APPENDIX A

Listed In Chronological Order:

1. Terratech Inc., Geologic/Geotechnical Investigation First Street Commercial Property, Hollister, California, October 1978
2. Terratech Inc., Fault Investigation J. C. Penny Building, Hollister, California Project 7737/1, July 1985
3. Terra Tech Inc., Investigation of the East Branch of the Calaveras Fault Prune Street School Site (Rancho San Justo Tandem School Site), Project 7973, June 1987
4. Applied Soil Mechanics, Work Order and Proposal for Downtown Surface Fault Investigations (December 14, 1990)
5. Applied Soil Mechanics, Inc., Fault Study, Poletti Property, 335 San Benito Street, Hollister, California: report prepared for City of Hollister Redevelopment Agency, July 5, 1991. File No. AO-2279-S1
6. Applied Soil Mechanics, Inc., Fault Study, Building Sites 1, 3-6 and 10, City of Hollister, California: report prepared for City of Hollister Redevelopment Agency, June 12 1991. File No. AO-2280-S1
7. Applied Soil Mechanics, Inc., Fault Study, Bruhn and Peterson Properties, Building Sites 7 & 8, 515, 525 and 530 San Benito Street, City of Hollister, California: report prepared for City of Hollister Redevelopment Agency, July 12 1991. File No. AO-2281-S1
8. Applied Soil Mechanics, Inc., Fault Study, Building Sites 9, Showcase Theatre, 705 San Benito Street, City of Hollister, California: report prepared for City of Hollister Redevelopment Agency, July 22 1991. File No. AO-2282-S1
9. Applied Soil Mechanics, Inc., Fault Study, “600 block” Properties, SC Corner of Sixth and San Benito Streets, Hollister, California: report prepared for City of Hollister Redevelopment Agency, July 17 1991. File No. AO-2323-S1
10. Letter from John Kingsley, Peer Review Geologist for the City of Hollister to Hugh Riley, City Manager for the City of Hollister, July 1991
11. Letter from John Kingsley, Peer Review Geologist for the City of Hollister to Hugh Riley, City Manager regarding the Machado property on Third Street, March 3, 1993
    a. Exhibit 1, Hollister 1991 Downtown Fault Study trench locations
    b. Exhibit 2, Location of proposed trenching on Site 1 for the 1991 Downtown Fault Study Proposal
    c. APN Map (unnumbered attachment to letter)
    d. Copy of July 12, 1991 peer review letter from John Kingsley to Hollister City Manager Hugh Riley for Sites 1, 3-6 & 10, File No. AO-2280-S1
    e. Copy of peer review response letter from Applied Soils Mechanics to John Kingsley, July 10, 1991 for Sites 1, 3-6 & 10, File No. AO-2280-S1

12. Memo from Tom Barry, Building Director to Barry Johnson, Redevelopment Agency regarding Earthquake Fault Studies: Hollister Downtown Area, April 29, 1994
13. Interoffice Memorandum from Barry Johnson, Redevelopment Program Manager to Stanley H. Hall, Interim City Manager, May 12, 1994
14. Earth Systems Consultants (formerly Applied Soils Mechanics), Proposal for a Geologic Fault Summary Report and Additional Fault Trenching, July 15, 1994
15. Letter from John Kingsley to City Manager Barry Johnson, Proposal for peer review consulting services for the July 1994 Earth Systems Proposal
16. Earth Systems Consultants, Geologic Fault Study San Benito Foods Storage Building, Hollister California, File NHW-7197-01, July 16, 1998
17. Pacific Rim Geologic, 2002 Fault Location and Engineering Geologic Investigation, Grace Property, Project 1093, unpublished report, 2002.
    a. Peer Review Letter from Lew Rosenberg to Ray Proffitt, City of Hollister Building Official regarding Pacific Rim Geologic Investigation Project 1093, September 27, 2002
    b. Peer Review Letter from Lew Rosenberg to Ray Proffitt, City of Hollister Building Official regarding Pacific Rim Geologic Investigation Project 1093, February 24, 2003
18. Vista Meadows Surface Fault Investigation
    a. Earth Systems Pacific, Geologic Investigation Vista Meadow Apartments East Park Street, File SH-10941-GA, August 12, 2008
    b. Peer Review Letter from Brian Papurello, Landset Engineers to Mary Paxton, City of Hollister, March 25, 2009
    c. Letter from Bret Faust, Earth Systems Pacific, June 4, 2009
    d. Peer Review Acceptance Letter from Brian Papurello to Abraham Prado, City of Hollister, June 10, 2009.
19. City of Hollister Fire Station No. 1 Fault Investigation
    a. Earth Systems Pacific, City of Hollister Fire Station No. 1 Fault Investigation, Report SH-11132-GA, December, 2010
    b. Peer review letters and responses.
20. Pacific Geotechnical Engineering, Cumulative Assessment of Fault Hazard Data in Downtown Hollister, Summary Letter Report and GIS Map Transmittal, City of Hollister, Project 2010.0177, January 6, 2012.
21. Letter from Mary Paxton to Bill Bryant, May 12, 2012
22. Letter from Mary Paxton to Bill Bryant, December 20, 2012
23. Letter from Mary Paxton to Bill Bryant and Jerry Tremain regarding submittal of 1991 downtown fault studies, November 14, 2014
24. November 19, 2014 Email from Mary Paxton to John Feltman regarding submittal of 1991 downtown fault studies

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GEOLOGIC/GEOTECHNICAL INVESTIGATION
FIRST STREET COMMERCIAL PROPERTY
Hollister, California

NOBLE CONST.

For

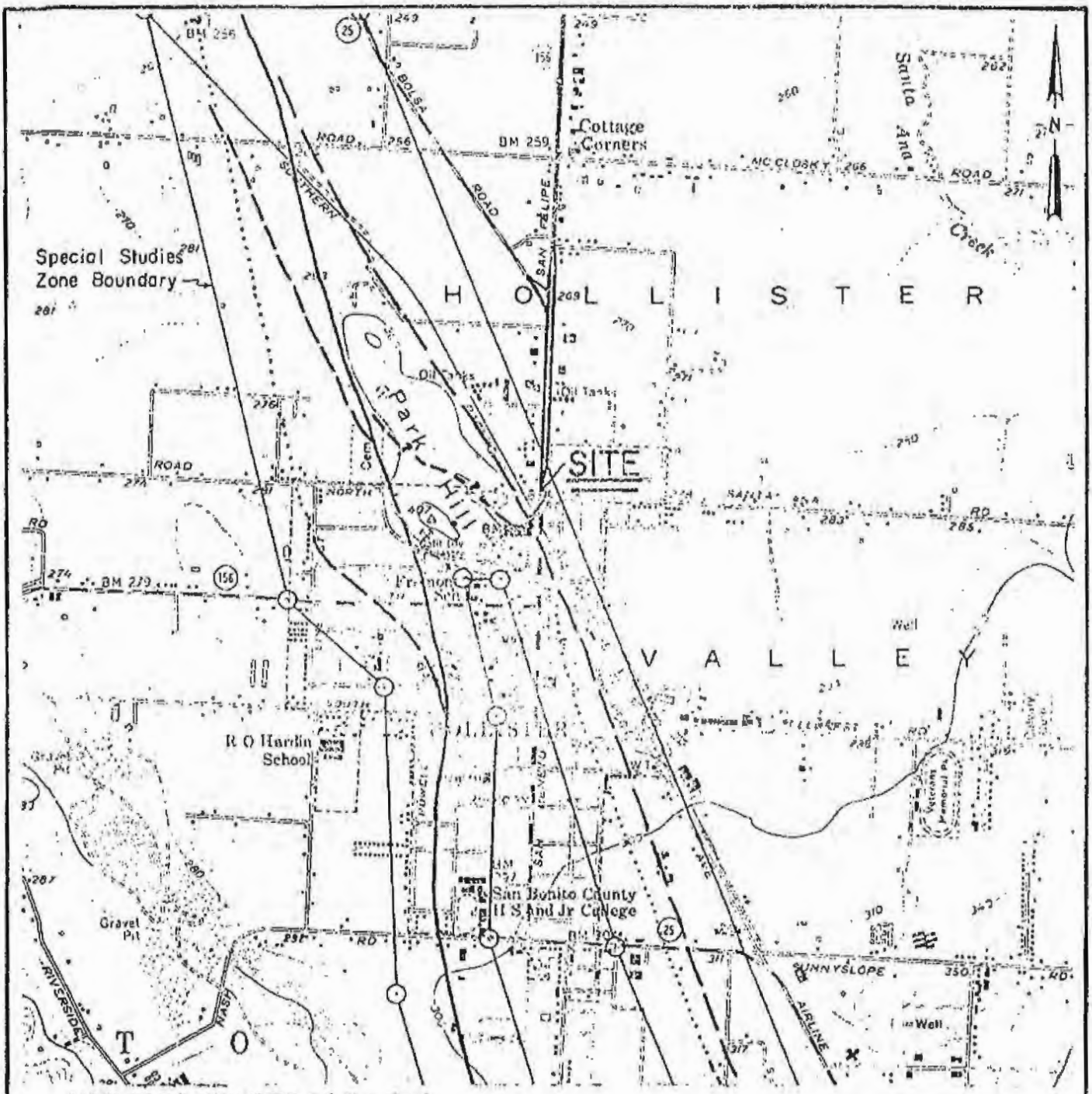
Paula Ames
c/o MH Engineering Company

BY

TERRATECH, INC.
8505 Church Street
Gilroy, California

October, 1978

APPENDIX A.1



BASE: U.S.G.S., HOLLISTER 7.5 Min. Quad

- Calaveras Fault traces (after Radbruch, 1968 and C.D.M.G., 1974)
  - Solid = definite
  - Dashed = inferred
  - Dotted = concealed
- Special Studies Zone

FIGURE I

VICINITY MAP

FIRST STREET COMMERCIAL SITE

HOLLISTER, CALIFORNIA

Scale: 1" = 2000'

PROJECT 7283 TERRATECH OCTOBER, 1978

APPENDIX A.1

GEOLOGIC/GEOTECHNICAL INVESTIGATION
FIRST STREET COMMERCIAL PROPERTY
Hollister, California

INTRODUCTION

The 1.2(±) acre parcel is located on the south side of First Street, approximately 80 feet west of the intersection with San Benito Street, in Hollister, California. A wood-frame structure, originally constructed for residential use, is situated on the property and currently serves as a commercial office building.

OBJECTIVES AND SCOPE OF WORK

Because of its unique setting between two mapped fault traces, and due to the presence of the site within the Alquist-Priolo Special Studies Zone associated with the active Calaveras Fault, the City has required a detailed geologic investigation prior to development.

The primary objective of our investigation was to assess geologic site conditions and any constraints that might be present in relation to site development. If development was determined to be feasible, the geotechnical considerations of site development would be addressed. We therefore established and fulfilled the following two stages of work for this investigation.

Stage 1 - Preliminary Geologic Evaluation

A) An evaluation of stereoscopically paired, aerial photographs of the site and its environs for evidence of faulting within the site,

B) Field geologic mapping of the site and surrounding areas,

C) Geophysical surveys across the site, utilizing magnetometer and seismic refraction survey methods in an attempt to locate anomalous subsurface fault shear zones,

D) Evaluation of all field results and oral presentation, including recommendations for supplemental studies.

Stage 2 - Detailed Geologic and Geotechnical Investigation

A) Trenching across the suspected fault zones to determine the nature of faulting as well as to locate the lateral extent of fault shear zones throughout the portion of the property to be developed,

B) Subsurface exploration by advancing exploration drill holes in those areas considered to possess only minimal geologic hazards,

C) Laboratory testing of selected soil samples recovered from the exploratory borings to determine their pertinent index and engineering properties,

D) Based upon the above findings, the preparation of recommendations for the geotechnical aspects of commercial development of the site as follows:

1) Site preparation, grading and compaction.

2) Design parameters for building foundations and concrete slabs-on-grade

No detailed studies were performed within the sloping, southwestern portion of the site occupied by Park Hill. While the present topography of this area may preclude development at this time, future proposals may be considered, requiring additional geologic studies.

SITE CONDITIONS

Surface conditions

A triangular shaped portion of the property, encompassing approximately one-half the site, or 0.6 (±) acres, is located in the northeastern area on flat ground and is therefore considered the area most likely for development. A two-story wood frame structure, presently used as an office building, with adjacent paved driveway and parking areas, is located near its center. While most of Park Hill has gently rounded natural slopes, the steep slopes within this site suggest that past quarry operations within historic times have removed materials from the toe of the hill. The slopes are covered with sparsely located low bushes and young trees, and all of the undeveloped area of the property supports a moderate growth of grass and weeds.

Regional Geology

The sediments which underlie the Hollister Valley are lake bed sediment deposited in Lake San Benito during the Pliocene and Pleistocene Epochs (Qsbl). These consist of unconsolidated CLAY, SILT, and minor SAND. Beneath the lake beds are the poorly consolidated GRAVEL and SILTSTONE and SANDSTONE of the San Benito Gravel unit (Qsbg). In the area of the Town of Hollister, these sediments have been disrupted by tectonic forces concentrated along the Calaveras Fault Zone.

Park Hill represents a horst, or structural block, folded and pushed up between two traces of the active Calaveras Fault (Figure 1).

Parallel and interconnecting fault traces mapped by Radbruch (1968) and Radbruch and Rogers (1969) were used by the State Geologist in 1974 to establish the Special Studies Zones in compliance with the Alquist-Priolo Geologic Hazards Act.

The main, actively creeping trace of the Calaveras Fault is somewhat coincident with the western edge of Park Hill. To the south, where this trace passes through Hollister, it is easily discernible by an observation of cultural features (streets, sidewalks, buildings) that are continuously being offset and damaged. A parallel easterly trace of the Calaveras Fault, trending N 25° W has been projected along the eastern toe of Park Hill; this projection shows the fault to cross the northeasterly corner of the subject site. A short fault trace connecting the two previously mentioned fault traces has been mapped across the Park Hill "saddle" area on a N 55° W trend, following the toe of that portion of Park Hill that lies within the subject site, thus being located within the study area. The latter two faults show no evidence of fault creep, but prudence dictates that they should be considered potentially active.

Site geology and subsurface conditions

The site is situated partially on the northeastern sloping portion of Park Hill, and partially on the level valley floor. Part of the sites' level area is believed to be a result of past quarrying operations.

Subsurface exploration shows the eastern portion of the property is underlain by deposits of unconsolidated SILT and CLAY, and medium dense SAND and GRAVEL with occasionally interbedded indurated siltstone. West of the existing structure, a trashy fill, extending to a depth of about 15 feet was encountered. Figure 3 presents logs of seven test pits excavated on a line parallel to First Street, showing the approximate thickness of fill. The fill, which exists in a loose condition and contains randomly located organic deposits, is unsuitable for support of permanent structures in its present condition. The approximate extent of fill is shown in Figure 2.

Fault location studies

Both geophysical methods and direct trench exploration were employed to isolate and identify site faulting. Initially, three magnetometer traverses and three seismic refraction survey lines were performed on the property, at locations shown on the Site Geologic Map (Figure 2). Anomalies observed in these lines prompted a more direct investigation by backhoe trenching. (See Appendix A for geophysical results).

Backhoe trenches were excavated at locations shown on the Site Geologic Map (Figure 2), generally to depths of about 12 feet. After shoring was installed, the trench sidewalls were cleaned and carefully examined. However, in Trench T-3, the trashy fill proved to be unstable and a portion caved in before being thoroughly examined (see Figure 3 for logs).

Near the southwestern end of Trench T-2, at Station 1+30, we encountered a minor fault (see Figures 2 and 3). At Station 1+10 in this same trench and where the bedding steepened considerably, we encountered a fault scarp developed on siltstone and overlain by loose sand and gravel.

Trench T-3 was subsequently excavated to explore the probable extension of the fault encountered in Trench T-2. At about Station 0+48 (Trench T-3), the bedding steepened and slickensided siltstone, indicative of previous shearing was evident. Unstable, caving trench walls precluded a thorough examination of this zone in-place, but on the basis of our surface observations, we believe a fault was in evidence at Station 0+48 in Trench T-3, and this fault is continuous with that shear zone encountered in Station 1+10 in Trench T-2.

We believe the fault trace found on the property represents the inferred connecting fault shown trending N 55° W on the Special Studies Map (Figure 1). The inferred fault trace trending N 25° W mapped along the eastern toe of Park Hill, was not encountered in our subsurface trenching and we believe this fault trace to be located northeast of the subject property.

Seismic considerations

The site of the proposed development is located within one of the most seismically active regions of California. Historically, the Hollister area has experienced numerous earthquakes and minor events occur frequently.

The nearest known active fault is the presently creeping trace of the Calaveras fault, located about 1,500 feet west of the site. The active San Andreas fault is located about 6 miles southwest of the site. Earthquakes epicentered along either of these faults could appreciably affect the site. The major seismic hazards and their potential effects on the site are described below:

1. Ground Rupture - On the basis of both our geophysical evaluation and trench examinations, we are of the opinion that a fault trace crosses the property as shown on Figure 2. The activity of this fault is unknown, however, we believe the fault should be considered at least potentially active, and must therefore conclude that there is a potential for earthquake-induced ground rupture within the site along or in close proximity to this fault trace.

2. Soil Liquefaction - This hazard is primarily associated with loose, saturated, clean fine sands. We suspect that the free groundwater surface is sufficiently deep and the sand sufficiently coarse so that liquefaction need not be a consideration at this site.

3. Ground Shaking - During the next 100 years or so, it is likely that the site will be severly shaken by an earthquake with an epicentral location on or near one of the active faults close to the property. Additionally, it is possible that severe ground shaking could activate shallow landsliding of materials on the steep slopes situated in the southwestern portion of the property.

RECOMMENDATIONS (Geology)

Because of the potential for surface rupture on the property, we recommend that no permanent structures for human occupancy be constructed within 30 feet of the fault shear zone. A setback zone reflecting this recommended distance has been established on the Site Geologic Map (Figure 2).

GEOTECHNICAL CONSIDERATIONS

The residual soils underlying the site are strong, relatively incompressible and have a low potential for volume changes associated with seasonal changes in soil water content. However, the trash fill located west of the existing structure has a heterogeneous composition and consistency, and in its present condition, is not considered suitable for support of permanent structures. Even pavement structures constructed on this trash material could, in a short time, experience subsidence that would lead to early failure. While foundations could be supported on deep piers founded on residual soils underlying the trashy fill, we prefer to review any development proposals before preparing detailed foundation design recommendations for this area of the property. Ideally, this trash fill and associated debris should be removed, and grade restored with approved import material, placed and compacted to the governing project technical requirements.

The following geotechnical recommendations are provided for developement in those areas east of the trashy fill, and northeast of the fault setback line.

Site preparation

The surface of the development area, including a 5-foot perimeter zone, should be stripped to remove surface vegetation and organic topsoil. Soil containing more than 2 percent by weight of organic matter should be considered organic.

Stripping depths should be decided in the field at the time of construction but for planning purposes an average stripping depth of 3 inches should be assumed.

Strippings may be either wasted off-site or stockpiled for subsequent use in landscaped areas.

Depressions and loose soil zones resulting from the removal of designated trees or underground structures that may be encountered during clearing and grubbing operations or site grading, should be carefully backfilled with thoroughly compacted on-site inorganic soil.

Grading and compaction

Stripped soil surfaces in those areas to receive structural fill, foundations, slabs-on-grade, or pavements, should be scarified to a depth of at least 8 inches, conditioned with water (or allowed to dry) to produce a soil-water content at least 2 percent above the optimum value and then compacted to a density equivalent to at least 90 percent of the maximum dry density of the soil as determined by ASTM Test D1557-70.

Structural fill using on-site inorganic soil should be placed in layers not exceeding 8 inches loose thickness, conditioned with water (or allowed to dry) and compacted to the requirements described previously.

For purposes of calculating grading elevations and fill volumes assume that loose soils in the upper 12-inch surface zone will decrease in volume by about 15 percent when used as structural fill or compacted in-place. Denser soils below this surface zone will decrease in volume by about 5 percent when used as structural fill and will compress about ½ inch when surface compacted, in-place.

Building foundations

Buildings up to 3 stories in height may be supported on conventional shallow foundations bearing on natural soil or compacted structural fill.

Reinforced concrete continuous footings may be designed to impose pressures on foundation soils up to 3,000 pounds per square foot from dead plus normal live loading provided the resulting foundation width is not less than 12 inches. Footings should be embedded at least 18 inches below rough pad grade or adjacent finished grade whichever is lower.

Individual reinforced concrete foundations, such as may be used for supporting interior columns or pier blocks, may be designed to impose pressures on foundation soils up to 3,500 pounds per square foot, and should be embedded at least 12 inches below rough pad grade.

Utility trenches

Vertical trench excavations up to 5 feet in depth should be capable of standing with minimal bracing for short construction periods. Attention is drawn to the State of California Safety Orders dealing with "Excavations and Trenches." Such orders require bracing for all trenches more than 5 feet deep.

For purposes of this section of the report, bedding is defined as that material placed in the trench to a depth of 1 foot above the top of pipe. Backfill is defined as fill placed above the bedding material.

Unless concrete bedding is required around utility pipes or conduits, imported free-draining sand should be used as bedding. Sand bedding should be jetted and compacted to a unit weight equivalent to at least 95 percent of the compaction test maximum (ASTM D1557-70). Sand proposed for use as bedding should be tested in our laboratory to determine its suitability.

On-site inorganic soil or suitable imported soil may be used as backfill. A representative sample of the imported soil proposed for use should be tested in our laboratory to determine its suitability.

In areas where settlement of the trench backfill should be minimized, such as under the driveway or adjacent to the house, the backfill should be placed in a series of horizontal layers, each layer not exceeding 8 inches in loose thickness, and compacted to a minimum 90 percent of the maximum laboratory test value (ASTM D1557-70).

Concrete Slabs-on-grade

Concrete floor slabs should be constructed on compacted soil subgrades prepared as described in the section on Grading and Compaction.

Where floor dampness must be minimized, a minimum 4 inch section of capillary break material covered with a membrane vapor barrier should be placed between the floor slab and the compacted soil subgrade. The capillary break should be free-draining, clean gravel or rock, such as 3/8" washed pea gravel or permeable aggregate complying with Caltrans Standard Specifications, Section 68, Class 1, Type A. The material proposed should be tested in our laboratory to verify its effectiveness as a capillary break. The membrane vapor barrier should be at least 10 mil thick polyethylene or its equivalent, unless it is protected by a covering layer of sand, in which case a material of 6 mil thickness may be used.

Where floor dampness is not objectionable, concrete slabs may be constructed directly on the compacted soil subgrade.

Surface drainage and landscaping

Surface drainage gradients should be planned to prevent ponding and to direct surface water away from building foundations, slabs, edges of pavements, and towards suitable collection and discharge facilities. Concrete splash blocks and channels should be provided beneath downspouts to carry rainwater away from building foundations.

Pavements should be designed with surface gradients of at least 2 percent in their principal directions of drainage.

Water seepage or the spread of extensive root systems into the soil subgrades of foundations, slabs or pavements could cause differential movements and consequent distress in these structural elements. The landscape designer should be advised of this and in particular should arrange that deep rooted trees or shrubs, especially those requiring heavy watering, are not planted alongside building foundations unless they are contained in planter boxes with watering restricted to the boxes.

Observation and testing during construction

We recommend that TERRATECH be commissioned to assist with the control of the geotechnical elements of project development by observation and testing during construction and particularly to undertake the following:

1. Observe site stripping and advise on stripping depths.

2. Observe, test and advise on scarifying, water conditioning and compaction of cut and fill in areas to receive foundations, slabs-on-grade, or pavements.

