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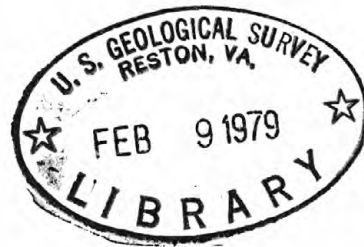
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GEOLOGIC DESCRIPTION  
OF  
SELECTED STRONG-MOTION ACCELEROGRAPH SITES  
PART II  
By B. L. Silverstein

OPEN FILE REPORT  
No. 79-428

This report is preliminary and has not  
been edited or reviewed for conformity with  
Geological Survey standards and nomenclature.

*Prepared on behalf of the  
National Science Foundation*



296806

## PREFACE

One of the major tasks of the U.S. Geological Survey as regards seismic engineering is the collection and dissemination of strong-motion accelerograph records. When analyzing these records certain information describing the instrument site is important: local geology; instrument housing (buildings, dams, bridges, instrument shelters, etc.); local topography; and proximity of an accelerograph to man-made structures that might influence the record. This report describes local geologic conditions of selected sites and is the second in a series of continuing reports covering strong-motion accelerograph sites in the western hemisphere. See Open File Report 78-1005 for part one.

I would like to acknowledge the help of R. B. Matthiesen, C. Rojahn and A. G. Brady for their review of the manuscript.

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## GEOLOGIC SITE DESCRIPTIONS OF STRONG-MOTION ACCELEROGRAPH SITES

The first page of the geologic site description includes a location map with a short verbal description of the local geology with references and other information including station name, number and coordinates as taken from Open File Report No. 77-374. The map is not designed to direct a visitor to the site, but to give a general location of the site. The second page gives a graphic representation (see Figure I) of the geology, seismic velocity and density. The word undifferentiated used in connection with the geologic log indicates the information may not be based on actual coring. The rock type depicted is present at the site but its sequence, thickness and depth are unknown. Depths indicated do not necessarily follow a linear scale. Lack of data indicates the need for further research; consequently updated and corrected versions may be part of future summaries. For the sake of brevity, only local site conditions are described.

The geologic code found on the bottom of the second page has been developed for a computerized summary of strong-motion station characteristics. The symbols used in this code are defined in Table I. The first three characters are a class code that broadly describes the surface materials and is intended for those interested only in general geology.

Rock types are given by two-letter abbreviations. A third letter, when present, describes the condition of the rock. For example, SH indicates shale, and SHF would indicate a fractured,

sheared or jointed shale. Lack of a descriptive term generally implies that its condition is not known. The abbreviations are not standardized to a particular nomenclature.

A number following the rock type indicates the depth of the rock, i.e., AL914; CS1067 means there is alluvium to 914 meters and a combination of sedimentary rocks from 914 to 1067 meters.

The letter K following a number is a 1000 times multiplier, e.g., 4K equals 4000 meters. In some cases a number is not given. This indicates that the actual depth is not known but evidence suggests that a particular rock is present. The semi-colon, not including the one immediately after the three letter general description, may be translated literally as "overlying". A plus sign between two (or more) rock names means both (or all) are present.

Example:

ALV; AL84; SSU; SH+SC

ALV; = alluvium at surface. (General surface geology)

AL84 = alluvium to 84m.

;SSU = overlying unconsolidated sandstone to unknown depth.

;SH+SC = overlying shale and schist to an unknown depth.

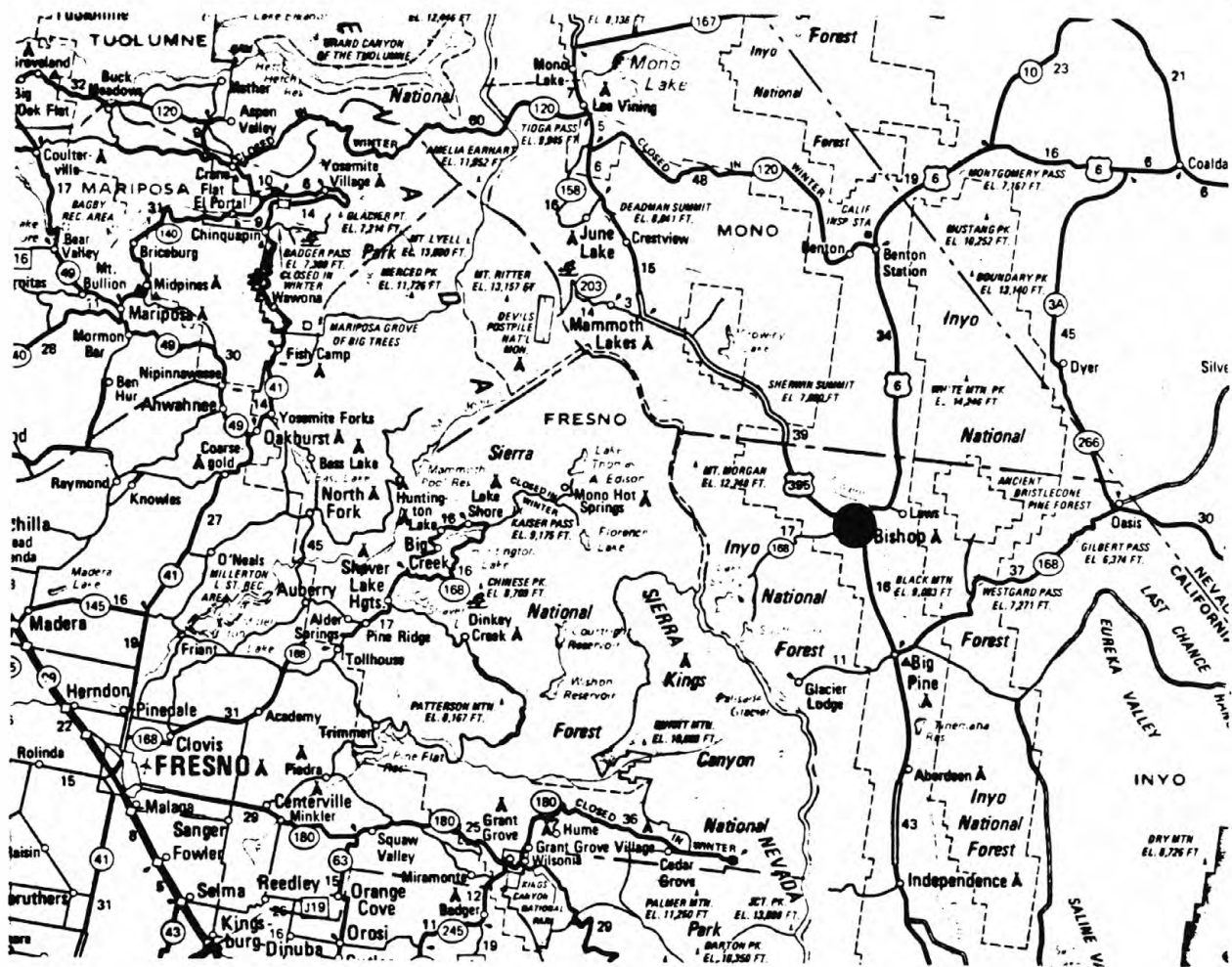
Station No. 1008 Station Bishop (C171) L. A. Water Dept. 200 W. South St.

Coordinates 37.36 N, 118.40 W

Bishop is located in the Owens Valley, a large graben that contains about 1800 m of valley fill. To the north of the Owens Valley is the Bishop tuff tableland which underlies the alluvium at increasing depths southward.

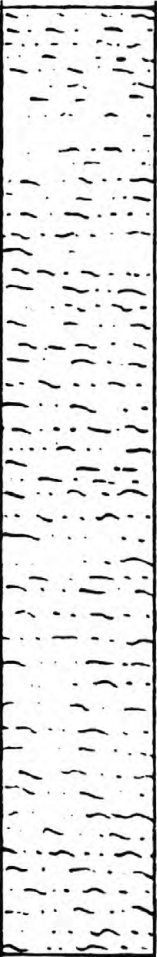

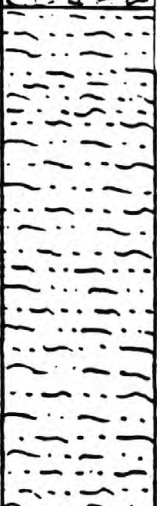
### REFERENCE

Bateman, Paul C., 1965, Geology and tungsten mineralization of the Bishop District, California; U.S.G.S. Prof. Paper 470.



GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 2/78 Station No. 1008 Station Bishop LA Water Dept. 200 W South St.

