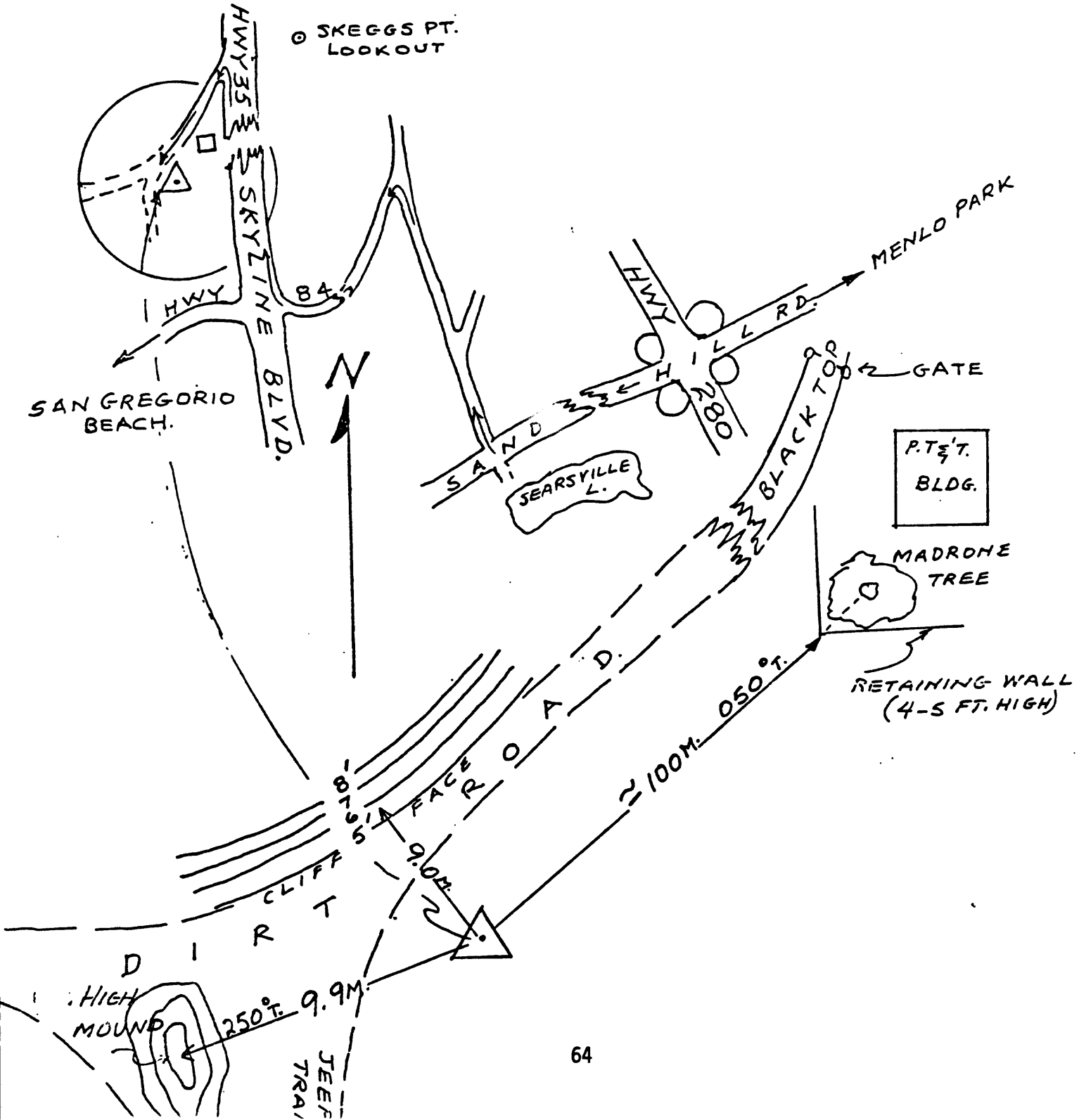
FOOTHILLS PARK ' SITE NO. 28 MINDEGO HILL 7½

DRIVE SOUTH ON JUNIPERO SERRA EXPRESSWAY TO PAGE MILL RD. TURN RT. AND STAY ON PAGE MILL, PASSING BENEATH HWY. 280 AND CONTINUING UP PAGE MILL TO MAIN ENTRANCE OF FOOTHILLS PARK MILEAGE FROM PARK ENTRANCE TO ACCESS ROAD AND PAGE MILL IS 1.5 MILES. SEE SKETCH BELOW.



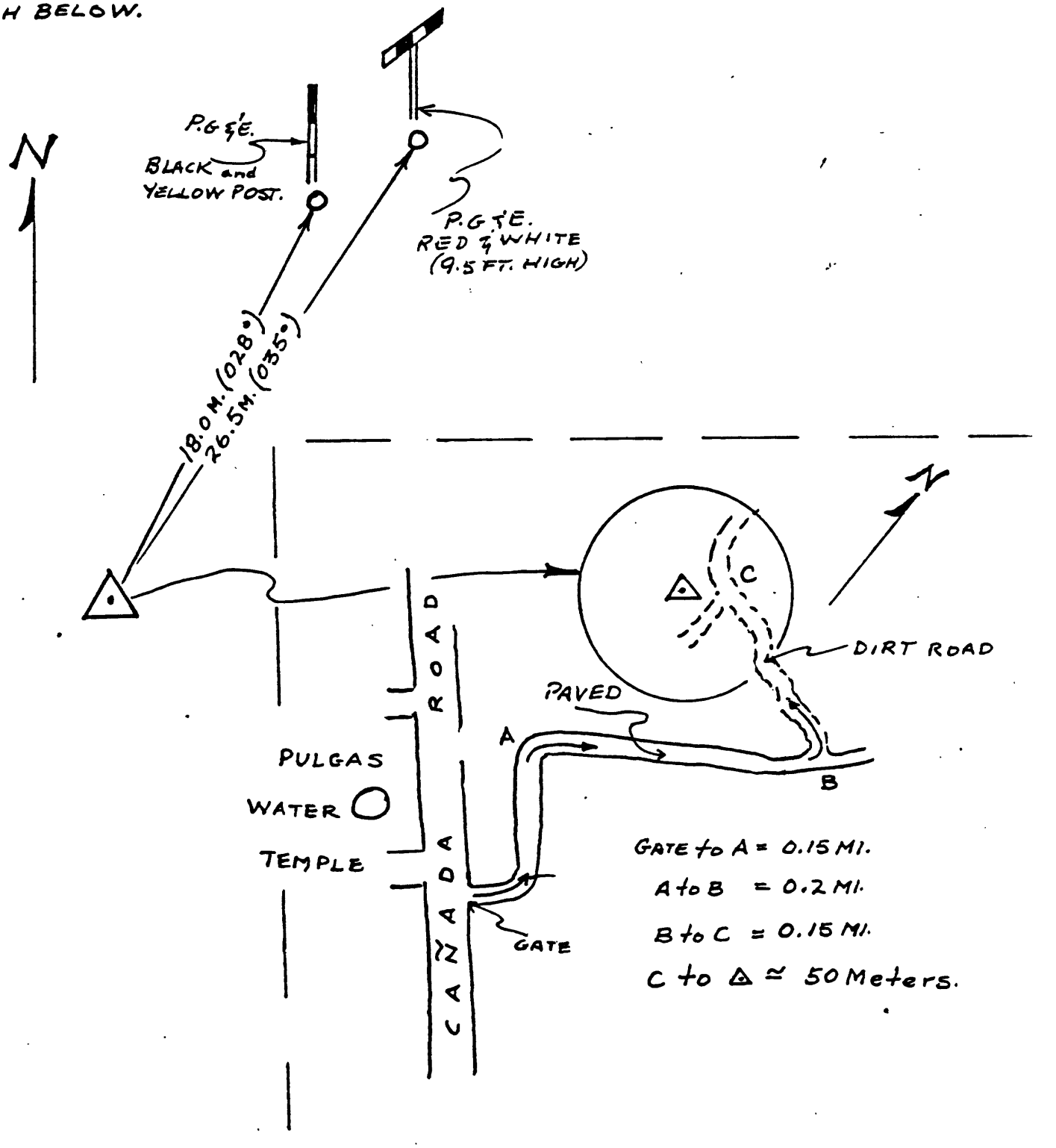
SIERRA MORENA SITE NO. 29 △ WOODSIDE 7½'

DRIVE WESTERLY ON SANDHILL RD. FROM MENLO PARK, TO PORTOLA RD., OPPOSITE SEARSVILLE LAKE ENTRANCE; TURN RIGHT AND CONTINUE ABOUT 0.18 MILES TO "Y" IN ROAD, KEEP TO THE LEFT AND GO ABOUT 0.58 MILES TO SHARP LEFT, (UPHILL CLIMB AND 180°). THIS IS LA HONDA RD. ON HWY. 84, CONTINUE TO THE TOP, (SKYLONDA) AND TURN RIGHT AT INTERSECTION OF HWY. 84 ON HWY. 35, SKYLINE BLVD. DRIVE NORTHWARD ON SKYLINE ABOUT 3.5 MILES TO SKEGG POINT LOOKOUT. THE SITE IS ON OPPOSITE SIDE OF ROAD FROM SKEGGS PT. AND THE BLACK TOPPED ACCESS ROAD TO IT. IS 400 FT. BEYOND. SEE SKETCH BELOW.



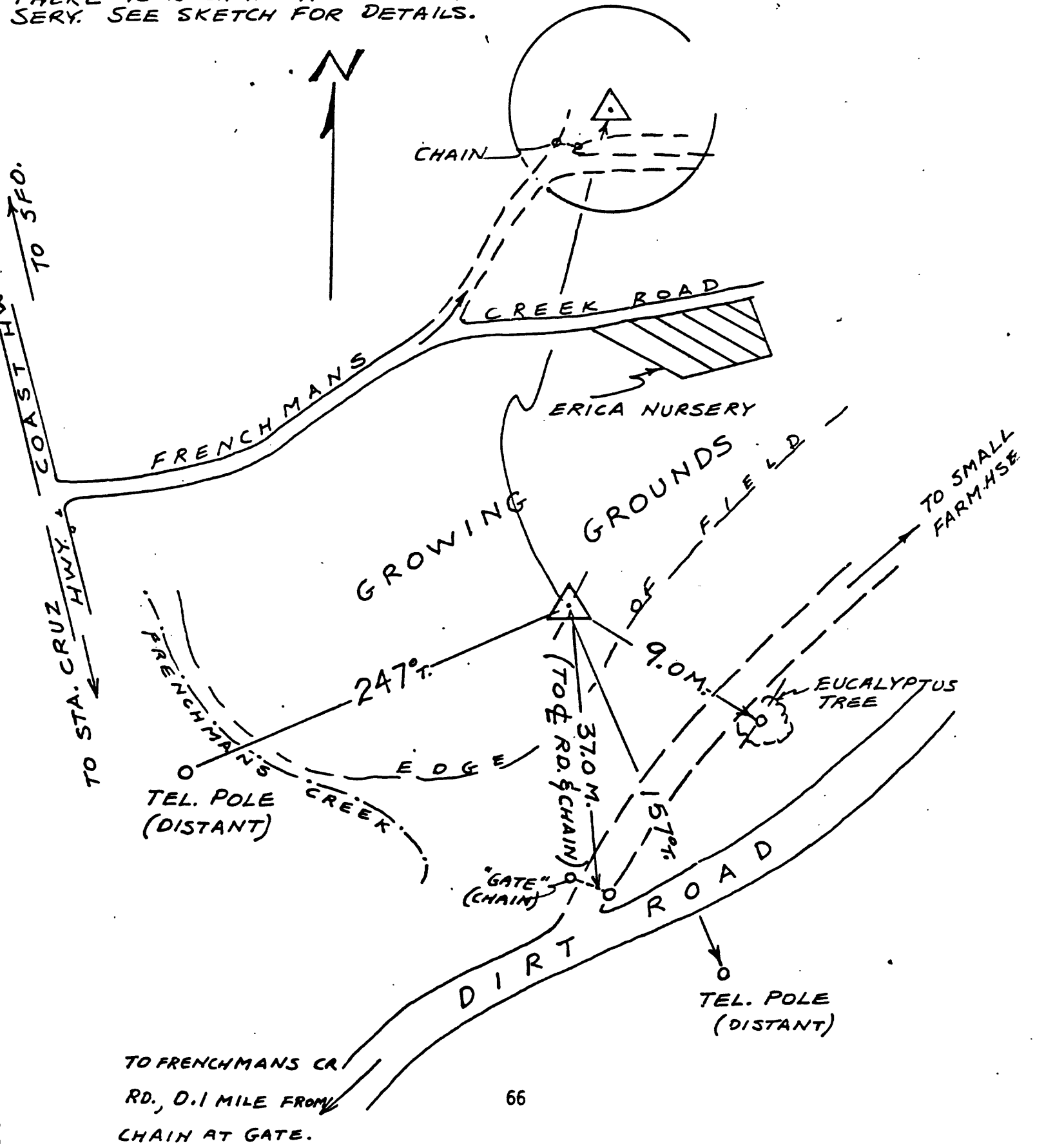
PULGAS TUNNEL SITE NO. 30 △ WOODSIDE 7½'

DRIVE UNDER HWY. 280 ON WOODSIDE ROAD TO INTERSECTION OF CAÑADA ROAD AND WOODSIDE. CONTINUE NORTHWESTERLY ON CAÑADA ABOU 5.0 MILES TO ENTRANCE GATE ON RIGHT SIDE OF CAÑADA RD., (OPPOSITE PULGAS WATER TEMPLE). ENTER GATE AND DRIVE PARALLEL TO CAÑADA RD. TO A CURVE TO THE RIGHT, (0.15 MI.); PROCEED UP HILL ANOTHER 0.2 MILES TO TURN OFF DIRT ROAD TO THE LEFT; CONTINUE UP A STEEP INCLINE 0.15 MILE TO A FLAT MEADOW ON THE LEFT. DIMLY MARKED CAR TRACKS LEAD TO THE SITE. KEEP A LOOKOUT FOR 2 SIGNS ≃ 30 FT. APART, MARKING P. G. & E. GAS PIPE LINE CROSSING UNDERGROUND. HOLE IS NEARBY. SEE SKETCH BELOW.



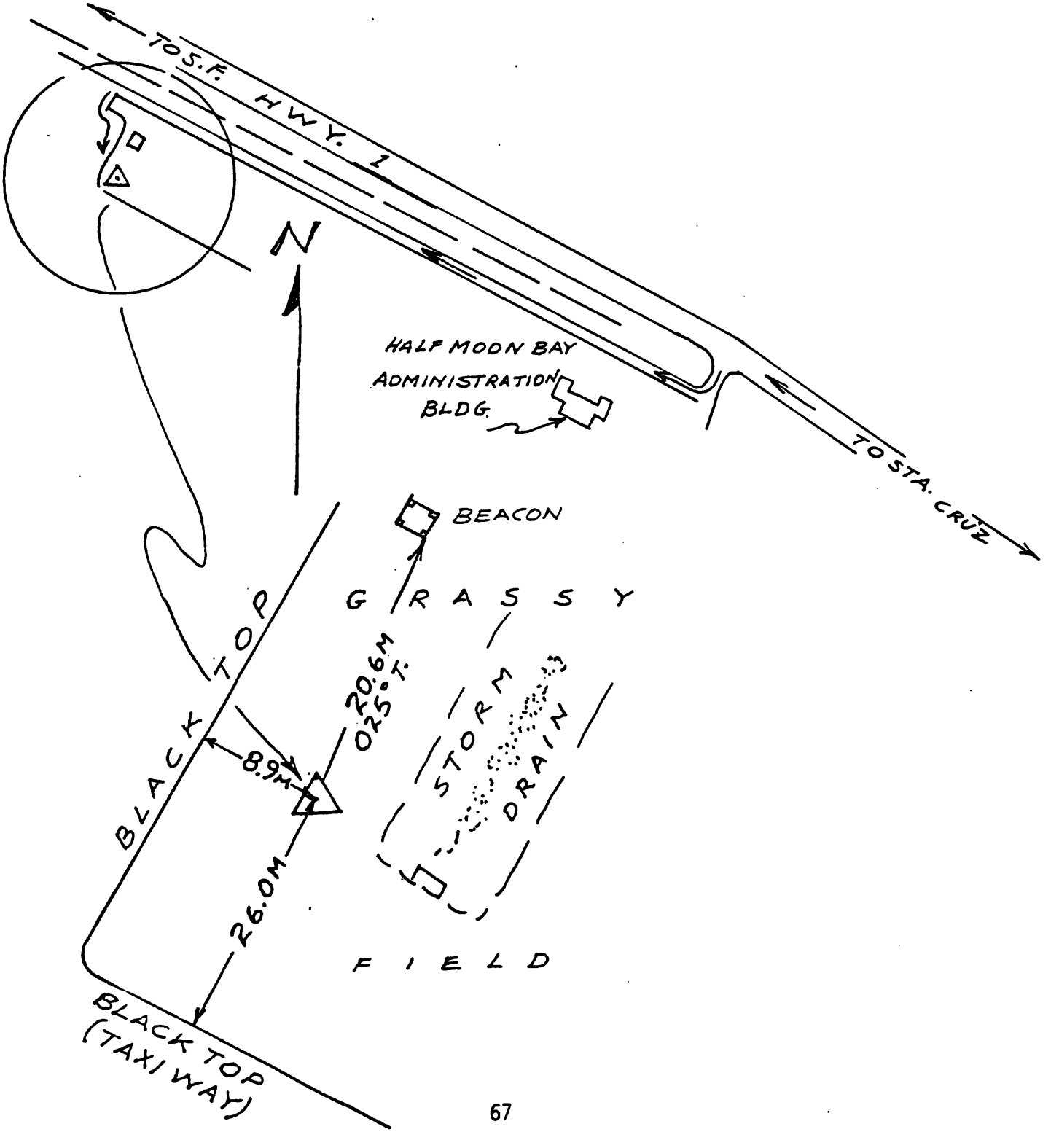
FRENCHMANS CREEK SITE NO. 31 △ HALF MOON BAY 7½'

DRIVE NORTH ON HWY. 1, COAST HIGHWAY FROM HWY. 92, TO FRENCHMANS CREEK RD., CONTINUE UP "F.C. RD." TO LEFT FORK, (DIRT ROAD 0.9 MILES FROM HWY. 1), PROCEED LEFT ON THIS FORK ABOUT 0.1 MILE TO ANOTHER LEFT FORK, DROPPING DOWN INTO FIELD. THERE IS A CHAIN ACROSS THIS ROAD WITH LOCK. KEY AT ERICA NURSERY. SEE SKETCH FOR DETAILS.