3. Review development proposals for the area west of the existing structure, and advise on special foundation construction and/or earthwork processing, as necessary.

LIMITATIONS

Development proposals that are significantly different from those assumed in our report will render our recommendations invalid unless such changes are reviewed by our staff and our specific recommendations modified accordingly.

Our findings and recommendations have been made in accordance with the geologic and foundation engineering principles and practices generally employed by the geologic and engineering professions. They have been based upon data obtained from field studies and explorations made at the locations indicated on the site geologic map (Figure 2).

Subsurface exploration of any site is necessarily confined to selected locations, and conditions may and often do vary between these locations. Should varied conditions come to light during project development, additional exploration, testing and construction modification may be required. To compare the generalized site conditions assumed in this report with those found on the site at the time of construction, all earthwork and associated operations should be observed by our field representative and tested where necessary.

Any person concerned with this project who observes conditions or features of the site or its surrounding areas which are different from those described in this report, should report them immediately to this office for evaluation.

Report Preparation:

Geology by

James B. Baker

Engineering by

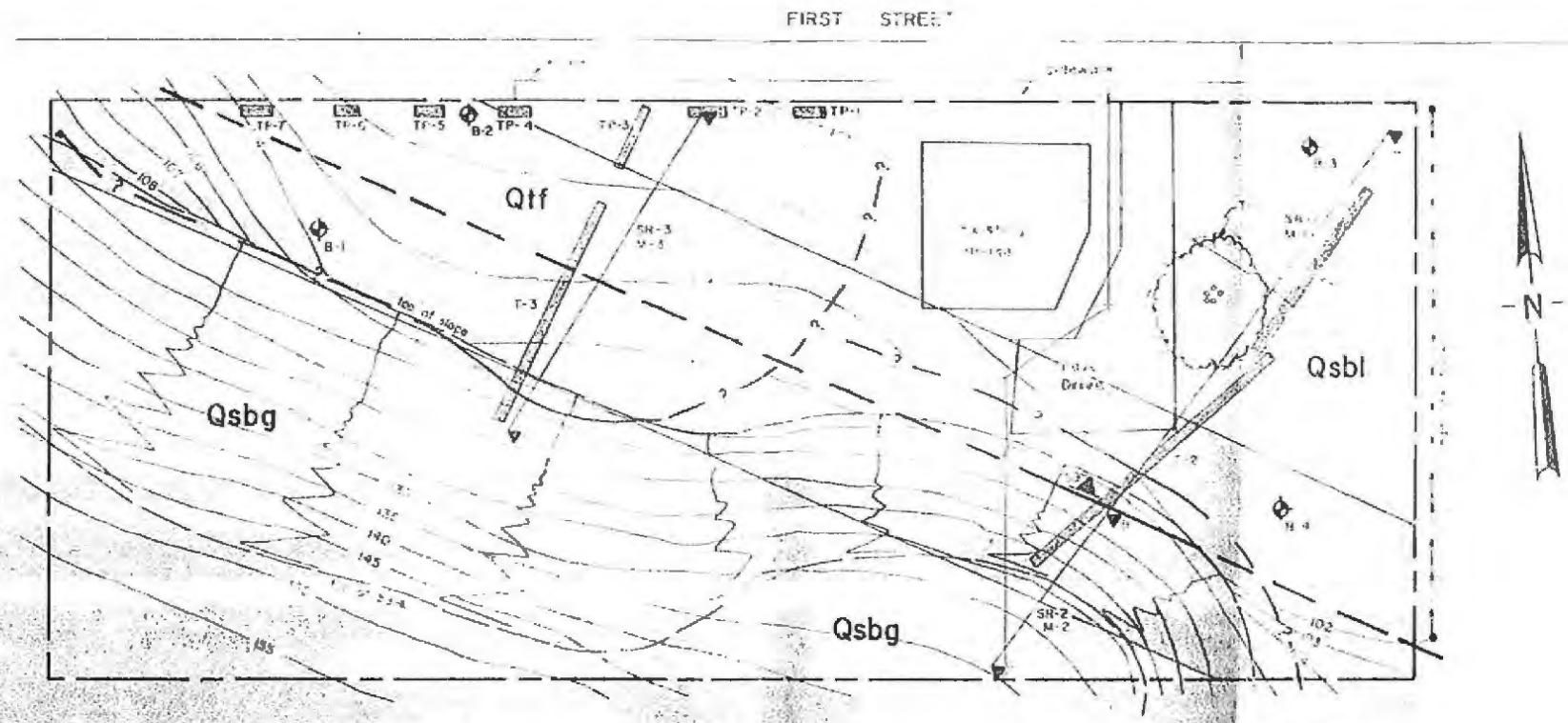
Kenneth L. Meleen
CE 17487

Report reviewed by

Joseph N. Gabriel
CEG 256

J. Alan Benfer
CEG 987

FIGURE 2



EXPLORATION SYMBOLS

SR. — Seismic Refraction Traverse
M — Magnetic Traverse
T — Exploration Trench
TP — Exploration Test Pit
B — Boring

SITE GEOLOGIC MAP

FIRST STREET COMMERCIAL SITE

HOLLISTER, CALIFORNIA

1" = 30'

GEOLOGIC SYMBOLS

Qtf — Trash Fill
Qsbl — San Benito Lake Beds
Qsbg — San Benito Gravels
— Fault Trace
solid = observed
dashed = inferred
— Recommended Setback Zone

PROJECT 7283 TERRATECH OCTOBER, 1978

APPENDIX A.1

BIBLIOGRAPHY

1. California Division of Mines and Geology, 1974, Special Studies Zone Map of the Hollister Quadrangle: State of California

2. Dibblee, T.W. Jr. and Rogers, T.H., 1975, Geologic Map of the Hollister 15' Quadrangle, California: U.S. Geologic Survey, open file map 75-394

3. Jenkins, Olaf P., 1973, Pleistocene Lake San Benito: California Geology, Volume 26, No. 7.

4. Kilburn, Chabot, 1972, Ground-water hydrology of the Hollister and San Juan Valleys, San Benito County, California, 1913-68: U.S. Geological Survey open file report.

5. Taliaferro, N.L., 1945, Geologic map of the Hollister 15' Quadrangle, California: Cal. Div. of Mines Bull. 143, pl. 1.

6. Radbruch, Dorothy H., 1968, Map showing recently active breaks along the Hayward fault zone and southern part of the Calaveras fault zone, California: U.S. Geological Survey open file map.

7. Radbruch, Dorothy H., and Rogers, Thomas H., 1969, Hayward and Calaveras Fault zones, in field trips of the national meeting of the Association of Engineering Geologists: San Francisco, California

APPENDIX A

GEOPHYSICAL SURVEYS

General Background

Total magnetic field

Variations in the local magnetic field were measured using the Geometrics G-816 portable proton-precession magnetometer. Readings were taken at 10 or 20 foot spaced stations along the line of profile. The instrument has digital readout with an accuracy of 1 gamma.

This technique accurately measures the intensity of the magnetic field at each station. The resulting plot of total intensity (in gammas) versus distance (in feet) often contain distinctive anomalies which may be associated with differences in magnetic susceptibility between subsurface units. Magnetic profiles can often be used in conjunction with the seismic refraction data to infer the configuration of subsurface materials by indicating the locations of important concealed contacts.

Seismic refraction

The seismic refraction survey was conducted with a Geometrics Nimbus ES-125 signal enhancement seismograph which allows measurement of the travel-time of compressional elastic waves traveling through the subsurface. Energy impulses are produced by impact of a 16 pound sledge-hammer on the ground surface. The signal enhancement and CRT display capabilities of the instrument allow confident identification and measurement of delay times for first arrivals.

This procedure measures velocities of subsurface materials. A plot of travel-times (in milliseconds) versus distance (in feet) is used. "Best-fit" straight lines are used to connect the data points and the slope of each line is the inverse of the apparent velocity of the corresponding layer. The velocities give a good indication of the character of the subsurface materials.

In most situations the velocities of layers increase with their depth below the ground surface. The wave front is refracted at the velocity contrast interfaces between layers. Since deeper waves have a longer path to travel, but travel more quickly while in the deeper layers, there is a critical distance beyond which the deeper refracted waves arrive before the shallower-pathed direct waves. This distance (Xc) and the measured velocities of the layers (V) are used to compute the depth (D) of the refracting velocity contrast interface. The following formula is used to calculate depth (D):

$$D_1 = \frac{Xc_1}{2}\sqrt{\frac{V_2-V_1}{V_2+V_1}}$$

Geologic interpretations of the geophysical profiles were made using all available information from other sources (i.e., geologic maps, surface topography, aerial photographs, etc.).

Results

Three magnetic traverses were conducted along the same lines as the seismic refraction lines (see Figure 2). The data are plotted in Figure A-1.

The magnetic profiles indicate a singificant decrease in total field intensity toward the northeast. This suggests that the structure continues to dip steeply to the northeast as observed in cut slope and trench exposures.

Three seismic refraction lines were run in a northeast orientation (see Figure 2), essentially perpendicular to the mapped trend of the fault shown striking between the two hills north and west of the site. The time/distance plots are presented in Figure A-1.

The velocities measured and depth calculated for refracting interfaces on the basis of the seismic refraction and magnetic data were used, in conjunction with the drill holes and exploration trenches, to formulate the interpreted cross sections shown in Figure A-1.

APPENDIX B

EXPLORATION DRILL HOLE LOG

HOLE No. B-1

PROJECT FIRST STREET COMMERCIAL SITE DATE 9/19/78 LOGGED BY JBR

DRILL RIG Cont. Flight HOLE DIA. 5½" SAMPLER Mod. Cal.

GROUNDWATER DEPTH INITIAL ---- FINAL ---- HOLE ELEV. 104

DESCRIPTION	SOIL TYPE	DEPTH	SAMPLE	BLOWS PER FOOT	POCKET PEN.(tsf)	TORVANE(tsf)		LIQUID LIMIT	WATER CONTENT	PLASTIC LIMIT	DRY DENSITY (pcf)	FAILURE STRAIN(%)	UNCONFINED SHEAR STRENGTH(psf)
Medium brown, dry, loose gravelly silty SAND with debris (Fill)	SM	1											
		2											
		3											
		4											
Bottom of Hole at 4' No Water Encountered		5											
		6											
		7											
		8											
		9											
		10											
		11											
		12											
		13											
		14											
		15											
		16											
		17											
		18											
		19											
		20											

PROJECT 7283 TERRATECH

EXPLORATION DRILL HOLE LOG

HOLE No. B-2

PROJECT FIRST STREET COMMERCIAL SITE DATE 9/19/78 LOGGED BY JBB

DRILL RIG Cont. Flight HOLE DIA. 5½" SAMPLER Mod. Cal.

GROUNDWATER DEPTH INITIAL ---- FINAL ---- HOLE ELEV. 102

Between pits: DESCRIPTION 16' from end of sidewalk	SOIL TYPE	DEPTH	SAMPLE	BLOWS PER FOOT	POCKET PEN. (tsf)	TORVANE (tsf)		LIQUID LIMIT	WATER CONTENT	PLASTIC LIMIT	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED SHEAR STRENGTH (psf)
Medium brown, slightly moist loose gravelly sandy SILT, with debris (fill)	ML	1											
		2											
		3											
wire & various debris		4											
		5		7					28		84	3.2	710
		6											
		7											
		8											
SILT, with organics and trash		9											
		10		11					13		122	5.4	840
(medium dense) Brown, medium dense sandy		11											
GRAVEL, coarse (1-4" cobbles) in loose coarse SAND, (wet) (residual soil)	GW	12											
		13											
Bottom of Hole at 14' No Water Encountered		14											
		15											
		16											
		17											
		18											
		19											
		20											

PROJECT 7283 TERRATECH

EXPLORATION DRILL HOLE LOG

HOLE No. B-3

PROJECT FIRST STREET COMMERCIAL SITE DATE 9/19/78 LOGGED BY JBB

DRILL RIG Cont. Flight HOLE DIA. 5½" SAMPLER Mod. Cal.

GROUNDWATER DEPTH INITIAL ----- FINAL ----- HOLE ELEV. 101

DESCRIPTION	SOIL TYPE	DEPTH	SAMPLE	BLOWS PER FOOT	POCKET PEN.(tsf)	TORVANE(tsf)		LIQUID LIMIT	WATER CONTENT	PLASTIC LIMIT	DRY DENSITY (pcf)	FAILURE STRAIN(%)	UNCONFINED SHEAR STRENGTH(psf)
Brown, moist, medium, dense, silty, sandy GRAVEL	GW	1											
Medium brown, moist, stiff, silty, sandy CLAY	CLS	2											
		3											
Light gray, moist, medium dense, sandy SILT	MLS	4		11					17		96	3.3	2590
		5		10									
		6											
		7											
		8											
		9											
		10		17					10		104		
Orange brown, damp, medium dense, fine SAND	SW	11											
Medium brown, damp, stiff, sandy CLAY	CLS	12											
		13											
		14											
		15											
		16											
		17											
		18											
		19											
		20											

APPENDIX A.1

EXPLORATION DRILL HOLE LOG

HOLE No. B-3

PROJECT FIRST STREET COMMERCIAL SITE DATE 9/19/78 LOGGED BY JBB

DRILL RIG Cont. Flight HOLE DIA. 5½" SAMPLER Mod. Cal.

GROUNDWATER DEPTH INITIAL ---- FINAL ---- HOLE ELEV. 101

DESCRIPTION	SOIL TYPE	DEPTH	SAMPLE	BLOWS PER FOOT	POCKET PEN.(tsf)	TORVANE(tsf)		LIQUID LIMIT	WATER CONTENT	PLASTIC LIMIT	DRY DENSITY (pcf)	FAILURE STRAIN(%)	UNCONFINED SHEAR STRENGTH(psf)
(Medium brown, damp, stiff, sandy CLAY)	CLS	21											
		22											
Brown, moist, very dense silty, fine SAND	SP	23											
		24											
		25											
		26											
		27											
		28											
Medium brown, damp, very stiff to hard silty CLAY to clayey SILT	ML/CL	29											
		30											
		31											
		32											
		33											
		34											
		35											
		36											
		37											
		38											
		39											
Bottom of Hole at 39' No Water Encountered		40											

EXPLORATION DRILL HOLE LOG

HOLE No. B-4

PROJECT FIRST STREET COMMERCIAL SITE DATE 9/19/78 LOGGED BY JBB

DRILL RIG Cont. Flight HOLE DIA. 5½" SAMPLER Mod. Cal.

GROUNDWATER DEPTH INITIAL ----- FINAL ----- HOLE ELEV. 102

DESCRIPTION	SOIL TYPE	DEPTH	SAMPLE	BLOWS PER FOOT	POCKET PEN.(tsf)	TORVANE(tsf)		LIQUID LIMIT	WATER CONTENT	PLASTIC LIMIT	DRY DENSITY (pcf)	FAILURE STRAIN(%)	UNCONFINED SHEAR STRENGTH(psf)
Dark brown, dry to slightly moist, medium dense, silty GRAVEL	GW	1											
		2											
Dark red brown, moist, stiff to very stiff, gravelly CLAY with caliche nodules	CLG	3											
		4											
		5		24					11		107	2.9	3970
		6											
Medium orange brown, moist, clayey, SAND with some gravel	SC	7											
		8											
		9											
		10											
Light gray brown, moist, dense GRAVEL, with coarse SAND	GW	11											
		12											
		13											
		14											
Bottom of Hole at 14' No Water Encountered		15											
		16											
		17											
		18											
		19											
		20											

PROJECT 7283 TERRATECH

FAULT INVESTIGATION
J.C. PENNEY BUILDING
HOLLISTER, CALIFORNIA

PROJECT 7737/1

For

Mr. Mike Fitzpatrick
c/o Jane Watson
133 Alice Court
Danville, California

By

TERRATECH, INC.
8505 Church Street
Gilroy, California
(408) 842-0236

July, 1985

APPENDIX A.2

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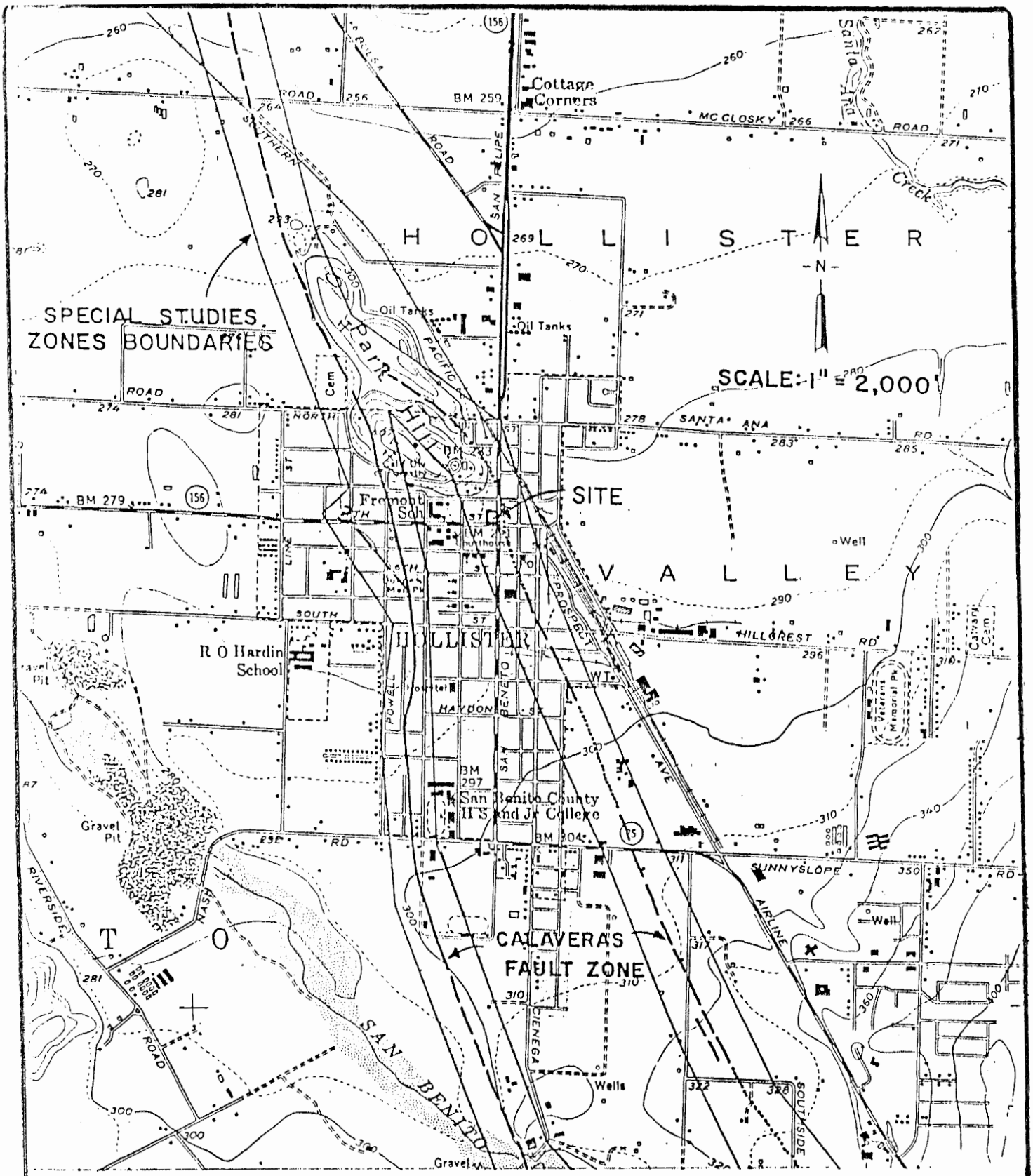


STATE OF CALIFORNIA SPECIAL STUDIES ZONES MAP, HOLLISTER QUADRANGLE REVISED, 1982, CALAVERAS FAULT ZONE.

TERRATECH

VICINITY MAP

FORMER J.C. PENNEY BUILDING
HOLLISTER, CALIFORNIA

FIGURE 1

PROJECT 7737/1

APPENDIX A.2

FAULT INVESTIGATION
J.C. PENNEY BUILDING
HOLLISTER, CA

INTRODUCTION

This report presents the results of our fault investigation performed at the site of the former J.C. Penney building. The 0.40(±) acre site is located on the northwest corner of Fourth and San Benito Streets in downtown Hollister, California. It is proposed to raze the abandoned building which was damaged by fire and to eventually redevelop the site.

The site is located within a Special Studies Zone established along the eastern trace of the Calaveras fault zone. The zonation of this fault was mandated by the Alquist-Priolo Geologic Hazards Act, enacted by the California legislature in 1972. The concealed fault trace has been mapped by the California Division of Mines and Geology (C.D.M.G) approximately 100 feet east of the parcel. Our investigation explored the site for the presence of the fault.

For this investigation we performed the following tasks:

1. A review of our files of past projects we have performed in the area, as well as aerial photographs and geologic literature pertaining to the area.

2. A reconnaissance in the vicinity of the project to locate any distress in cultural features possibly caused by historic movement along the fault.

3. The excavation and logging of two 11 to 13 foot deep exploratory trenches across the parcel. One 61 foot long trench was excavated in the alley north of the parcel and a second trench, 79 feet long, was excavated diagonally across the existing open area situated in the northwestern corner of the parcel.

4. A discussion of preliminary findings with project consultants.

5. The preparation of this written report of our findings, conclusions and recommendations including a regional fault map, site plan and trench logs.

FINDINGS

SITE CONDITIONS

The majority of the site is covered by a brick and concrete two-story building previously occupied by the J.C. Penney department store. A fire

economically destroyed the structure approximately two years ago. The damaged upper story constructed of brick was removed as a safety precaution. The northwest portion of the building was also razed leaving an open space, and in this area several brick footings approximately two feet deep remain.

Hawkins Alley trends east-west at the rear (north) of the parcel and a turn-of-the-century two-story brick building is located immediately west of the parcel.

Several utilities were discovered in the alley, including a steel fuel storage tank located at the west end of trench T-2. Probing of the tank through a vent pipe suggests the top of the tank is at a depth of about 10 feet and the tank bottom is about 16 feet. A buried pipe appears to trend south from the tank about 70 feet to a concrete cellar approximately 10 feet deep. We suspect the cellar was actually a boiler room which received fuel from the storage tank.

REGIONAL GEOLOGY

The City of Hollister is located in a geologically active area. The active Calaveras and San Andreas Faults, both capable of generating large earthquakes, are located nearby. These faults are locally creeping about 1 cm/year and converge just south of the Hollister area.

During Pleistocene time, the Hollister Valley was occupied by Lake San Benito. Numerous streams fed this lake and the resulting fluvial and lacustrine sediments may locally attain a thickness of 1000 feet (Kilburn). The interbedded fluvial and lacustrine sand, silt, and clay likely range in age from Pleistocene to early Holocene. Bedrock underlying these sediments is believed to be Pliocene Age sedimentary rock; however, exact basement relationships are uncertain due to complex faulting at depth.

SITE GEOLOGY

The concealed trace of the eastern branch of the Calaveras fault has been mapped by the C.D.M.G. as passing through Park Hill, located north of the site and through the intersection of Third and San Benito Streets, about 100 feet northeast of the J.C. Penney site (see Figure 1). Although the nearby eastern trace appears to be seismically active, no continual creep has been documented on this trace. Active right lateral creep is occurring on the main Calaveras trace, located 1/4 mile west of the

site. Here, the precise fault location can be readily identified by severe cracking of curbs, streets and structures situated on the fault. Because of extensive downtown development and lack of creep, the eastern branch is not easily identified at the surface. At the south end of Hollister, however, the eastern trace is marked by a prominent scarp several feet high.