<u>Depth</u> meters	<u>P-Wave</u> m/sec	<u>S-Wave</u> m/sec	<u>Density</u> g/cm <sup>3</sup>	<u>Log</u>	<u>Site Geology</u>
					Alluvium
50					
100					
150					
					Bishop Tuff
200					
					Alluvium
250					

ALV;AL167;TF200;AL



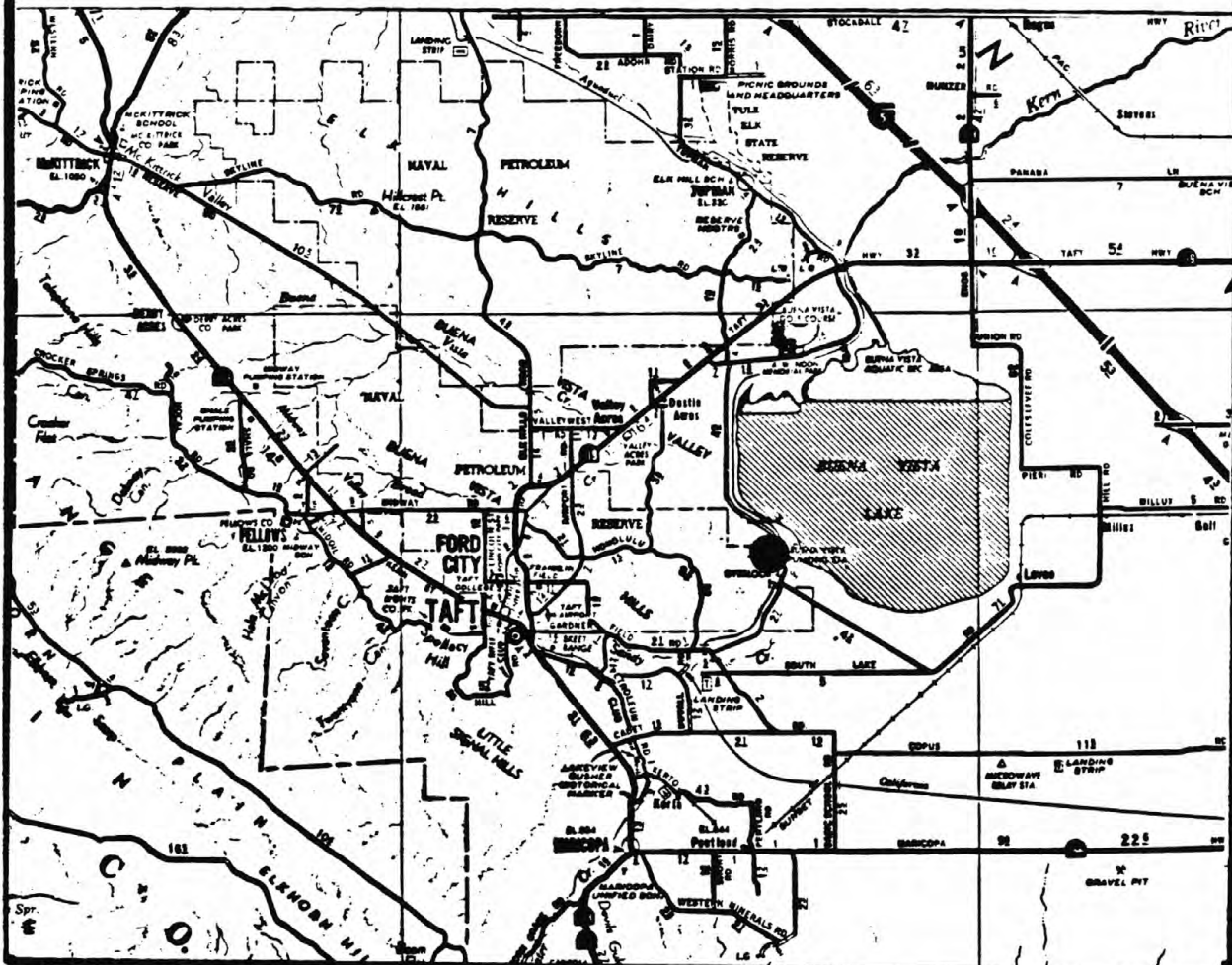
Station No. 1120 Station Buena Vista Pumping Plant

Coordinates 35.16 N, 119.35 W

The site rests on old alluvial fan deposits of the Tulare formation. These alternating beds (locally) of sand and mudstone overlie semi-consolidated to consolidated siltstone, sandstone, shale and conglomerate. This in turn is believed to cover granitics of the Sierra Nevada batholith.

### Reference

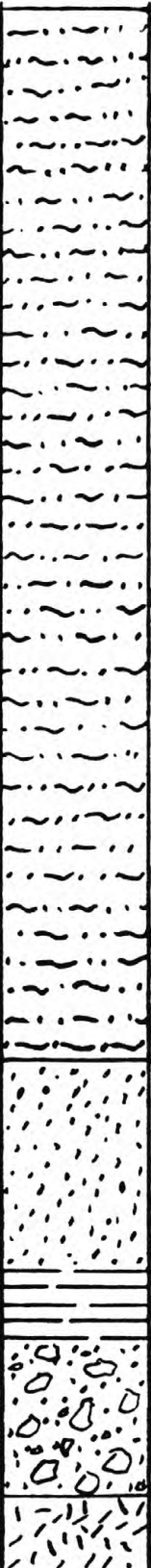
Wood, P.R., and Dale, R.H., 1964; Geology and Ground-Water Features of the Edison-Maricopa Area, Kern County, California; USGS Water Supply Paper 1656





GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 10/78 Station No. 1120 Station Buena Vista Pumping Plant

<u>Depth</u> meters	<u>P-Wave</u> m/sec	<u>S-Wave</u> m/sec	<u>Density</u> g/cm <sup>3</sup>	<u>Log</u>	<u>Site Geology</u>
					<p>Alluvium</p> <p>Undifferentiated siltstone, sandstone, shale, and conglomerate.</p> <p>Granitic basement</p>

ALV;AL;CS;X

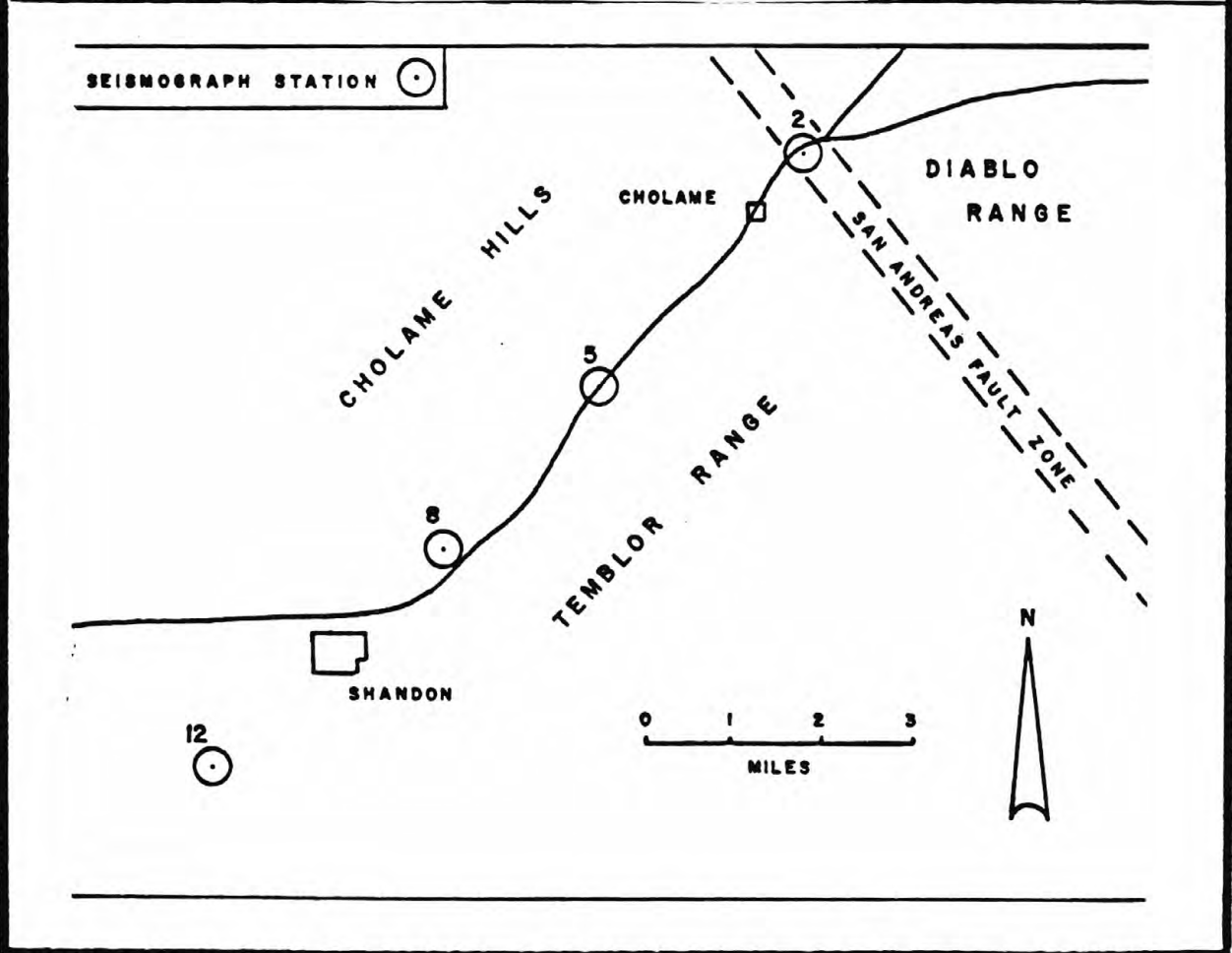
Station No. 1013-16 Station Cholame-Shandon Stations 2,5,8, and 12

Coordinates \_\_\_\_\_ N, \_\_\_\_\_ W

Coordinates: Cholame 2 = 35.73N, 120.29W; Cholame 5 = 35.70N, 120.33W; Cholame 8 = 35.67N, 120.36W; and Cholame 12 = 35.64N, 120.40W.

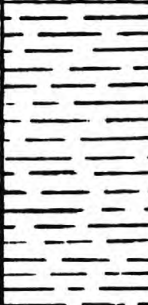


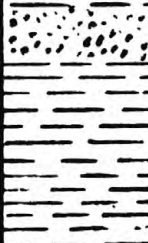

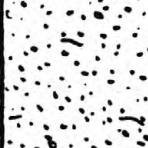

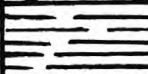

In the Cholame area west of the San Andreas the geology consists of approximately 1500m of Paso Robles formation overlying Tertiary sandstone and shale overlying a granitic and metamorphic basement. East of the San Andreas the sequence is Paso Robles over undifferentiated Tertiary sedimentary rocks and Cretaceous mudstone and sandstone over a basement of Franciscan sandstone, shale, ultramafics and serpentine.