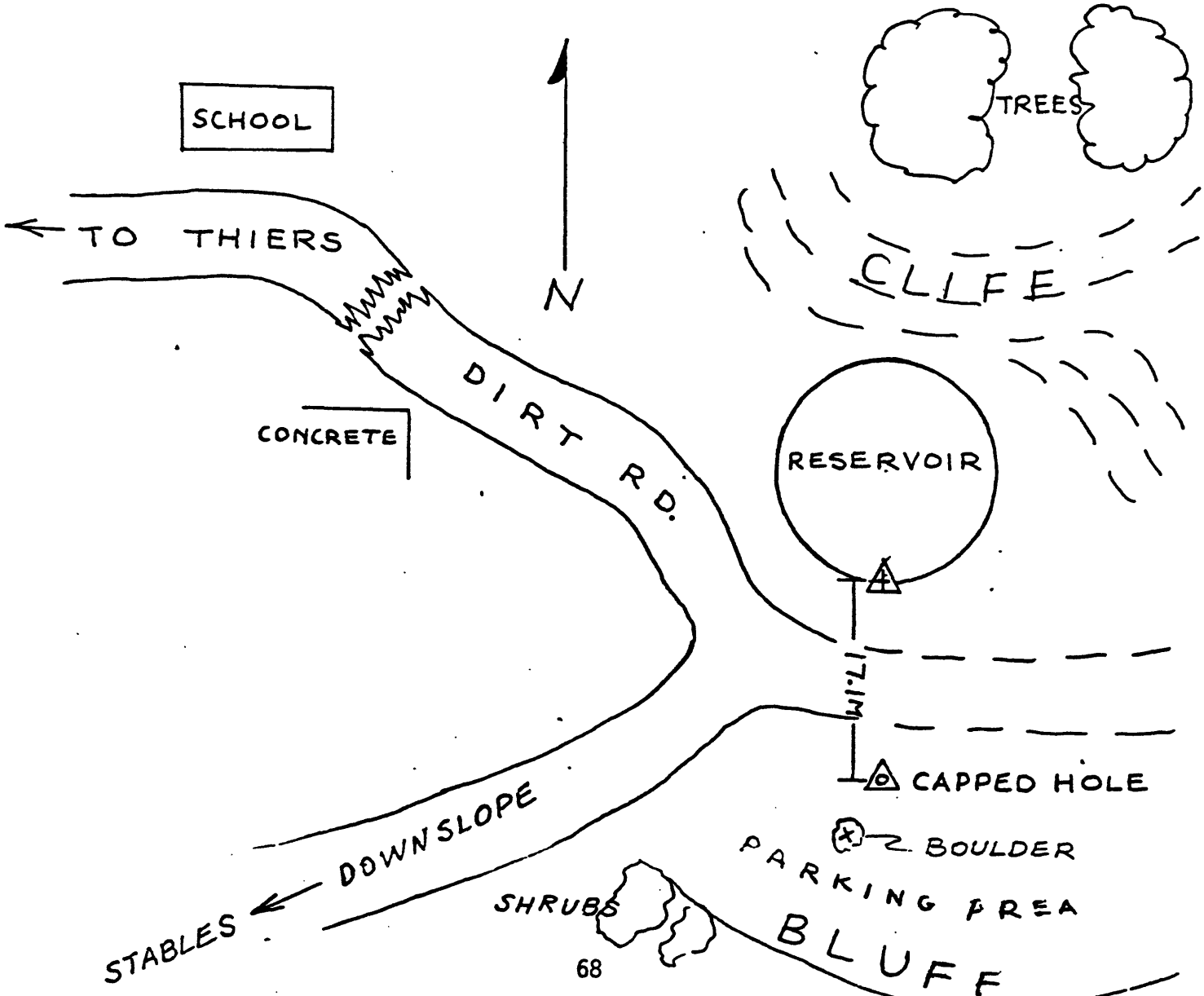
HALF MOON BAY TERRACE SITE NO. 32 △ MONTARA MT. 7½'

DRIVE TO HWY. 1, COAST HWY. VIA HWY. 280 & 92. TURN RT. ON HWY. 1 AND PROCEED ABOUT 4.7 MILES TO HALF MOON BAY AIRPORT TURNOFF; (CAUTION, TRICKY, SHORT WARNING AND HOLDING LANE). TURN LEFT AND RIGHT UPON ENTRY INTO AIRPORT, ROAD PARALELLS HWY. 1 TO THE NORTH. SEE SKETCH FOR DETAILS.



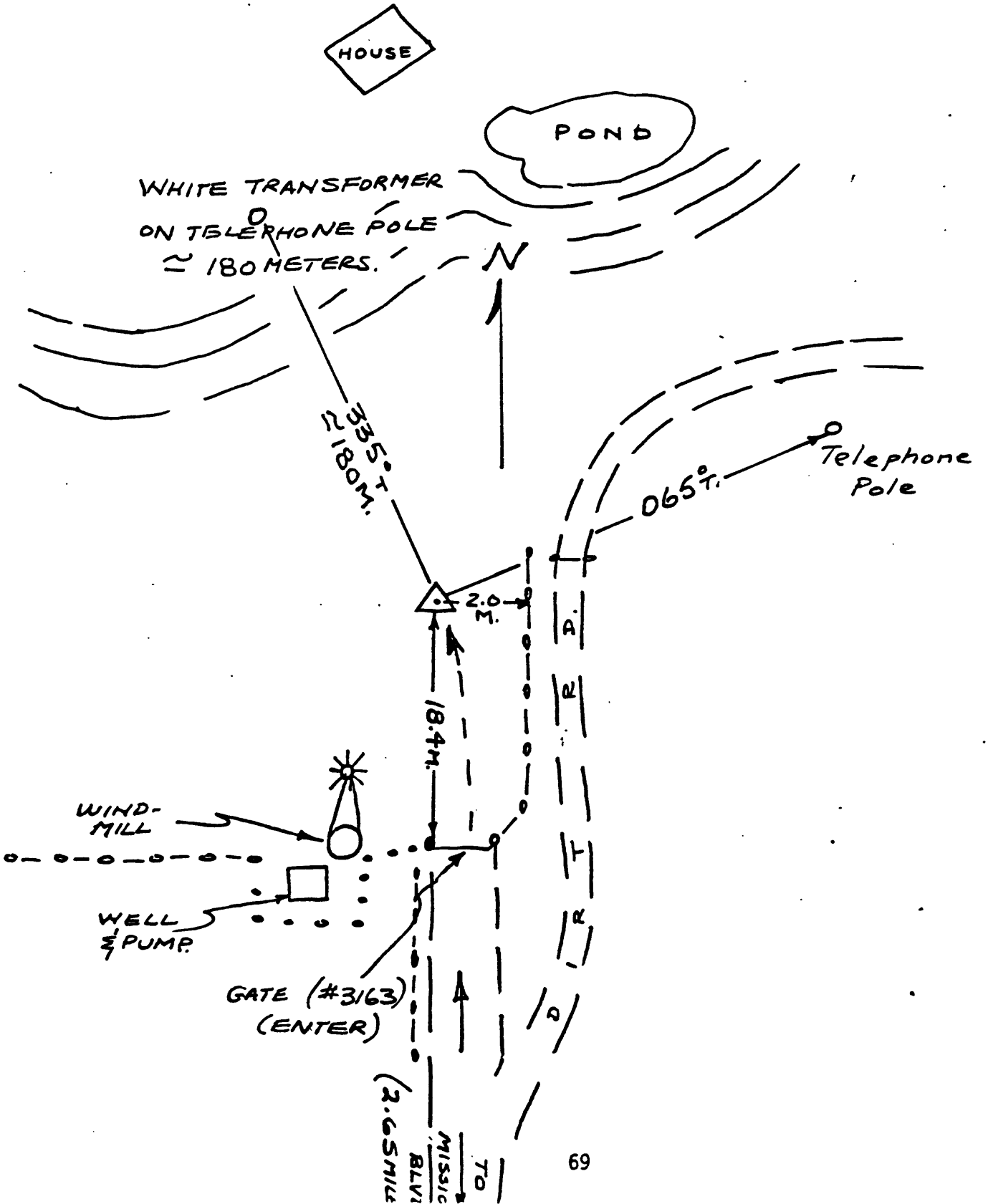
VISTA GRANDE SITE NO. 33 SAN FRANCISCO, SOUTH 7½'
DALY CITY

AT THE INTERSECTION OF THIERS ST. AND FLORENCE, CONTINUE ON THIERS WHICH TURNS INTO A DIRT RD. KEEPING TO THE RIGHT, GO TO A POINT IN FRONT OF A LARGE RESERVOIR. A FLAT PROMONTORY PARKING LOT FOR RIDING STABLES IS THE GENERAL AREA IN WHICH THE HOLE IS LOCATED. ON THE BOTTOM OF THE STEEL LINK FENCE SURROUNDING THE RESERVOIR THERE IS A SHEET METAL BAND ENCIRCLING THE TANK. ETCHED IN THIS BAND A SYMBOL ⚠ WILL BE FOUND. FROM THIS MARK IN A SOUTHERLY DIRECTION, 17.1 METER TO THE HOLE. 1.75 METERS BEYOND THE HOLE A SMALL BOULDER WITH AN "X" MARKED ON ITS TOP IS FOUND, BEARING 007° T. TO THE HOLE FROM IT. SEE MAP BELOW FOR FURTHER DETAILS. HOLE IS CAPPED AND COVERED WITH A 10"x10" STEEL PLATE.



MORRISON CANYON SITE NO. 34 NILES, CALIF. 7½'

DRIVE EAST FROM MENLO PARK ACROSS THE DUMBARTON BRIDGE TO HWY #17. CONTINUE SOUTH ON HWY. 17 TO STEVENSON BLVD. TURN LEFT (EAST ON STEVENSON AND DRIVE TO MISSION BLVD., (END OF STEVENSON). TUR LEFT ON MISSION AND GO 3/4 OF A MILE TO MORRISON CANYON ROAD. TAKE A RIGHT TURN, AND STAY ON MORRISON CANYON ROAD. AT VARGAS ROAD, KEEP TO THE LEFT. IT IS ABOUT 0.9 MILES TO HOLE FROM THIS INTER-SECTION. SKETCH MAPS BELOW.



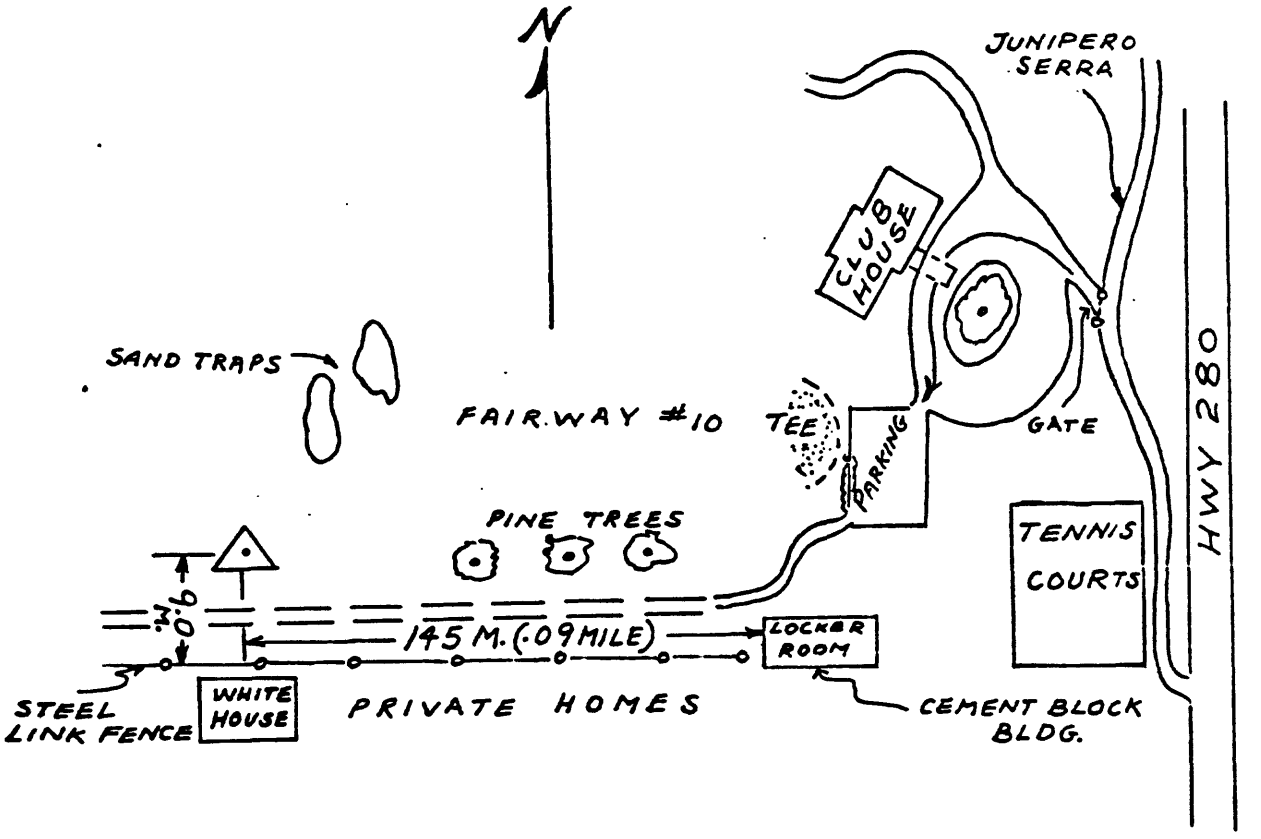
LAKE MERCED GOLF & COUNTRY CLUB, SITE NO. 35 △ SAN FRANCISCO (SO.) 7½'

DALY CITY, 2300 JUNIPERO SERRA BLVD.

TRAVELLING NORTH ON HWY. 280 IN DALY CITY, GET ONTO JUNIPERO SERRA BLVD. STAY ON THE WEST SIDE OF HWY 280, AND GO TWO BLOCKS BEYOND SCHOOL ST. TURN LEFT OFF OF JUNIPERO SERRA INTO LAKE MERCED GOLF & COUNTRY CLUB. KEEP TO THE RIGHT AND PROCEED UNDER ENTRANCE WAY. CONTINUE ON INTO PARKING LOT TO THE RIGHT, (THROUGH BREAK IN HEDGE). LEAVE PARKING LOT ON DIRT ROAD TOWARD CEMENT BLOCK BUILDING, PARALLEL TO #10 FAIRWAY. START MILEAGE CHECK AT WEST END OF BLOCK BUILDING; IT IS 0.09 MILES, (145 METERS) TO HOLE. THIS DIRT ROAD PARALLELS A STEEL LINK FENCE. AT 0.09 MILE MARK, MEASURE 9.0 METERS TO HOLE. CAPPED AND COVERED WITH STEEL PLATE.