To evaluate the site for potential faulting, two exploratory trenches were excavated on the site (see Figure 2). Trench T-1 was excavated for 79 feet in a northeasterly direction in the open area located in the northwestern corner of the parcel. Trench T-2, 61 feet long, was oriented in an east-west direction in Hawkins Alley north of the existing building. It was not possible to connect the ends of the two trenches due to the presence of the buried fuel tank. Both trenches were excavated to depths ranging from 11 to 13 feet.

The northerly walls of both trenches were carefully inspected and logged (see trench logs, Figures 3A and 3B). Sediments encountered consist of horizontal, thinly bedded silt, silty fine sand, silty clay and admixtures of each. The soils grade both laterally and vertically, which is characteristic of lake sediments and represent Lake San Benito deposits.

No deformation of bedding or any evidence of faulting was encountered in either trench. Due to the presence of the existing building, it was not possible to evaluate approximately 40 feet of the southwestern portion of the parcel. We would not expect the eastern branch to pass through this area. We suspect the trace is located close to where mapped by the C.D.M.G.; that is, approximately 100 feet northeast of the property.

Upon completion of our fault investigation, both trenches were backfilled. Trench T-1 was backfilled with native soil deposited in lifts and compacted by hand with a vibratory compactor (Wacker). Trench T-2 was backfilled with imported clean sand, moisture conditioned and compacted in lifts. Trench T-2 was then capped with 6 inches of concrete to restore the alley surface.

SEISMICITY

Seismic hazards constitute the most significant geologic constraint that could affect site development. As mapped by the C.D.M.G., the eastern branch of the Calaveras fault passes within 100 feet of the site. The actively creeping trace of the Calaveras Fault lies 1/4 mile vest of the property. The active San Andreas Fault is located approximately 4-1/2 miles to the southwest.

The major seismic hazards and their potential effects on this site are as follows.

Ground Rupture: During a strong earthquake, ground rupture and surface offset often occur along faults and typically coincide with preexisting fault traces. Our investigation did not reveal any evidence of past faulting across the site and we therefore conclude that the potential for ground rupture at the site is low.

Seismic Shaking: The property is located within the seismically active Hollister Valley and is situated near several faults that are capable of causing violent shaking at the site. Based on historic records and on the known seismicity of the area, it is likely that within the next 50 years the site will experience an earthquake of Richter Magnitude 6.0 or greater, as well as numerous smaller earthquakes, all generated within 20 miles of the site. A strong earthquake epicentered along any of the major faults situated in the vicinity of the site would probably cause severe ground shaking. This potential hazard is shared by many other sites in Hollister. Of additional concern is the possibility that the adjacent building west of the site may collapse during strong ground shaking, resulting in damage to structures constructed on the J.C. Penney site. This early 1900's two-story building appears to be constructed of unreinforced brick which typically performs badly during strong earthquakes.

Liquefaction: Liquefaction of loose, saturated silt and sand during an earthquake will reduce the shear strength of these soils and can contribute to lurch cracking and abrupt settlement of the ground surface or structures. Potentially liquefiable deposits of silt and sand may underlie the property, however, there is currently insufficient subsurface information available to evaluate this potential hazard. Detailed subsurface exploration and laboratory testing will be necessary to evaluate liquefaction potential.

CONCLUSIONS AND RECOMMENDATIONS

Our investigation revealed no evidence of faulting across the former J.C. Penney site and we conclude that the eastern branch of the Calaveras fault is probably located off-site as mapped by the C.D.M.G.

Once development plans are established, we recommend that a deep boring should be drilled and inplace samples obtained and tested to evaluate the

liquefaction potential of the subsurface soils. In addition, the structural stability of the adjacent brick building should be evaluated and development plans should include measures to mitigate potential damage to site structures should the adjacent brick building collapse during seismic shaking. Recommendations for processing of on-site fill, site stripping, grading, utility trenching and surface drainage should be addressed in a geotechnical report.

LIMITATIONS

In developing the conclusions and recommendations given above, we have followed the principles and practices generally employed by the geologic profession.

Any person concerned with this project who observes conditions or features of the site or its surrounding area which are different from those described in this report, should report them immediately to this office for evaluation.

Sincerely,

TERRATECH, INC.

J. Alan Benfer

J. Alan Benfer
Engineering Geologist 987

JAB:ljh

REFERENCES

1. Bay Soils, Inc., 1981, Preliminary geologic evaluation on proposed shopping center northeast corner of Nash Road and Southside Road, Hollister, California.

2. Dibblee, T.W., Jr., 1975, Geologic map of the Hollister quadrangle, California, U.S. Geological Survey Open File Map 75-394.

3. Kiburn, Chabot, 1972, Groundwater hydrology of the Hollister and San Juan Valleys, San Benito County, California, U.S. Geological Survey Open File Report.

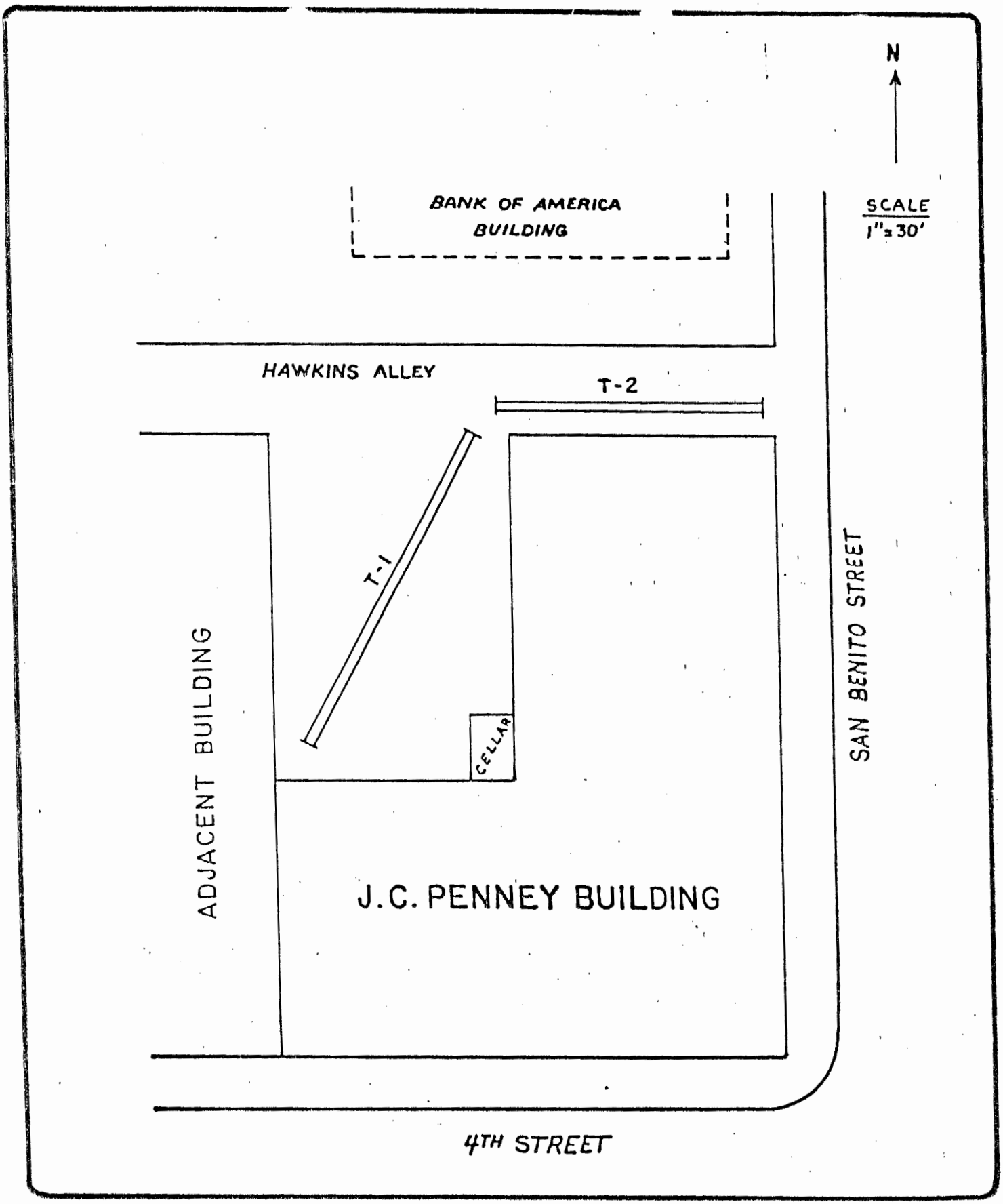
4. Radbruch, D.H., 1968, Map showing recently active breaks along the Hayward fault zone and southern part of the Calaveras fault zone, California, U.S. Geological Survey Map.

5. State of California, 1982, Special studies zones, Hollister quadrangle, Scale 1:24,000.

6. Terratech, Inc., 1981, Nob Hill shopping center complex, Hollister, California.

STEREOSCOPIC AERIAL PHOTOGAPHS

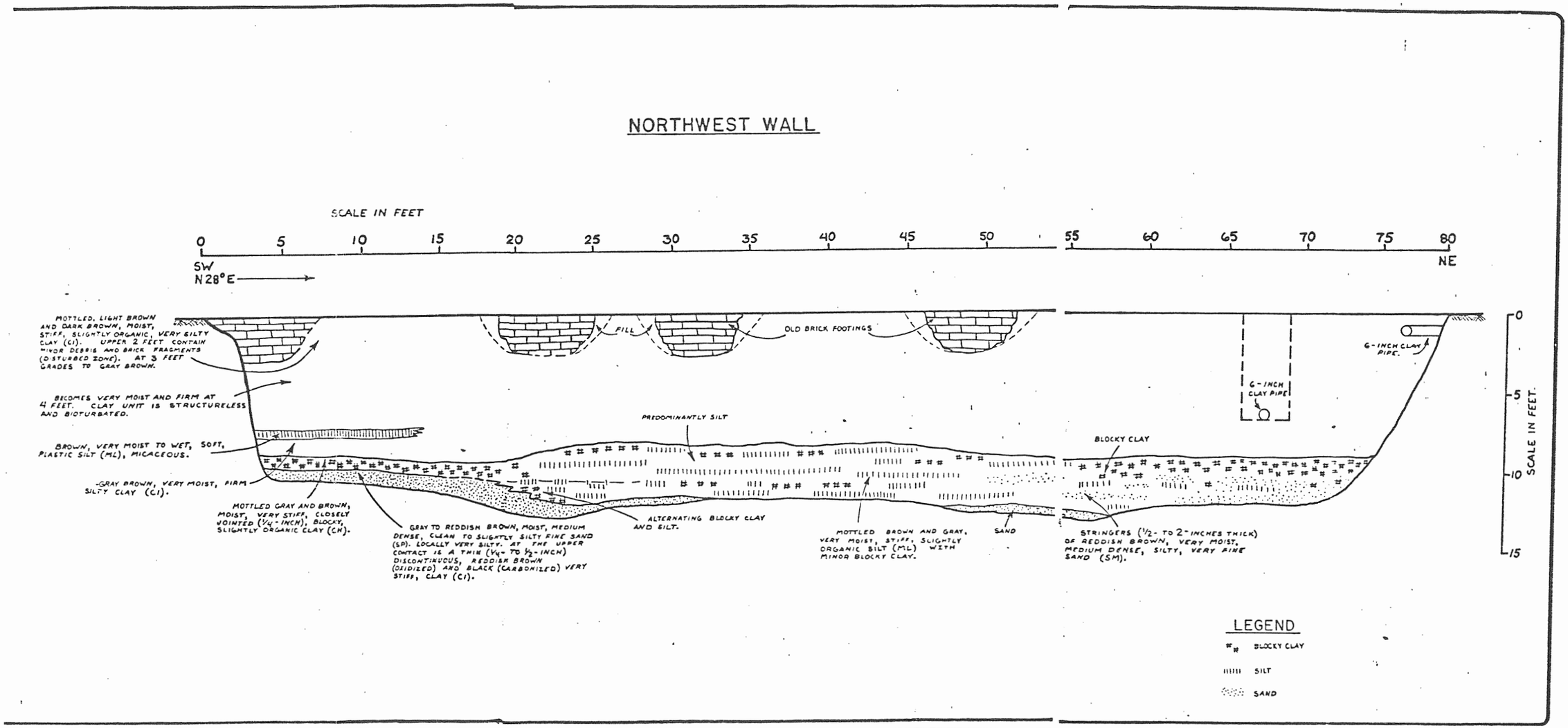
Date	By	Type	Scale	Flight and Frame Nos.	
7/12/74	U.S.G.S.	Color	1:20,000	12	82, 83, 84, 85, 86, 87



TERRATECH

SITE PLAN
FORMER J.C. PENNEY BUILDING
HOLLISTER, CALIFORNIA

FIGURE 2
PROJECT 7737/1



ERRATECH

EXPLORATORY TRENCH T-1

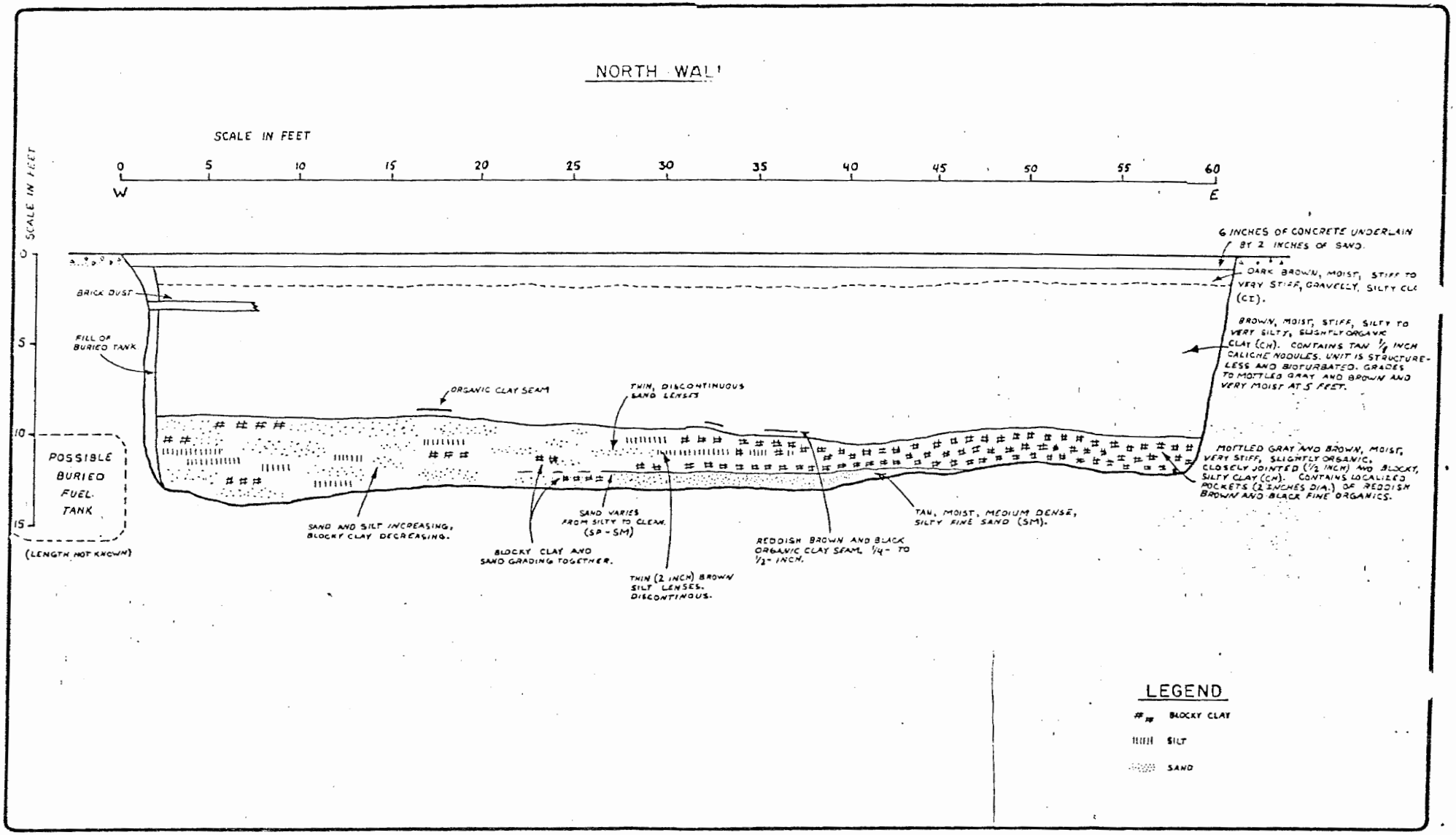
FORMER J.C. PENNEY BUILDING

HOLLISTER, CALIFORNIA

FIGURE 3-A

PROJECT 7737/1

APPENDIX A.2



TERRATECH

EXPLORATORY TRENCH LOG T-2
FORMER J.C. PENNEY BUILDING
HOLLISTER, CALIFORNIA

FIGURE 3-B

PROJECT 7737/1

APPENDIX A-2

INVESTIGATION OF THE
EAST BRANCH OF THE CALAVERAS FAULT
PRUNE STREET SCHOOL SITE
(RANCHO SAN JUSTO TANDEM SCHOOL SITE)
HOLLISTER, CALIFORNIA

PROJECT 7973

For

Hollister School District
P.O. Box 1067
761 South Street
Hollister, California 95023

By

TERRATECH, INC.
7891 Westwood Drive, Suite 101
Gilroy, California

June 1987

JUL 1988
RECEIVED
CITY OF HOLLISTER
PLANNING DEPT.

APPENDIX A.3

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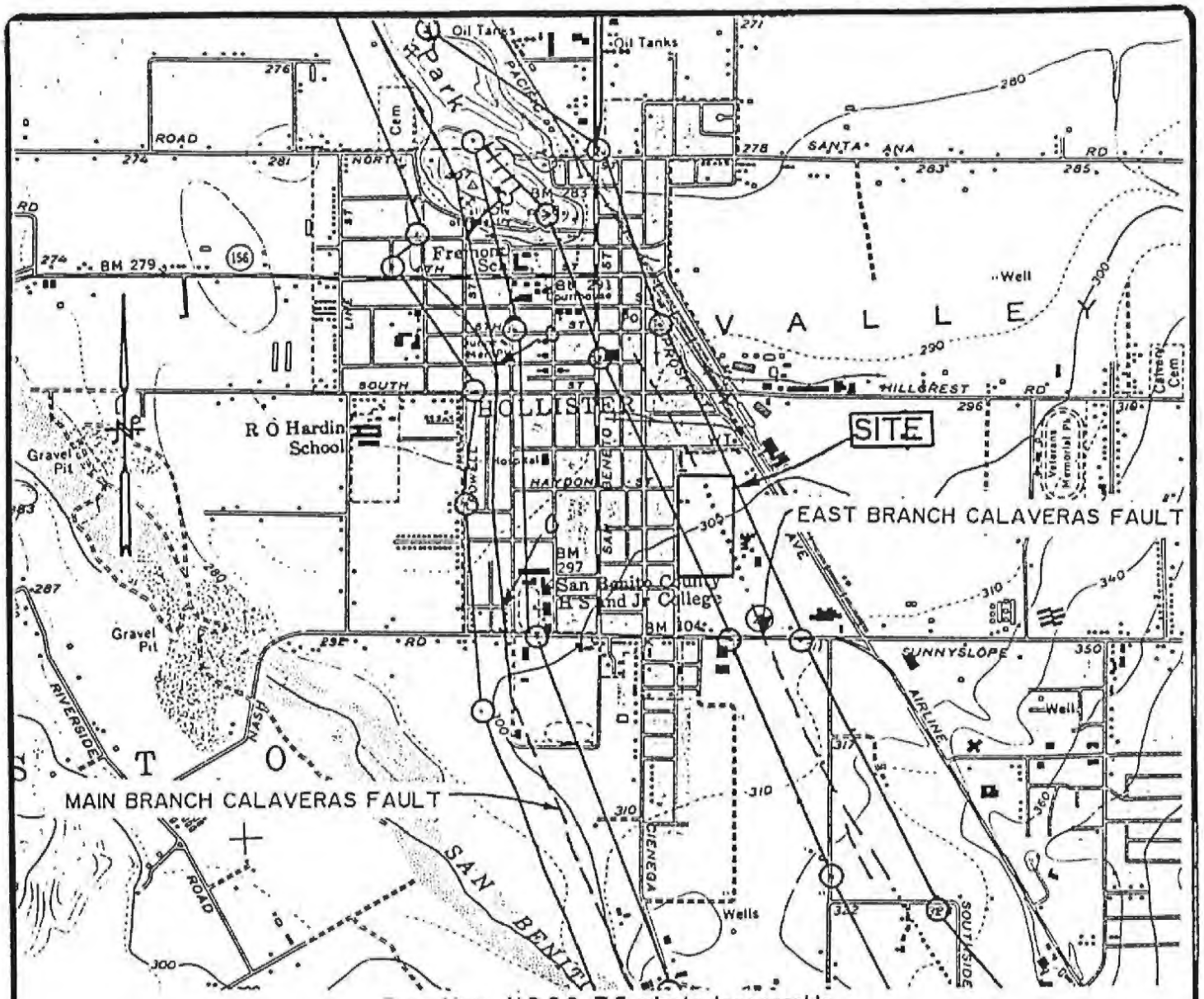
Figure 7. Log of Exploratory Trench 4 . . . . . In pocket

Figure 8. Log of Exploratory Trench 5 . . . . . In pocket

Figure 9. Logs of Exploratory Trenches 7a & 7b. . . . . In pocket



Base Map: U.S.G.S. 7.5 minute topographic quadrangle: Hollister (1955, photorevised 1971).

EXPLANATION (CDMG, 1982)

Boundary of Alquist-Priolo Special Studies Zone

Active or potentially active fault, dashed where inferred; evidence of slow displacement (creep) indicated by "C".

JUNE 1987

SCALE 1"=2000'

TERRATECH

VICINITY MAP

PRUNE STREET SCHOOL SITE
(RANCHO SAN JUSTO TANDEM SCHOOL SITE)
HOLLISTER, CALIFORNIA

FIGURE 1

PROJECT 7973

APPENDIX A.3

INVESTIGATION OF THE EAST BRANCH OF THE CALAVERAS FAULT
PRUNE STREET SCHOOL SITE
(RANCHO SAN JUSTO TANDEM SCHOOL SITE)
HOLLISTER, CALIFORNIA

INTRODUCTION

This report presents the results of our investigation of a 1600-foot-long segment of the East Branch of the Calaveras fault on the 20-acre Prune Street school site in Hollister, California (Figure 1). The property is bounded by Rancho Drive on the east, Prune Street on the west, and single-family houses on the north and south. Proposed development consists of a tandem school to the existing Rancho San Justo Junior High School, which is located across Rancho Drive from the property. A small parcel at the southwestern corner of the campus of the existing school was also investigated during this study (see Figure 2).

With the exception of the southwestern and northeastern corners of the 20-acre property, the Prune Street school site lies within the State of California (Alquist-Priolo) Special Studies Zone established for the East Branch of the Calaveras fault (CDMG, 1982). The purpose of the Alquist-Priolo Special Studies Zones Act is "to prohibit the location of most structures for human occupancy across the traces of active faults and to mitigate thereby the hazard of fault-rupture" (Hart, 1985).

SCOPE OF WORK

The purpose of our investigation was to determine the location of the East Branch of the Calaveras fault on the two parcels and to recommend a "building exclusion zone" along the fault. We performed the following work.