References  
Maley, R.P., 1970; Shallow Seismic Refraction Studies at the Strong-Motion Stations in the Cholame Creek Valley, California; Master of Science Thesis for the University of Southern California.  
Shannon & Wilson, Inc. and Agbabian Ass<sup>c</sup>. for U.S. Nuclear Regulatory Commission. 1976; Geotechnical and Strong-Motion Earthquake Data from U.S. Accelerograph Stations, NUREG-0029 Vol. I



GEOLOGIC SUMMARY OF STRONG-MOTION SITES

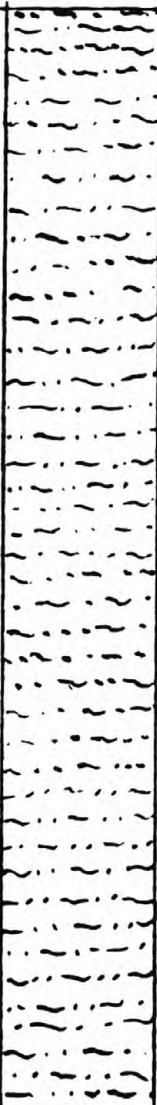


Date 3/78 Station No. 1013 Station Cholame-Shandon 2 (C228)

<u>Depth</u> meters	<u>P-Wave</u> m/sec	<u>S-Wave</u> m/sec	<u>Density</u> g/cm <sup>3</sup>	<u>Log</u>	<u>Site Geology</u>
		139			Undifferentiated clay and sands. (85% clay)
20		203			
		230			
40		290			
		334			Paso Robles Fm.-mainly unconsolidated sandstones with minor clay silts and gravels.
60		490			
		605			Unknown depth
80					Franciscan shale and schist
					

ALV;AL84;SSU;SH+SC

GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 3/78 Station No. 1014 Station Cholame-Shandon 5 (C227)

<u>Depth</u> <u>meters</u>	<u>P-Wave</u> <u>m/sec</u>	<u>S-Wave</u> <u>m/sec</u>	<u>Density</u> <u>g/cm<sup>3</sup></u>	<u>Log</u>	<u>Site Geology</u>
.6	228				Alluvium- sand, gravel and clay
	335				
9					
10	1005				
	1600				Unknown depth
27	1981 est.				
					Paso Robles Fm.- mainly unconsolidated sandstone.

ALV;AL;SSU

GEOLOGIC SUMMARY OF STRONG-MOTION SITES




Date 3/78 Station No. 1015 Station Cholame-Shandon 8 (C226)

<u>Depth</u> meters	<u>P-Wave</u> m/sec	<u>S-Wave</u> m/sec	<u>Density</u> g/cm <sup>3</sup>	<u>Log</u>	<u>Site Geology</u>
2.6	228	335			Alluvium-thin veneer
9	518				Paso Robles Fm.-mainly sandstone that becomes more consolidated at depth.
23	1005				
	2438 est.				
1700					Unspecified basement

ALV;ALV;SSUL.7K

GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 3/78 Station No. 1016 Station Cholame-Shandon 12 (C229)

<u>Depth</u> meters	<u>P-Wave</u> m/sec	<u>S-Wave</u> m/sec	<u>Density</u> g/cm <sup>3</sup>	<u>Log</u>	<u>Site Geology</u>
1.2	396				Alluvium- gravity terrace
8	747				
30	914				Paso Robles Fm.- mainly unconsolidated sandstones.
1700	1981 est.				
					Amphibolite

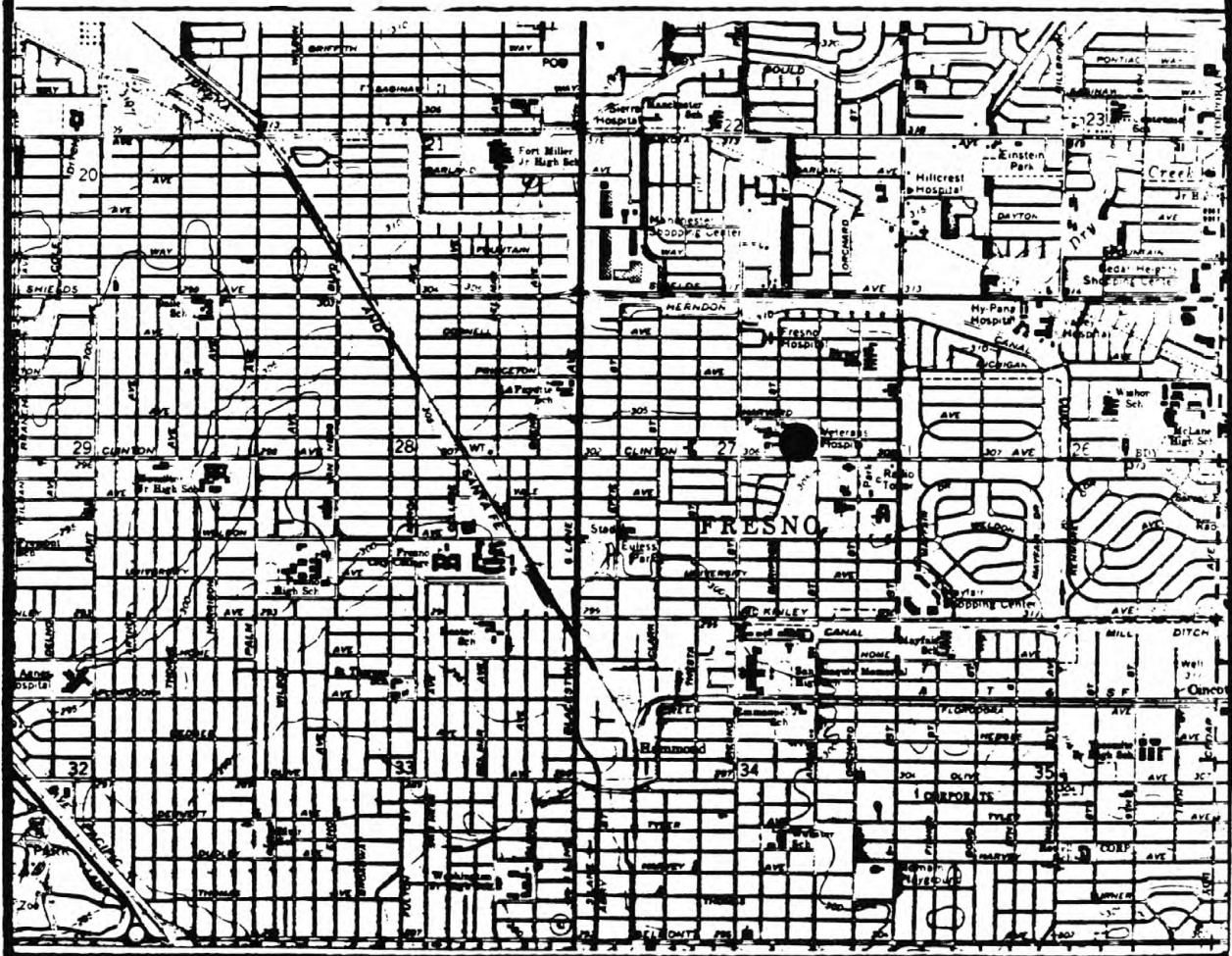
ALV;AL30;SSU1.7K;AM



The Veterans Hospital is located on approximately 1200 meters of old alluvium; sands, silts, gravels, and clays. The basement rocks are granitics of the Sierra Nevada batholith. The water table in 1963 was about 20 meters below the surface under most of the city,

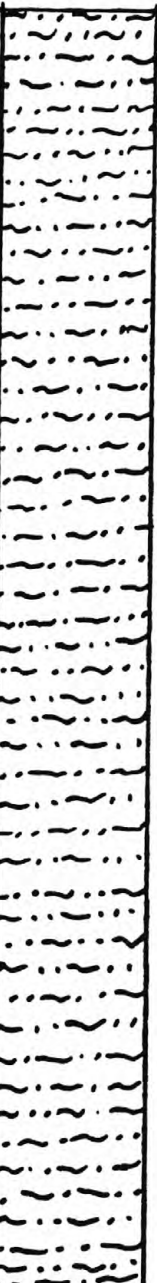

#### References

- Woodward-Lungren & Assoc., 1973; Geologic, Seismologic, and Earthquake Engineering Investigations and Evaluations, Veterans Administration Hospital, Fresno, California, N1001P-247  
Dept. of Water Resources, 1965; Fresno-Clovis Metropolitan Area Water Quality Investigation: Bulliten No. 143-3  
Division of Oil and Gas, 1964; Exploratory Wells Drilled Outside of Oil and Gas Fields in California  
Page, R., 1969; Hydrology and Water Quality in the Fresno Area, Ca., USGS Open File Report



GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 10/78 Station No. 1229 Station Fresno VA Hospital

<u>Depth</u> meters	<u>P-Wave</u> m/sec	<u>S-Wave</u> m/sec	<u>Density</u> g/cm <sup>3</sup>	<u>Log</u>	<u>Site Geology</u>
					Alluvium
1200					Granitic Basement

ALV;ALL.2K;X

Station No. 1222 Station Menlo Park 1330 University Dr.