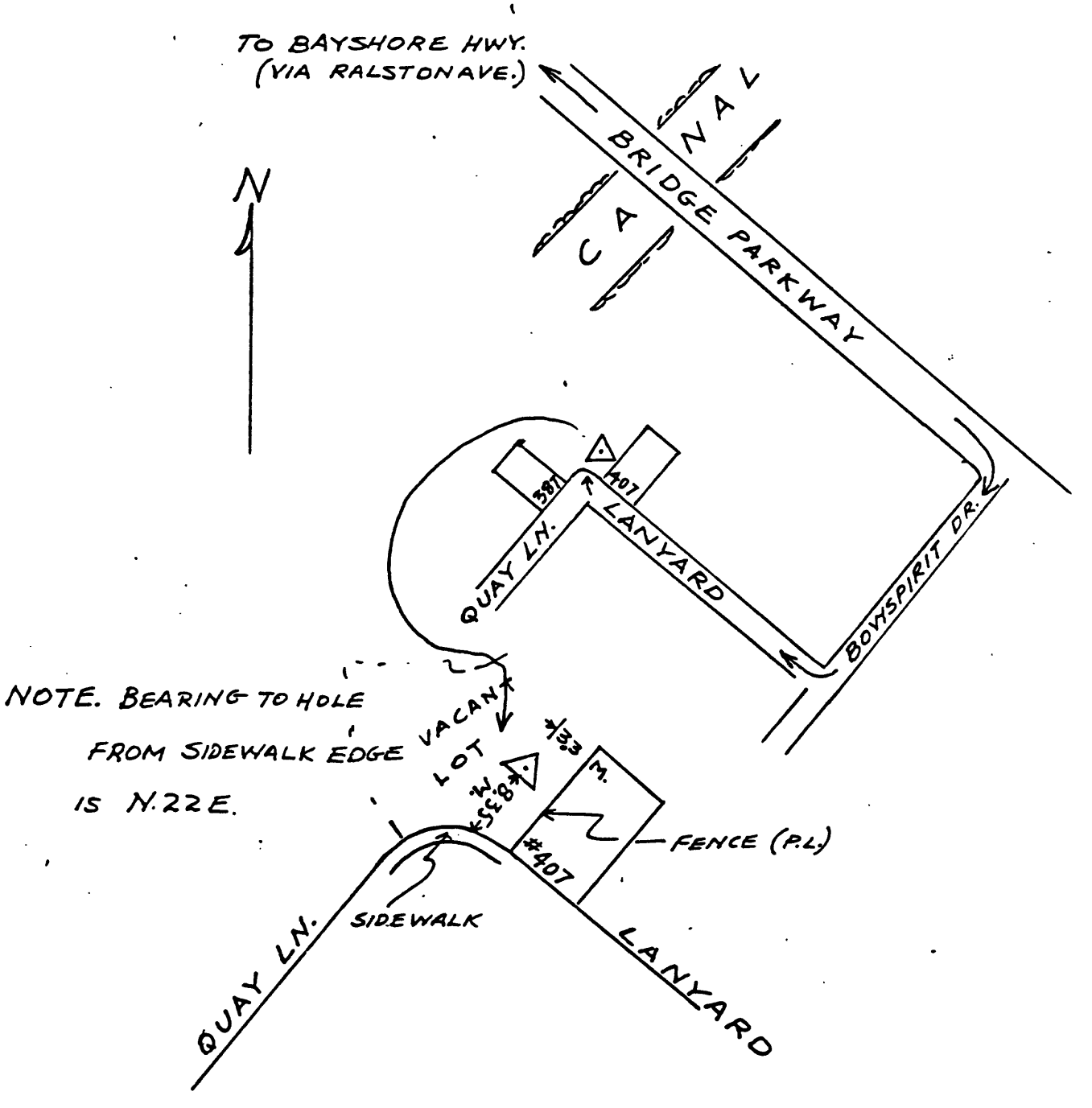
SURVEY DATE: OCT. 20, 1975

E.F. ROTH



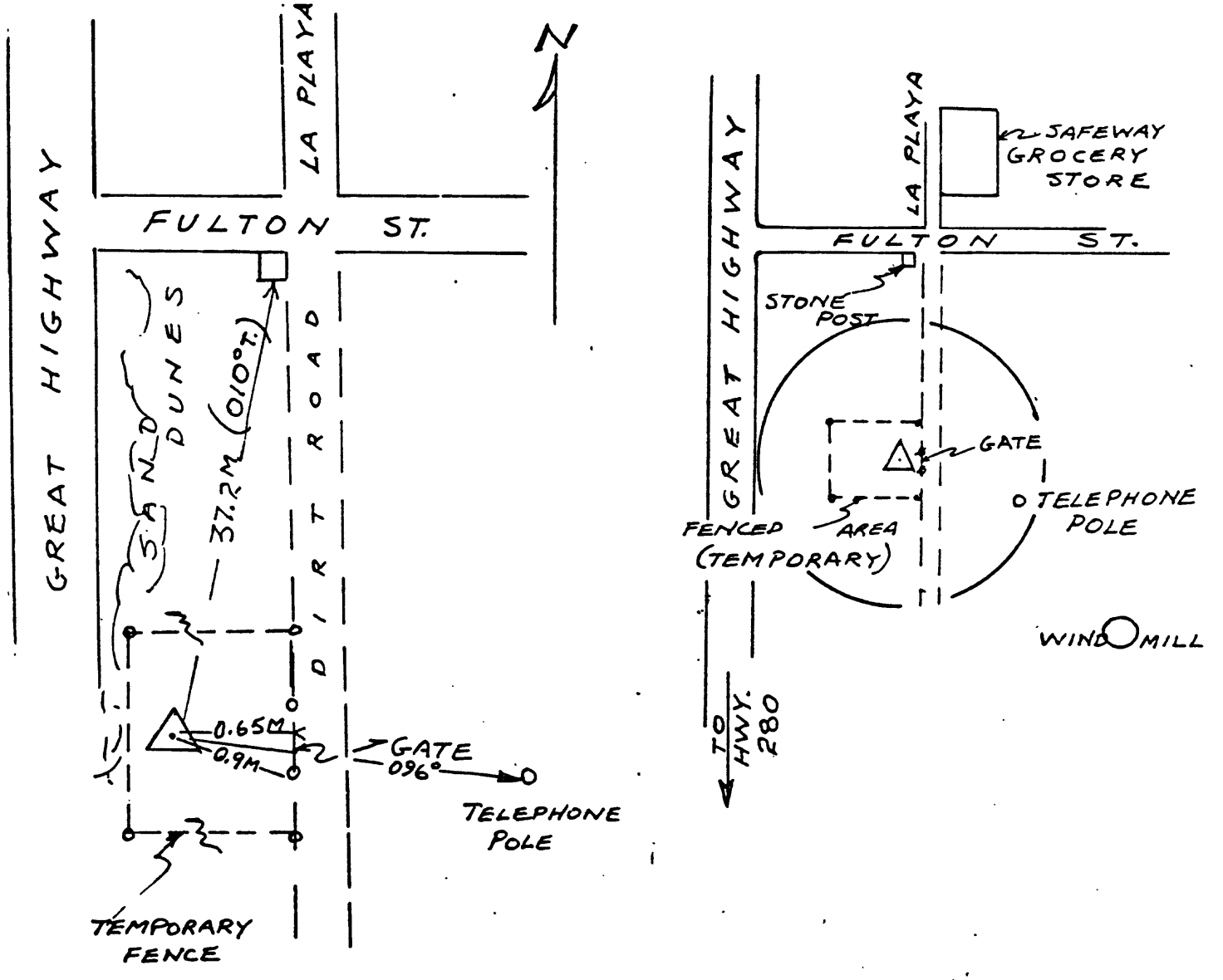
BRIDGEWAY PARK SITE NO. 36 △ SAN MATEO 7½'

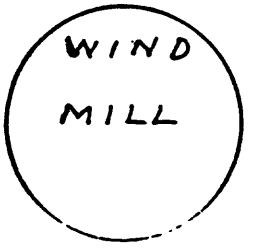
DRIVE NORTH ON HWY #101, (BAYSHORE FWY.) TO MARINE WORLD TURN OFF, (RALSTON AVE.) IN BELMONT; CONTINUE ON RALSTON AVE. PAST MARINE WORLD ENTRANCE. CROSS SLOUGH ON BRIDGE PARKWAY, TAKE 1ST RIGHT, (BOWSPIRIT DR.) TO LANYARD, DRIVE TO LEFT CURVE, (LANYARD BECOMES QUAY LANE HERE). SEE SKETCH BELOW FOR DETAILS.



WINDMILL SITE NO. 37 △ SAN FRANCISCO (NO.) 7½'

DRIVE NORTH ON HWY. 280 TO PACIFICA, SKYLINE BLVD. OFF LANE, CONTINUE ON SKYLINE TO VICINITY OF LAKE MERCED, TAKE LEFT AND CONTINUE NORTH ON GREAT HIGHWAY TO NORTH EDGE OF GOLDEN GATE PARK, (FULTON STREET). TURN RIGHT ON FULTON AND RIGHT AGAIN, (ABOUT 100 FT. BACK INTO PARK) ON ACCESS ROAD. AREA IS ALL SANDY TERRAIN, USE CAUTION WHILE DRIVING. SEE SKETCH BELOW.

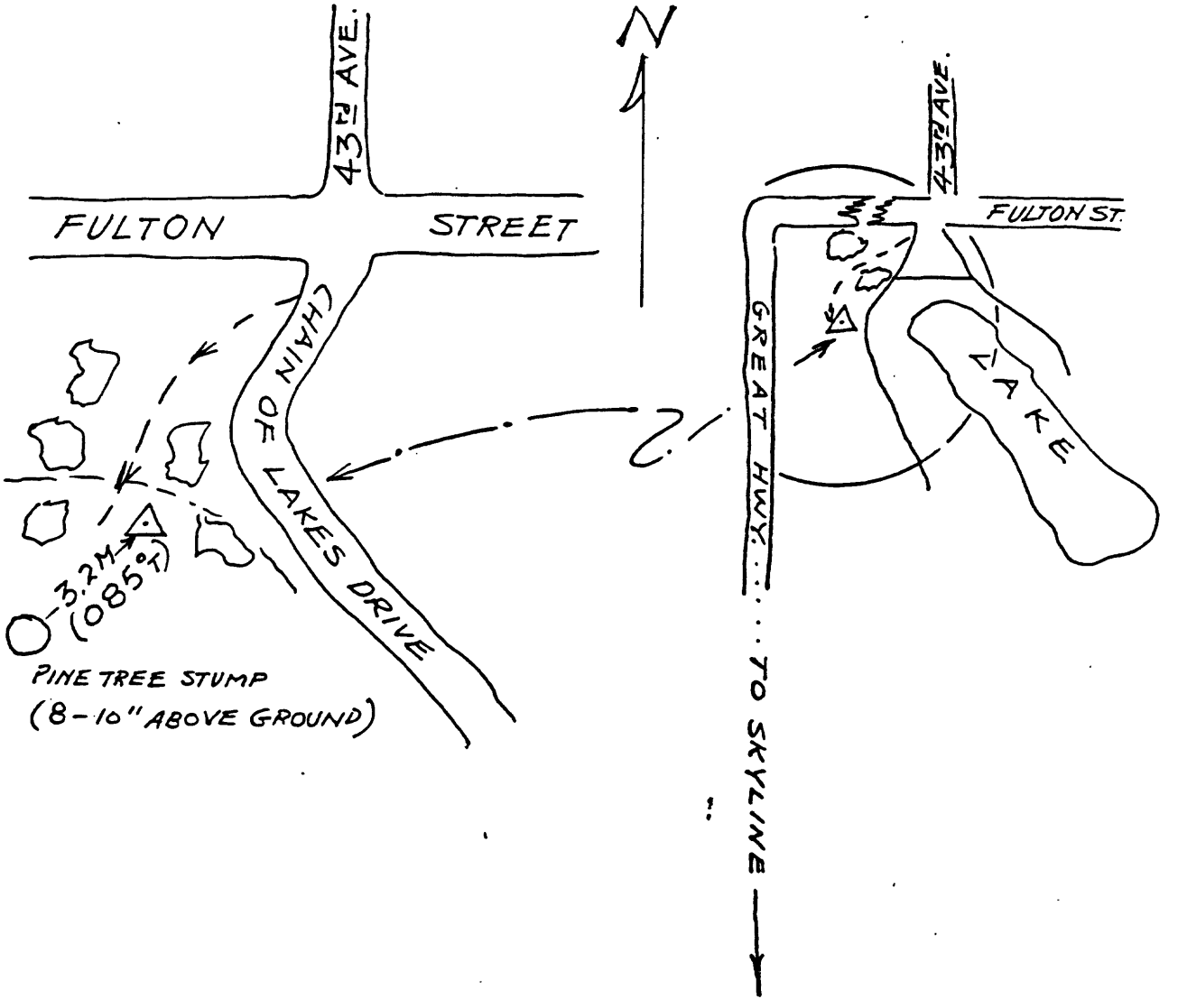




CHAIN OF LAKES SITE NO. 38 △ SAN FRANCISCO (NO.) 7½

DRIVE NORTH ON HWY. #280 TO VICINITY OF SAN ANDREAS LAKE, MERGE ONTO SKYLINE BLVD. AND DRIVE NORTH TO THE GREAT HIGHWAY, (ESPLANADE) IN SAN FRANCISCO. TAKE RIGHT TURN ONTO FULTON ST., GO TO 43rd AVE., TURN RIGHT, AND AGAIN TAKE A SHARP RIGHT THROUGH TREES TO SITE. SEE SKETCH BELOW.

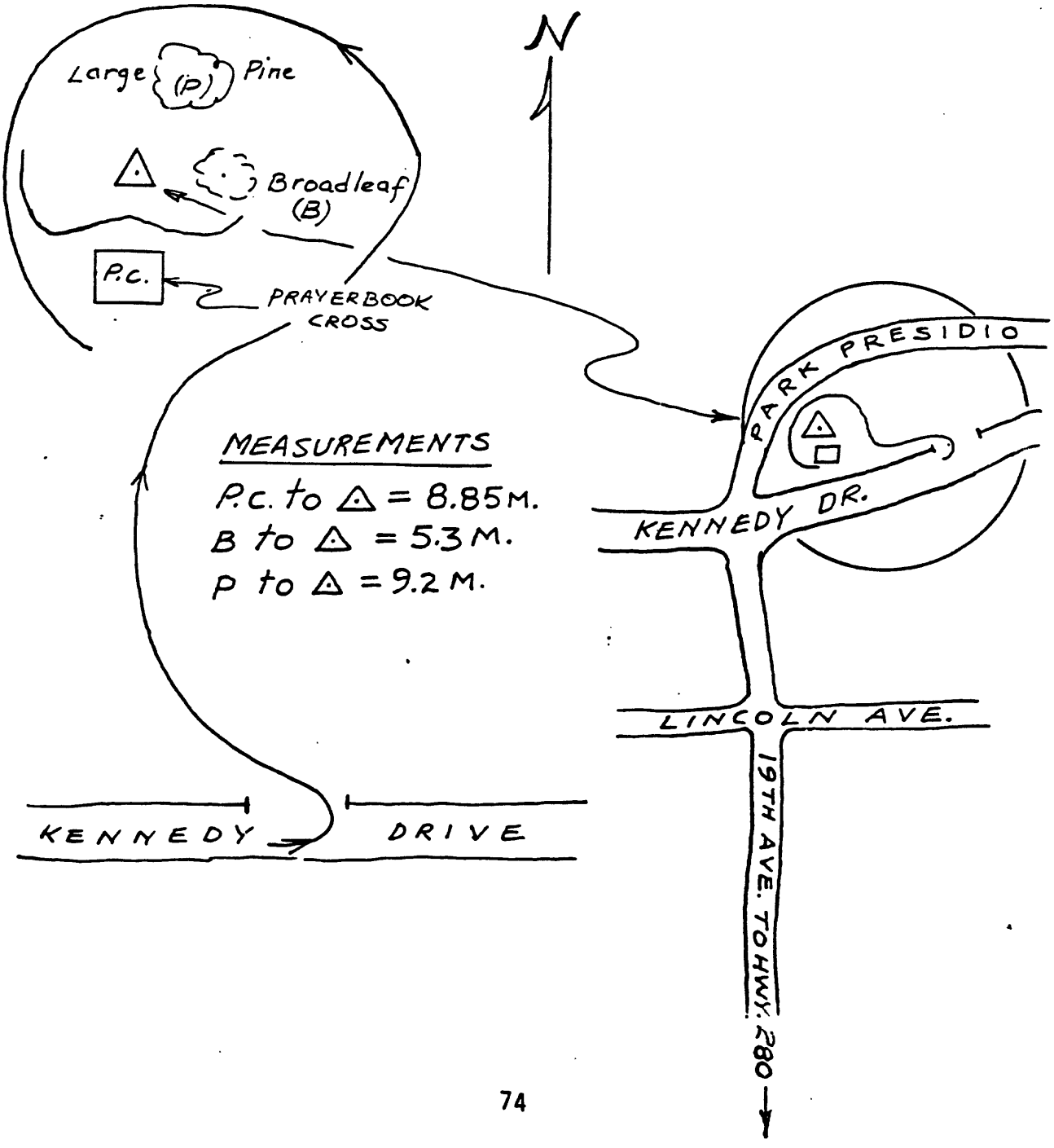
* HOLE CASED TO 70 FT.



PRAYERBOOK CROSS SITE NO. 39 △ SAN FRANCISCO (NO.) 7½'

DRIVE NORTH ON HWY. #280 TO DALY CITY; MERGE ONTO 19TH. AVE. AND CONTINUE ON 19TH TO GOLDEN GATE PARK, AND INTO PARK, TAKING A RIGHT AT NORTH PART OF PARK ON KENNEDY DR. (MAIN DR.). DRIVE ABOUT 0.1 MILE, AND CROSS THE DRIVE TO OPPOSITE SIDE, ENTERING DRIVEWAY, (BREAK IN CURB); PROCEED IN A WESTERLY DIRECTION TO HILL TOP, (PRAYER BOOK CROSS).