1. Reviewed file data on our previous investigations along the East Branch of the Calaveras fault.

2. Researched other available published and unpublished geologic literature pertaining to the property and the fault.

3. Studied stereoscopic aerial photographs taken in 1967, 1974, and 1987 for evidence of faulting that cannot be seen from the ground surface.

4. Performed surface geologic mapping and constructed four topographic profiles approximately perpendicular to the fault.

5. Excavated, inspected, and logged eight exploratory backhoe trenches to locate subsurface evidence of faulting. The area of the mapped fault was explored with a total of 939 linear feet of trench on April 14-17, April 20-21, and June 8-9, 1987.

6. Compiled and analyzed our data and formulated conclusions and recommendations for a building exclusion zone.

7. Prepared this report.

FINDINGS

Site Surface Conditions

The proposed school site is nearly level. A subtle, west-facing topographic scarp trends northwestward through the southern half of the 20-acre parcel, curving northward and becoming more prominent in the northern half of the parcel (see Figure 2). The scarp is about 5 feet high and 70 feet wide near the northern property line. Immediately north of the site the scarp has been modified by agricultural activities to a near-vertical step about 2 feet high along a north-south trending fence. The scarp bends back to the northwest between the proposed school site and Hawkins Street. No scarp is visible on the small parcel in the southwestern corner of the existing school campus, even on aerial photographs taken before the site was graded for the school.

The 20-acre parcel is occupied by a mature, producing walnut orchard with a small cluster of farm buildings. The ground surface was disced before our field investigation. The small parcel on the existing campus was vacant at the time of our investigation but has since been paved for recreational use.

Regional Geology

Subsurface Materials

The city of Hollister is located on a broad, flat alluvial plain near the southern end of the Santa Clara Valley. Published subsurface information indicates the valley is locally underlain by several hundred feet of unconsolidated sediments that unconformably overlie various bedrock formations. The near-surface sediments in the immediate vicinity of Hollister have been interpreted to be either ancient lake (lacustrine) deposits (Jenkins, 1973; Herd, 1978) or overbank flood (alluvial) deposits from the San Benito River (Hoose, 1983). Carbon 14 (radiocarbon) dating suggests an age of approximately 4000 years for the uppermost beds of the near-surface sediments near the city of Hollister (Herd, 1978; Hoose, 1983).

The alluvial/lacustrine deposits in and around Hollister are typically clay, silt, and fine to medium-grained sand (Terratech, 1981, 1982, 1983,

1984a, 1984b, 1986). These sediments are generally well bedded, and individual layers continue laterally for hundreds of feet.

The depth to ground water is generally greater than 100 feet (Kilburn, 1972).

Calaveras Fault Zone

The Calaveras fault zone trends northwestward through the City of Hollister. Two nearly parallel branches of the fault cross the city, but only the Main Branch is believed to be historically active. The sense of displacement across the fault zone is right lateral strike slip, with the west side moving northward relative to the east side.

Main Branch of the Calaveras Fault

The Main Branch of the Calaveras fault is located approximately 2300 feet west of the Prune Street school site (Dibblee, 1975; CDMG, 1982) and is actively creeping in the vicinity of Hollister at a rate of about 1 centimeter per year (Rogers and Nason, 1968; Berkland, 1975; Harsh and Pavone, 1978; Wagner, 1978; Page, 1982). Structures and pavements built across the Main Branch have been visibly deformed.

East Branch of the Calaveras Fault

The East Branch of the Calaveras fault passes through the proposed school site. Southeast of Hollister, the East Branch is believed to coincide with the Paicines fault (Dibblee, 1975 and 1979), which is creeping at a rate of about 1/2 cm/yr (Harsh and Pavoni, 1978; Harms and others, 1987). In 1983, approximately 1000 linear feet of concrete curb was inspected at several locations along the trend of the East Branch of the Calaveras fault in Hollister (Terratech, unpublished data). No pattern of fractures or displacements in the curbs was detected. This suggests the fault is not actively creeping in the vicinity of the proposed school site.

The location and length of the East Branch of the Calaveras fault in the Hollister area are demonstrated by topographic, ground water, geophysical, and geodetic evidence. Much of the length of the East Branch in the city of Hollister is marked by a subtle, discontinuous, west-facing topographic scarp. A boundary between areas of different ground water elevation on opposite sides of the scarp has been interpreted to mark the subsurface location of the fault (Kilburn, 1972; Farrar, 1981). An anomalous gravitational pattern measured along the trend of the scarp has been interpreted to represent vertical displacement of bedrock along the fault (Robbins, 1982). Regional geodetic survey work indicates tectonic strain is accumulating between fault-bounded blocks on either side of the East Branch of the Calaveras fault (Langbein, 1978).

Trench exposures of deformed near-surface alluvial/lacustrine sediments at other sites in Hollister suggest movement has occurred along the East

Branch within the past 4000 years (Terratech, 1981, 1983, 1984b). Such recent movement indicates the fault could be classified as active, according to the CDMG (Hart, 1985).

Site Geology

Topographic and geologic features and the locations of our exploratory trenches are shown on the Geologic Map, Figure 2. Our interpretation of the subsurface geologic structure is shown on the Geologic Cross Section, Figure 3. Logs of our eight exploratory trenches are presented in Figures 4 through 9.

Subsurface Materials

Materials underlying the proposed school site are unconsolidated, horizontally bedded clay, silt, and fine to medium-grained sand. These materials are described in detail on the accompanying trench logs. The upper 6 to 9 feet consist generally of massive clay and silt beds overlying thin, discontinuous clay and silt beds. Below a depth of about 6 to 9 feet, thin, laterally continuous, easily traceable beds of sand, silt, and clay are present.

On-Site Faulting

The East Branch of the Calaveras fault has been mapped across the southwestern corner of the existing Rancho San Justo Junior High School campus and the center of the proposed school site (Dibblee, 1975; CDMG, 1982). Trench locations were selected by interpretation of stereoscopic aerial photographs and by topographic profiling.

Subsurface Evidence of Faulting

The East Branch of the Calaveras fault was exposed in seven of our eight trenches. The eighth trench, Trench 7a, caved across the fault before that section of the trench could be shored. Trench 7b was located nearby to permit examination of the fault.

Where exposed in our trenches, the width of the zone of fault-generated ground deformation varies from about 13 to 35 feet. The zone of deformation generally consists of three to five distinct fault traces within a section of warped beds. The fault traces are marked by displaced beds, steeply dipping clay seams, and occasional voids. The warped beds generally describe a westward-dipping monoclinal flexure.

Map Alignment of the Fault

The East Branch of the Calaveras fault curves across the site and is generally located west of the alignment shown on the Special Studies Zone map (CDMG, 1982). Near the center of the orchard, the fault is located

about 95 feet west of the CDMG alignment. From the southwestern corner of the existing campus to the center of the 20-acre parcel, the fault trends about N30°W. North of that point, the fault alignment bends to an approximate N-S trend.

The bend in the fault coincides with the bend in the topographic scarp on the site (see Figure 2).

The bend in the fault is the first known to be recognized along the East Branch of the Calaveras fault. The Main Branch of the Calaveras fault bends slightly at several locations in and near the city of Hollister (CDMG, 1982).

Fault Mechanism

Measured attitudes of individual fault traces on the site diverge from the through-going trend of the East Branch on the site. Strike and dip angles vary within trenches and between trenches. Dip angles are vertical to steeply inclined eastward and westward. Strike angles vary from N-S to N30°E both north and south of the bend in the fault. In Trench 3, near the bend in the fault, measured strike angles vary from N-S to N40°E. The divergence between the alignment of individual fault traces and the through-going trend of the fault suggests the segment of the East Branch on the site consists of multiple, short, closely spaced en echelon fault traces rather than a continuous plane of rupture.

All of the trenches exposed evidence of apparent vertical displacement, down to the west. The net apparent vertical displacement across the zone of deformation is about 1-1/2 to 3 feet, measured at the top of the easily traceable, displaced beds at depths of about 6 to 9 feet. Trenches 3, 4, 5, 6, and 7b displayed graben-like structures with east-down as well as larger west-down apparent displacements across individual fault traces. Net strike-slip displacement could not be determined.

Evidence of vertical displacement has been found elsewhere along the East Branch of the Calaveras fault (Terratech, 1983). At this site, the apparent vertical displacements, the westward-dipping monoclinal flexure, and the west-facing topographic scarp indicate the East Branch may be an oblique-slip, or diagonal displacement, fault.

Age of Faulting

As described previously, radiocarbon dating indicates the near-surface sediments in the vicinity of Hollister are about 4000 years old. Because these sediments are faulted on the site, the East Branch of the Calaveras fault should be considered active. No fault traces could be followed to the ground surface in any of our trenches, but all materials within about 6 to 9 feet of the ground surface are either so laterally discontinuous or so massive that some fault traces may extend closer to the surface and not be visible.

Other Significant Features

Trenches 1, 3, 4, and 7a exposed thin, vertical clay seams well outside the zone of fault-generated ground deformation. These clay-filled fractures may record ancient episodes of liquefaction produced by large earthquakes on the Calaveras or San Andreas faults. Liquefaction could have occurred only when the ground water table was closer to the ground surface than it is today.

CONCLUSIONS

1. The alluvial/lacustrine sediments within about 6 to 9 feet of the ground surface on the site have been displaced and warped along the East Branch of the Calaveras fault. The width of the zone of fault-generated ground deformation varies from about 13 to 35 feet.

2. The map alignment of the fault bends from about N30°W in the southern half of the site to approximately N-S in the northern half of the site.

3. On-site faulting is judged to have occurred within about the last 4000 years. The East Branch of the Calaveras fault should be considered active.

4. Future ground displacement probably will be confined to an area very close to the zone of fault-generated ground deformation as mapped in this investigation. Future ground warping may extend somewhat beyond the area of observed past ground deformation.

RECOMMENDATIONS

We recommend that structures for human occupancy not be built within 50 feet of the mapped zone of fault-generated ground deformation. Our building exclusion zone is shown on Figure 2 and varies in width from about 115 to 135 feet on most of the site. At the northern edge of the site, the building exclusion zone is about 165 feet wide to accommodate possible bends in the alignment of the fault north of Trench 1.

A geotechnical investigation should be performed for the proposed school site before detailed foundation and structural designs are made. Preliminary seismic design can be based on information contained in Terratech's 1987 report, "Geologic and Seismic Evaluation, Relocatable Classroom Buildings, (existing) Rancho San Justo Junior High School, Hollister, California."

LIMITATIONS

This report and its findings, conclusions, and recommendations have been provided in accordance with the principles and practices generally employed in the engineering geologic profession. Our findings are based on research of readily available geologic literature, interpretation of stereoscopic aerial photographs, inspection of ground surface conditions, and inspection of subsurface exposures at eight trench locations.

Report prepared by:

TERRATECH, INC.

Elizabeth L. Mathieson
CEG 1249

Reviewed by:

Peter C. Anderson
CEG 1189

REFERENCES

Bay Soils, Inc., 1981, Preliminary Geologic Evaluation on Proposed Shopping Center, Northeast (sic) corner of Nash Road and Southside Road, Hollister, California: unpublished report, 4 p.

Berkland, J.O., 1975, Accidental Creepmeter -- The 300-foot Cochrane Bridge over Lake Anderson, Santa Clara County, California (abs.): Geological Society of America, Cordilleran Section, Abstracts with Program, v. 7, n. 3, p. 298.

California Division of Mines and Geology, 1982, Special Studies Zones Map of the Hollister Quadrangle, San Benito County, California, 1:24,000.

Dibblee, T.W., Jr., 1975, Geologic Map of the Hollister Quadrangle: U.S. Geological Survey Open File Map 75-394, 1:62,500.

Dibblee, T.W., Jr., 1979, Preliminary Geologic Map of the Paicines Quadrangle, San Benito and Monterey Counties, California: U.S. Geological Survey Open-File Report 79-290, 1:24,000.

Farrar, C.D., 1981, Ground Water Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California: U.S. Geological Survey, Water Resources Investigation, Open-File report 81-66, 9 p.

Harms, K.K., Harden, J.W., and Clark, M.M., 1987, Use of Quantified Soil Development to Determine Slip Rates on the Paicines Fault, Northern California (abs.): Geological Society of America, Cordilleran Section, Abstracts with Program, v. 19, n. 6, p. 387.

Harsh, P.W., and Pavoni, N., 1978, Slip on the Paicines Fault: Bulletin of the Seismological Society of America, v. 68, n. 4, p. 1191-1193.

Hart, E.W., 1985, Fault-Rupture Hazard Zones in California: California Division of Mines and Geology Special Publication 42, revised edition, 25 p.

Herd, D.G., 1978, Neotectonics of the San Francisco Bay Region, California, in Summaries of Technical Reports, Volume V, prepared by participants in the National Earthquake Hazards Reduction Program: U.S. Geological Survey, p. 22-24.

Hoose, S.N., 1983, Holocene Fluvial and Lacustrine(?) Deposits in the Vicinity of Hollister and the San Juan Valley, California: Program and Abstracts, Annual Meeting of Pacific Sections of AAPG, SEG, and SEPM, Sacramento, California, p. 93.

Jenkins, O.P., 1973, Pleistocene Lake San Benito: California Geology, v. 26, n. 7, p. 151-163.

Kilburn, Chabot, 1972, Ground-Water Hydrology of the Hollister and San Juan Valleys, San Benito County, California, U.S. Geological Survey Water Resources Division, Open File Report, 44 p.

Langbein, J., 1978, Observed Strain During Fault Slip on the Calaveras Fault near Hollister, California: Seismological Society of America, Abstracts of Annual Meeting, Reno, Nevada, p. 31.

Lawson, A.C., Chairman, 1908, The California Earthquake of April 18, 1906, Report of the State Earthquake Investigation Committee: Carnegie Institution of Washington, 451 p.

Page, B.M., 1982, The Calaveras Fault Zone of California -- An Active Plate Boundary Element, in Hart, E.W., and others, eds, Proceedings of Conference on Earthquake Hazards in the Eastern San Francisco Bay Area: California Division of Mines Special Publication 62, p. 175-184.

Robbins, S.L., 1982, Complete Bouguer Gravity, Aeromagnetic, and Generalized Geologic Map of the Hollister 15-minute Quadrangle, California: U.S. Geological Survey, Geophysical Investigations Map GP-945, 1:62,500.

Radbruch, D.H., and Rogers, T.H., Field trip 2A and 2B, Hayward and Calaveras fault zones, in National Meeting, San Francisco, California, 1969, Guidebook: Association of Engineering Geologists, p. B-1 - B-25.

Rogers, T.H., and Nason, R.D., 1968, Active Faulting in the Hollister Area, in Dickinson, W.R., and Grantz, A., Proceedings of Conference on Geologic Problems of the San Andreas Fault System: Stanford University Press, p. 42-45.

Taliaferro, N.L., 1948, Geologic Map of the Hollister Quadrangle: California Division of Mines and Geology Bulletin 143, Plate 1, 1:62,500.

Taylor, C.L., Cummings, J.C., and Ridley, A.P., 1980, Discontinuous En Echelon Faulting and Ground Warping, Portola Valley, California, in Streitz, Robert and Sherburne, Roger, eds, Studies of the San Andreas Fault Zone in Northern California: California Division of Mines and Geology Special Report 140, p. 59-70.

Terratech, Inc., 1981, Geologic Investigation, Proposed Nob Hill Shopping Center Complex, Hollister, California: unpublished report, 5 p.

Terratech, Inc., 1982, Geologic and Geotechnical Investigation, Park Street Apartments, Hollister, California: unpublished report, 12 p.

Terratech, Inc., 1983, Geologic Investigation, East Branch of the Calaveras Fault, Tiffany Ranch, Hollister, California: unpublished report, 9 p.

Terratech, Inc., 1984a, Fault Investigation, Diablo West Apartments, Hollister, California: unpublished report, 4 p.

Terratech, Inc., 1984b, Report of Fault Investigation, Village Green Commercial Site, Hollister, California: unpublished report, 2 p.

Terratech, Inc., 1986, Geologic Investigation of the Calaveras Fault, San Benito High School Warehouse, Hollister, California: unpublished report, 7 p.

Terratech, Inc., 1987, Geologic and Seismic Evaluation, Relocatable Classroom Buildings, Rancho San Justo Junior High School, Hollister, California: unpublished report, 4 p.

Wagner, D.L., 1978, Environmental Geologic Analysis of the Diablo Range Study Area II, Southern Santa Clara County, California: California Division of Mines and Geology Cooperative Study with the Santa Clara County Planning Department, 46 p.

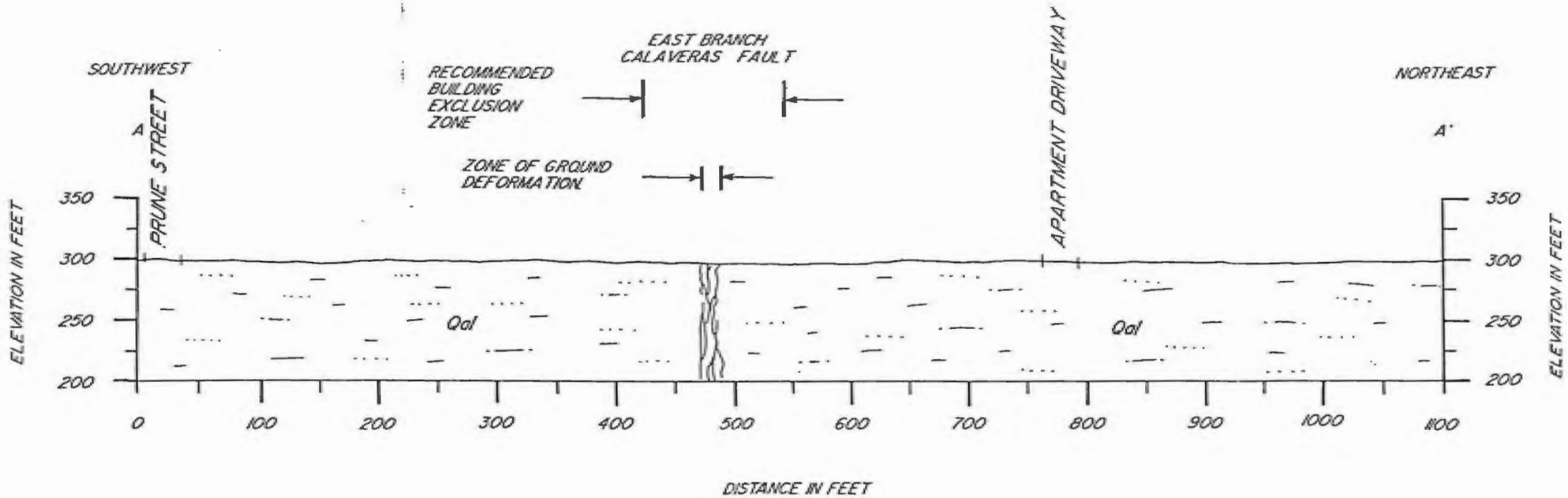
Woodward-Clyde & Associates, McClure & Messinger, 1968, Earthquake Fault and Earthquake Engineering Studies, Proposed Upper Grade School Site, Hollister, California: unpublished report, 25 p.

Woodward-Clyde & Associates, 1969, Soil Investigation for the Proposed 7th and 8th Grade School, Prospect Avenue near Nash Road, Hollister, California: unpublished report, 10 p.

Woodward-Clyde Consultants, 1978, Geologic Evaluation, Prospect Avenue Property, Hollister, California: unpublished report, 14 p.

AERIAL PHOTOGRAPHS

Date	Agency	Type	Roll & Frame	Scale
5/15/67	U.S.G.S.	black & white	BUX-1HH-108,109	1:20,000
7/12/74	U.S.G.S.	color	1-SFB 12-84,85 12-134,135	1:20,000
3/19/84	Aero-Geodetic	black & white	842494 4-2 thru 4-6	1:10,000



See Figure 2 for location of section and for explanation.

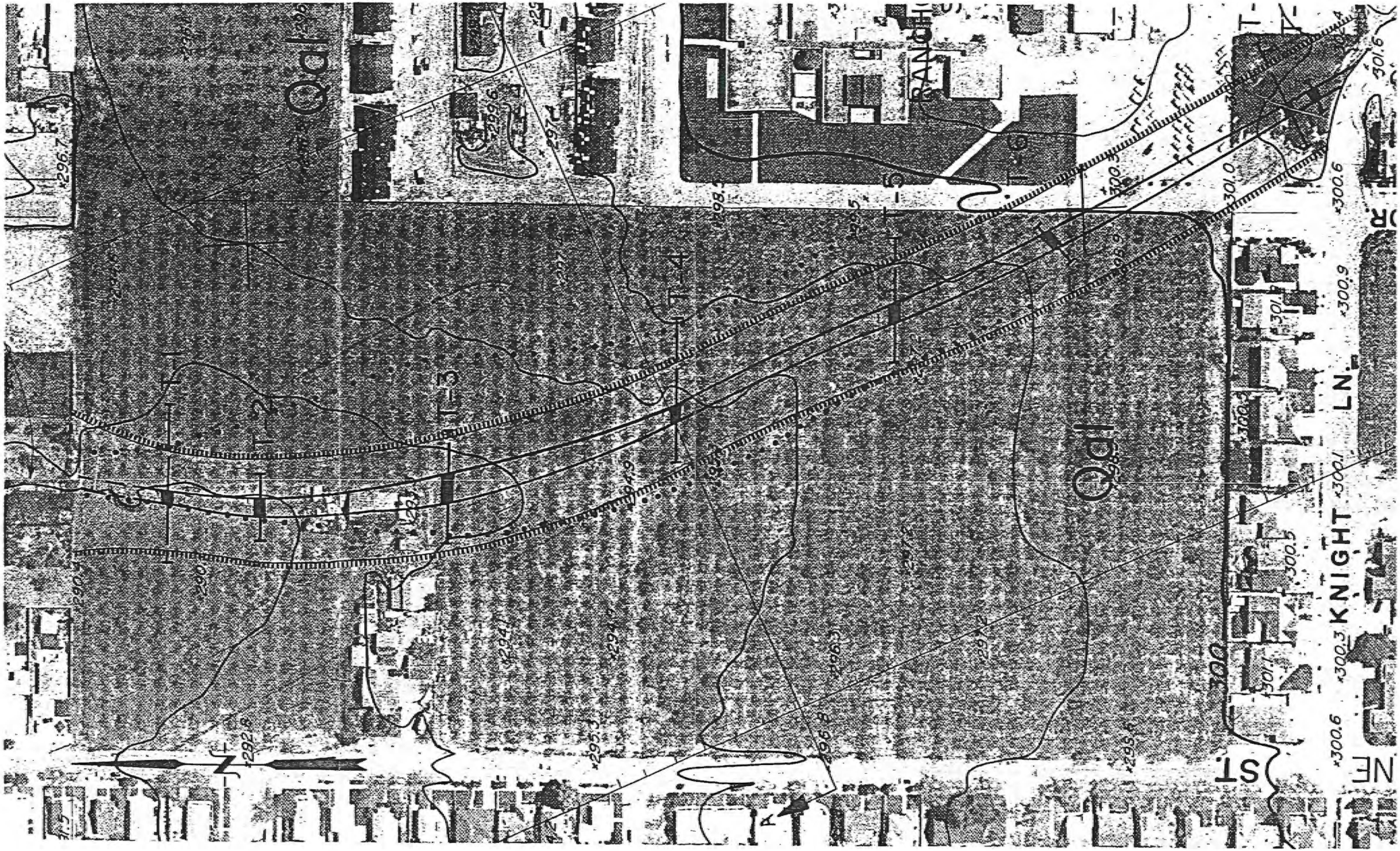
JUNE 1987

TERRATECH

GEOLOGIC CROSS SECTION
PRUNE STREET SCHOOL SITE
(RANCHO SAN JUSTO TANDEM SCHOOL SITE)
HOLLISTER, CALIFORNIA

FIGURE 3

PROJECT 7973


Qal
Qal
KNIGHT LN.
ST
RANCHO
T-1
T-2
T-3
T-4
T-5
T-6
N
300
×296.7
×300.6
×300.9
×300.1
×300.3
×300.6
301.6
301.0
301.1
300.5

EXPLANATION

Qal — Alluvium (lake deposits?); clay, silt, and sand; Holocene and late Pleistocene age.