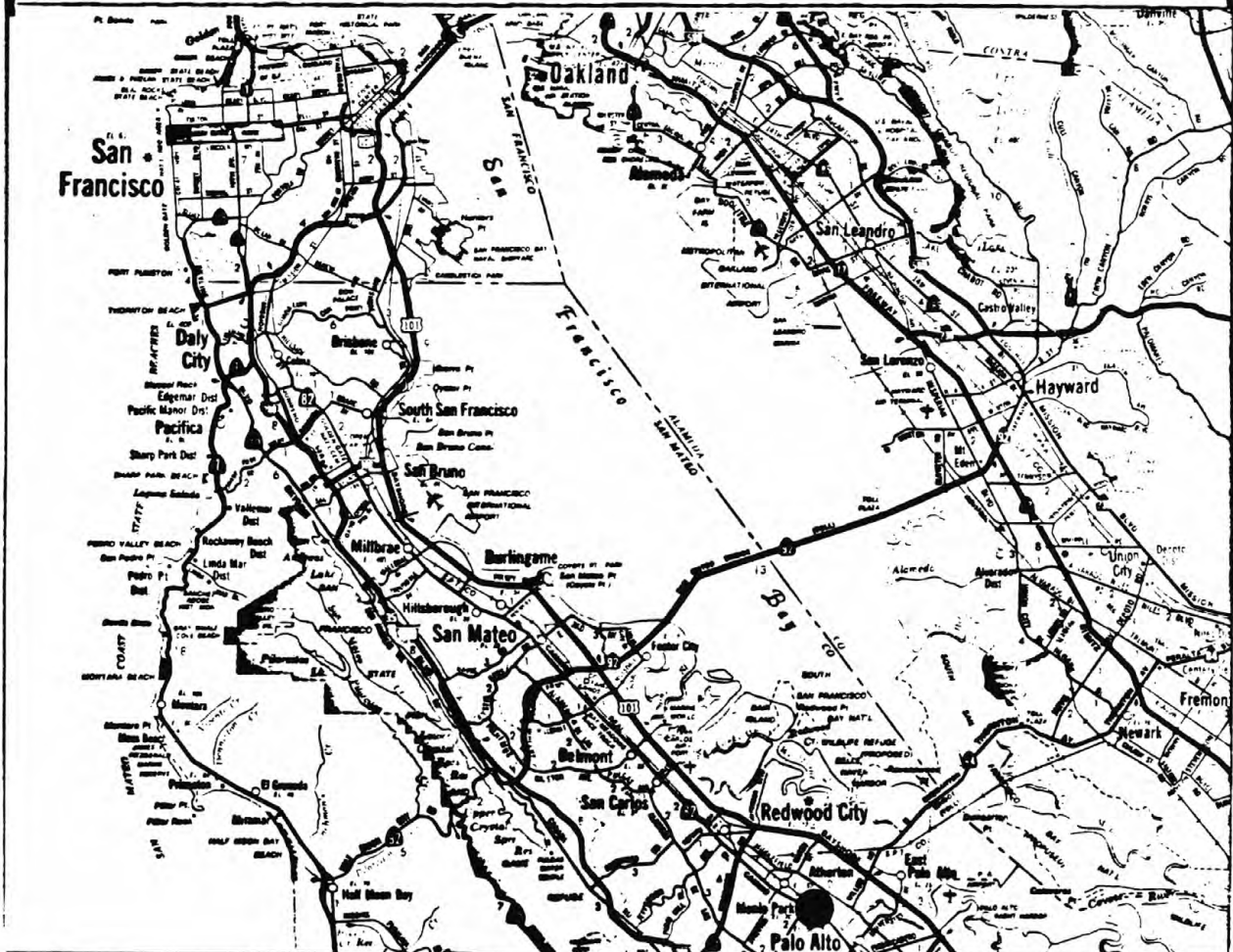
Coordinates 37.45 N, 122.19 W

The instrument sits on alluvial fill of the Santa Clara Valley, a large northwest trending downwarped and down faulted structural block. The depth of the alluvium is unknown, however: about 20 km southeast of the site the depth of the alluvium is believed to be about 700 km deep.

#### References

Cooper, Clark and Assoc., 1970 Geotechnical Study of the North San Jose and Alviso Area, Santa Clara County, California

Dibblee, T.W. Jr., Geology of the Palo Alto Quad., Santa Clara and San Mateo Counties, California; California Division of Mines and Geology



GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 10/78 Station No. 1222 Station Menlo Park 1330 University Dr.

<u>Depth</u> meters	<u>P-Wave</u> m/sec	<u>S-Wave</u> m/sec	<u>Density</u> g/cm <sup>3</sup>	<u>Log</u>	<u>Site Geology</u>
					Alluvium to unknown depth

ALV;ALD

Station No. 1215 Station Mt. Diablo Summit Building

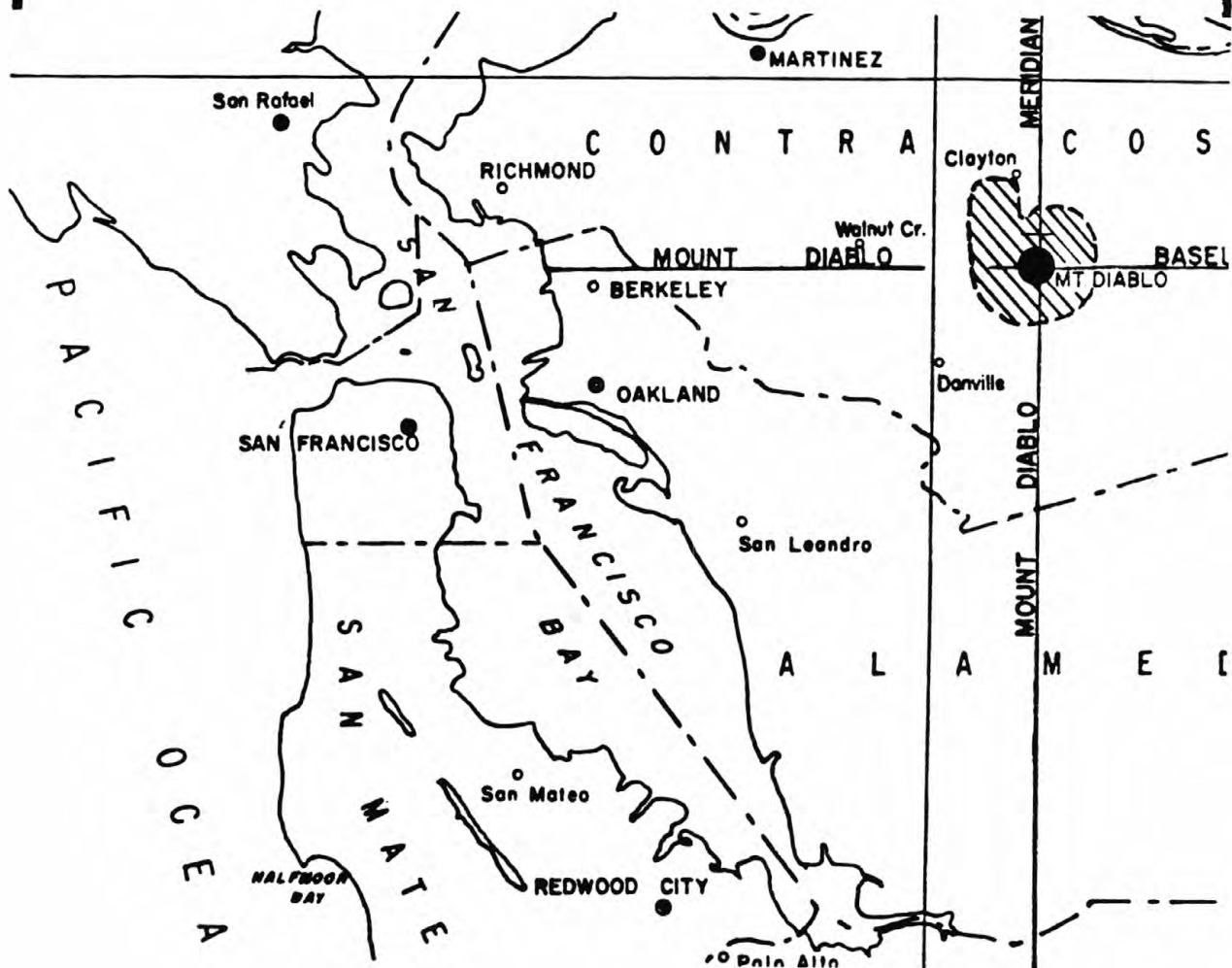
Coordinates 37.88 N, 121.91 W

The site rests on an assemblage of Franciscan greenstone, chert, graywacke sandstone, shale, limestone, schist, and conglomerate with associated serpentine bodies, and minor diabase and pillow basalts.

References

Pampeyan, E. H., 1963; *Geology and Mineral Deposits of Mt. Diablo, Contra Costa County, California*; CDMG Special Report 80

Brabb, E.E., Sonneman, H. S., and Switzer, J. R., 1971; *Preliminary Geologic Map of the Mt. Diablo-Byron Area, Contra Costa, Alameda, and San Joaquin Counties, California*





GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 11/78 Station No. 1215 Station Mt. Diablo Summit Building

<u>Depth</u> <u>meters</u>	<u>P-Wave</u> <u>m/sec</u>	<u>S-Wave</u> <u>m/sec</u>	<u>Density</u> <u>g/cm<sup>3</sup></u>	<u>Log</u>	<u>Site Geology</u>
					Franciscan greenstone, chert, graywacke, shale, limestone, schist, conglomerate, serpentine, diabase and pillow basalts (undifferentiated)