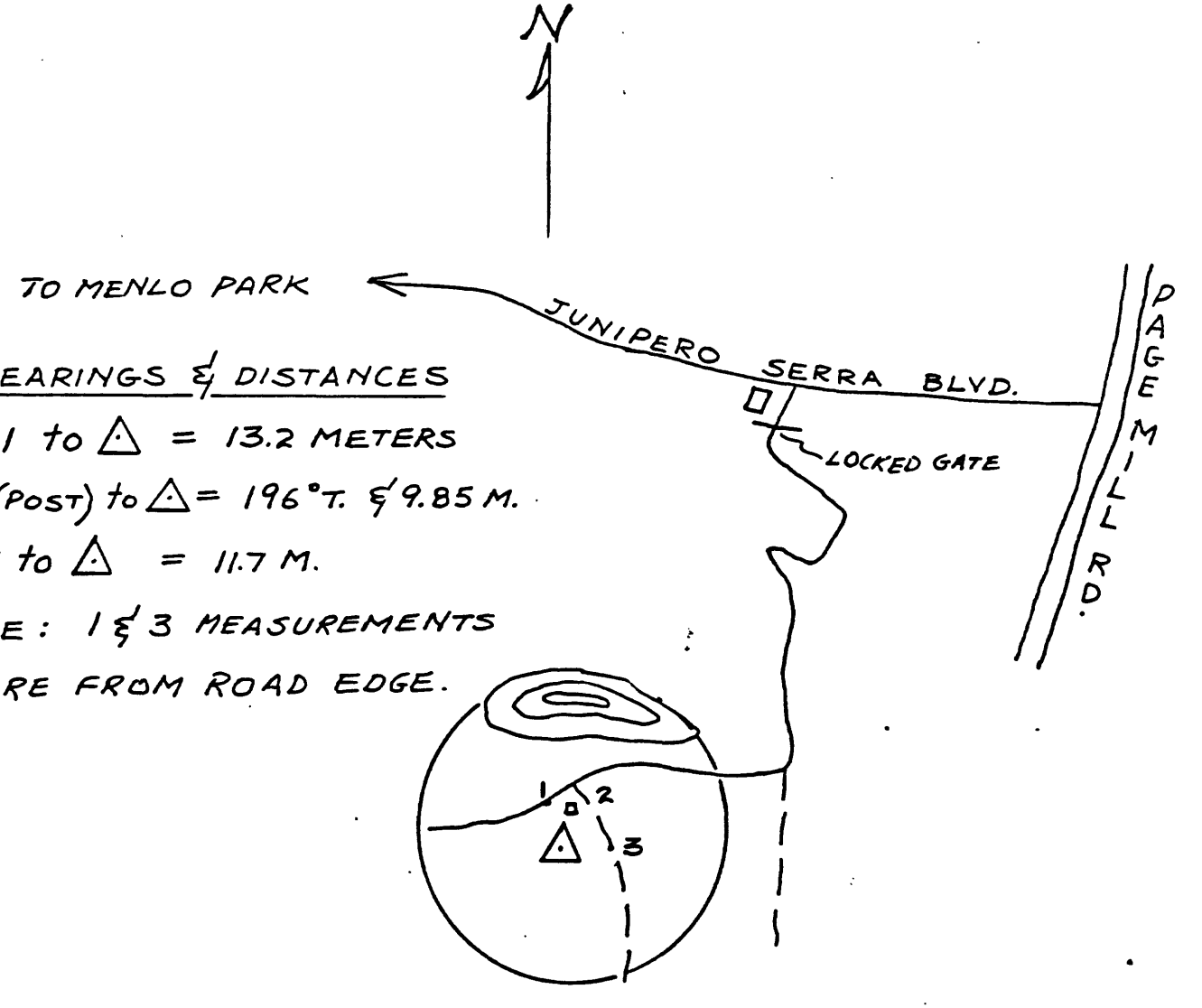
SEE SKETCH BELOW.



PAGE MILL SITE NO. 40 △ PALO ALTO 7½'

DRIVE SOUTHEASTERLY ON JUNIPERO SERRA BLVD. FROM INTERSECTION AT ALPINE ROAD ABOUT 1.65 MILES TO ROAD ON RIGHT SIDE (PRIVATE) OF JUNIPERO SERRA; ROAD IS NEXT TO LAST HOUSE BEFORE LARGE FIELD; IT (ROAD) IS ABOUT 0.65 MILES FROM ROAD TO PAGE MILL RD. INTERSECTION. PROCEED UP ROAD TO LOCKED GATE (ELECTRONICALLY CONTROLLED), KEY WITH ED ROTH. IT IS ABOUT 0.645 MILES FROM GATE TO HOLE ON MODERATELY PAVED ROAD.

SEE SKETCH BELOW.



BEARINGS & DISTANCES

1 to △ = 13.2 METERS

2 (POST) to △ = 196°T. & 9.85 M.

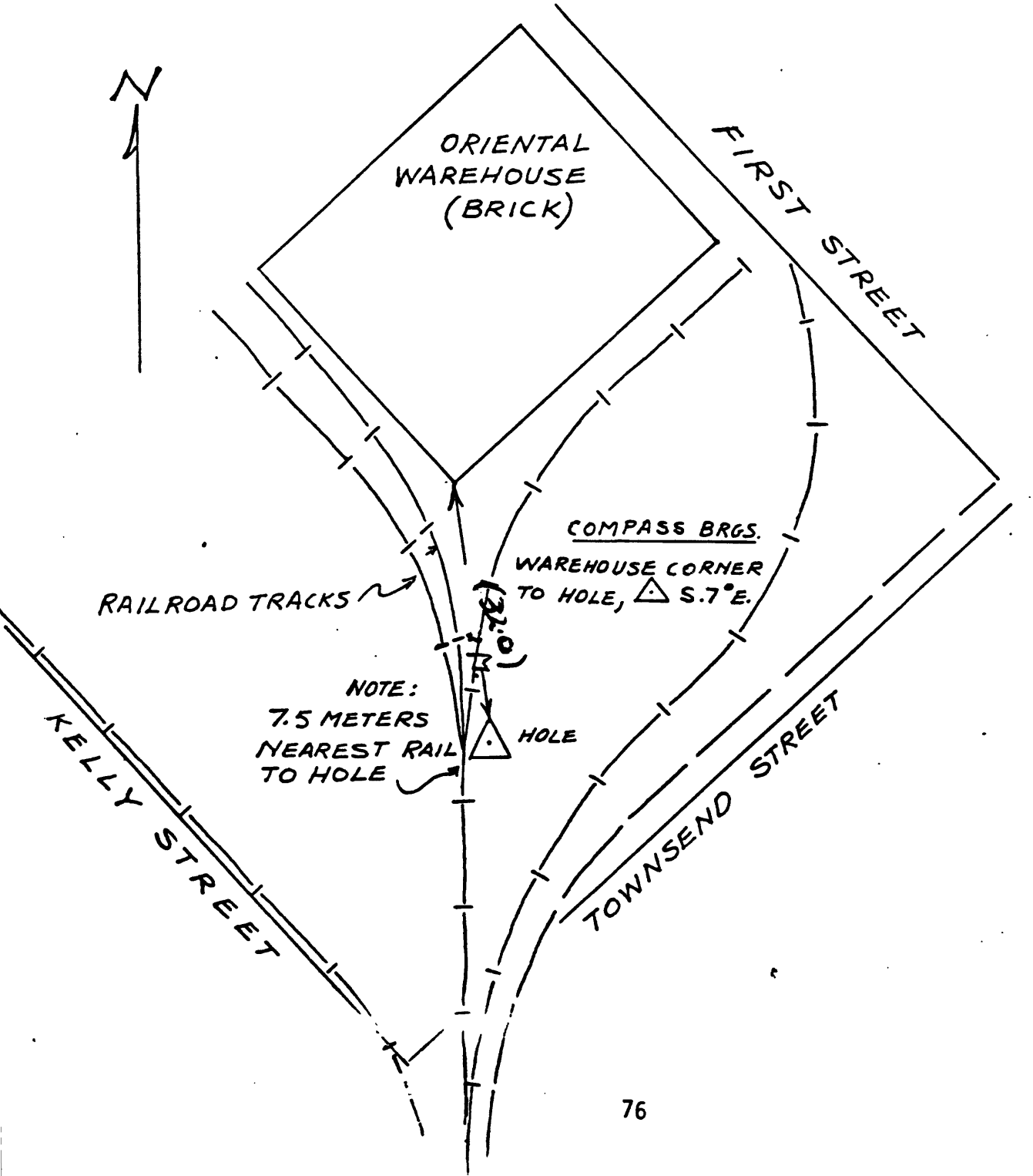
3 to △ = 11.7 M.

NOTE: 1 & 3 MEASUREMENTS ARE FROM ROAD EDGE.

SOUTHERN PACIFIC SITE NO. 41 △ SAN FRANCISCO (NO.) 7½'

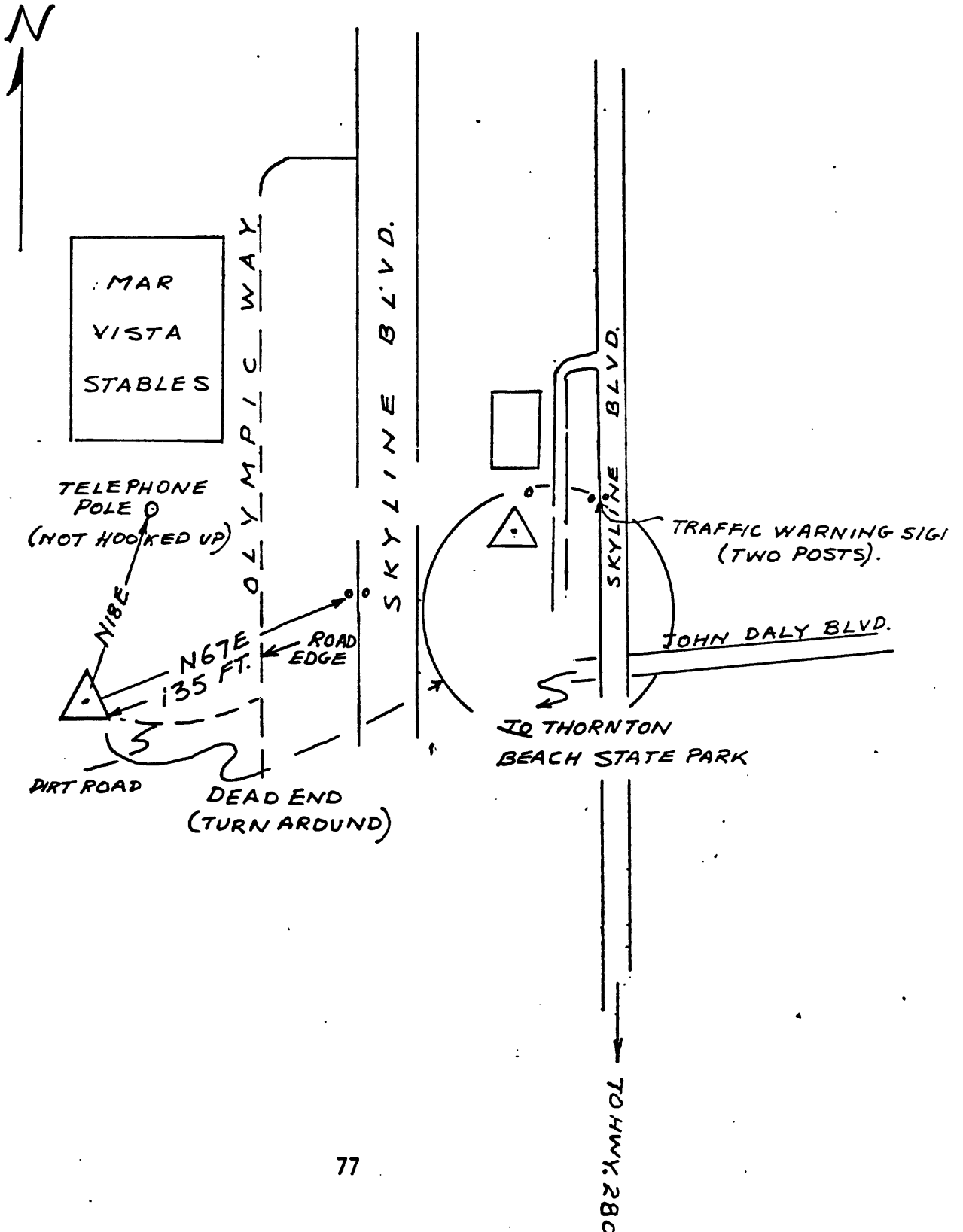
DRIVE NORTH ON HWY. #101, (BAYSHORE FWY.) AND MERGE OFF 101 AT 6TH STREET, HWY. 280 RAMP. CONTINUE ON 280 TO 3RD STREET; TURN LEFT GO ONE SHORT BLOCK TO TOWNSEND STREET, TURN RIGHT ON TOWNSEND AND CONTINUE TO SECTION OF STREET WHERE R.R. TRACKS CROSS STREET OBLIQUELY INTO AREA OF KELLY STREET. SITE IS IN LARGE VACANT LOT NEAR BRICK WAREHOUSE IN DIRECTION OF CONTINUING TRACK FOOTAGE. SEE SKETCH BELOW.

S.P. REFERENCE FILE #9251/310-1
DEC. 1, 1975.



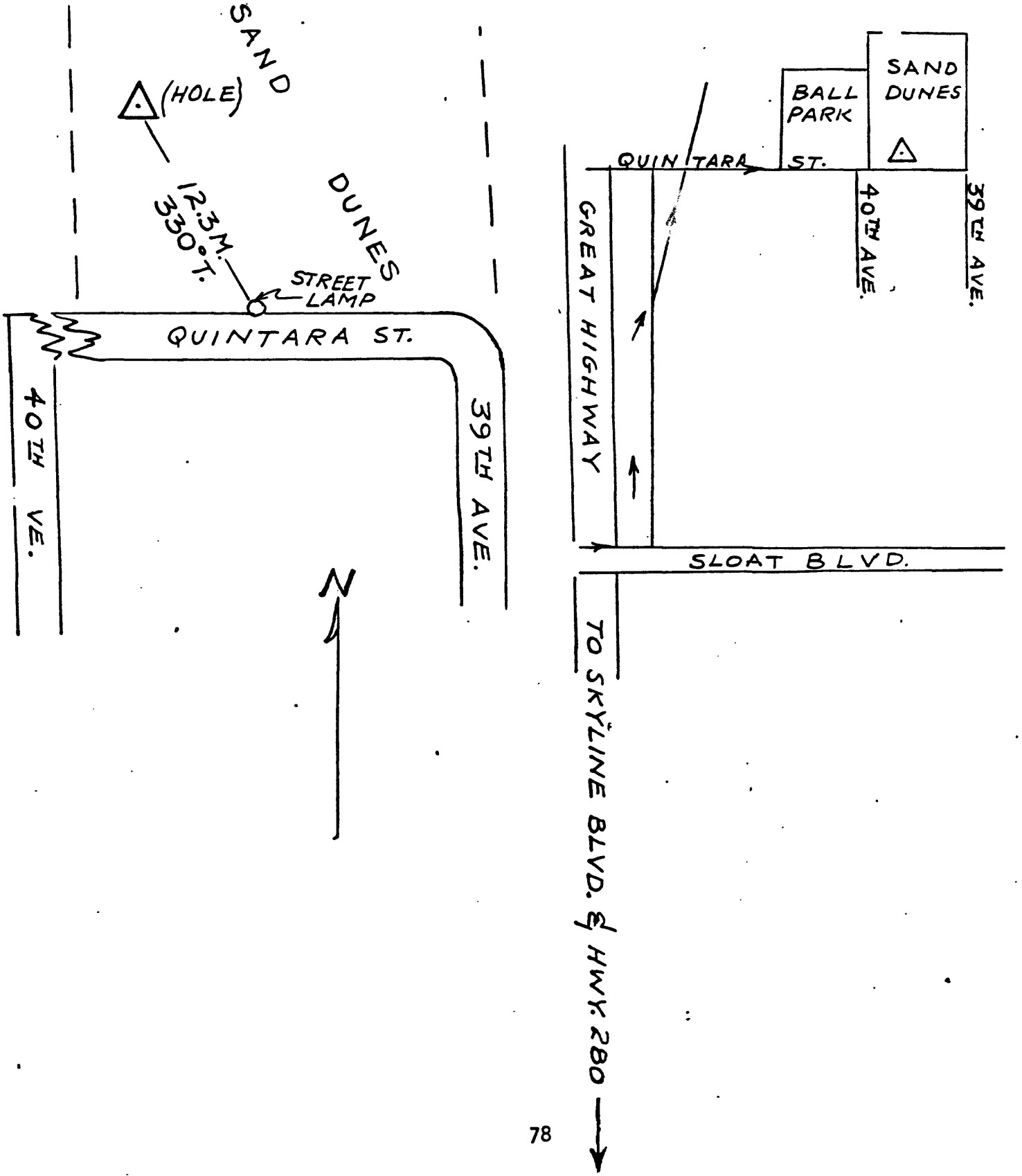
MAR VISTA SITE NO. 42 SAN FRANCISCO, (SO.) 7½'

DRIVE NORTH ON HWY. 280 TO VICINITY OF SAN ANDREAS LAKE, TAKE PACIFIC SKYLINE BLVD. OFF RAMP AND CONTINUE NORTH ON SKYLINE TO JOHN DALY BLVD. STAY IN LEFT LANE AFTER CROSSING JOHN DALY, AND TURN LEFT ON OLYMPIC WAY (CUL de SAC) IN FRONT OF MAR VISTA RIDING STABLE. CONTINUE ON OLYMPIC WAY, (SOUTHERLY) TO DIRT ROAD. SEE SKETCH BELOW.