East branch of the Calaveras fault; zone of deformation; dashed where approximately located.

Crest and toe of west-facing topographic scarp; scarp tapers out to southeast.

T-7b — Exploratory backhoe trench; heavy bar denotes area of observed fault-generated ground deformation

Recommended building exclusion zone. (between thin lines).

Boundaries of CDMG Special Studies Zone.

A' — Line of geologic cross section (Figure 3).

f

0 100 200

SCALE IN FEET

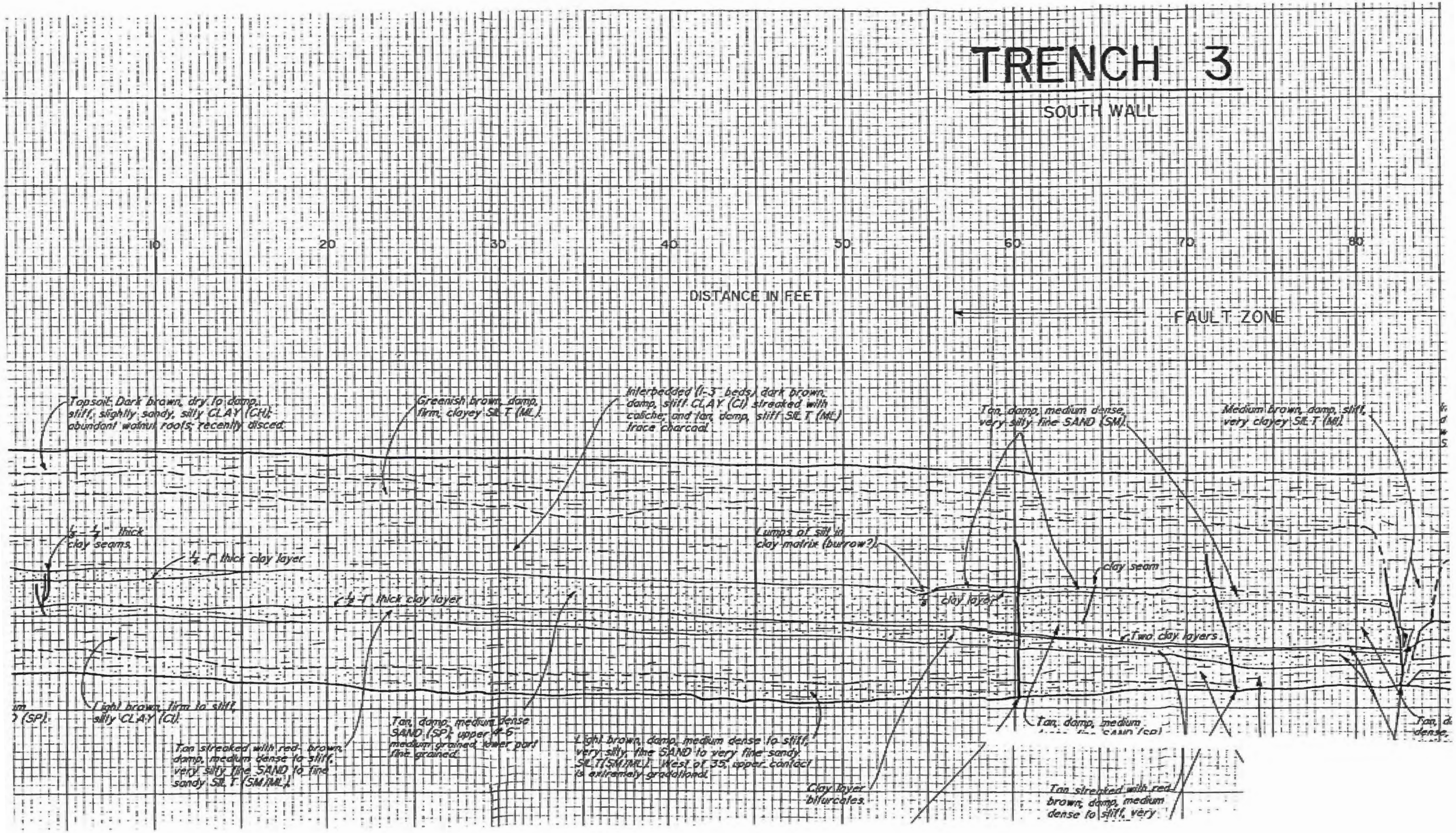
BASE MAP: AERO-GEODETIC CORP.
JOB NO. 842494
DATE OF PHOTOGRAPHY 3-19-84

APPENDIX A.3

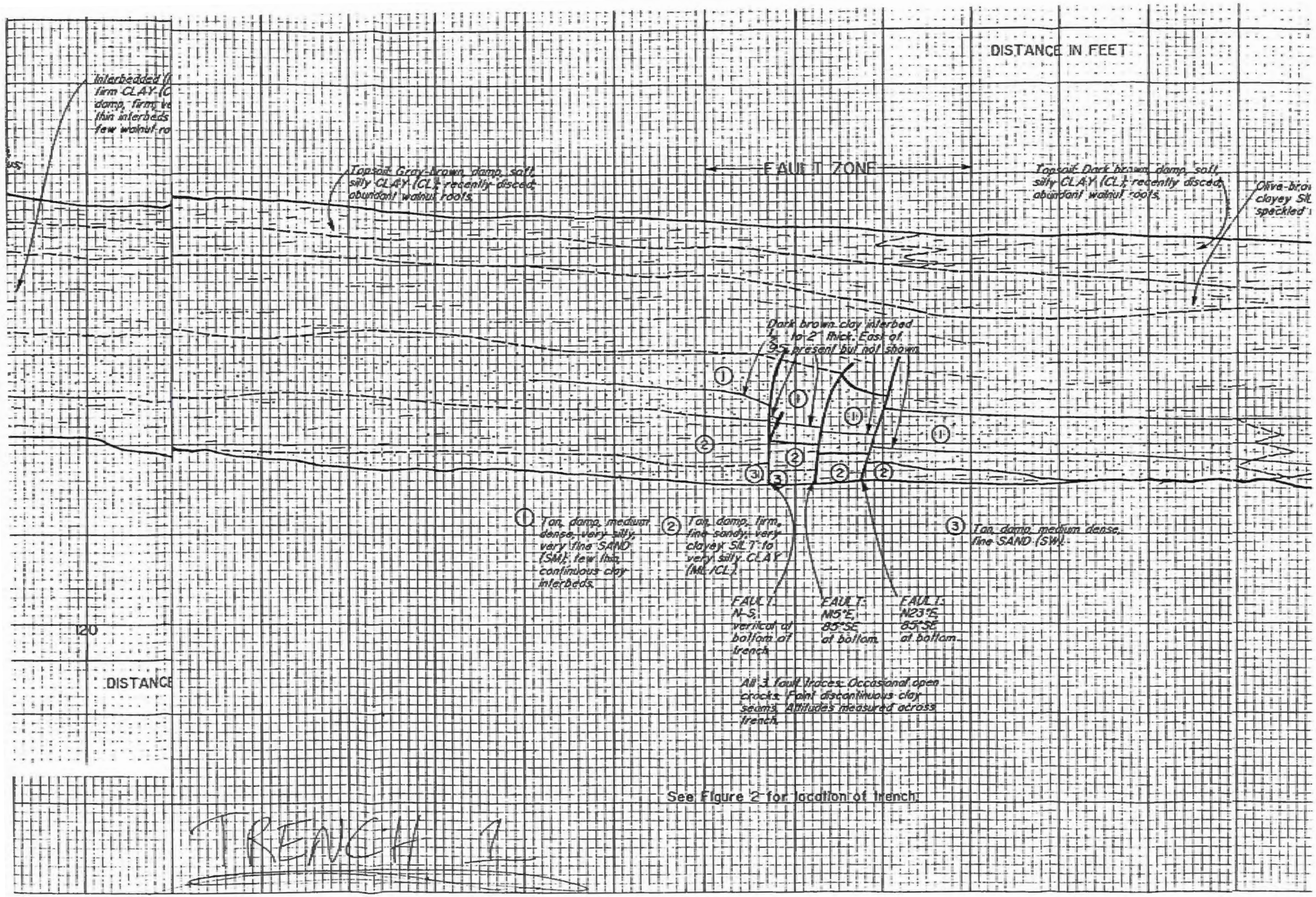
JUNE 1987

GEOLOGIC MAP

FIGURE 1


TRENCH 3
SOUTH WALL
10
20
30
40
50
60
70
80
DISTANCE IN FEET
FAULT ZONE
Topsoil; Dark brown, dry to damp, stiff, slightly sandy, silty CLAY (CH); abundant walnut roots; recently disced.
Greenish brown, damp, firm, clayey SILT (ML).
Interbedded (1-3" beds) dark brown, damp, stiff CLAY (CI) streaked with caliche; and tan, damp, stiff SILT (ML) trace charcoal.
Tan, damp, medium dense, very silty fine SAND (SM).
Medium brown, damp, stiff, very clayey SILT (ML)
1/2 - 1/4" thick clay seams.
1/4" thick clay layer.
1/2" thick clay layer.
Lumps of silt in clay matrix (burrow?).
clay layer.
clay seam.
two clay layers.
Light brown, firm to stiff, silty CLAY (CI).
Tan streaked with red-brown, damp, medium dense to stiff, very silty fine SAND to fine sandy SILT (SM/ML).
Tan, damp, medium dense SAND (SP), upper 4-6" medium grained, lower part fine grained.
Light brown, damp, medium dense to stiff, very silty, fine SAND to very fine sandy SILT (SM/ML). West of 35, upper contact is extremely gradational.
Clay layer bifurcates.
Tan, damp, medium
Tan streaked with red-brown, damp, medium dense to stiff, very

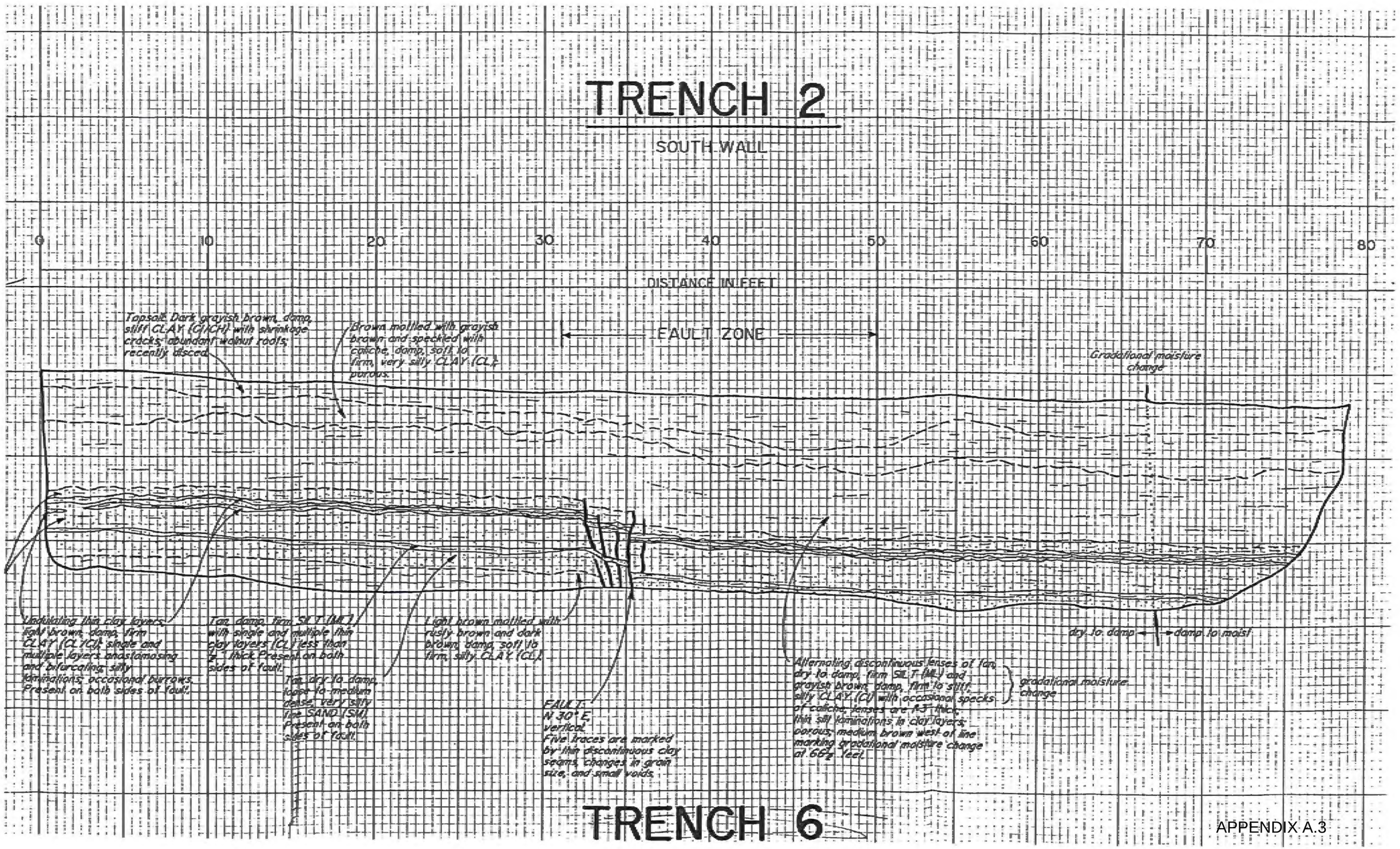
APPENDIX A.3

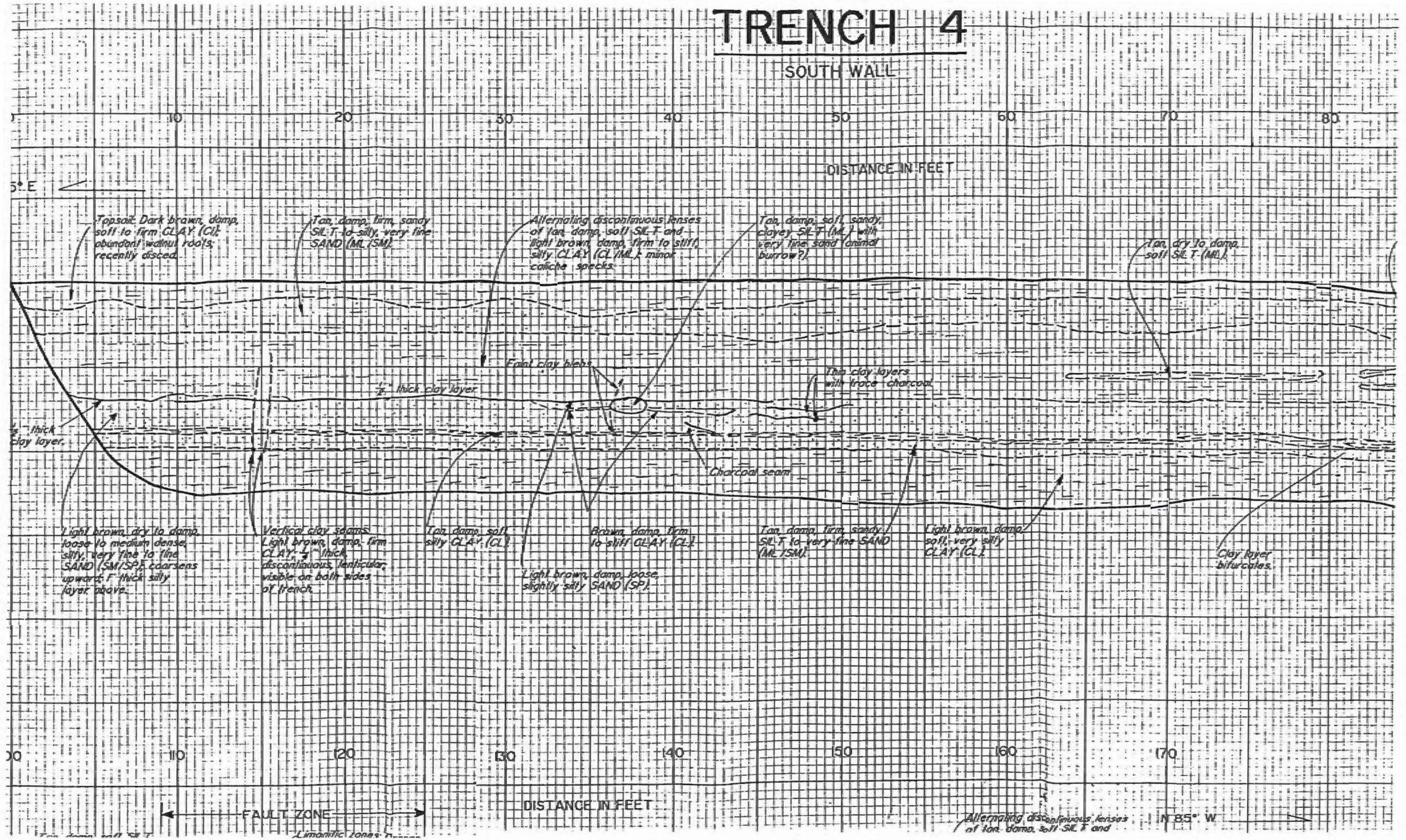


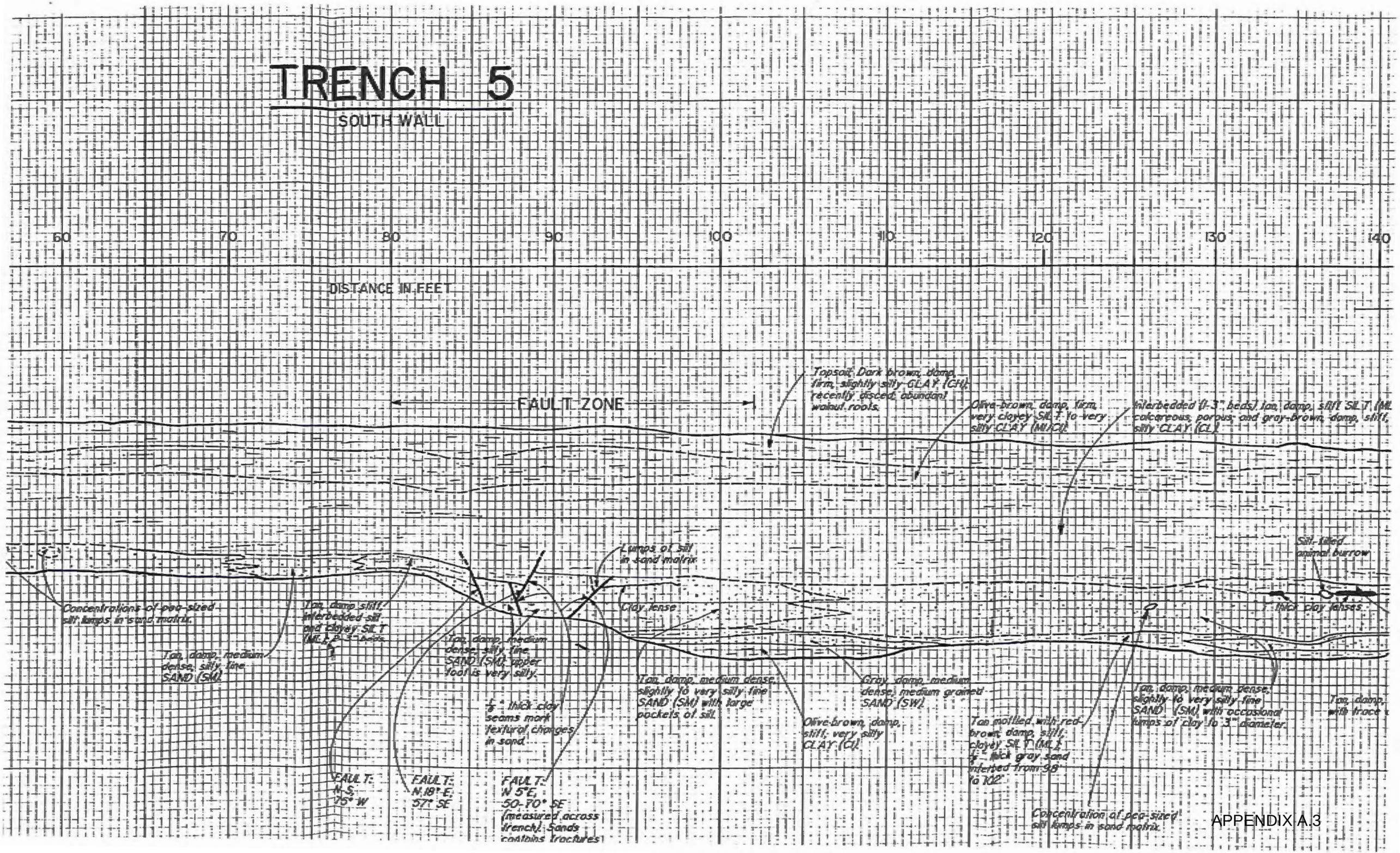
Trench logged April 14-15, 1987.