MLX;FR



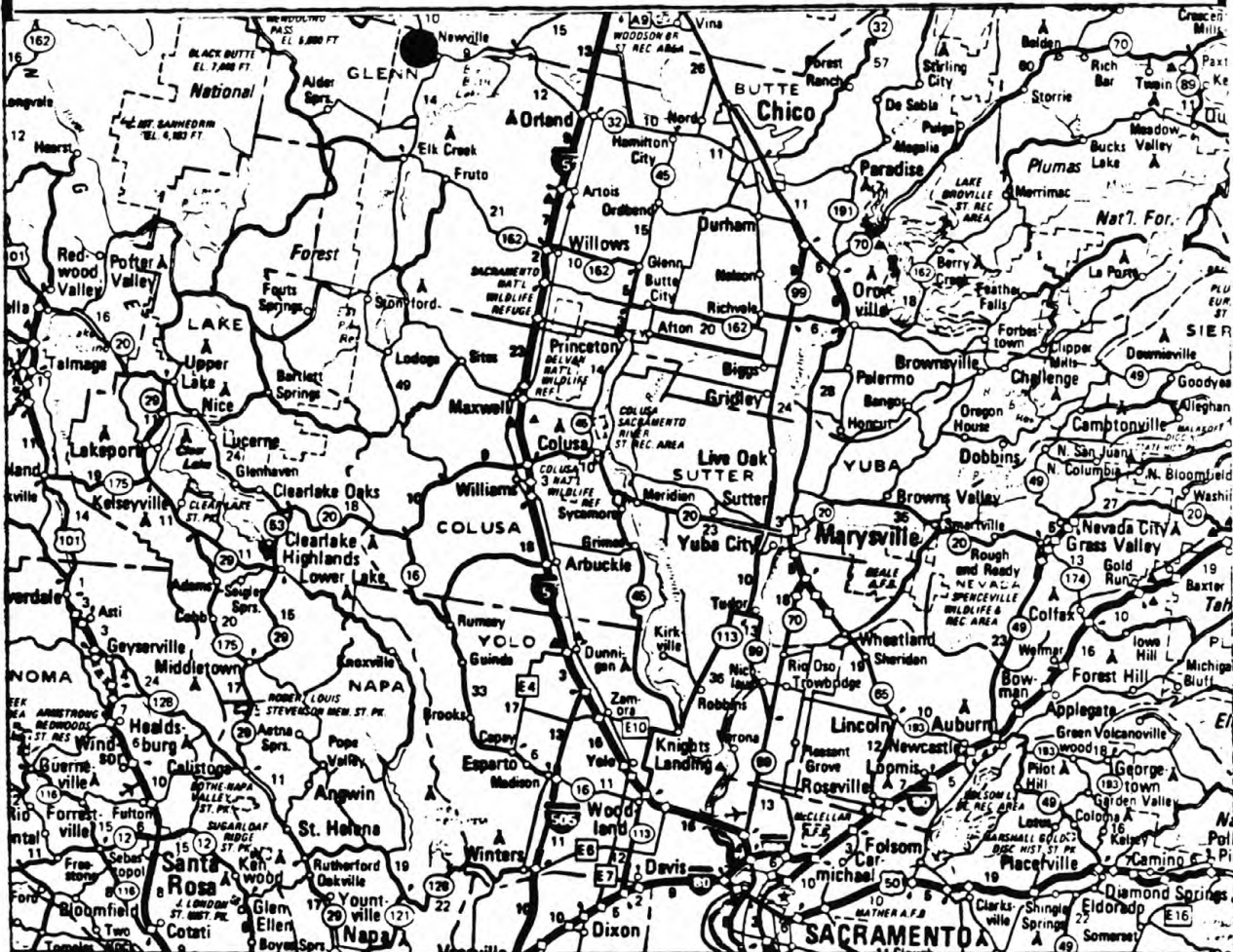
Station No. 1046 Station Newville, Flood Farm

Coordinates 39.79 N, 122.52 W

This station is located on undifferentiated Mesozoic mudstone and sandstone of the Paskenta formation about three hundred meters from a fault whose offset has been determined to be at least two hundred meters.


#### Reference

Dept. of Water Resources, 1965; North Coastal Area Investigation, Engineering Geology; Vol. 1: Upper Eel River Development, Appendix E, Bulliten No. 136.



GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 10/78 Station No. 1046 Station Newville, Flood Farm

<u>Depth</u> meters	<u>P-Wave</u> m/sec	<u>S-Wave</u> m/sec	<u>Density</u> g/cm <sup>3</sup>	<u>Log</u>	<u>Site Geology</u>
					<p>Undifferentiated mudstone and sandstone of the Paskenta formation.</p>

SED;MS+SS

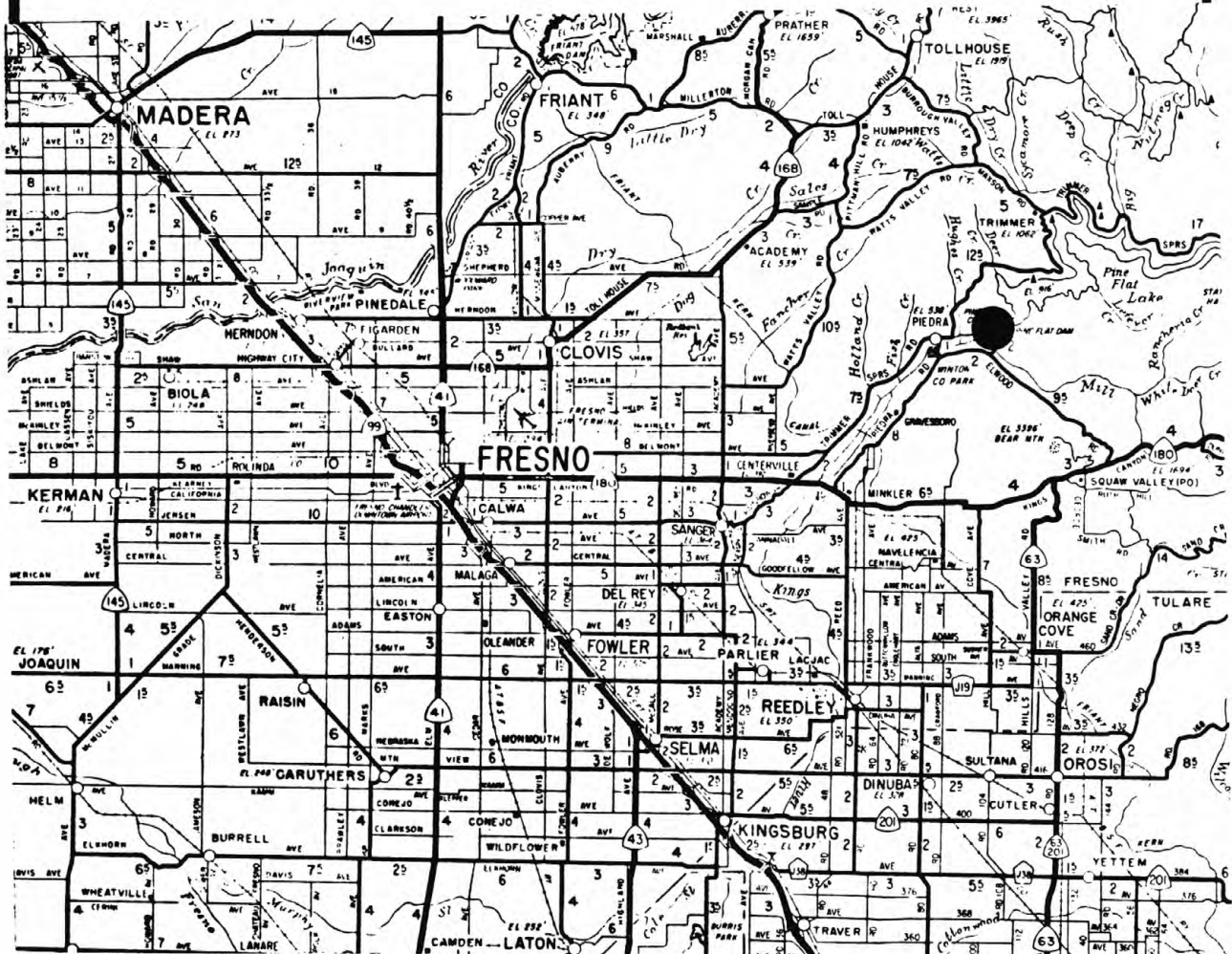
Station No. 1054 Station Pine Flat Dam

Coordinates 36.83 N, 119.33 W

Jointed amphibolite underlies almost all of the dam foundation area as well as the riverbed for several hundred feet upstream and downstream. This is underlain by granitics of the Sierra Nevada Batholith.

Reference

U.S. Corps of Engineers, 1947; Pine Flat Project, Part IV- Dam and Appurtenances, Appendix A, Geology; NC28(#54-70)



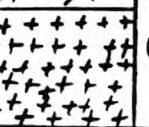


GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 10/78

Station No. 1054

Station Pine Flat Dam

<u>Depth</u> <u>meters</u>	<u>P-Wave</u> <u>m/sec</u>	<u>S-Wave</u> <u>m/sec</u>	<u>Density</u> <u>g/cm<sup>3</sup></u>	<u>Log</u>	<u>Site Geology</u>
1					Rock Talus- angular fragments embedded in a clay sand matrix.
					Amphibolite
					Unknown depth. Granitic basement-mainly quartz-diorite with accompanying hornblende gabbro & diorite.