QUINTARA SITE NO. 43 △ SAN FRANCISCO (SO.) 7½'

DRIVE NORTH ON HWY. 280 TO VICINITY OF SAN ANDREAS LAKE, MERGE ONTO SKYLINE BLVD. AND DRIVE NORTH ON SKYLINE TO GREAT HIGHWAY, (ESPLANADE) IN SAN FRANCISCO. IMMEDIATELY AFTER TRAFFIC LIGHT AT GREAT HIGHWAY & SLOAT BLVD., TURN RIGHT (STOP SIGN) THEN LEFT PARALELLING "G.H." UNTIL QUINTARA, (8 BLOCKS). TAKE RIGHT TURN ON QUINTARA AND DRIVE UP HILL TO 40TH AVE., (9 BLOCKS). SEE SKETCH



HILLVIEW COURT WESTLAKE PALISADE SAN FRANCISCO

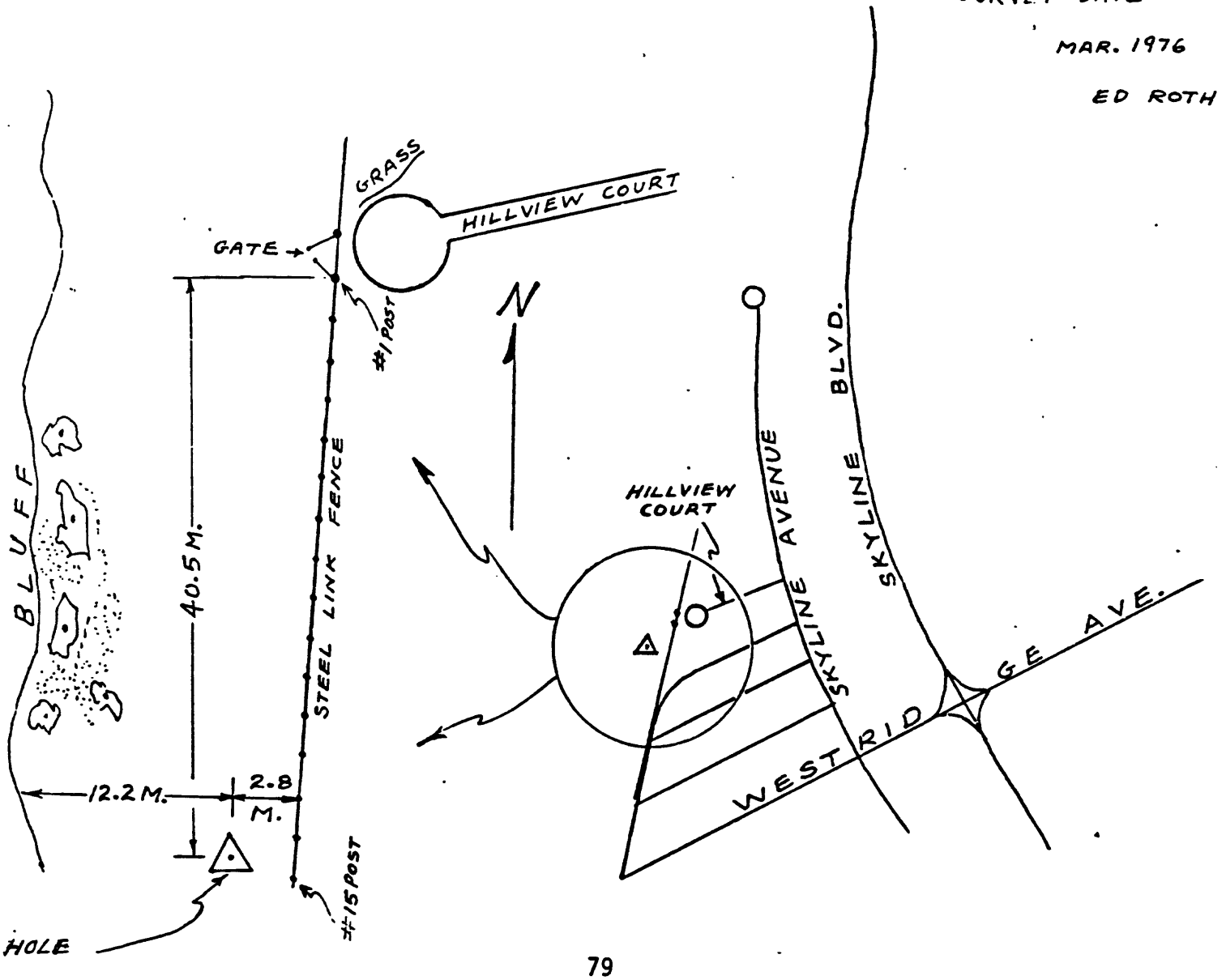
DALY CITY, CA. SITE NO. 44 △ SOUTH 7½'

DRIVE NORTH ON HWY. 280 TO THE PACIFICA, SKYLINE BLVD. OFF RAMP (VICINITY OF LAKE SAN ANDREAS). TAKE, OFF RAMP AND CONTINUE ON SKY-LINE BLVD. TO WESTRIDGE AVE, (ONE MAJOR INTERSECTION NORTH OF WESTMOOR AVE.). TAKE A LEFT ON WESTRIDGE AVE., THEN A RIGHT ON SKYLINE AVE. GO FOUR, (4) BLOCKS TO HILLVIEW CT., LEFT TO END OF CUL DE SAC, THROUGH GATE, NOT LOCKED. SEE SKETCH FOR FURTHER DETAILS.

SURVEY DATE

MAR. 1976

ED ROTH



AVALON DRIVE SITE 45 WESTLAKE PALISADE △ SAN FRANCISCO 7½ (SO.)

DALY CITY, CA.

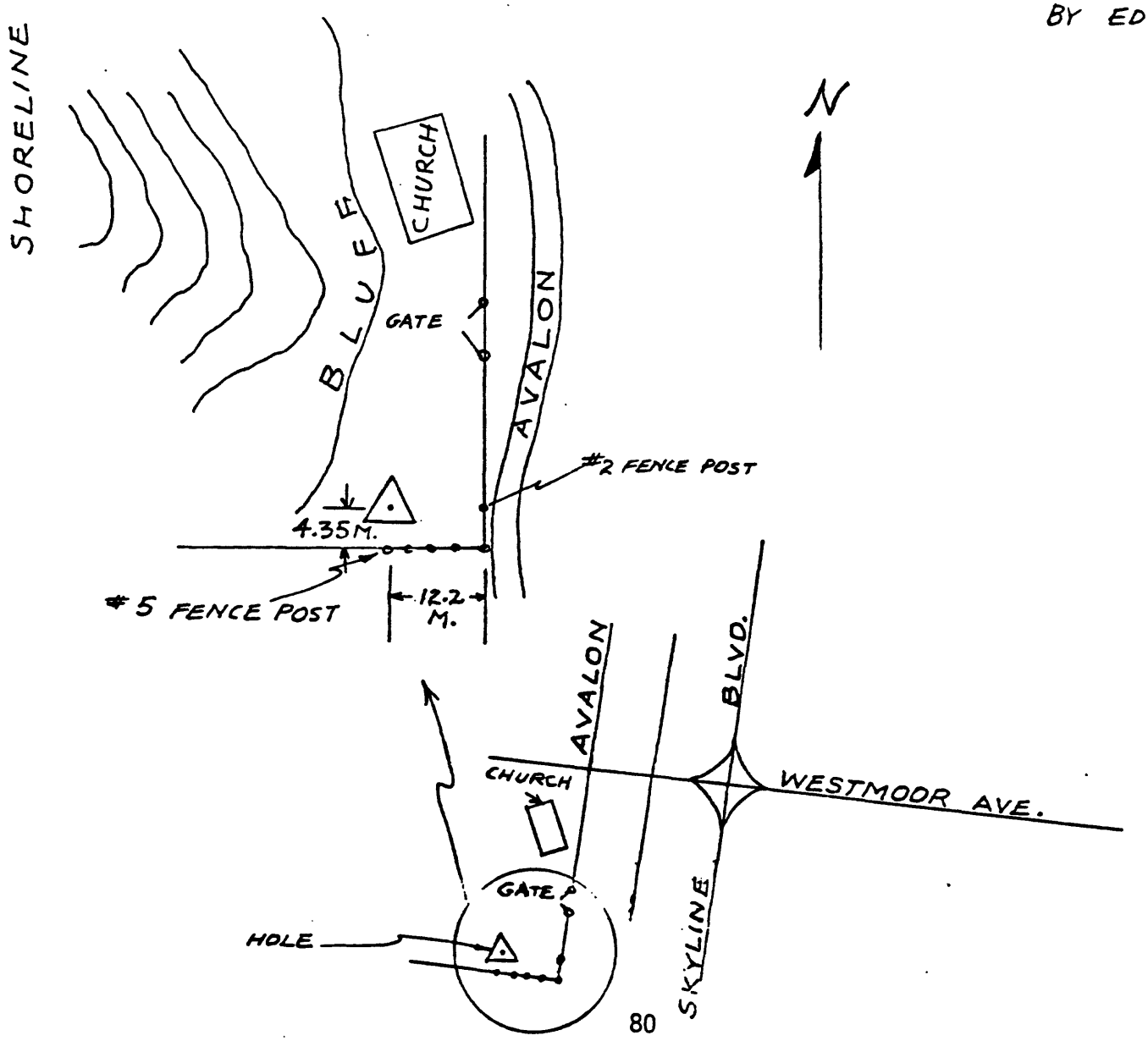
DRIVE NORTH ON HWY. 280, TAKING THE PACIFICA, SKYLINE BLVD. OFF LANE, (LAKE SAN ANDREAS VICINITY). CONTINUE ON SKYLINE BLVD. TO WESTMOOR AVE. INTERSECTION, DALY CITY. TURN LEFT, GO TWO BLOCKS TO AVALON DRIVE; TURN LEFT, GO PAST CHURCH AND STOP AT GATE IN STEEL LINK FENCE, (ABOUT 0.15 MILE FROM WESTMOOR AND AVALON DRIVE). SEE SKETCH MAP BELOW FOR DETAILS.

ED ROTH HAS KEY TO LOCKED GATE.

DATE OF SURVEY

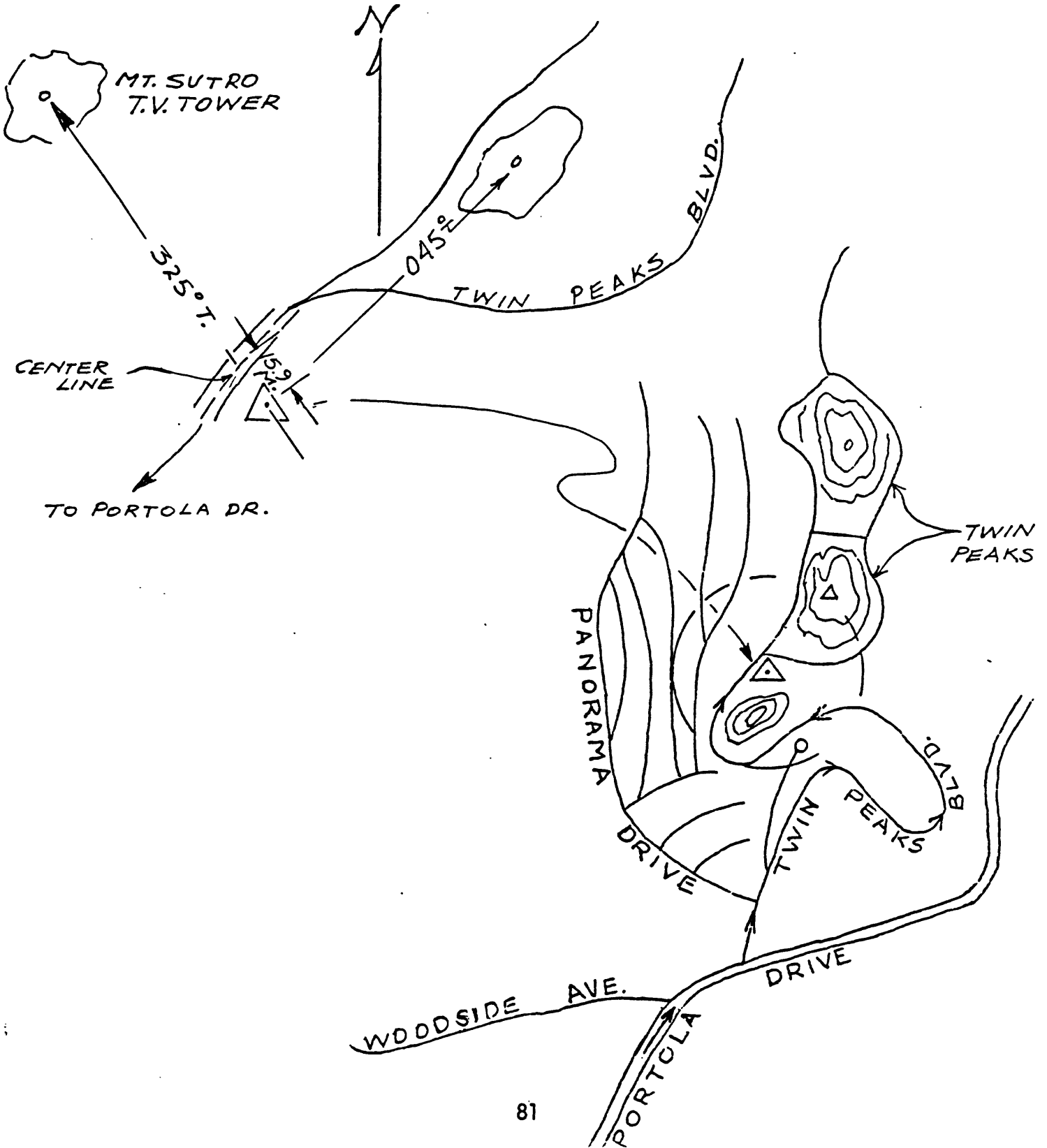
MARCH, 1976

BY ED ROTH



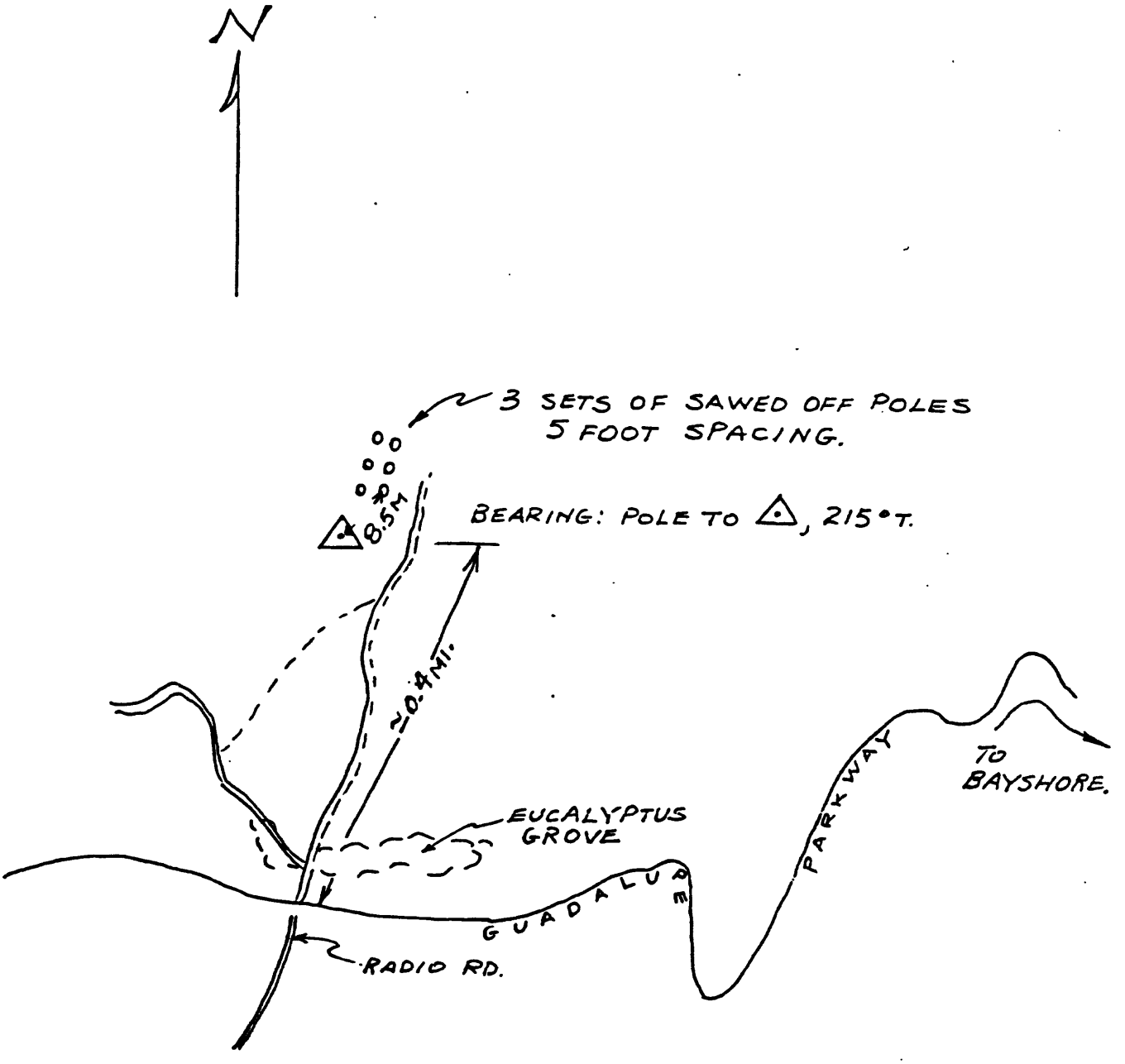
TWIN PEAKS SITE NO. 46 △ SAN FRANCISCO (NO.) 7½'

DRIVE NORTH ON HWY. 280 TO 19TH AVE. GOLDEN GATE BRIDGE OFF LANE (DALY CITY). MERGE LEFT AND CONTINUE ON 19TH AVE. TO SLOAT BLVD. TURN RIGHT AND IN ABOUT 0.2 MILE, SLOAT BECOMES (OBLIQUE LEFT) PORTOLA DRIVE. DRIVE ON PORTOLA DRIVE TO TWIN PEAKS BLVD., (ABOUT 1.35 MILES). TURN LEFT AND STAY ON TWIN PEAKS BLVD. TO FIRST RIGHT; SITE IS IN "QUARRY" AT THIS JUNCTION. SEE SKETCH BELOW.



SAN BRUNO MT. SITE NO. 47 △ SAN FRANCISCO (SO.) 7½'

DRIVE NORTH ON HWY. 101 (BAYSHORE) TO BRISBANE, COW PALACE OFF RAM TAKE THIS (OVERHEAD) TO 2ND SIGNAL LIGHT. THIS INTERSECTION IS ≃ 1.7 MILES FROM OVERHEAD. TURN LEFT (GUADALUPE PKWY.) AND CLIMB ABOUT 2.0 MILES TO MESA AREA WHERE FWY. INTERSECTS, (FAINTLY) WITH ROAD (NAMED RADIO RD.). TURN RIGHT, (NORTH) OVER CURBING AND CONTINUE ON RUTTED BLACK TOPPED ROAD, (BECOMES DIRT) THROUGH EUCALYPTUS GROVE ≃ 0.3 MILES, UPHILL TO SANDSTONE OUTCROP ON LEFT. SEE SKETCH BELOW FOR DETAILS.