DATE JUNE 1987 DWN BY CHKD APPR

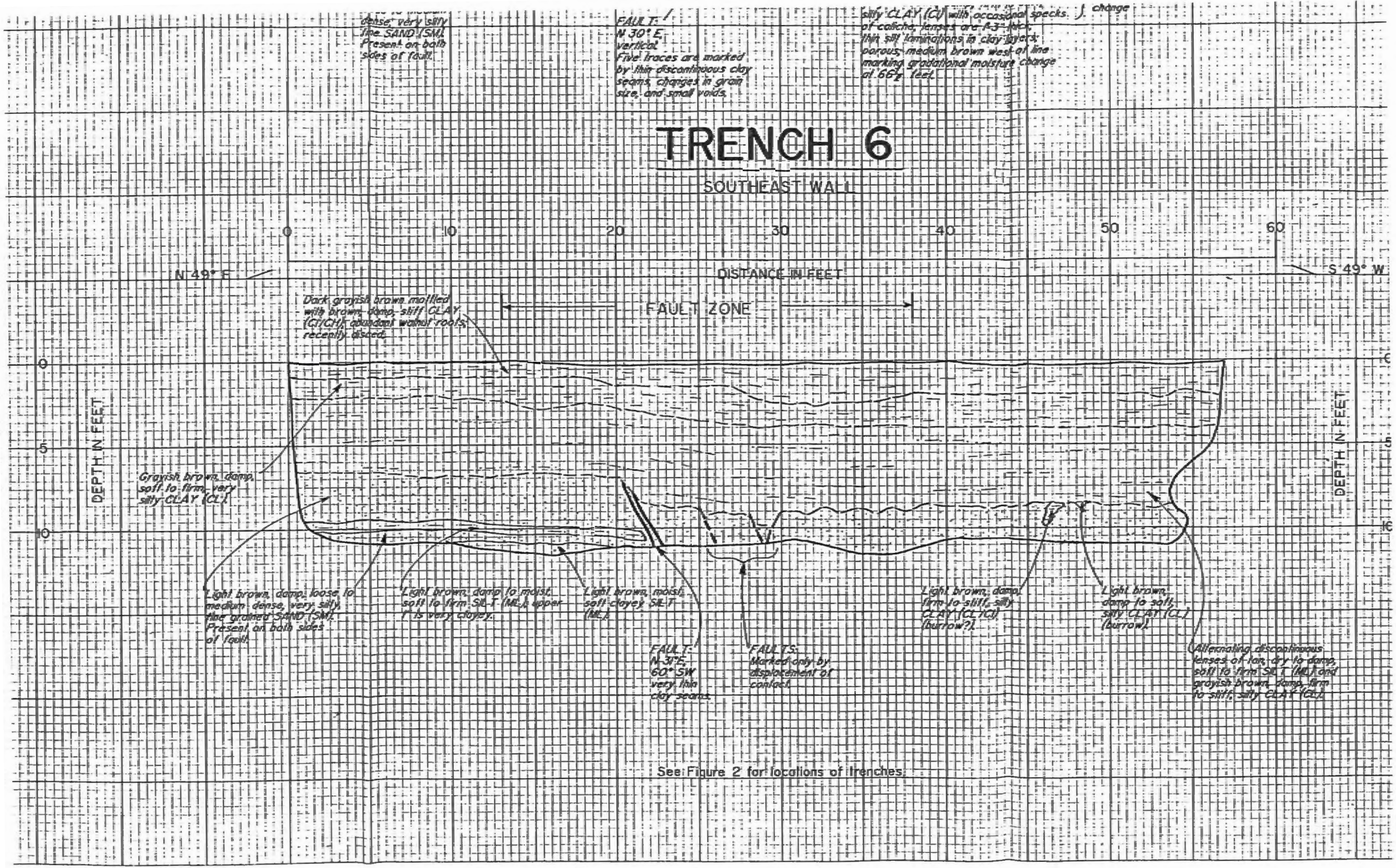
APPENDIX A.3

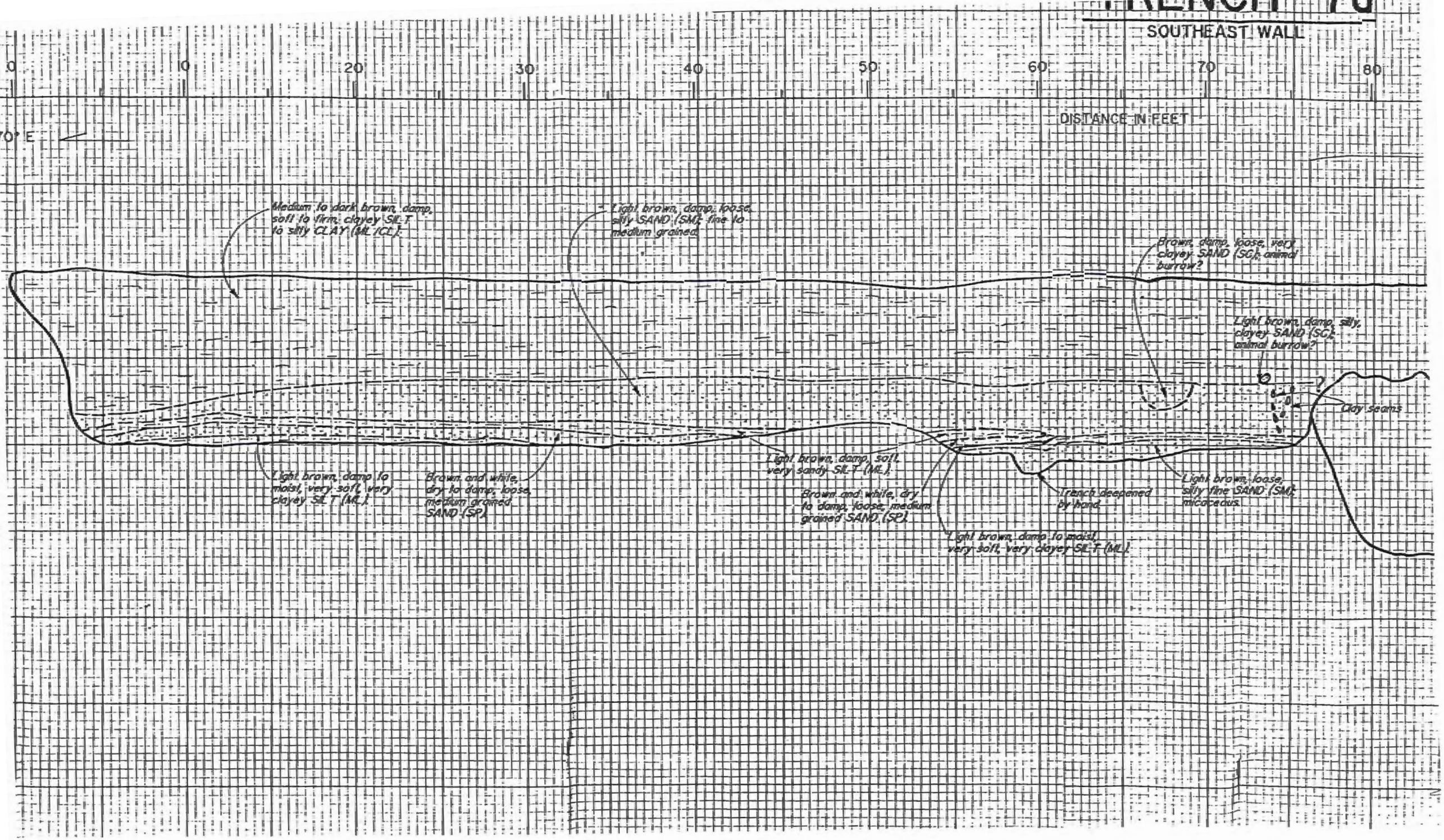

TRENCH 2
SOUTH WALL
0
10
20
30
40
50
60
70
80
DISTANCE IN FEET
FAULT ZONE
Topsoil: Dark grayish brown, damp, stiff CLAY (CL/CH) with shrinkage cracks; abundant walnut roots; recently disced.
Brown mottled with grayish brown and speckled with caliche, damp, soft to firm, very silty CLAY (CL); porous.
Gradational moisture change
Undulating thin clay layers; light brown, damp, firm CLAY (CL/CH); single and multiple layers anastomosing and bifurcating; silty laminations; occasional burrows. Present on both sides of fault.
Tan, damp, firm SILT (ML) with single and multiple thin clay layers (CL) less than ¼" thick. Present on both sides of fault.
Tan, dry to damp, loose to medium dense, very silty fine SAND (SM). Present on both sides of fault.
Light brown mottled with rusty brown and dark brown, damp, soft to firm, silty CLAY (CL).
FAULT: N 30° E, vertical. Five traces are marked by thin discontinuous clay seams, changes in grain size, and small voids.
Alternating discontinuous lenses of tan, dry to damp, firm SILT (ML) and grayish brown, damp, firm to stiff, silty CLAY (CL) with occasional specks of caliche; lenses are ¼" thick; thin silt laminations in clay layers; porous; medium brown west of line marking gradational moisture change at 66½ feet.
gradational moisture change
dry to damp ← → damp to moist
TRENCH 6

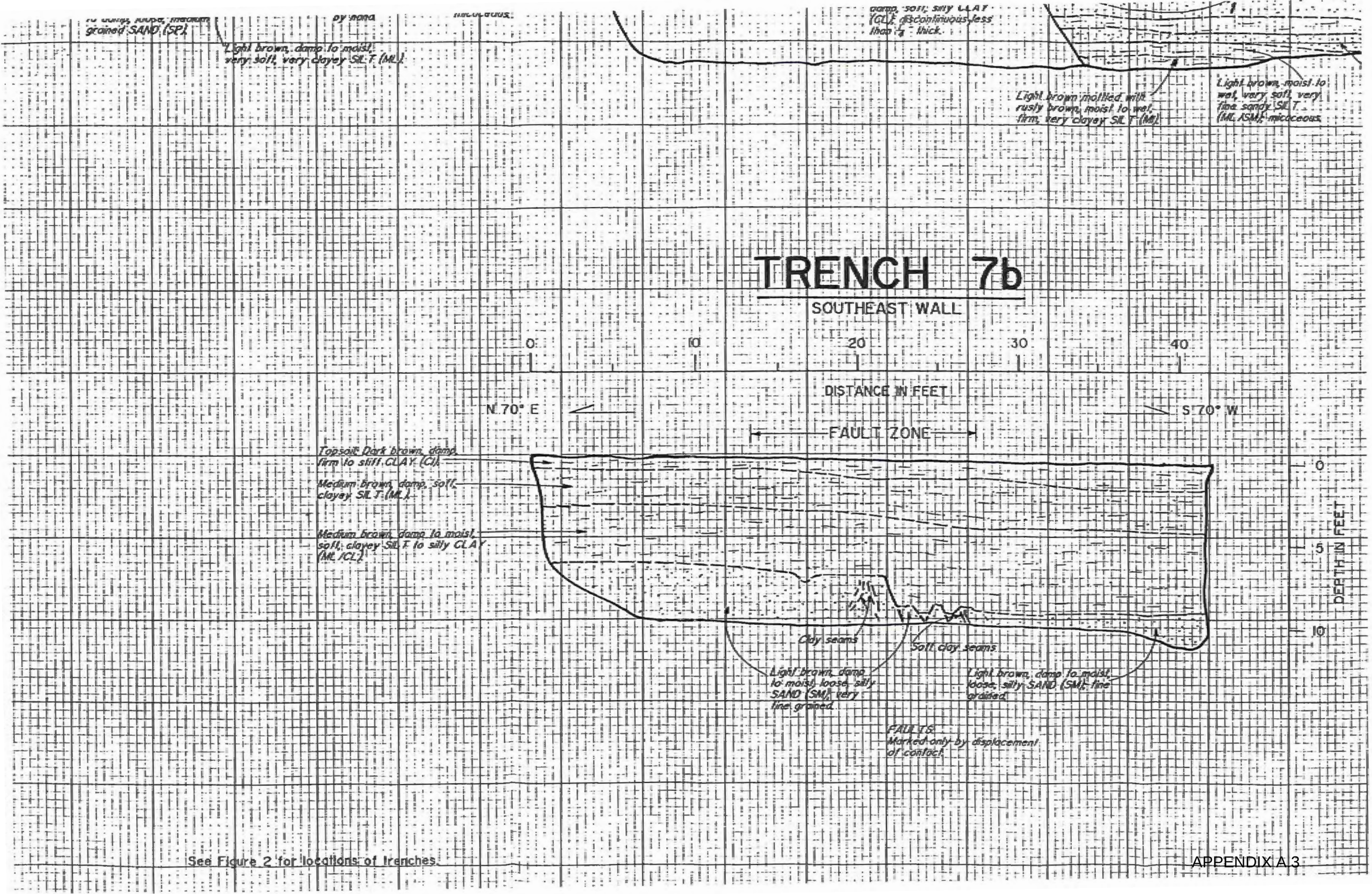

TRENCH 4
SOUTH WALL
10
20
30
40
50
60
70
80
DISTANCE IN FEET
Topsoil: Dark brown, damp, soft to firm CLAY (CL); abundant walnut roots; recently disced.
Tan, damp, firm, sandy SILT to silty, very fine SAND (ML/SM).
Alternating discontinuous lenses of tan, damp, soft SILT and light brown, damp, firm to stiff, silty CLAY (CL/ML); minor caliche specks.
Tan, damp, soft, sandy, clayey SILT (ML) with very fine sand (animal burrow?).
Tan, dry to damp, soft SILT (ML).
Faint clay blebs.
½" thick clay layer.
Thin clay layers with trace charcoal.
½" thick clay layer.
Charcoal seam.
Light brown, dry to damp, loose to medium dense, silty, very fine to fine SAND (SM/SP); coarsens upward; 1" thick silty layer above.
Vertical clay seams. Light brown, damp, firm CLAY; ½" thick, discontinuous, lenticular; visible on both sides of trench.
Tan, damp, soft, silty CLAY (CL).
Light brown, damp, loose, slightly silty SAND (SP).
Brown, damp, firm to stiff CLAY (CL).
Tan, damp, firm, sandy SILT to very fine SAND (ML/SM).
Light brown, damp, soft, very silty CLAY (CL).
Clay layer bifurcates.
110
120
130
140
150
160
170
FAULT ZONE
DISTANCE IN FEET
Alternating discontinuous lenses of tan, damp, soft SILT and
N 85° W


TRENCH 5
SOUTH WALL
60
70
80
90
100
110
120
130
140
DISTANCE IN FEET
FAULT ZONE
Topsoil, Dark brown, damp, firm, slightly silty CLAY (CH); recently disced, abundant walnut roots.
Olive-brown, damp, firm, very clayey SILT to very silty CLAY (ML/CL)
Interbedded (1-3" beds) tan, damp, stiff SILT (ML) calcareous, porous and gray-brown, damp, stiff, silty CLAY (CL)
Silt-filled animal burrow
Lumps of silt in sand matrix
Clay lense
Concentrations of pea-sized silt lumps in sand matrix.
Tan, damp, stiff, interbedded silt and clayey SILT (ML), 0.3" beds.
Tan, damp, medium dense, silty fine SAND (SM)
Tan, damp, medium dense, silty fine SAND (SM); upper foot is very silty.
1/8" thick clay seams mark textural changes in sand.
Tan, damp, medium dense, slightly to very silty fine SAND (SM) with large pockets of silt.
Olive-brown, damp, stiff, very silty CLAY (CL)
Gray, damp, medium dense, medium grained SAND (SW)
Tan mottled with red-brown, damp, stiff, clayey SILT (ML); 1/8" thick gray sand interbed from 98" to 102"
Concentration of pea-sized silt lumps in sand matrix.
Tan, damp, medium dense, slightly to very silty fine SAND (SM) with occasional lumps of clay to 3" diameter.
Thick clay lenses
Tan, damp, with trace
FAULT: N-S, 75° W
FAULT: N 18° E, 57° SE
FAULT: N 5° E, 50-70° SE (measured across trench). Sands contains fractures

APPENDIX A.3


TRENCH 6
SOUTHEAST WALL
0
10
20
30
40
50
60
N 49° E
S 49° W
DISTANCE IN FEET
FAULT ZONE
DEPTH IN FEET
0
5
10
dense, very silty fine SAND (SM). Present on both sides of fault.
FAULT: N 30° E, vertical. Fine traces are marked by thin discontinuous clay seams, changes in grain size, and small voids.
silty CLAY (CL) with occasional specks of caliche, lenses are 1-3" fine, thin silt laminations in clay layers, porous, medium brown west of line marking gradational moisture change at 66½ feet.
Dark grayish brown mottled with brown, damp, stiff CLAY (CL/CH), abundant walnut roots, recently disced.
Grayish brown, damp, soft to firm, very silty CLAY (CL).
Light brown, damp, loose to medium dense, very silty, fine grained SAND (SM). Present on both sides of fault.
Light brown, damp to moist, soft to firm SILT (ML), upper 1' is very clayey.
Light brown, moist, soft clayey SILT (ML).
FAULT: N 31° E, 60° SW very thin clay seams.
FAULTS: Marked only by displacement of contact.
Light brown, damp, firm to stiff, silty CLAY (CL/CI) (burrow?).
Light brown, damp to soft, silty CLAY (CL) (burrow).
Alternating discontinuous lenses of tan, dry to damp, soft to firm SILT (ML) and grayish brown, damp, firm to stiff, silty CLAY (CL).
See Figure 2 for locations of trenches.


TRENCH 7d
SOUTHEAST WALL
0
10
20
30
40
50
60
70
80
DISTANCE IN FEET
70° E
Medium to dark brown, damp, soft to firm, clayey SILT to silty CLAY (ML/CL).
Light brown, damp, loose, silty SAND (SM), fine to medium grained.
Brown, damp, loose, very clayey SAND (SC), animal burrow?
Light brown, damp, silty, clayey SAND (SC), animal burrow?
Clay seams
Light brown, damp to moist, very soft, very clayey SILT (ML).
Brown and white, dry to damp, loose, medium grained SAND (SP).
Light brown, damp, soft, very sandy SILT (ML).
Brown and white, dry to damp, loose, medium grained SAND (SP).
Trench deepened by hand.
Light brown, loose, silty fine SAND (SM), micaceous.
Light brown, damp to moist, very soft, very clayey SILT (ML).



See Figure 2 for locations of trenches.

Applied Soil Mechanics, Inc.

SOIL AND FOUNDATION ENGINEERS • GEOLOGISTS
835 Blossom Hill Road, Suite 215 • San Jose, California 95123
(408) 365-8100 • FAX (408) 365-8362

WORK ORDER

APPLIED SOIL MECHANICS, INC., a California corporation, ("Company") and Client agree to a work assignment for Company, as follows:

Name of Project: Proposed Building Sites 1-9, Hollister

Order Received By: Jack Greene Date: December 14, 1990

Authorized By: Mr. Hugh R. Riley, City Manager Job No.: AP-1178

Client Name: Hollister Redevelopment Agency, City Hall

Address: 375 Fifth Street
Hollister, CA 95023

Location of Job: 9 Building Sites off Fourth Street, downtown Hollister, California

Description of Work: Fault Studies as outlined in our proposal dated 12/14/90

Fee to be Charged: Fee per attached proposal dated December 14, 1990

TERMS

Invoices will be submitted at completion of work or at approximately four (4) week intervals and are due and payable upon presentation. After one billing cycle (4 weeks) a Service Charge may be added at the rate of 1.5% per four week period.

In the event it becomes necessary to commence suit to collect amounts due, Client agrees to pay interest at the rate of 10% per annum on unpaid amounts, from date of invoice plus attorney's fees as the court may deem reasonable.

Cancellation of this contract (or proposal) by Client must be in writing. Client agrees to pay for all services and materials provided up to time of cancellation.

APPLIED SOIL MECHANICS, INC.

By: Carl W. Greenlee
Carl W. Greenlee, President

AGREED TO AND ACCEPTED:

City of Hollister
(Please print firm name)

By: City Manager
Signature Title

Date: December 17, 1990

Please sign and return one copy

RESOLUTION NO. 90-33R

BE IT RESOLVED BY THE REDEVELOPMENT AGENCY OF THE CITY OF HOLLISTER, that the Executive Director of the Redevelopment Agency of the City of Hollister be and is hereby authorized and directed, for and on behalf of the Redevelopment Agency of the City of Hollister and as its act and deed, to execute the Work Order from Applied Soil Mechanics, Inc. for Fault Studies as outlined in proposal of December 14, 1990.

PASSED AND ADOPTED this 17th day of December, 1990, by the following votes:

AYES: Agency Members Escover, Irish, Hallberg, and Chairman Kuckenbaker.

NOES: None.

ABSENT: Agency Member Camacho-Light.

Mary E. Kuckenbaker
Chairwoman, Redevelopment Agency
of the City of Hollister

ATTEST:

Margaret K. Gibb
Secretary, Redevelopment Agency
of the City of Hollister

DUPLICATE OF ORIGINAL
ON FILE IN THE
OFFICE OF THE CITY CLERK,
CITY OF HOLLISTER

MEMORANDUM STUDY (#204)

DATE: December 13, 1990

TO: Honorable Chairwoman and Agency Members
Hollister Redevelopment Agency

FROM: Hugh Riley, Executive Director HR

SUBJECT: Geologic Study - Downtown Buildings

BACKGROUND

The Agency received seven proposals from geologists in response to its recent Request for Proposals. The firm of Applied Soil Mechanics, with offices in San Jose and Hollister, was selected for the work to conduct the Fault Studies on nine structures or sites and to prepare reports necessary to clear these sites for construction or substantial rehabilitation. A summary of Applied Soil Mechanic's proposal and cost breakdown is attached.

The City of Hollister will also need to retain the services of a Review Geologist to review th report findings prior to submittal of the reports to the State of California. Mr. John Kingsley, Kingsley and Associates, will provide this service. (Item A-11 - Council Agenda).

The City of Hollister will be responsible for hauling of spoils from the sites and proper disposal as well as the contracting for and hauling backfill material to the site and providing traffic safety services. The City will also be responsible for breaking up of any required asphalt and concrete, probably by contract.

Staff consultants estimate that the overall project cost, including allowances for City support, will be $250,000 including appropriate contingency. Itemized invoices will be submitted periodically based on actual work which will allow cost control adjustment for variables that may arise. Funds for the project are budgeted in the Agency's Capital Improvement Program (2291-00-3, Downtown Revitalization) for 1990-1992.

RECOMMENDATION

1. Receive report from Executive Director.

2. Adopt Resolution No. 90-33 R authorizing Executive Director to execute work order for Geologic Study with Applied Soil Mechanics.

Applied Soil Mechanics, Inc.

SOIL AND FOUNDATION ENGINEERS • GEOLOGISTS

835 Blossom Hill Road, Suite 215 • San Jose, California 95123

(408) 365-8100 • FAX (408) 365-8362

File No. AP-1188

November 16, 1990

Hollister Redevelopment Agency
City Hall
375 Fifth Street
Hollister, California 95023

Attention: Chris Reyes

Subject: **Proposed Buildings 1-9**
Fourth Street
Hollister, California
FAULT STUDY

Dear Mr. Reyes:

We are pleased to submit herein a proposal to conduct a Fault Study for all of the the subject Properties.

We would suggest that the most cost effective and unified effort to complete these studies would be best done by a comprehensive series of reports. Such a series of reports would limit duplication of effort and could be performed in a timely manner.

Essentially, we would suggest establishing a trenching program that would treat buildings No. 1, 3, 4, 5 and 6 as one report. Building No. 2 as a separate report. Building No. 7 & 8 has a separate report, and finally, a separate report for Building No. 9.

Our proposal would be subject to some modification in that we would like the input of the reviewing agency before putting together a detailed proposal.

We hope you consider this package approach and we would be happy to discuss this concept in the near future with you and your representatives.

We thank you for the opportunity to submit this proposal. If you have any questions, please give us a call.

Sincerely,

APPLIED SOIL MECHANICS, INC.

Jack Greene
Salinas Office Manager

CWG

Carl W. Greenlee, President
Geotechnical Engineer #355

Copies: 8 to Addressee

Applied Soil Mechanics, Inc.

SOIL AND FOUNDATION ENGINEERS • GEOLOGISTS

835 Blossom Hill Road, Suite 215 • San Jose, California 95123

(408) 365-8100 • FAX (408) 365-8362

File No. AP-1179

November 13, 1990

Hollister Redevelopment Agency
City Hall
375 Fifth Street
Hollister, California 95023

Attention: Chris Reyes

Subject: **Proposed IOOF / Caputo Printing Property (Building Site No. 1)**
Fourth Street
Hollister, California
FAULT STUDY

Dear Mr. Reyes:

We are pleased to submit herein a proposal to conduct a Fault Study for the subject IOOF & Caputo Printing Property.

The subject property is currently a level, partially vacant lot. We understand that a previously existing commercial building was located on the lot and was partially destroyed by the Loma Prieta Earthquake of October 17, 1989.

The site is bounded on the east by an adjacent commercial building, on the west by parking lot, on the north by an alley, and on the south by Fourth Street.

The subject lot is located within the Alquist-Priolo Zone for the Calaveras Fault. The most widely used means of evaluating a site for faults within an Alquist Priolo Zone is by excavating exploratory trenches oriented orthogonal to the mapped fault trace in the area of any proposed structures and extending 50 feet beyond the proposed building footprint. Because the site is bounded on all sides by streets with underground utilities and adjacent commercial buildings, there may be grounds for seeking a variance to extending the trench beyond the building footprint or the property lines.