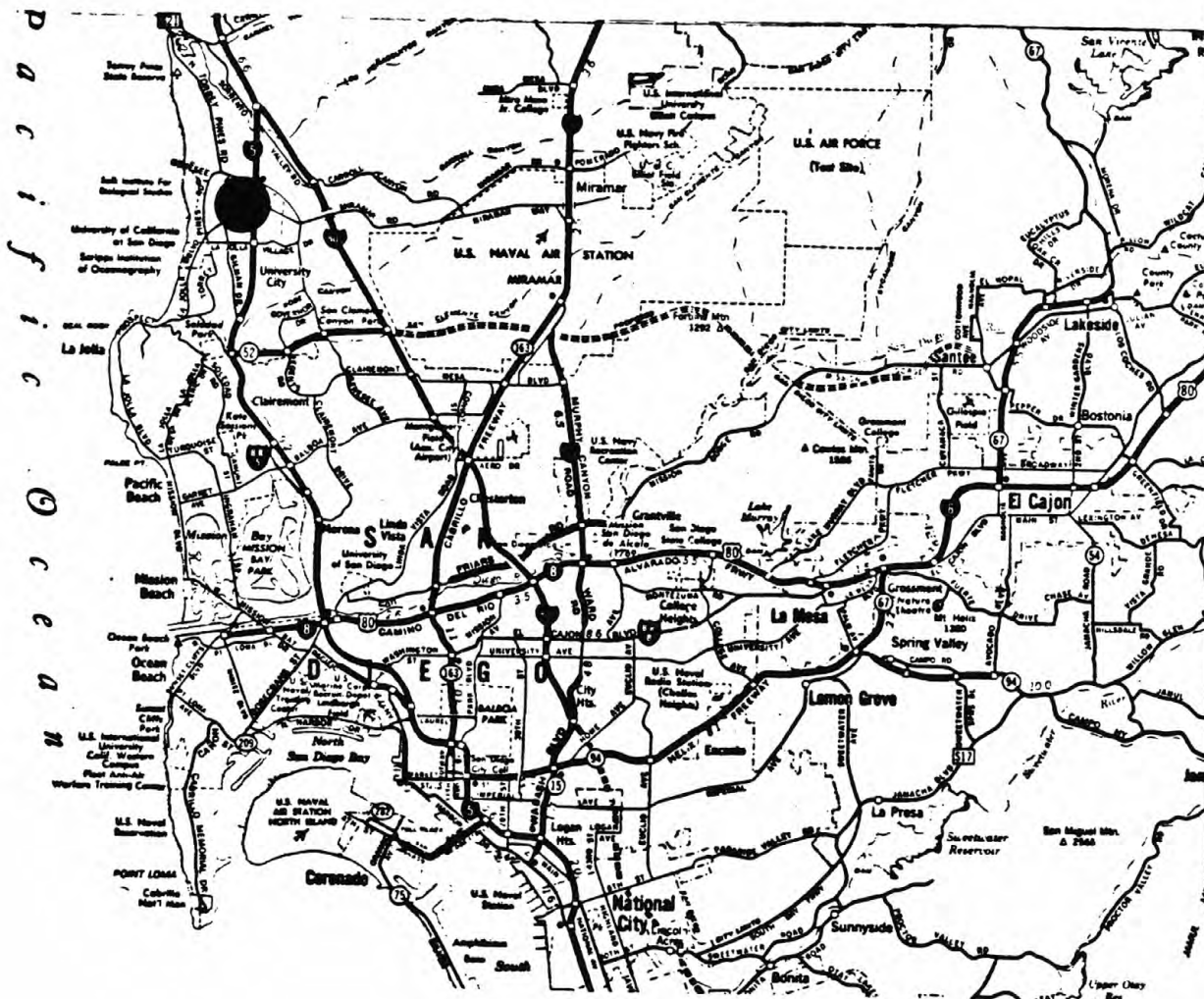
ALV;AC1;AMS;DI



The subsurface rocks in this area are slightly dipping Eocene shales, sandstones and conglomerates of the La Jolla and Poway Groups; which are usually capped by the loosely friable, indurated Pleistocene sandstone and conglomerate of the Lindavista Formation.

REFERENCE

Dames and Moore, 1974; Site Evaluations Studies, Veterans Administration Hospital, San Diego, California; 2712-007-10.



GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 9/78

Station No. 639

Station San Diego VA Hosp. La Jolla, Bldg. 2

<u>Depth</u> <u>meters</u>	<u>P-Wave</u> <u>m/sec</u>	<u>S-Wave</u> <u>m/sec</u>	<u>Density</u> <u>g/cm<sup>3</sup></u>	<u>Log</u>	<u>Site Geology</u>
					Fill- Silty sand
1.0					Silty sand
					Sandy clay
			1.22		Sandstone
			1.91		
5.0			1.78		
			1.81		
			1.73		
			1.70		
			1.73		
10.0			1.73		
			1.70		
			1.68		
			1.72		
16.0			1.70		Core date: Sept. 5, 1967
					Sandstones, shales, & conglomerate
76.0					Crystalline Basement

ALV;AL1;SS760;X



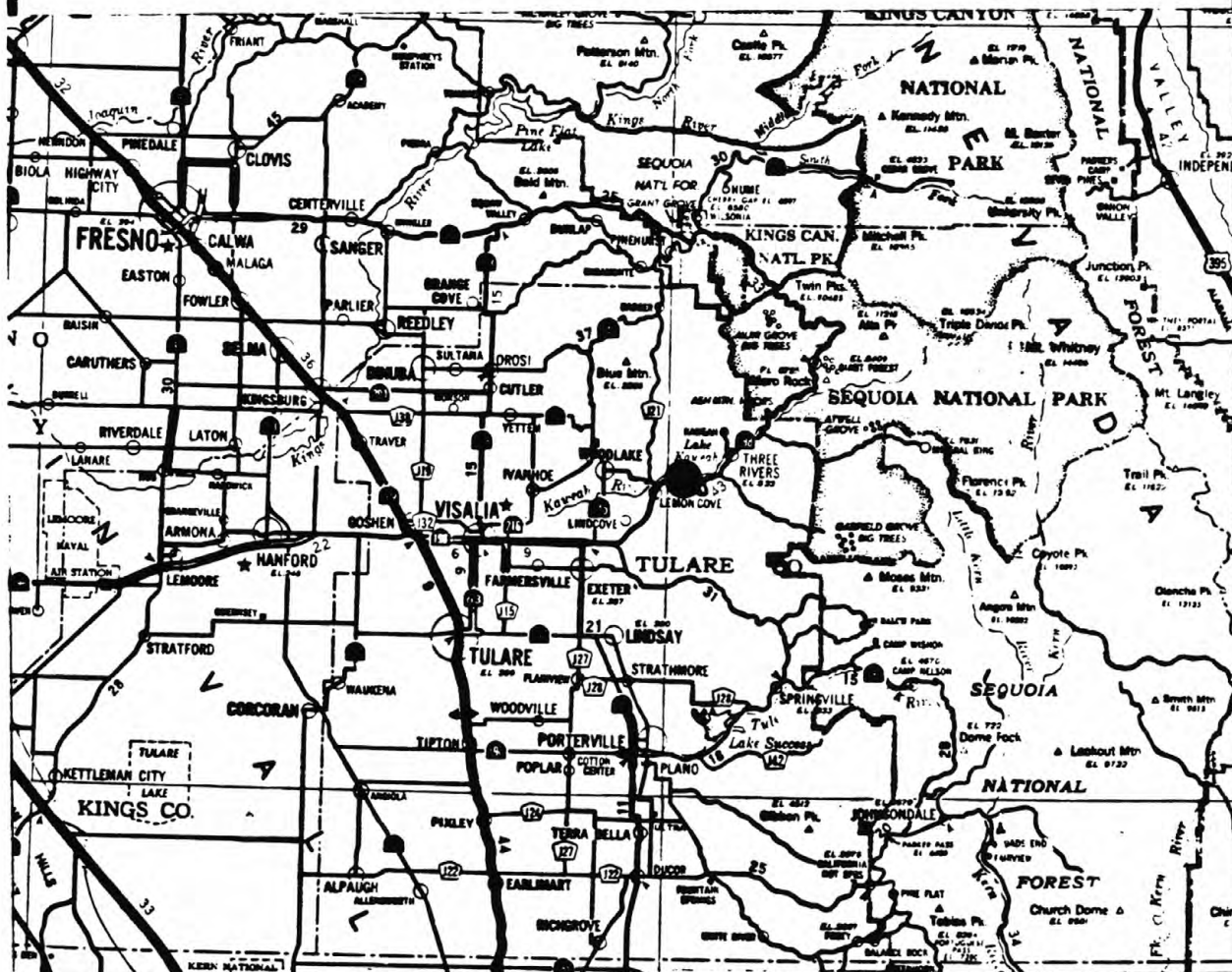
Station No. 1098 Station Terminus Dam

Coordinates 36.41 N, 119.00 W

The rock underlying the dam is the Lemon Cove formation. This consists of sedimentary rocks that have been metamorphosed to quartzite, schist, hornfels, and marble that have been intruded by numerous aplite and lamprophyre dikes. The marble occurs as beds or lenses up to 50 m thick. The rock underlying the auxiliary dam is granitics of the Sierra Nevada batholith.

#### Reference

US Army Corps of Engineers, 1962; Foundation Report, Terminus Dam Project; Sacramento, California, NC41(#98-70)



GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 10/78 Station No. 1098 Station Terminus Dam

<u>Depth</u> meters	<u>P-Wave</u> m/sec	<u>S-Wave</u> m/sec	<u>Density</u> g/cm <sup>3</sup>	<u>Log</u>	<u>Site Geology</u>
					Quartzite schist, marble with numerous dike intrusions. (Undifferentiated)