SKYLINE BLVD. WESTLAKE PALISADE SAN FRANCISCO SO. 7½'

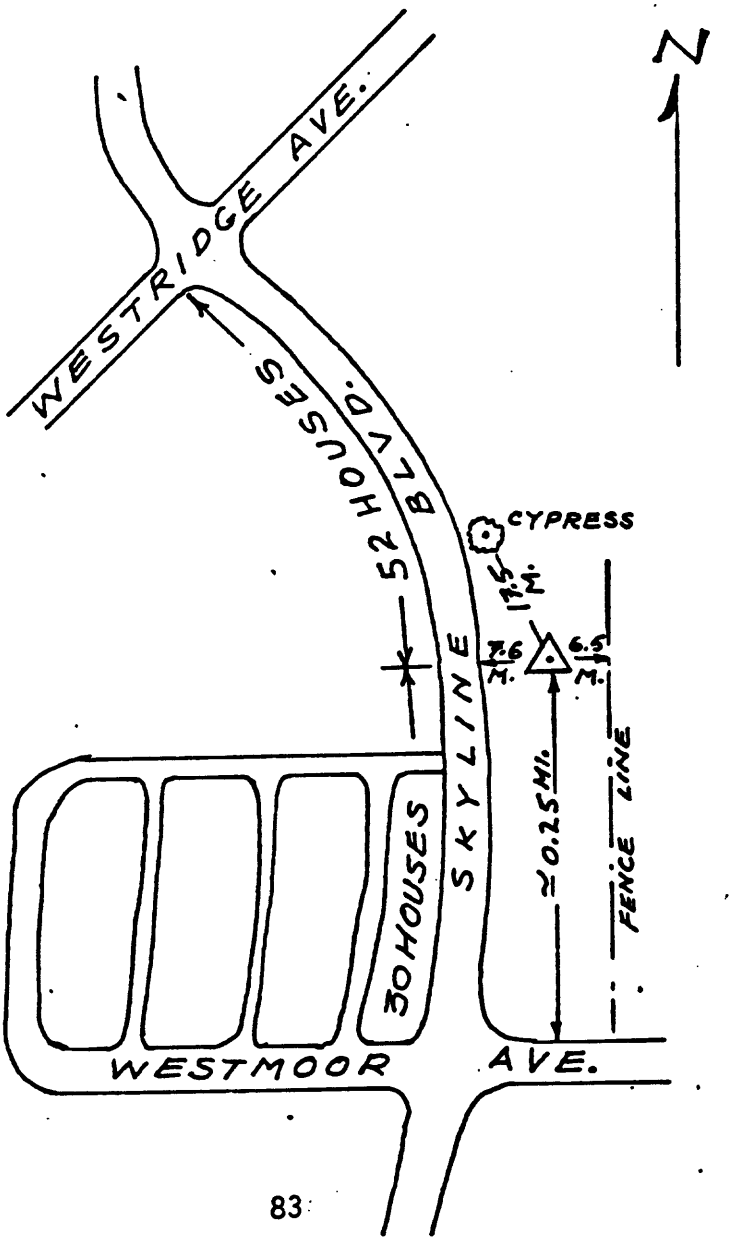
DALY CITY SITE NO. 48 △

DRIVE NORTH ON HWY. 280 TO PACIFICA, SKYLINE BLVD. OFF LANE. CONTINUE ON SKYLINE BLVD. ≃ 0.25 MILE BEYOND WESTMOOR AVE. DRIVE UP OVER ROLLED CURB ≃ 100 FT. SHORT OF A 6 TO 8 FT. HIGH CYPRESS BUSH. THE HOLE IS ≃ 17.5 METERS SOUTH OF THIS BUSH; AND IT IS 6.5 METERS FROM HOLE TO FENCE, AND 7.6 METERS TO CURB EDGE.

DATE OF SURVEY

FEB. 4, 1976

BY : ED ROTH



SKYLINE AT WESTMOOR AVE. WESTLAKE PALISADE SAN FRANCISCO

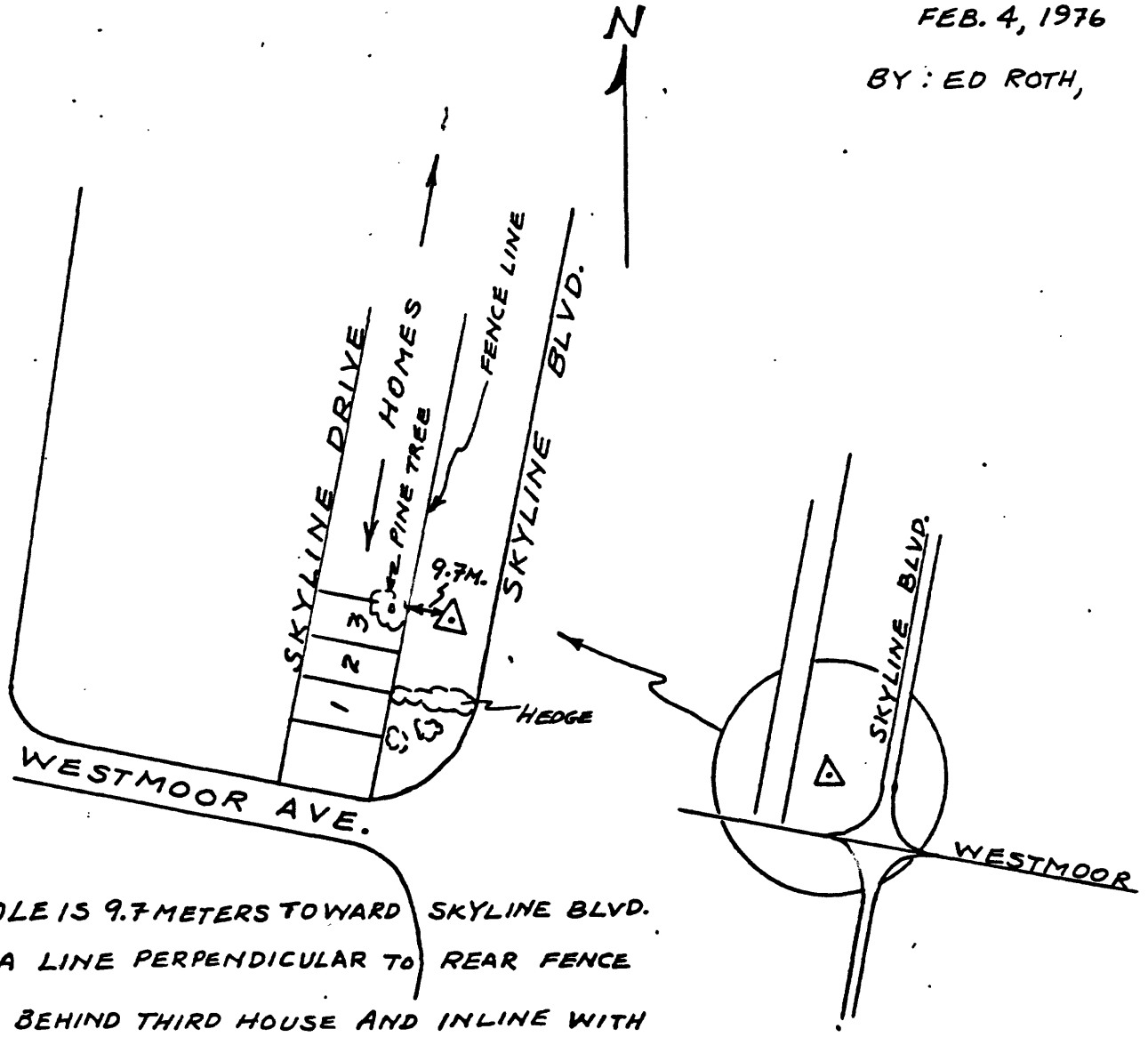
DALY CITY SITE NO. 49 SOUTH 7½'

DRIVE NORTH ON HWY. 280, TAKING THE PACIFICA SKYLINE BLVD. OFF LANE. DRIVE TO INTERSECTION OF SKYLINE BLVD. AND WESTMOOR AVE. HOLE IS IN LOW CHAPARRAL ON THE N.W. QUADRANT OF THIS LARGE INTERSECTION. SEE SKETCH MAP BELOW FOR DETAILS.*

DATE OF SURVEY

FEB. 4, 1976

BY: ED ROTH,

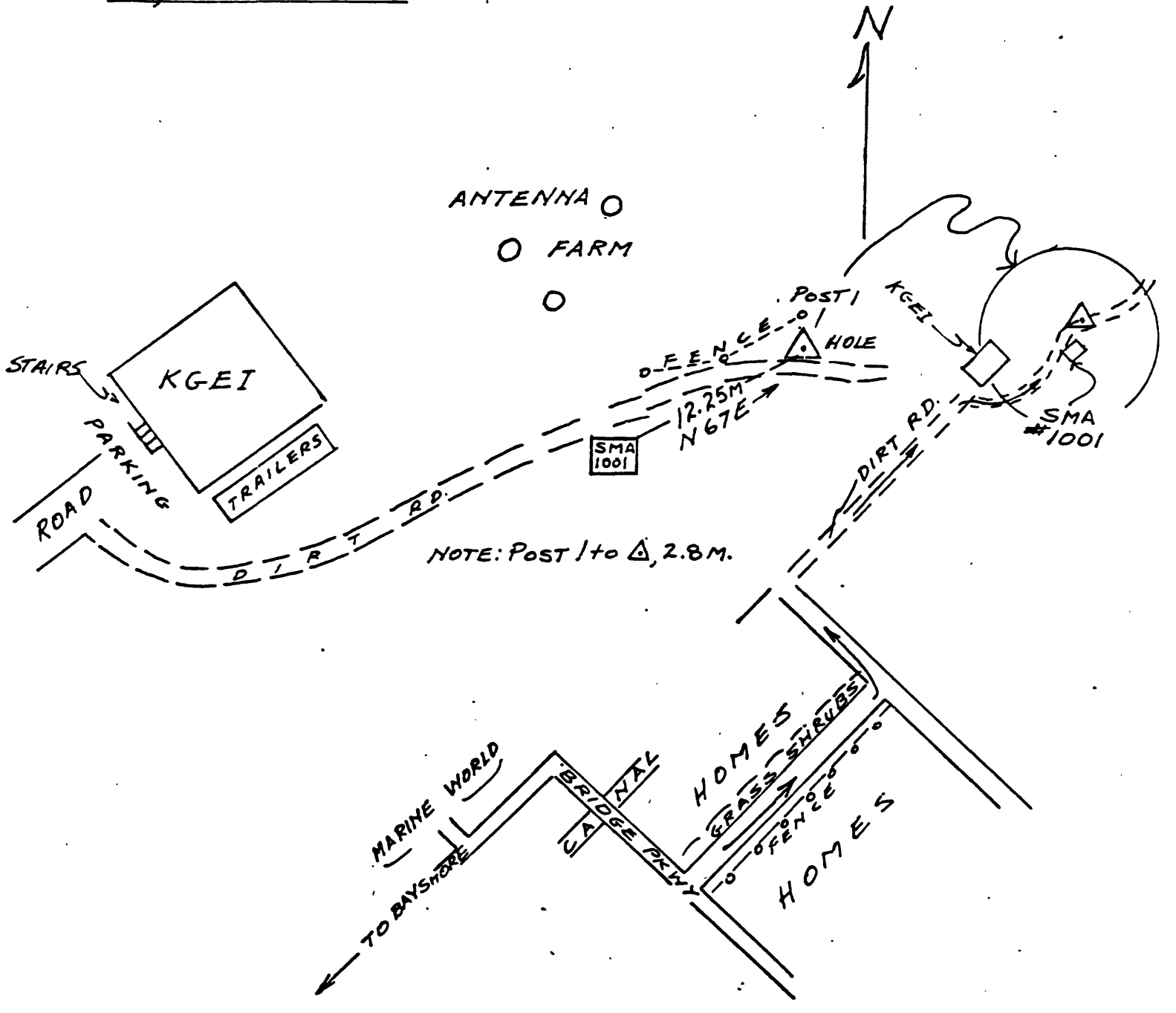


HOLE IS 9.7 METERS TOWARD SKYLINE BLVD. ON A LINE PERPENDICULAR TO REAR FENCE LINE BEHIND THIRD HOUSE AND INLINE WITH PROPERTY FENCE LINE AT PINE TREE BETWEEN THIRD AND FOURTH HOUSE

KGEI SITE NO. 50 △ REDWOOD PT. 7½'

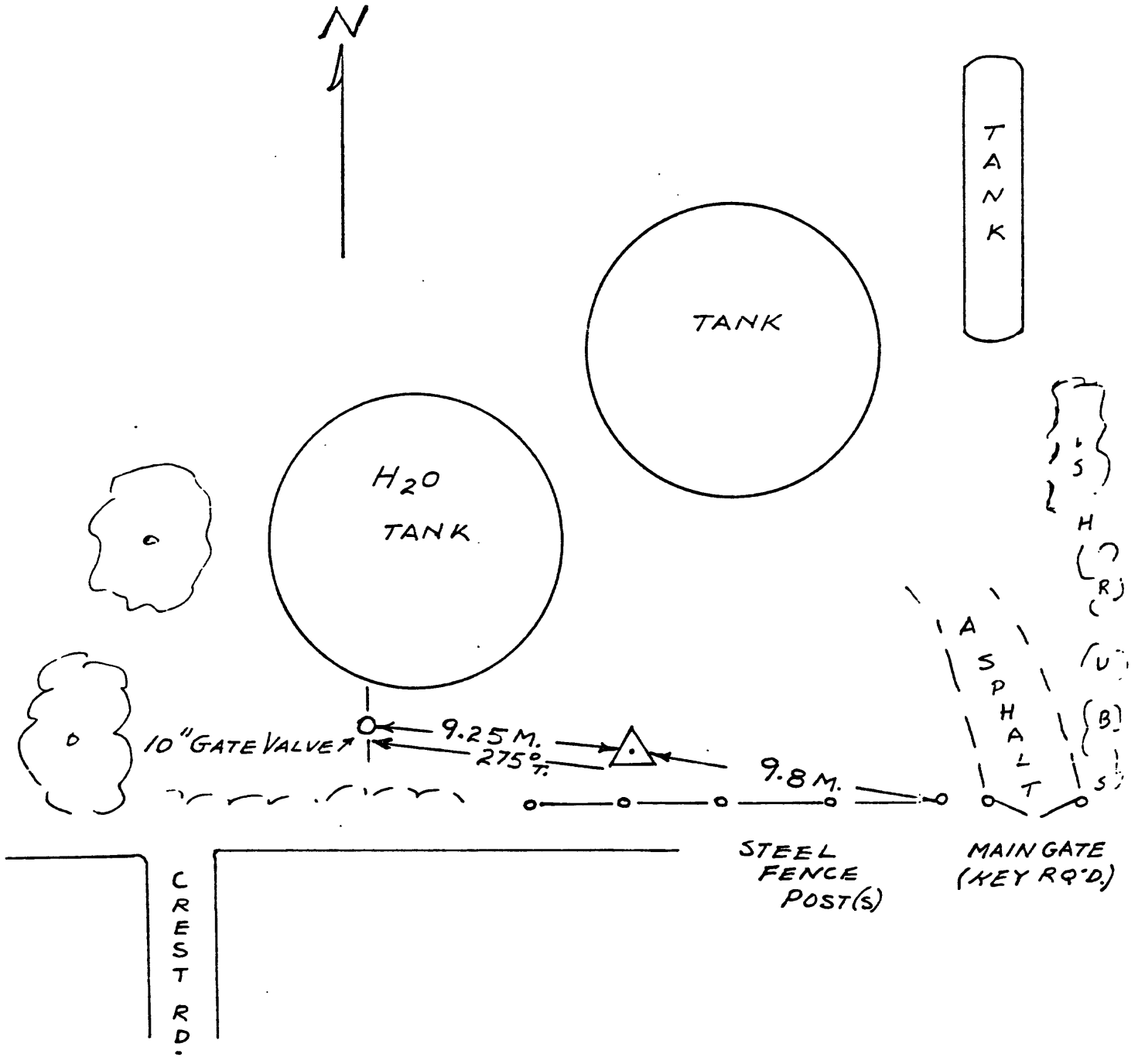
DRIVE NORTH ON HWY. #101, (BAYSHORE FWY) TO RALSTON AVE., MARINE WORLD TURN OFF. PROCEED TOWARD BAY ON RALSTON, PAST MARINE WORL OVER CANAL ON BRIDGE PARKWAY ABOUT 0.325 MILES TO DIVIDED (?) ROAD, TURN LEFT AND CONTINUE FOR ABOUT 3/4 OF A MILE, TO INTERSECTING PAVED, (DIVIDED ?) ROAD, TURN LEFT FOR ≃ 0.1 MILE, AND TURN RIGHT ON DIRT ROAD, KGEI BLDG. IS VISIBLE AT END OF THIS ROAD. SEE SKETCH BELOW.

NOTE: DO NOT USE ELECTRIC BLASTING CAPS AT THIS HOLE, TOO GREAT A RISK WITH STRONG R.F. SIGNALS. DIRT ROAD AT RADIO STATION VERY SLIPPERY WHEN WET, DON'T USE IT !!