We have included several prices in our proposal based on what degree of involvement the City of Hollister Redevelopment Agency desires, as well as requirements concerning the Alquist Priolo Special Studies Act requirements.

Our proposal would be subject to some modification in that we would like the input of the reviewing agency before beginning any actual trenching on the site.

Fault Study

The scope of our overall Fault Evaluation Study will include the following:

1. Review of available published geological reports and maps covering areas in the vicinity of the subject site;

2. Interpretation of a series of aerial photographs of the vicinity utilizing stereoscopic examination equipment and techniques;

3. Geologic reconnaissance of the site and surrounding areas;

4. Special attention will be given to the property and its location within the Alquist-Priolo Special Study zone;

5. Exploratory trenching to a depth of approximately 8 to 15 feet below street elevation. We estimate approximately 2.5 days (1 day if the 50' offset is waived) will be required to complete the trenching at the site, and 50' on either side of the proposed structure of the building pad to determine the presence or absence of geologic faults which might impact the proposed structure. We have assumed that the replacement structure will fill the entire site and will not have any setbacks from the property line. The location of our proposed exploratory trench program are shown on the accompanying site plan;

6. All right of way agreements and all concrete sidewalks and asphalt pavements are to be removed by the City of Hollister before the start of trenching and replaced by the City of Hollister upon completion of the backfilling of the trenches;

7. Use a private locater for underground lines, as well as USA and the City of Hollister records;

8. All detouring of traffic and access to the site will be performed by the City of Hollister;

9. All work is to performed during normal working hours;

10. Repair of all broken lines will be undertaken by the City of Hollister; and

11. Geologic analysis of the data generated from the subsurface exploration, resulting in the compilation of a written report presenting our findings and making recommendations related to the geologic hazards at the site.

We are presenting several prices based on the extent of our actual work. Please note carefully the pricing breakdowns and the extent of the work involved:

(1) A Fault Evaluation Study, including the above scope of work, for the subject property, performed and reported as outlined herein, with no special backfill requirements and with the City of Hollister supplying backhoe, shoring, and a complete safety program (including covering of the trenches at night), can be prepared for an overall estimated fee of $5,400.00. If we receive a variance and are not required to extend the exploratory trenches the additional 50' on either side of the proposed structure, then the report can be prepared for an estimated fee of 4,300.00.

(2) A Fault Evaluation Study for the proposed property where we subcontract Mark Nicholson, Inc, at prevailing wage, to excavate and backfill the trenches using a John Deere 510 extendahoe. Backfill material for the trenches on the subject property will consist of two sack grout (or a controlled density backfill) up to five feet below the ground surface. The upper five feet of trench will be backfilled with four feet of Marina sand compacted to 90% relative compaction and a 12 inch native soil cap. The backfill for trenches in San Benito Street will consist entirely of two

sack grout with a 4 inch cap asphalt cap. Alleys, sidewalks, and other streets will be backfilled with two sack grout up to 5 feet below the street grade, with the upper 5 feet backfilled with compacted Marina sand (upper 12' at 95% relative compaction) and the required pavement or sidewalk cap. All backfill material will be supplied by San Benito Supply. Applied Soil Mechanics, Inc. would supply safety equipment after arriving at an acceptable joint agreement with the City of Hollister. Such a Fault Evaluation Study could be prepared for for an estimated fee of $14,000.00. If we receive a variance and do not have to do the additional 50' on either side of the structure, then the report can be prepared for an estimated fee of $9,600.00.

(3) A Fault Evaluation Study as outlined above in (1) (2) with the removal of all spoils from the site and their proper disposal can be prepared for an estimated fee of $15,000.00. If we receive a variance and are not required to extend the trenches the additional 50' on either side of the proposed structure, then the report can be prepared for an estimated fee of $10,200.00.

(4) A Fault Study as outlined above in (1), (2) & (3) with the addition of removal and replacement of all asphalt (2" cap on city streets, 4" on San Benito Street) and concrete sidewalks (3' wide) and with grout being brought up to finished subgrade and capped with asphalt, can be prepared for an estimated fee of $23,000.00. If we receive a variance and are not required to extend the trenches the additional 50' on either side of the proposed structure, then the report can be prepared for an estimated fee of $11,500.00.

If the results of the above proposed study indicates further trenching is required, we will notify you regarding the affect on the timing and cost of our report. Are pricing is based on the amount of time that will be expended for trenching as outlined above and, any archaeological discoveries, underground obstacles which may impede the trenching (such as underground tanks, old undocumented fill or unknown fill, or rocks/concrete), weather, and similar delays will affect the timing and cost of our report. The estimated cost of the subject study and report would have to be renegotiated at that time.

This proposal does not include any fees for testing of backfill in trenches or any additional geotechnical services.

We propose to complete all work on the project within five weeks of receiving the signed work order on the project, dependent on the weather & government agencies (such as Caltrans).

This proposal will be effective for the described work if undertaken during the next 60 days. It will be subject to renegotiation should there be any substantial change in the proposed planning or design from that currently being contemplated.

We thank you for the opportunity to submit this proposal. If you have any questions, please give us a call.

Sincerely,

APPLIED SOIL MECHANICS, INC.

Jack Greene
Salinas Office Manager

Carl W. Greenlee, President
Geotechnical Engineer #355

Copies: 8 to Addressee

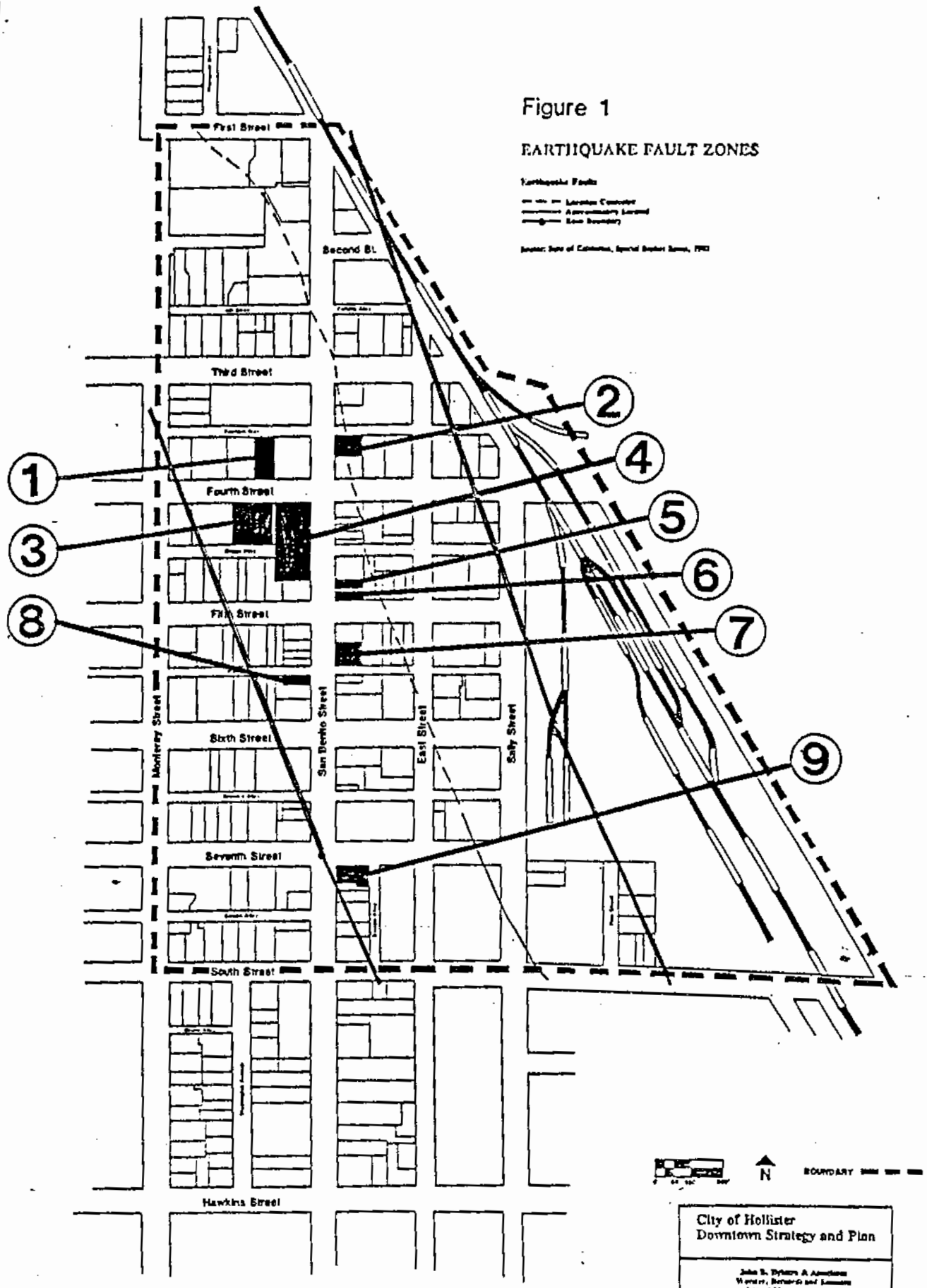


Figure 1
EARTHQUAKE FAULT ZONES
First Street
Second St.
Third Street
Fourth Street
Fifth Street
Sixth Street
Seventh Street
South Street
Hawkins Street
Monterey Street
San Benito Street
East Street
Sally Street
1
2
3
4
5
6
7
8
9
N
BOUNDARY
City of Hollister
Downtown Strategy and Plan