MET; QZF+SCF+MRF+DK

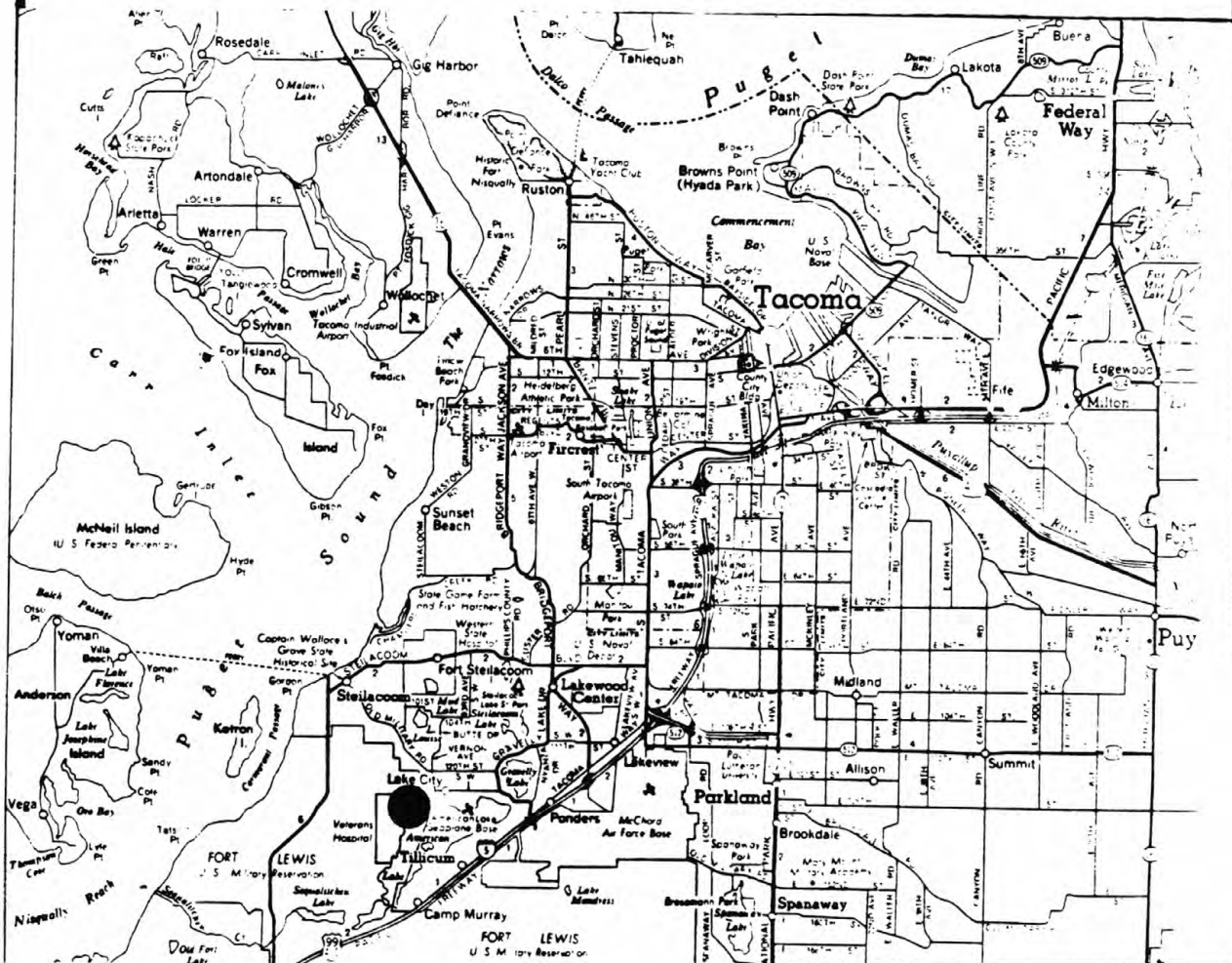
Station No. 2130 Station American Lake VA Hospital

Coordinates 47.13 N, 122.57 W

The geology in the vicinity of the American Lake VA Hospital consists mainly of Pleistocene glacial drift at least 400 m deep. This overlies basalt and a basement of unknown rock type. (The glacial drift is believed to be about 1000 m deep.)

Reference

Dames and Moore; 1974, Site Evaluation Studies, Veterans Administration Hospital, American Lake, Washington; No. 2712-011-05



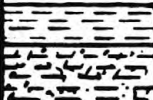

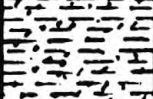
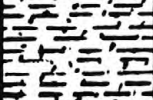
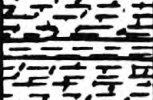

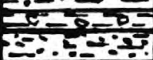
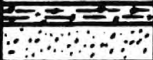
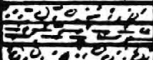
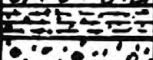

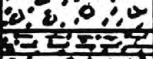
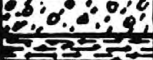
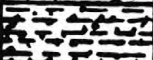
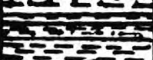
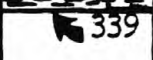




GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 11/78 Station No. 2130 Station American Lake VA Hospital

<u>Depth</u> meters	<u>P-Wave</u> m/sec	<u>S-Wave</u> m/sec	<u>Density</u> g/cm <sup>3</sup>	<u>Log</u>	<u>Site Geology</u>
					Soil
					Sand and gravel
20					Clay
					Sand and gravel
					Clay, sand and gravel
					Sand and gravel
					Clay, sand & gravel
					Sand and pebble gravel
40					Sand
					Sand, gravel & cobbles
					Clay
					Sand
					Clay, silty
					Clay
60					Clay
					Clay, sand & gravel
80					Clay, sand & gravel
					Sand and cobble gravel
					Sandy clay
100					Sandy clay
					Clay
120					Clay
					Clay
140					Clay
					Clay
160					Clay
					Clay
180					Clay

GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 11/78 Station No. 2130 Station American Lake VA Hospital (cont.)

<u>Depth</u> meters	<u>P-Wave</u> m/sec	<u>S-Wave</u> m/sec	<u>Density</u> g/cm <sup>3</sup>	<u>Log</u>	<u>Site Geology</u>
					Sandy clay
220					Clay
					Sandy clay
240					Clay
					Sandy clay
260					Clay with some pebble gravel
					Sand and clay
280					Sandy clay
					Sand
					Sand, gravel & some clay
					Sandy clay
					Gravel & sand
300					Sandy clay
					Gravel and sand
320					Sandy clay
					Sandy clay
					Clay
					Sandy clay
340					Silty clay
					Bottom of core Located 1/2 mile west of site.

ALV; AL340; AL



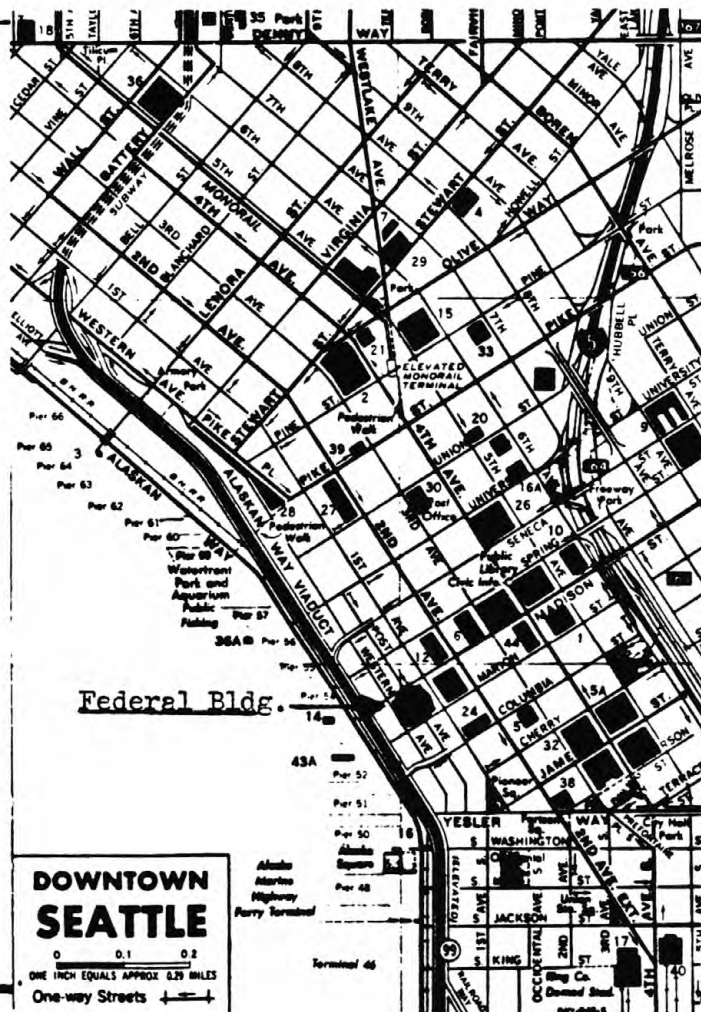
Station No. 2102 Station Seattle Federal Building

Coordinates 47.60 N, 122.33 W

The old Federal Office Building rests upon wood piles that are driven through silty sand and pebbly sand which may be late glacial in age. The piles were driven to refusal into lodgement till ("hard gray clay with scattered medium to coarse sand and gravel to ½-inch... (till texture).") The lodgement till is approximately 40-50 feet thick and is underlain by a hard, gray, clay and silty clay. The clay is distinguished from the lodgement till by the absence of coarser particle sizes and the reduction in blow counts.

### Reference

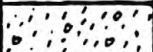

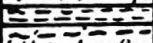
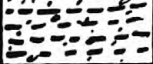
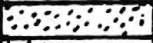

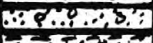
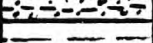

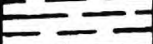

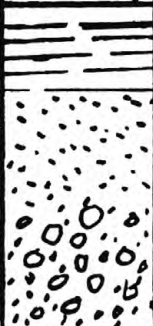
Information on file with the Seismic Engineering Branch of the U.S. Geological Survey, Menlo Park, California





GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 11/78 Station No. 2102 Station Seattle - Federal Building

<u>Depth</u> meters	<u>P-Wave</u> m/sec	<u>S-Wave</u> m/sec	<u>Density</u> g/cm <sup>3</sup>	<u>Log</u>	<u>Site Geology</u>
					Fill-mainly sand, some gravel
10					Sand with scattered gravel
					Clay
					Clay with scattered sand & gravel
20					Sand
					Sand with scattered clayey silt
					Sand with scattered gravel
					Clay with scattered sand & gravel
30					Clay (slickenslided & fractured)
					Clay
40					Bottom of core- 39 m (3/2/68)
					Unconsolidated Quaternary and late Tertiary silt, clay, sand, gravel and till.
1150					Tertiary shale, sandstone, and conglomerate