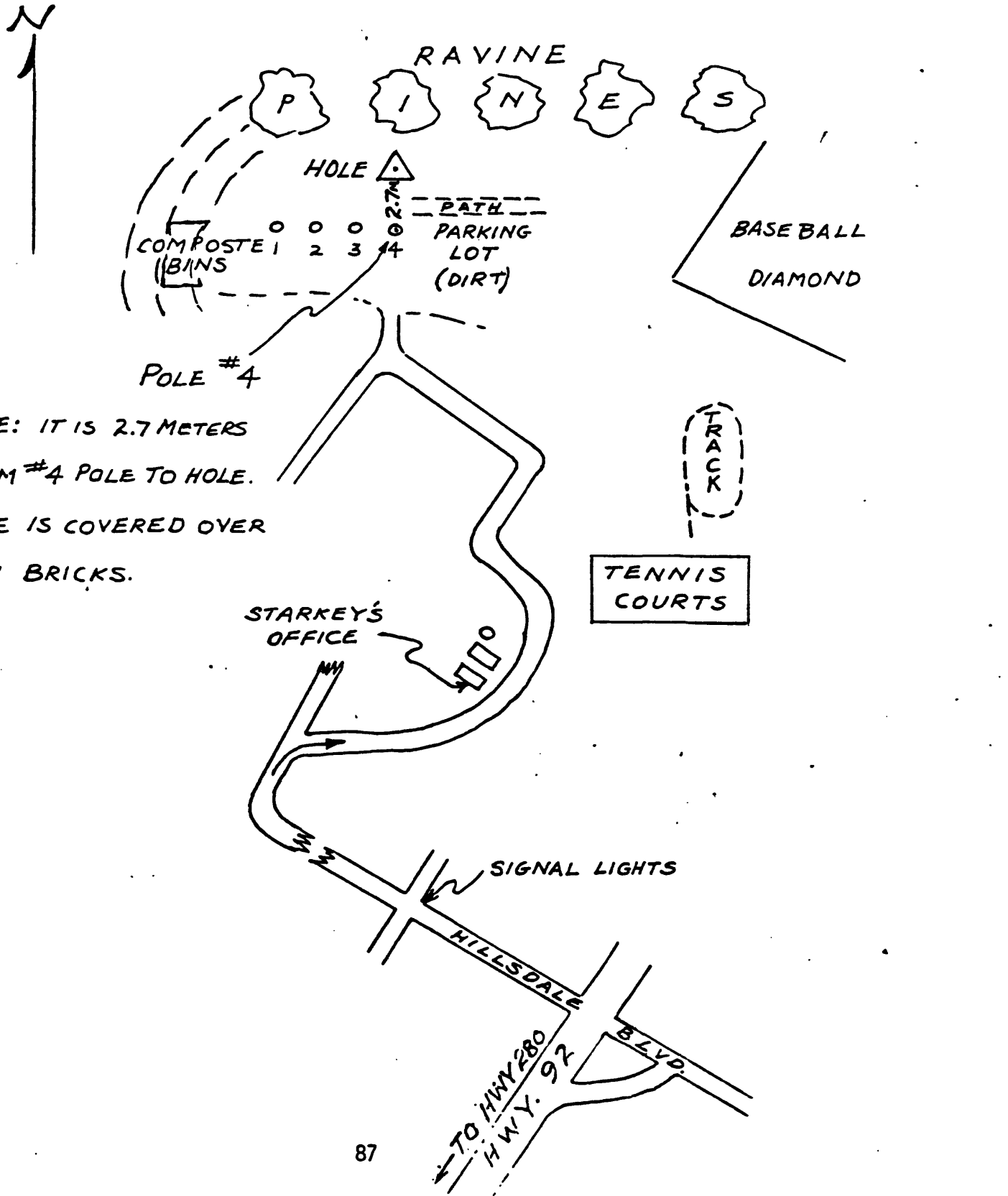
CREST ROAD SITE NO. 51 △ WOODSIDE 7½'

DRIVE NORTH ON BAYSHORE FWY. (#101) TO WOODSIDE ROAD (IN REDWOOD CITY), TAKE OFF RAMP TO WOODSIDE; GO ABOUT 2.75 MILES TO ALAMEDA de las PULGAS. TURN RIGHT ON THE ALAMEDA, GO 0.5 MILES TO MASSACHUSETTS, TURN LEFT, (NAME CHANGES TO WOODSIDE DRIVE), CONTINUE ABOUT 0.9 MILES (WINDING ROUTE) TO RIDGEWAY ROAD, TURN RIGHT ON RIDGEWAY AND CONTINUE ON CREST TO IT'S END; TAKE RIGHT TURN, TANK IS ABOUT 100 FT. ON LEFT SIDE. SEE SKETCH BELOW. KEY NEEDED.



COLLEGE OF SAN MATEO SITE NO. 52 △ SAN MATEO 7½'

DRIVE NORTH ON HWY. 280 TO HWY. 92, ARTHUR YOUNGER FREEWAY. TAKE OFF RAMP ON 92 AND GO ABOUT 3.0 MILES TO HILLSDALE BLVD. TAKE LEFT ON HILLSDALE TO CSM. TAKE FIRST RIGHT INTO CAMPUS AND FIRST RIGHT AGAIN, (SHIPPING RECEIVING SIGN). CONTINUE ON ROAD, DOWN INCLINE PAST TENNIS COURTS, ABOVE TRACK, THROUGH GATE CURVING ABOVE AND AROUND BASEBALL DIAMOND TO OVERFLOW PARKING AREA. SEE SKETCH BELOW : E.F. ROTH, JUNE 1976.



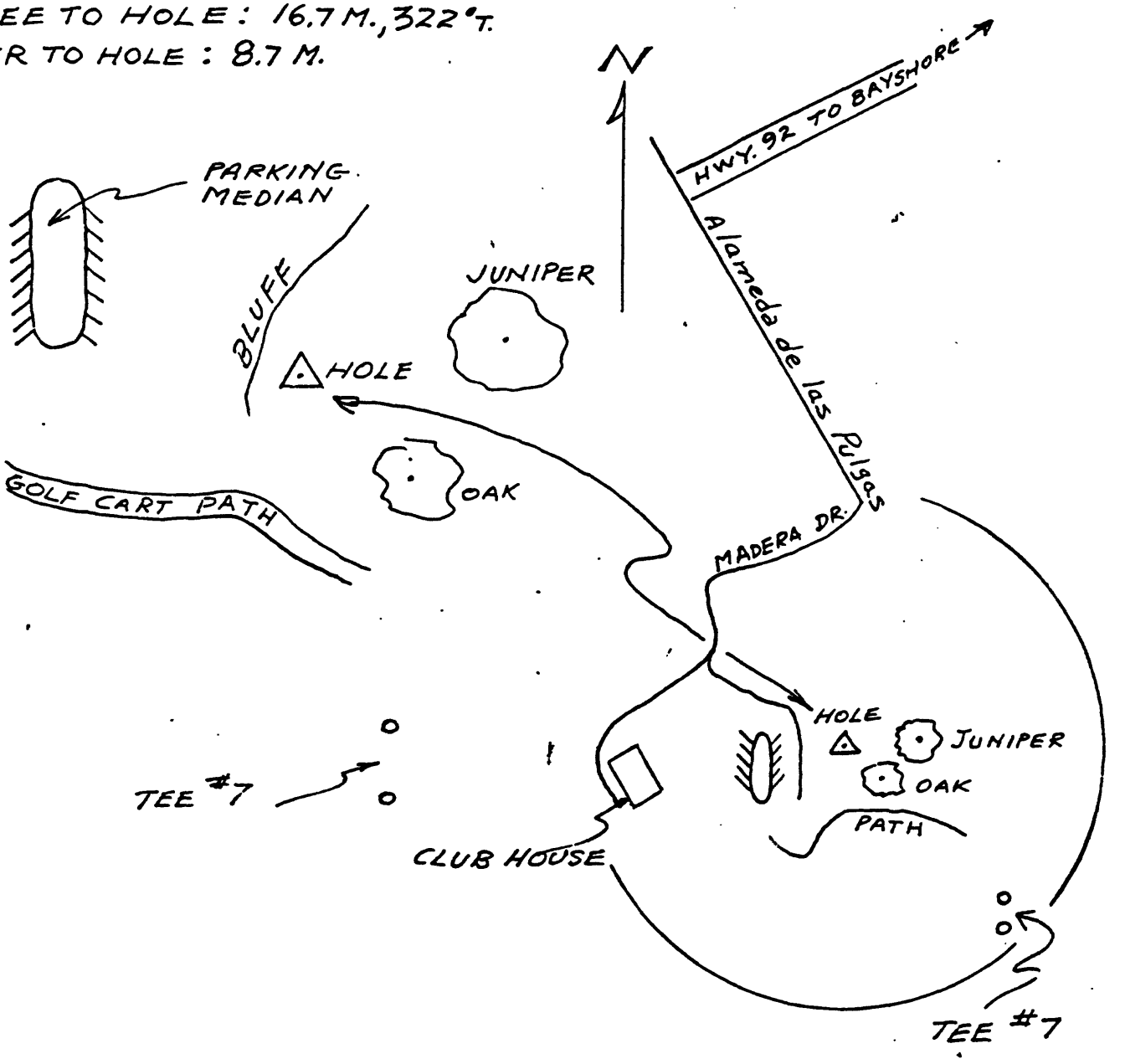
PENINSULA COUNTRY CLUB SITE NO. 53 △ SAN MATEO 7½'

DRIVE NORTH ON HWY. #101, (BAYSHORE) TO HWY. #92, TAKE #92 (HALFMOON BAY DIRECTION) ABOUT 1.50 MILES TO ALAMEDA de las PULGAS. GO LEFT ON ALAMEDA, (S.E.) 0.25 MILES TO PENINSULA COUNTRY CLUB ENTRANCE, (MADERA DRIVE), ON RIGHT SIDE OF ALAMEDA. DRIVE INTO PARKING AREA. SEE SKETCH BELOW.

DISTANCES & BEARINGS

OAK TREE TO HOLE: 16.7 M., 322° T.

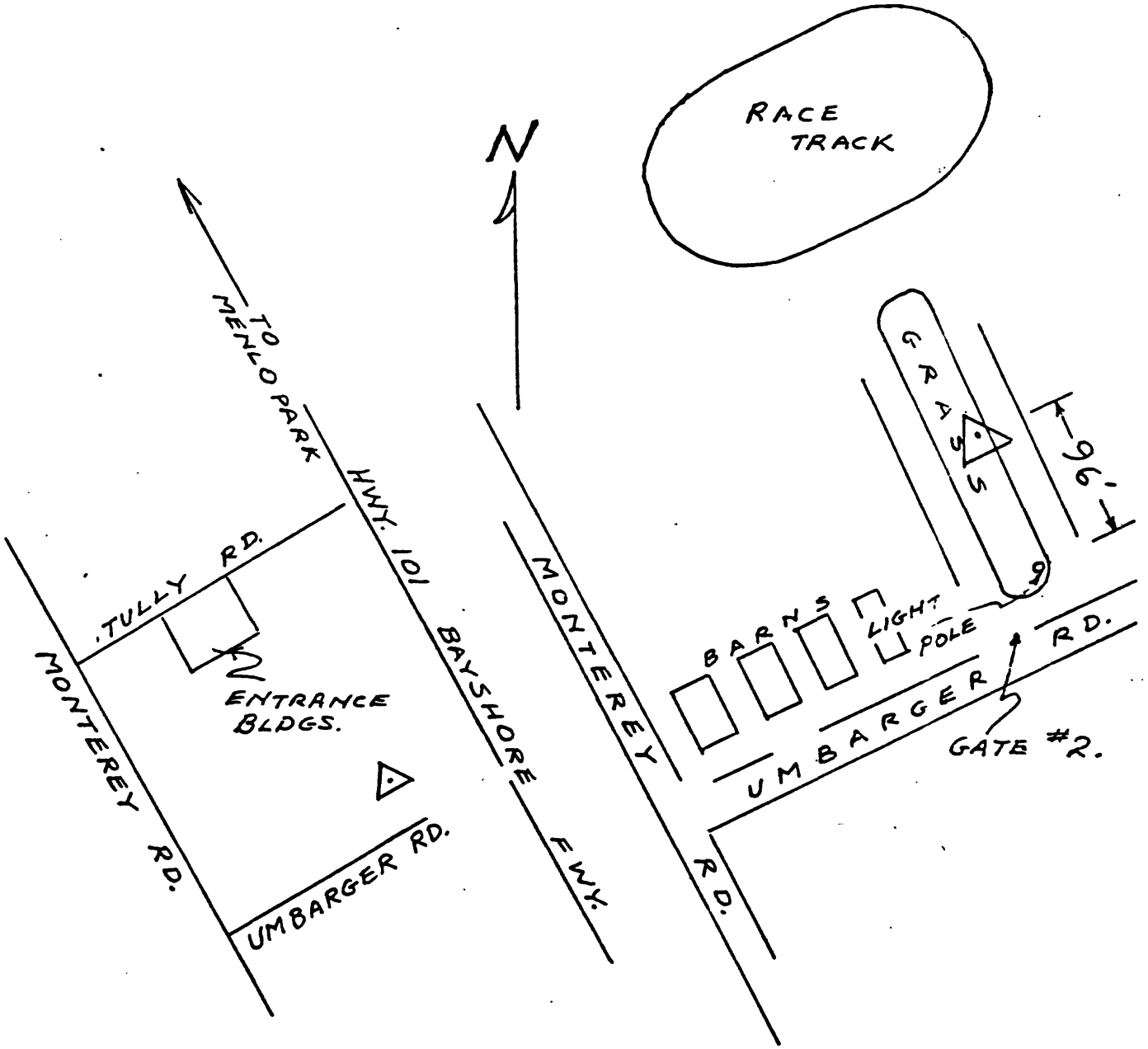
JUNIPER TO HOLE: 8.7 M.



SANTA CLARA COUNTY FAIRGROUNDS △ SAN JOSE EAST 7

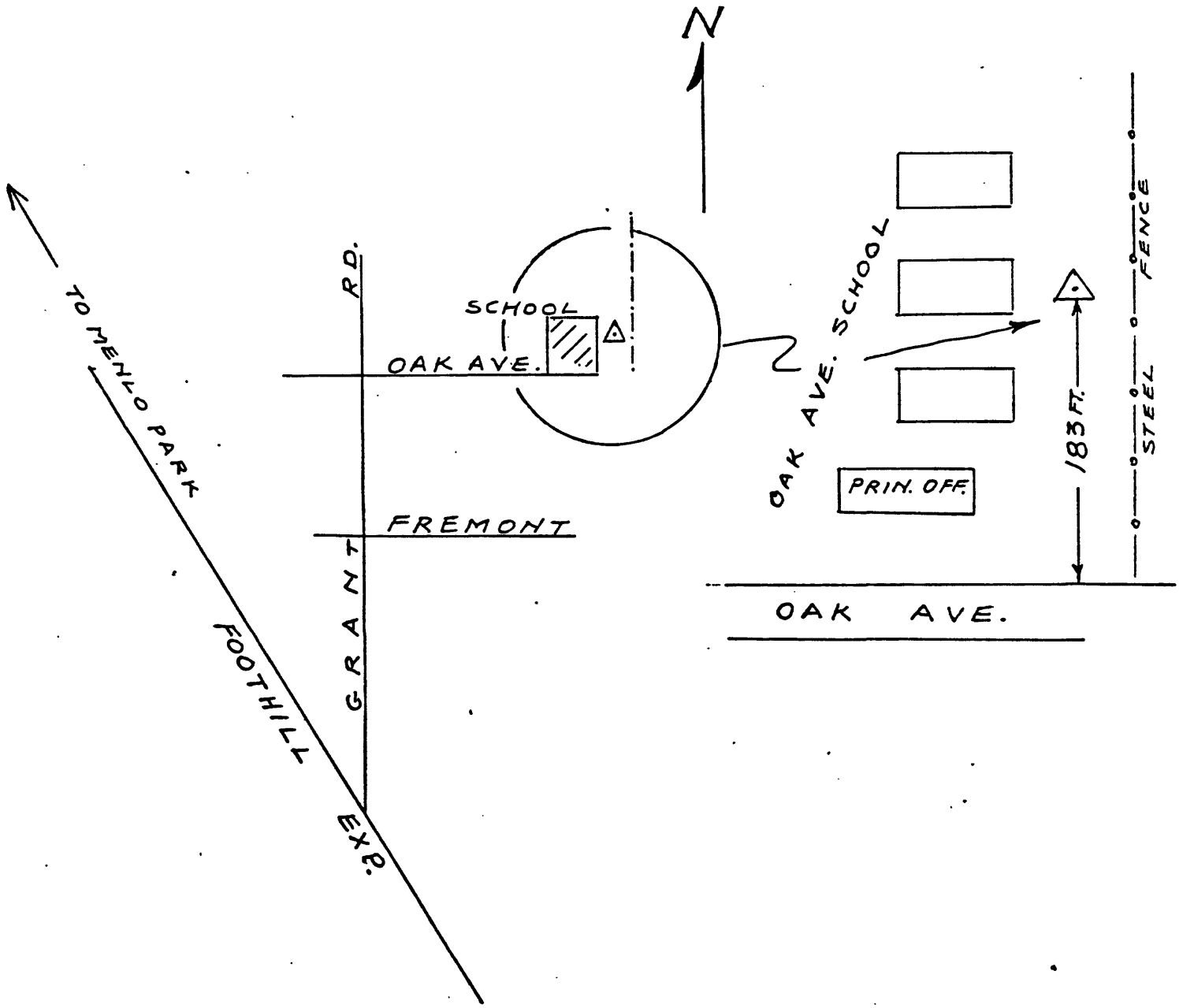
SITE NO. 54 344 TULLY RD., SAN JOSE

DRIVE SOUTH FROM MENLO PARK ON HWY. 101, (BAYSHORE FWY.) TO TULLY ROAD, (IN SAN JOSE), TURN RIGHT AND GO 1.9 MILES TO MONTEREY ROAD, TURN LEFT ON MONTEREY AND GO 0.5 MILES TO UMBARGER ROAD, TURN LEF AND CONTINUE ON UMBARGER ≃ 0.45 MILES TO GATE NO. 2, (SOUTH EN ENTER THROUGH GATE . . . . . SEE SKETCH BELOW.



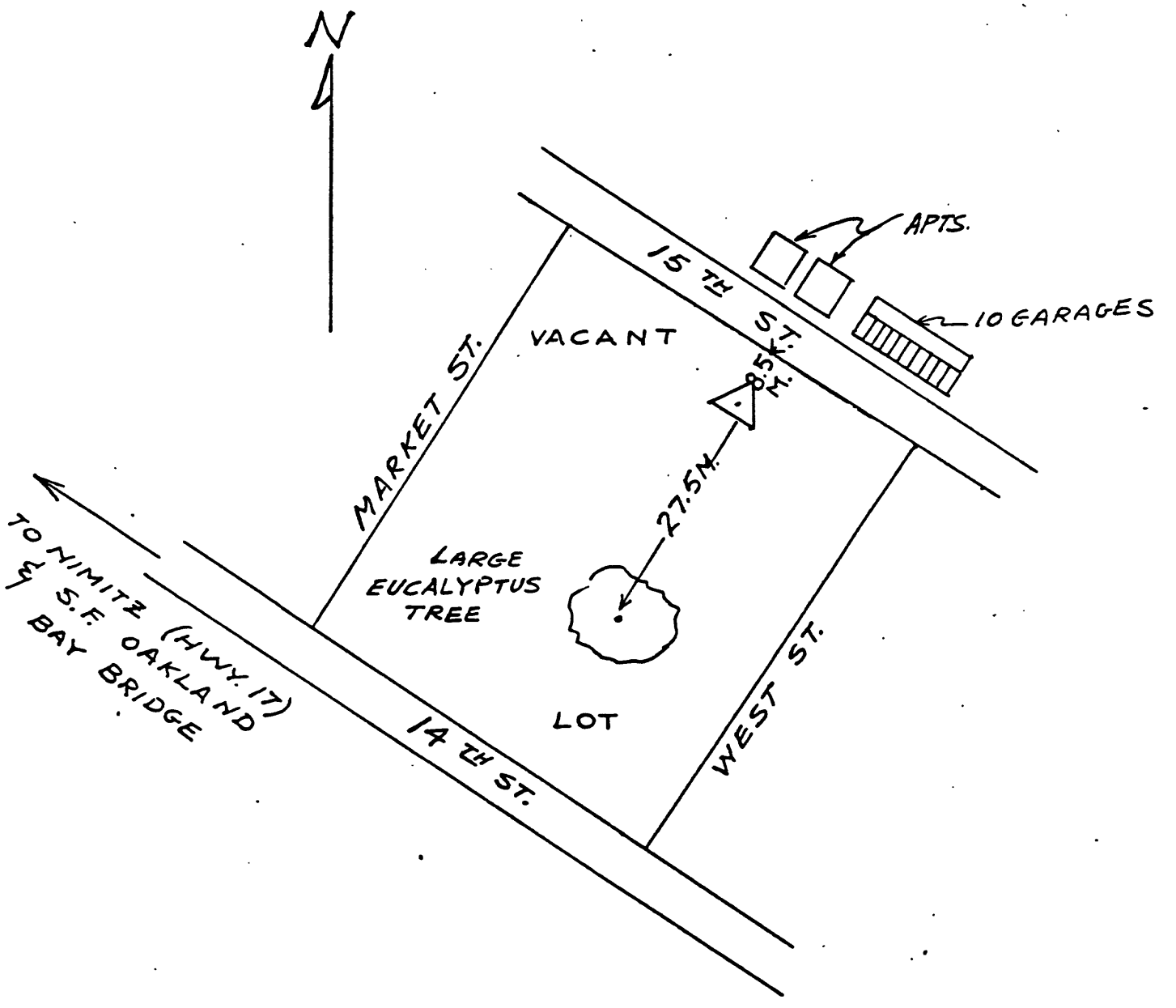
OAK AVENUE SITE NO. 55 △ CUPERTINO 7½'

DRIVE SOUTH FROM MENLO PARK TO LOS ALTOS ON FOOTHILL EXPRESSWAY. TURN LEFT OFF FOOTHILL ONTO GRANT RD. AND 0.75 MILE NORTH TO OAK AVE., TURN RIGHT AND CONTINUE 0.4 MILE ON OAK AVE., SCHOOL IS ON LEFT SIDE OF ROAD. SEE SKETCH FOR DETAILS.



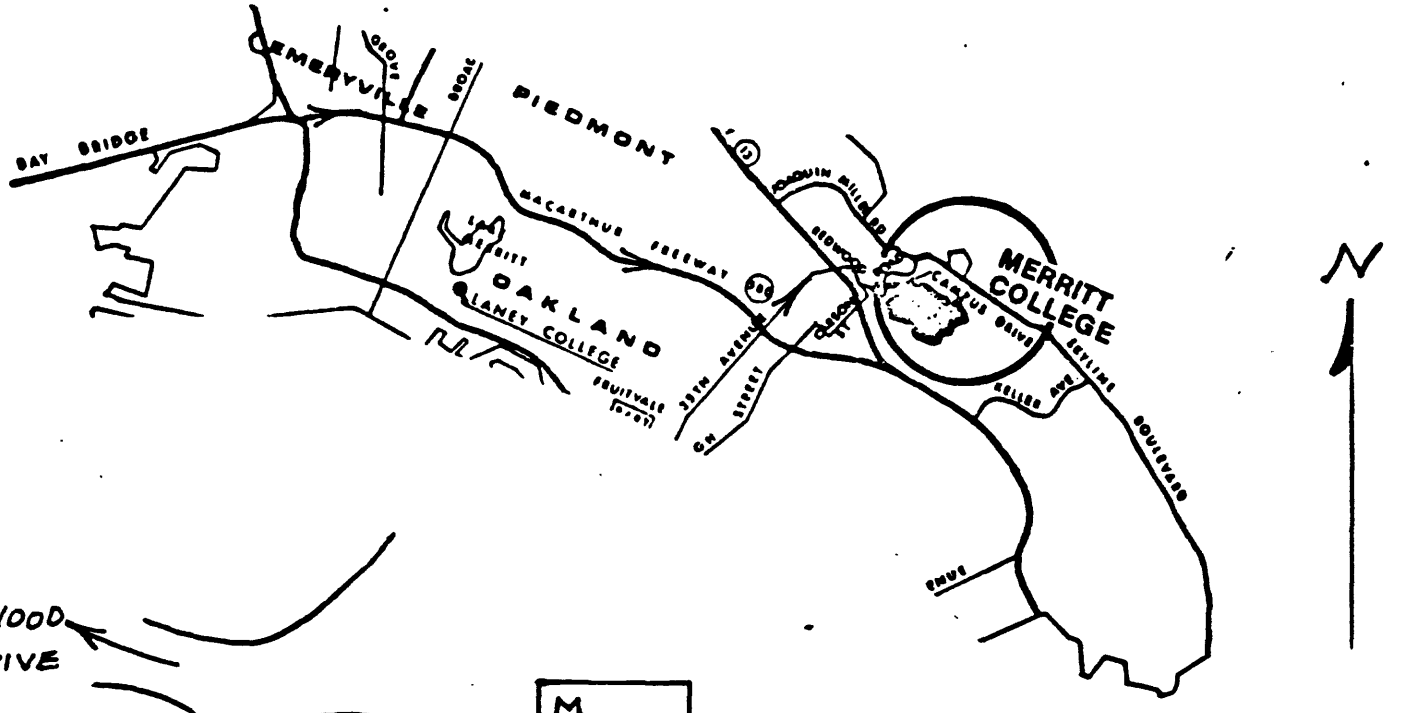
MERRITT SAND SITE NO. 56 △ OAKLAND WEST 7½'

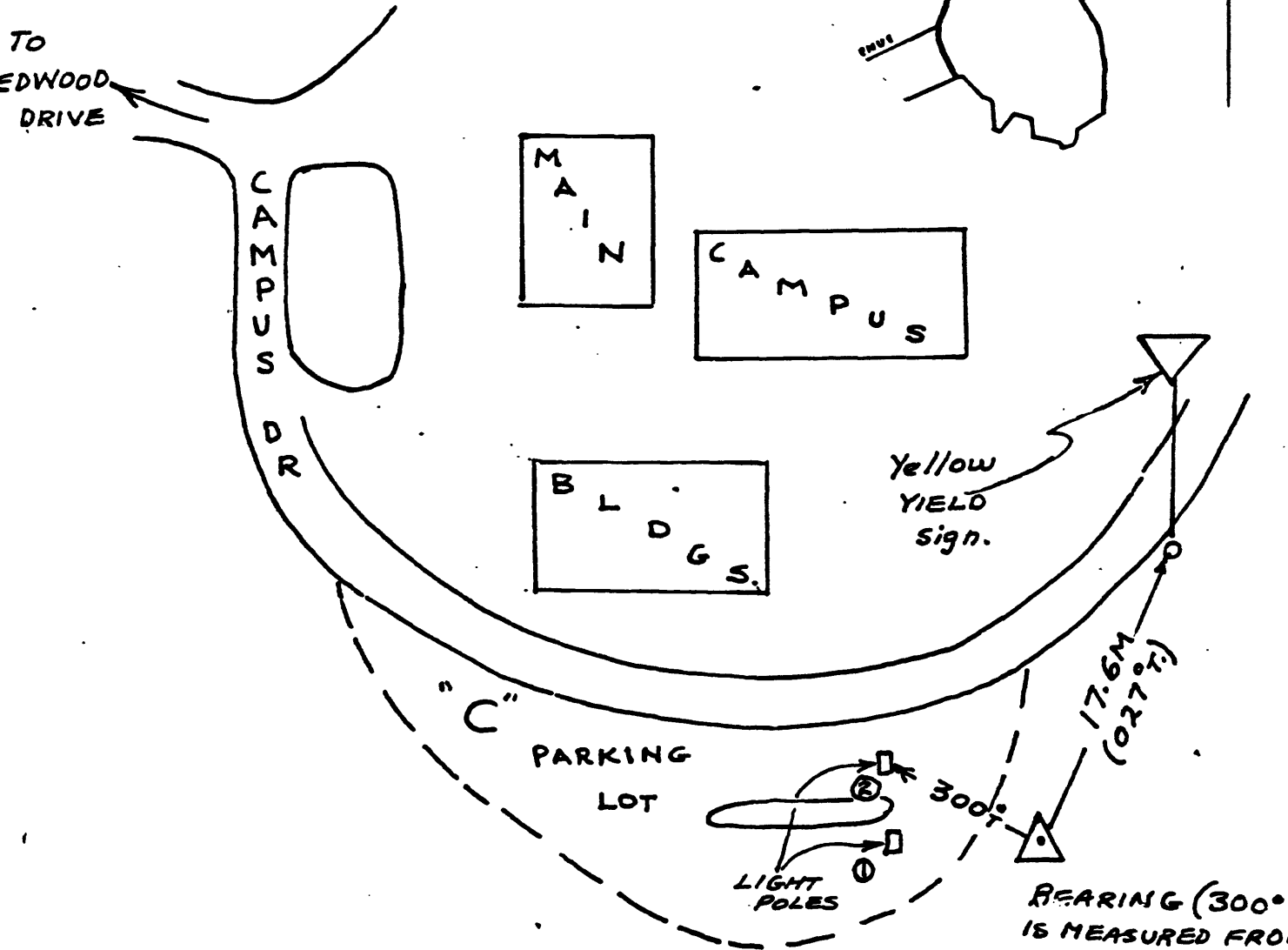
DRIVE NORTH ON HWY. 101, (BAYSHORE FWY.), CROSSING TO OAKLAND ON BAY BRIDGE; AFTER PASSING TOLL GATE, KEEP TO RIGHT AND MERGE ONTO HWY. 17, (NIMITZ FWY.), HEADING SOUTH TO 14TH STREET, (ABOUT 1.25 MILES) TAKE 14TH STREET EASTERLY TO MARKET ST., TURN LEFT ON MARKET, GO ONE BLOCK TO 15TH ST. TURN RT. AND GO ONE-HALF BLOCK TO AREA OF HOLE. SEE SKETCH BELOW.



MERRITT COLLEGE SITE NO. 57 OAKLAND EAST 7½

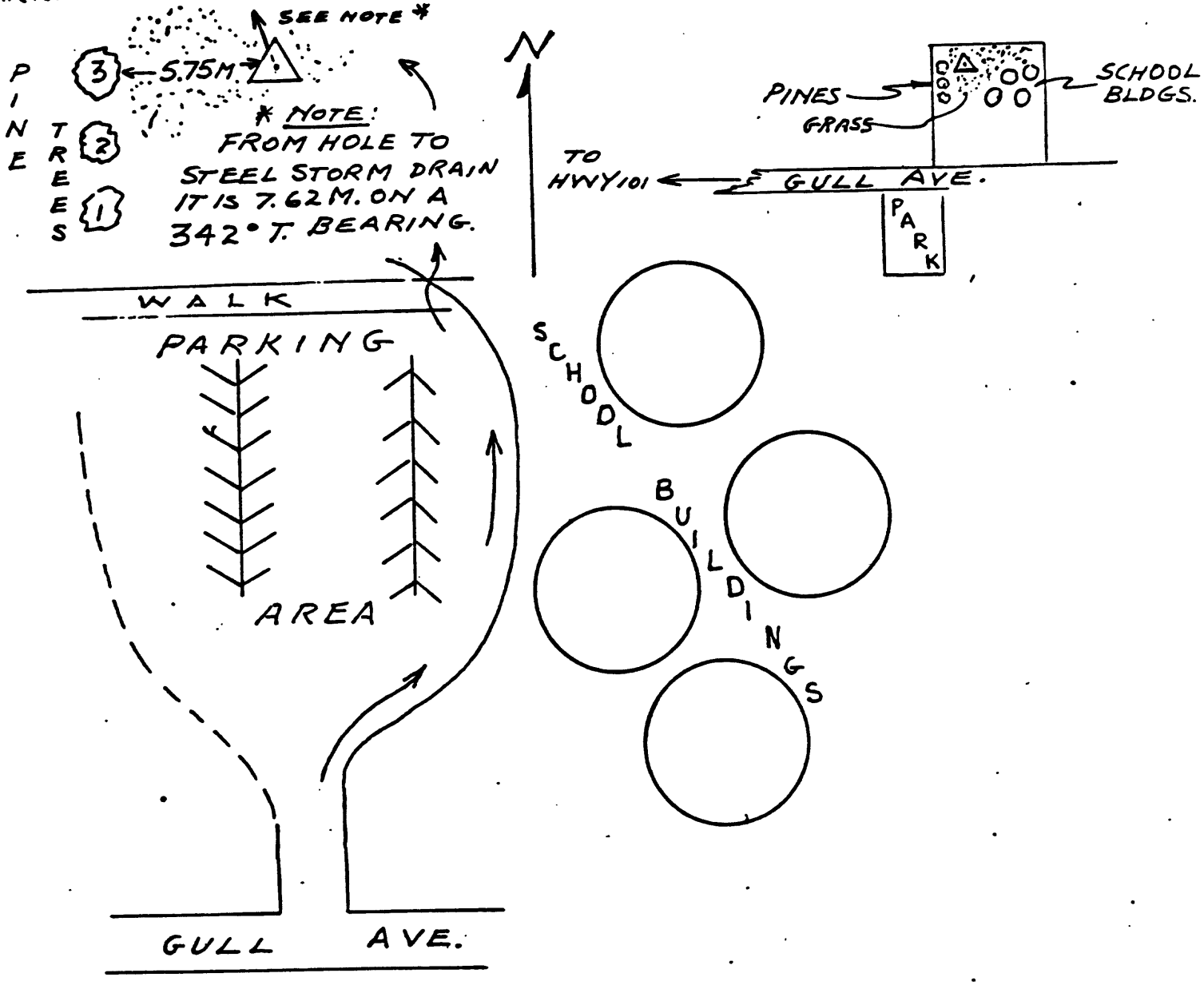
DRIVE NORTH ON BAYSHORE FWY. (#101), CROSSING THE BAY ON THE S.F.-OAKLAND BAY BRIDGE; SHORTLY AFTER LEAVING TOLL PLAZA AREA GET ON HWY. 580 AND DRIVE TO 35TH AVE. TURN TO RIGHT AT OFF RAMP, THEN LEFT BACK OVER 580 TO REDWOOD AVE. TAKE REDWOOD UPHILL TO MERRITT COLLEGE ENTRANCE. SEE SKETCH MAPS BELOW.





UDUBON SCHOOL SITE NO. 58 △ SAN MATEO 7½'

DRIVE NORTH ON HWY. #101, (BAYSHORE FWY.) TO HILLSDALE BLVD., (MAIN ENTRANCE TO FOSTER CITY); TURN AND DRIVE TOWARD BAY TO GULL AVE. TURN RIGHT AT GULL AND DRIVE 3 BLOCKS TO PARK ON LEFT. AUDUBON SCHOOL ENTRANCE IS OPPOSITE EAST EDGE OF PARK. DRIVE INTO SCHOOL PARKING LOT. SKETCH MAP BELOW.



CARMICHAEL SCHOOL SITE NO. 59 △ SAN FRANCISCO (NO.) 7½'

DRIVE NORTH ON HWY. #101, (BAYSHORE FWY.) TO OFF RAMP OF HWY. 280 AND 6TH ST., (≅ 2 MILES BEYOND CANDLESTICK PARK TURNOFF). TAKE 6TH ST. AT THE END OF HWY. 280 AND PROCEED TO HARRISON; GO LEFT ON HARRISON TO 7TH STREET, TURN RT. ON 7TH, GO ONE (1) BLOCK TO FOLSOM, GO RT. TO SHERMAN AND RT. AGAIN ON SHERMAN. PRINCIPALS OFFICE IS MID-BLOCK ON SHERMAN BETWEEN FOLSOM & HARRISON. SEE SKETCH BELOW.

NOTE: AREA OF HOLE IS USED AS PARKING BY TEACHERS. AT LEAST OVERNIGHT NOTIFICATION TO CLEAR AREA.