ALV; AL1150; CS

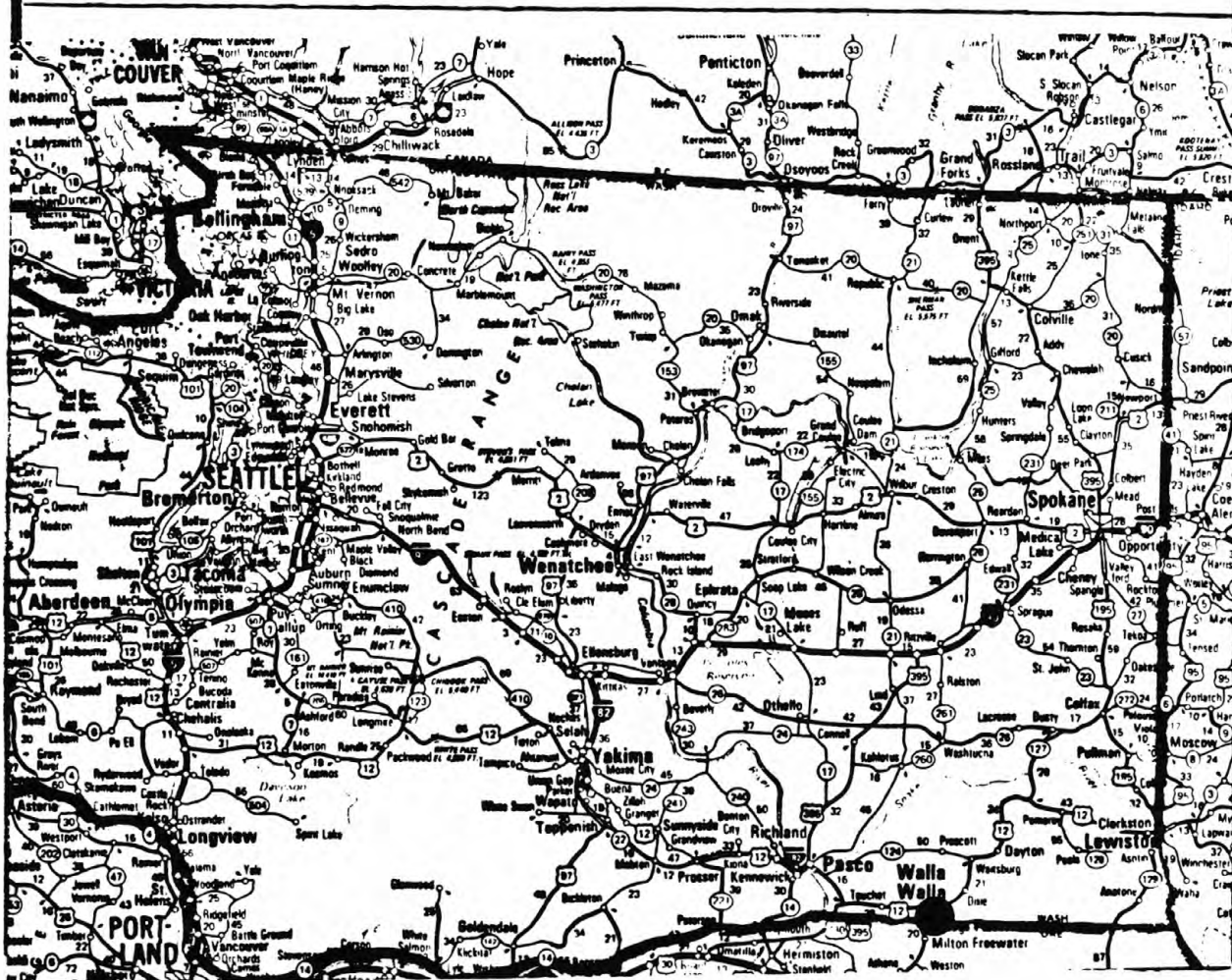
Station No. 2124 Station Walla Walla V. A. Hospital

Coordinates 45.64 N, 122.66 W

The hospital is located on the Columbia River basalt plateau which was locally downwarped into the Walla Walla basin by steep folding and faulting. This basin was then filled by a sequence of sedimentary deposits known as the Touchet beds.

#### REFERENCE

Dames & Moore, 1974; Site Evaluation Studies, Veterans Administration Hospital, Walla Walla, Washington; 2712-012-05.



GEOLOGIC SUMMARY OF STRONG-MOTION SITES

Date 10/78 Station No. 2124 Station Walla Walla V.A. Hospital

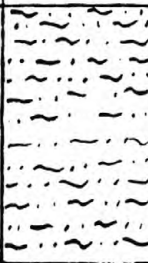


<u>Depth</u> meters	<u>P-Wave</u> m/sec	<u>S-Wave</u> m/sec	<u>Density</u> g/cm <sup>3</sup>	<u>Log</u>	<u>Site Geology</u>
30					Alluvium
					"Old gravel and clays"
183					Columbia River Basalt

TABLE I

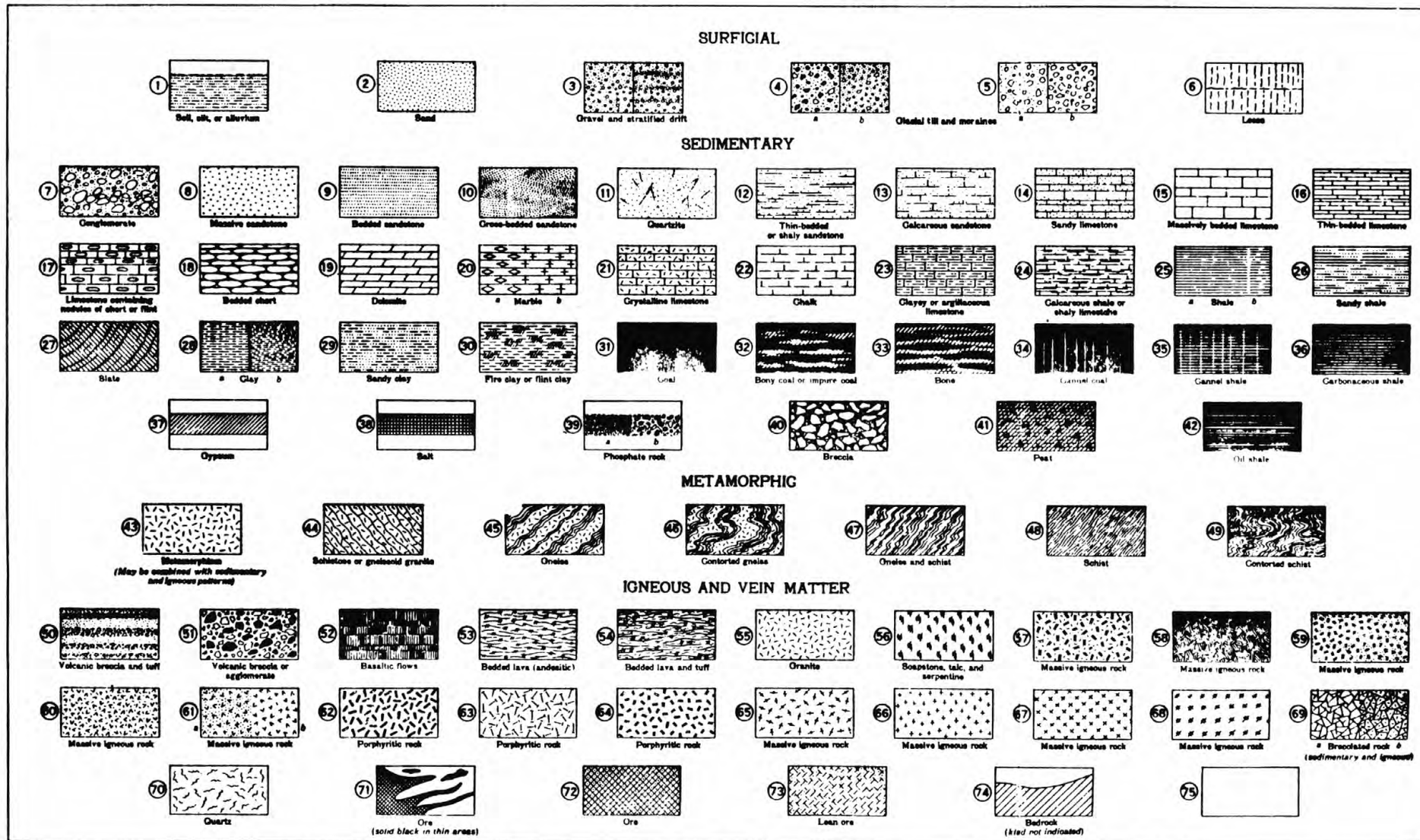
ALPHABETIZED GEOLOGIC CODE

<u>ROCK TYPES</u>	<u>CLASS CODE</u>
AC Coarse Alluvium	ALV Alluvium
AF Artificial Fill	IGN Igneous Rock
AG Agglomerate	MET Metamorphic Rock
AL Alluvium	MIX Mixture of Rock Types
AM Amphibolite	SED Sedimentary Rock
AN Andesite	
BA Basalt	
BR Breccia	
CG Conglomerate	
CH Chert	
CI Combination Igneous	
CM Combination Metamorphics	
CR Combination Rock Types	
CS Combination Sedimentary	
CY Claystone	
DI Diorite	
DK Dikes or Sills	
DO Dolomite	
FR Franciscan Rocks	
GB Gabbro	
GD Granodiorite	
GN Gneiss	
GR Granite	
GS Greenstone	
HF Hornsfe1	
LF Lava Flows	
LS Limestone	
MR Marble	
MS Mudstone	
MZ Monzonite	
OB Obsidian	
PH Phyllite	
PU Pumice	
QM Quartz Monzonite	
QZ Quartzite	
RY Rhyolite	
SC Schist	
SH Shale	
SI Siltstone	
SL Slate	
SP Serpentinite	
SS Sandstone	
SY Syenite	
TF Tuff	
VA Volcanic Ash	

EXPLANATORY SYMBOLS

C	Cemented
D	Deep
F	Fractured, Sheared, or Jointed
I	Interbedded
K	x1000
L	Layered or Stratified
M	Massive
P	Permafrost
S	Semiconsolidated
U	Unconsolidated
V	Veneer
W	Weathered or Friable
X	Crystalline Basement
;	Overlying
+	And
.	Decimal

Figure I.



LITHOLOGIC SYMBOLS USED IN STRUCTURE AND COLUMNAR SECTIONS TO REPRESENT DIFFERENT KINDS OF ROCK