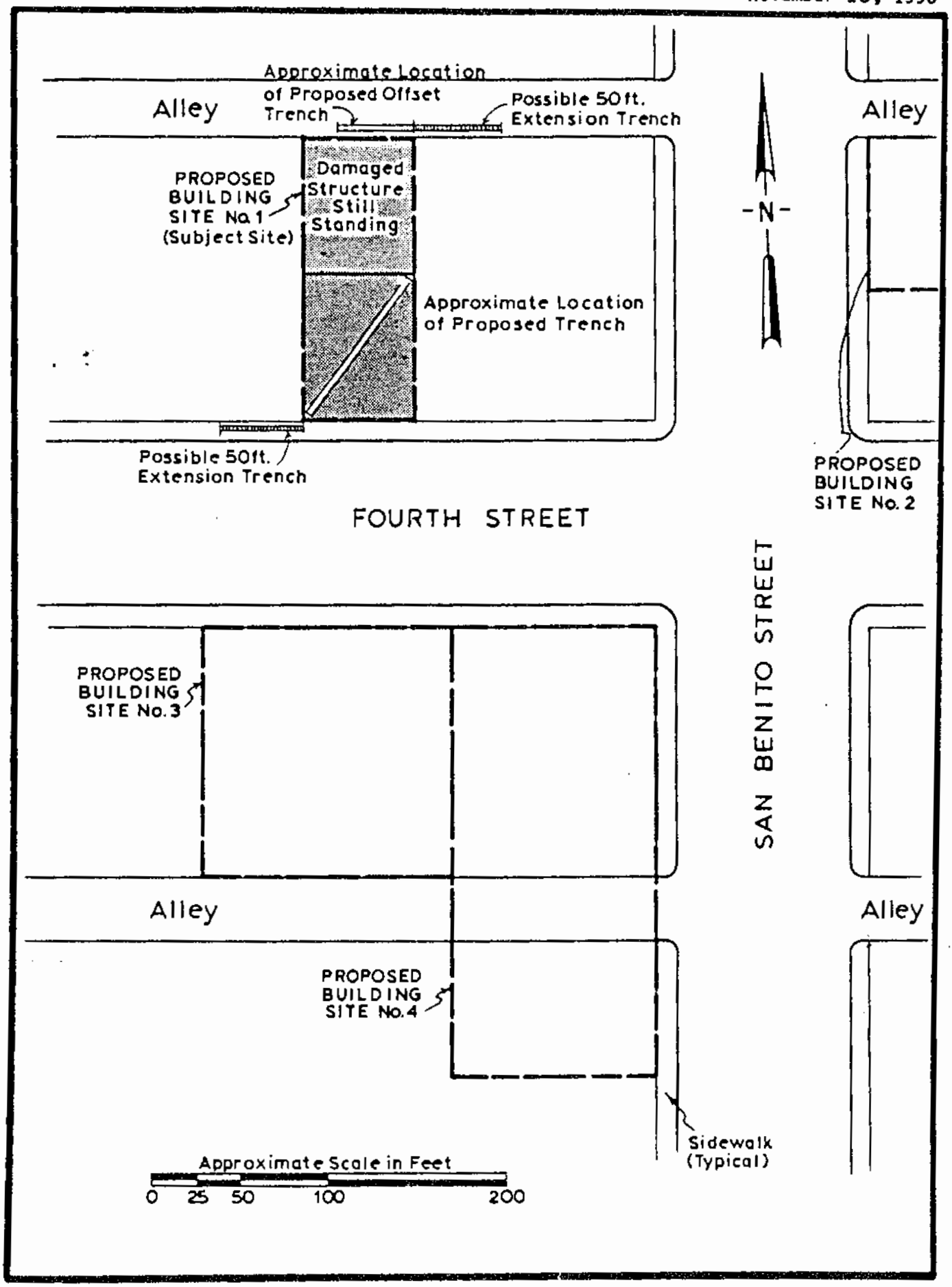


Figure 1 - Location Map, IOOF / Caputo Printing Site

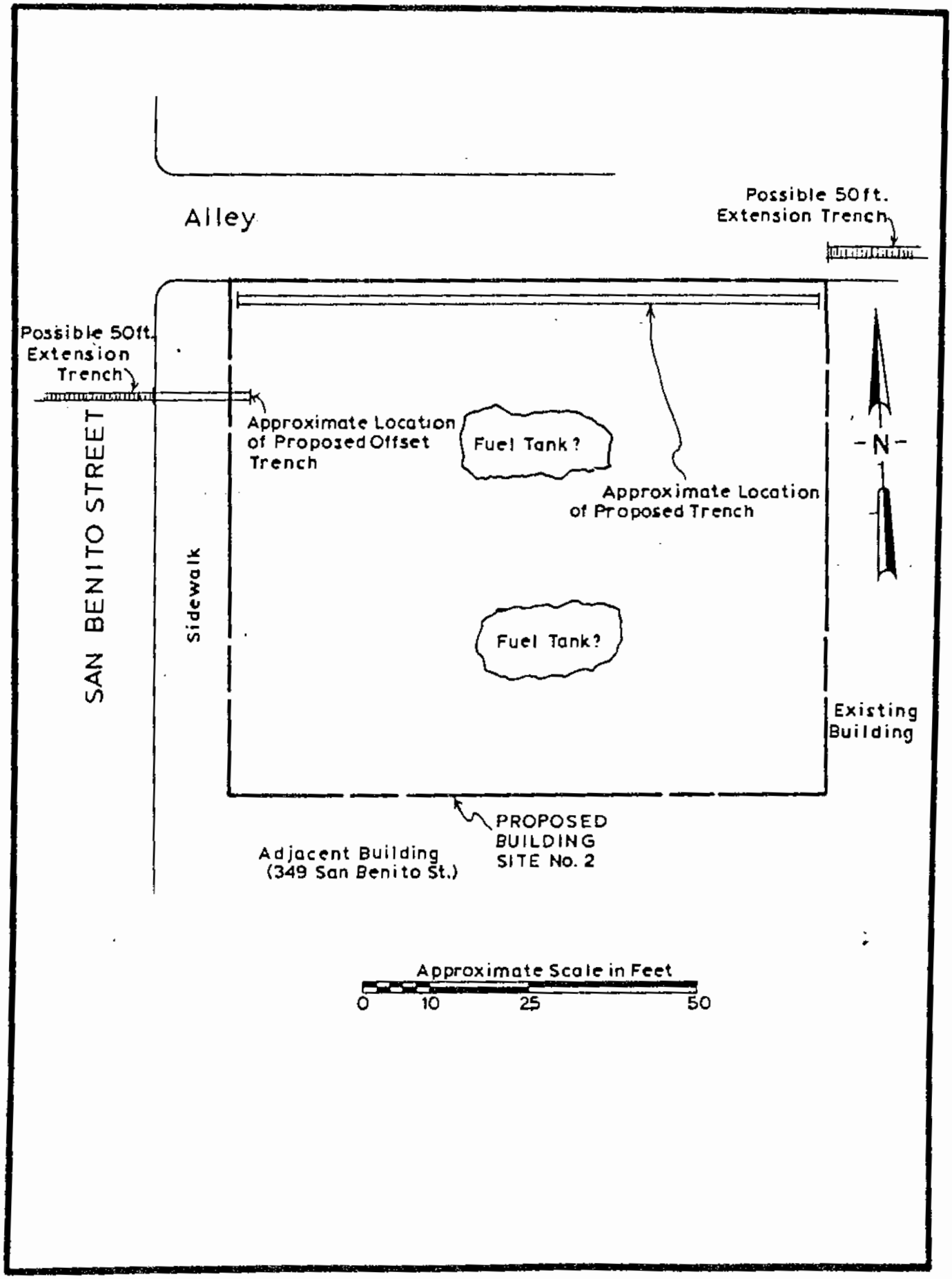


Figure 1 - Location Map, Stephens & Poletti Medical Supplies

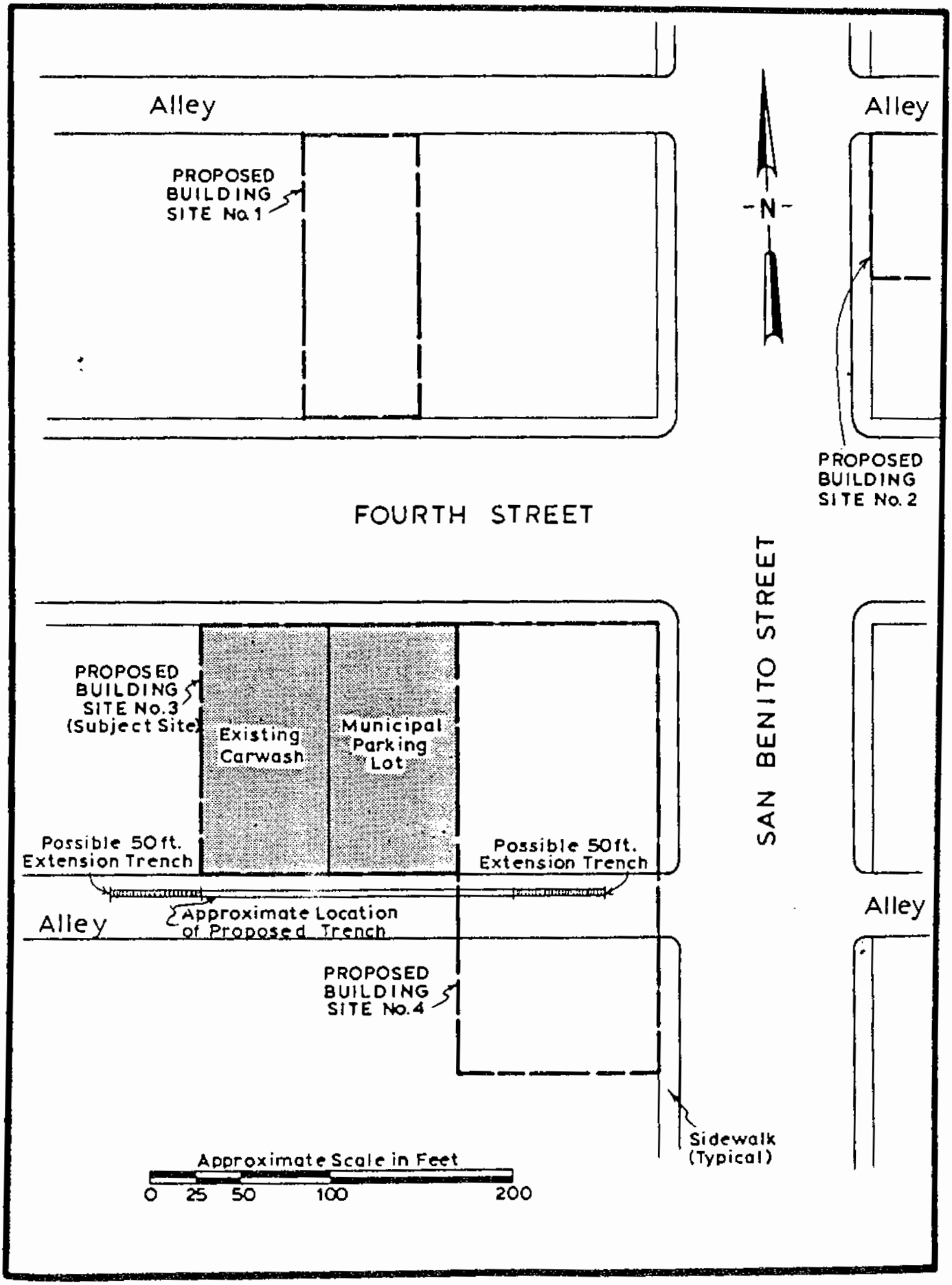


Figure 1 - Location Map, Fourth Street Car Wash

Applied Soil Mechanics

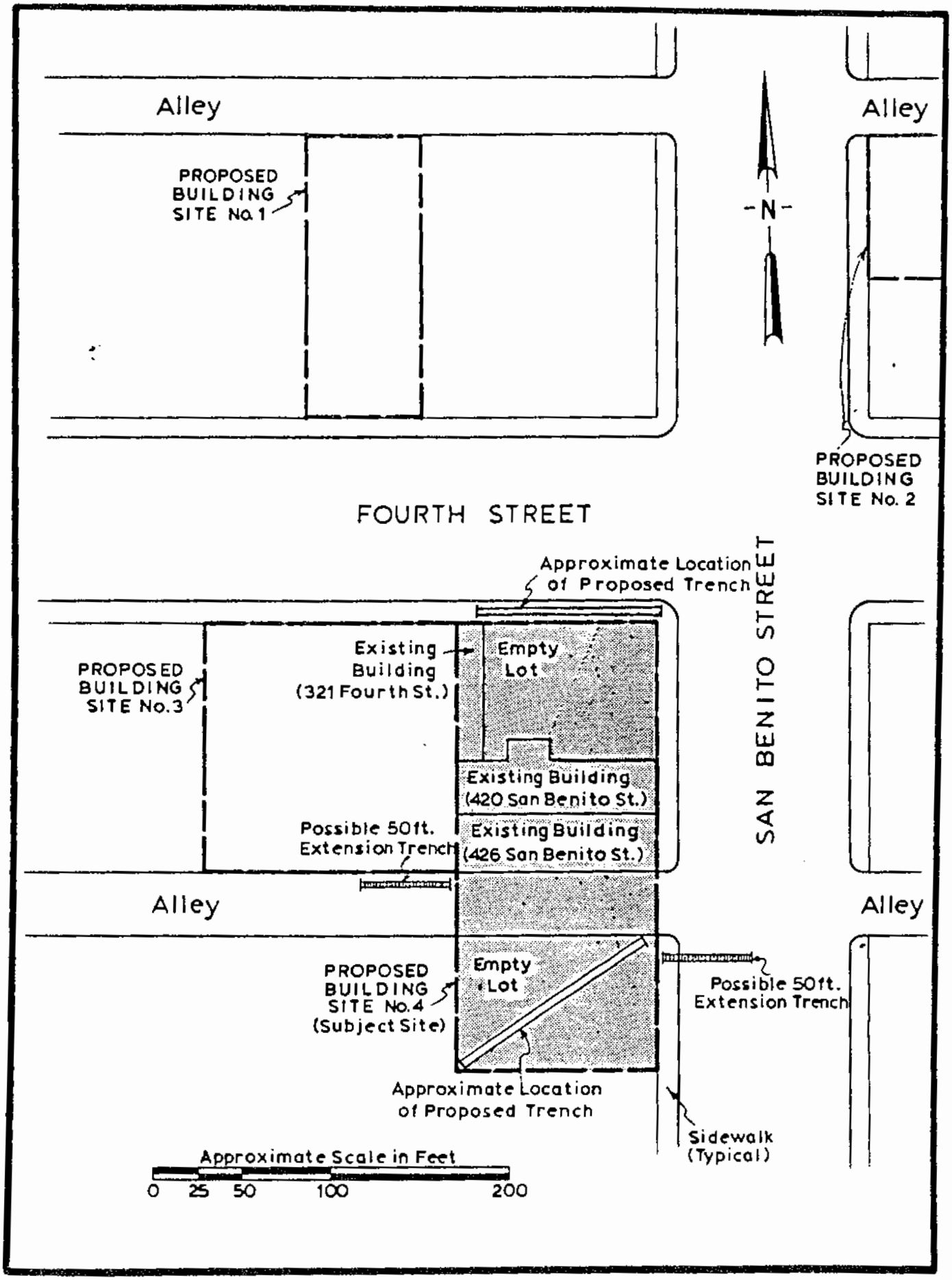


Figure 1 - Location Map, 400 Block

APPENDIX A.4

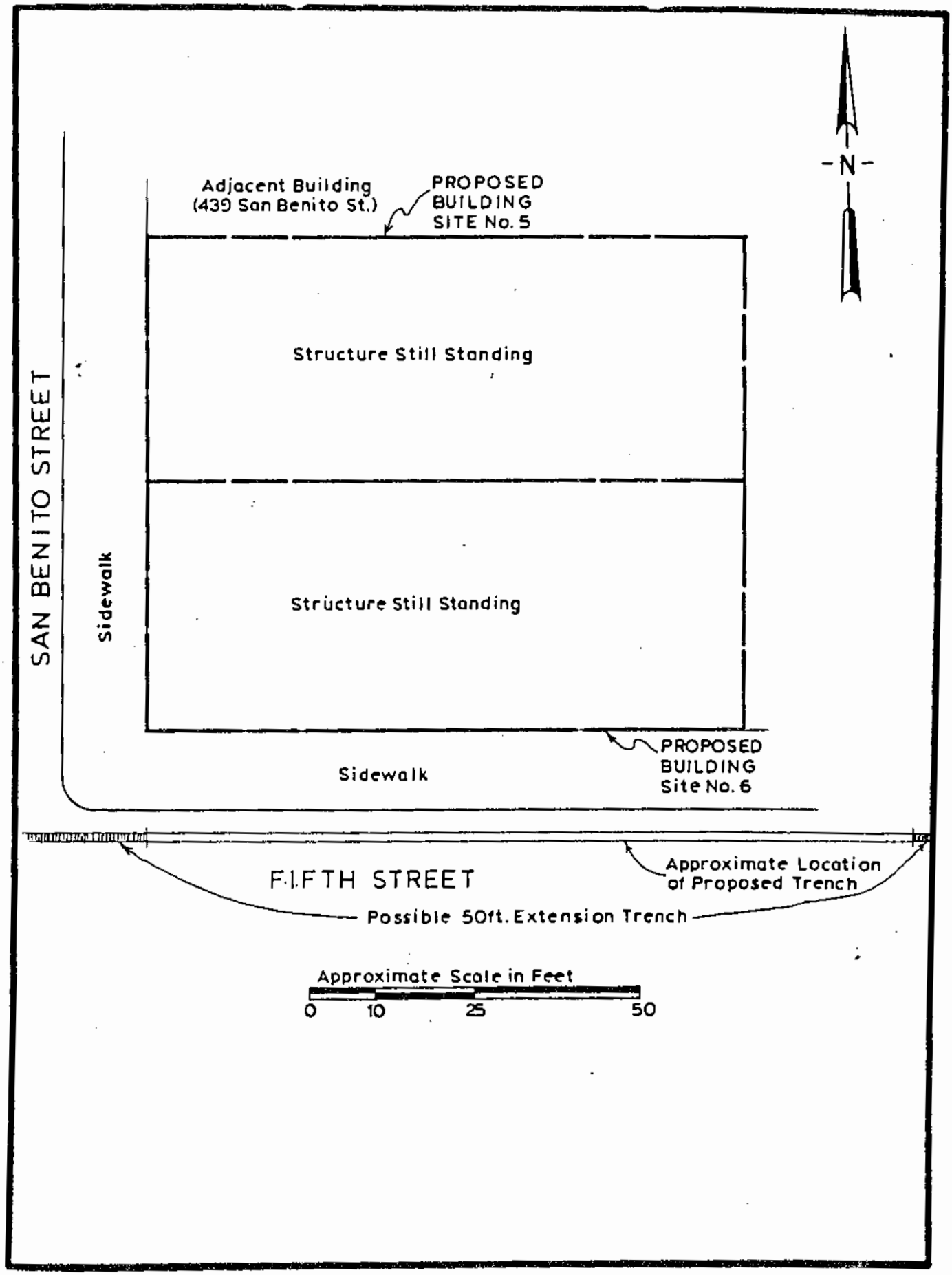


Figure 1 - Location Map, Las Palmas & Mode O'Day

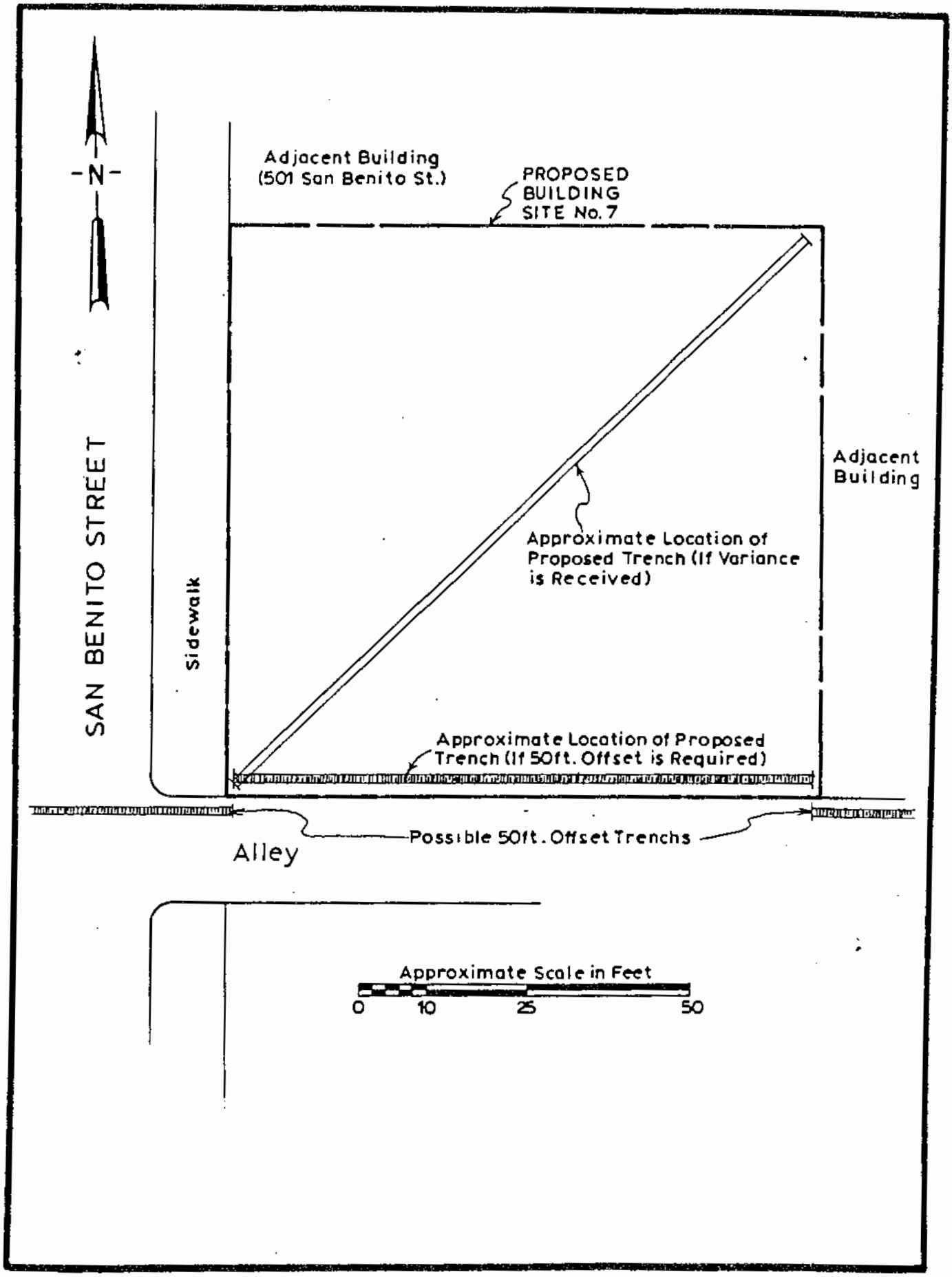


Figure 1 - Location Map, Dick Bruhn Bros.

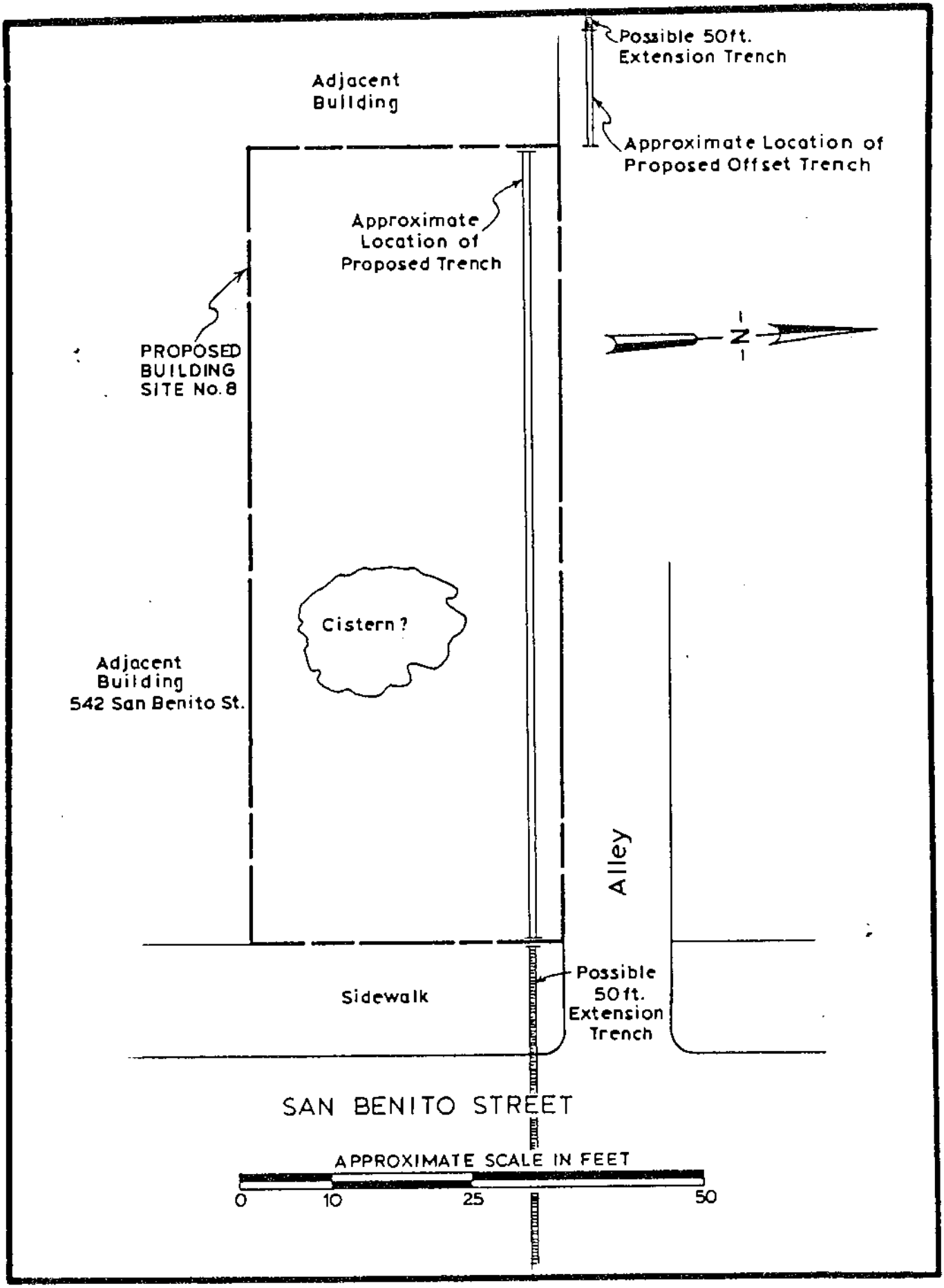


Figure 1 - Location Map, Peterson Building

Applied Soil Mechanics

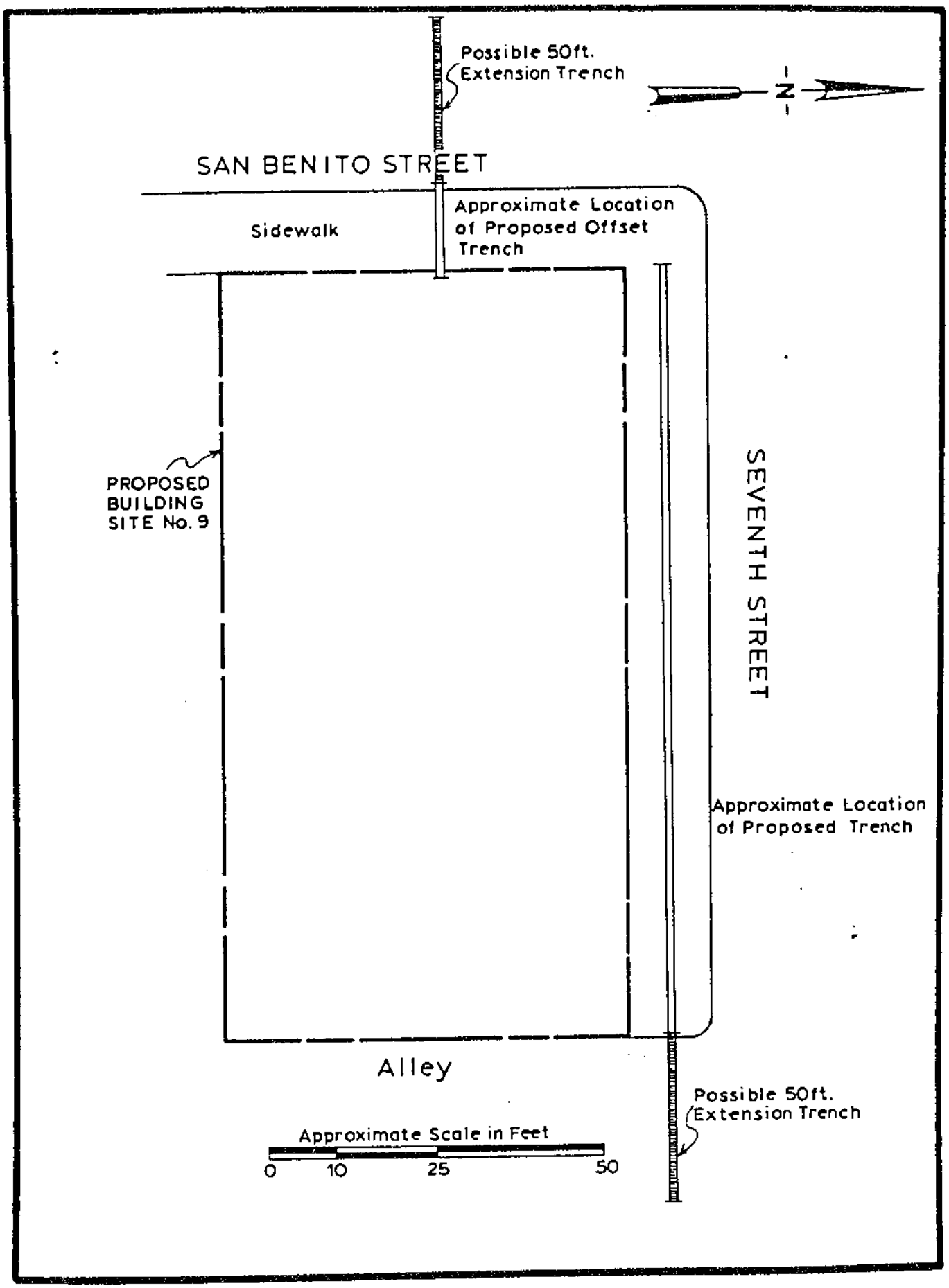


Figure 1 - Showcase Theater Property

Applied Soil Mechanics, Inc.

SOIL AND FOUNDATION ENGINEERS • GEOLOGISTS
835 Blossom Hill Road, Suite 215 • San Jose, California 95123
(408) 365-8100 • FAX (408) 365-8362

File No. AP-1178 December 14, 1990

Hollister Redevelopment Agency
City Hall
375 Fifth Street
Hollister, California 95023

Attention: Mr. Chris Reyes

Subject: **Existing Building Sites 1-9**
Fourth Street
Hollister, California
FAULT STUDY SUMMARY

Dear Mr. Reyes:

We are pleased to submit this letter as a summary of our previous proposal to conduct a Fault Study for the subject properties. This summary is also based on the discussions with Mr. Hugh Riley, the City Manager of Hollister, and other representatives of the City of Hollister at a meeting held on December 10, 1990.

We propose to develop a program that would strategically place the trenches such that Building Nos. 1, 3, 4, 5 and 6 could be addressed as one report; Building No. 2 as a separate report; Building No. 7 & 8 as a separate report, and Building No. 9 as a separate report. Initial work would start with Building No. 2 to be followed by Buildings 1, and then 3 through 6.

Once work commences, Applied Soil Mechanics Inc., would work with the City Engineer to apply for an encroachment permit with CalTrans for possible work in San Benito Street.

It is our understanding that the City of Hollister would be responsible for hauling the spoils generated as a result of trenching, from the sites to a proper disposal area, as well as the contracting for and hauling to the site both the two-sack "cement/sand slurry" and "Marina" sand backfill materials. Placement of these materials will be observed and verified by Applied Soil Mechanics Inc. Actual labor will be supplied by subcontractors to Applied Soil Mechanics.

The City of Hollister will also be responsible for the sawing and breaking up of any required asphalt and concrete to be removed to allow for exploratory trenches. The actual removal of this material will be performed by Mark Nicholson, Inc., subcontractor to Applied Soil Mechanics, Inc. Applied Soil Mechanics will verify the backfilling of the trenches to top of subgrade. In the street and sidewalk areas, the City of Hollister will be responsible for the placement of a cold patch and eventual permanent replacement of base rock, asphalt and concrete to put the areas back to original configuration.

File No. AP-1188 December 14, 1990

Applied Soil Mechanics, Inc., will prepare and implement a safety plan for the Fault Studies which will be submitted to the City of Hollister for review and approval. Applied Soil Mechanics, Inc., will coordinate the program with Mr. Chris Reyes of the Hollister Redevelopment Agency, who will be responsible for notifying the Hollister Police Department and Highway Patrol, when appropriate, of our work schedule.

Responsibility for any repair of broken lines, in the course of the Fault Studies, will be undertaken by the City of Hollister. However, Applied Soil Mechanics, Inc., in conjunction with our subcontractors, will make a good faith effort to locate existing lines prior to initiating field work and will attempt to repair breaks that may occur.

All trench backfill testing will be performed by Applied Soil Mechanics Inc., and test results will be presented in the final report.

We have not, at this time, included the cost of the private locater for underground lines. The results from the locater may influence the proposed placement of trenches. After initial agreement on the placement of the trenches, USA underground alert will be notified. After which time final trench placement will be established.

All invoices will be itemized and will be submitted to the Hollister Redevelopment Agency for review and payment.

Submitted herein is our proposed budget and a proposed trench program.

We look forward to working with you on this project. If you have any questions, please give us a call.

Sincerely,

APPLIED SOIL MECHANICS, INC.

Written by:

Jack Greene/wo

Jack Greene
Salinas Office Manager

Reviewed by:

Carl W. Greenlee

Carl W. Greenlee, President
Geotechnical Engineer #355

JG/sp

Copies: 2 to Addressee

File No. AP-1178 December 14, 1990

Site #2 Stephens & Poletti Medical Supplies site. This estimate is based on two days of work to excavate, map, and backfill 155' of exploratory trench. It does not include the possible 50' extension into San Benito Avenue.

Phase of Construction	Assumed Coverage (Preliminary Estimate)	Estimated Cost
Meetings, Consultations, and Plan Review	Sr. Geol: 16 hrs Tech: 8 hrs	$1,200.00
Field Personnel	2 Techs: 2 days @ 4-8 hrs a day	$1,400.00
	Geol: 2 days @ 8 hrs a day	$1,200.00
	Trench Tech: 2 days @ 8 hrs a day	$900.00
	Sr. Geol Trench Site Review: 8 hrs	$800.00
Field Activities	Excavating, Compacting, Backfilling Exploratory Trench (2 days)	$3,000.00
	Cement/Sand Grout Slurry Backfill Placement	$200.00
Safety	Closing and Opening Site (trench covers, signs, etc.)	$400.00
	Supplies, including steel plates, cones, plywood (can be reused on other sites)	$1,000.00
Fault Study Report at completion of field project		$5,900.00
	ESTIMATED FEE	$16,000.00

Applied Soil Mechanics, Inc.

SOIL AND FOUNDATION ENGINEERS • GEOLOGISTS
835 Blossom Hill Road, Suite 215 • San Jose, California 95123
(408) 365-8100 • FAX (408) 365-8362

WORK ORDER

APPLIED SOIL MECHANICS, INC., a California corporation, ("Company") and Client agree to a work assignment for Company, as follows:

Name of Project: Proposed Building Sites 1-9, Hollister

Order Received By: Jack Greene Date: December 14, 1990

Authorized By: Mr. Hugh R. Riley, City Manager Job No.: AP-1188

Client Name: Hollister Redevelopment Agency, City Hall

Address: 375 Fifth Street
Hollister, CA 95023

Location of Job: 9 Building Sites off Fourth Street, downtown Hollister, California

Description of Work: Fault Studies as outlined in our proposal dated 12/14/90

Fee to be Charged: Fee per attached proposal dated December 14, 1990

TERMS

Invoices will be submitted at completion of work or at approximately four (4) week intervals and are due and payable upon presentation. After one billing cycle (4 weeks) a Service Charge may be added at the rate of 1.5% per four week period.

In the event it becomes necessary to commence suit to collect amounts due, Client agrees to pay interest at the rate of 10% per annum on unpaid amounts, from date of invoice plus attorney's fees as the court may deem reasonable.

Cancellation of this contract (or proposal) by Client must be in writing. Client agrees to pay for all services and materials provided up to time of cancellation.

APPLIED SOIL MECHANICS, INC.

By: Carl W. Greenlee
Carl W. Greenlee, President

AGREED TO AND ACCEPTED:

(Please print firm name)

Applied Soil Mechanics
INCORPORATED
SOIL AND FOUNDATION ENGINEERS • GEOLOGISTS

FAULT STUDY

Poletti Property
335 San Benito Street
Hollister, California

JULY 1991

APPENDIX A.5

Applied Soil Mechanics, Inc.
SOIL AND FOUNDATION ENGINEERS • GEOLOGISTS
835 Blossom Hill Road, Suite 215 • San Jose, California 95123
(408) 365-8100 • FAX (408) 365-8362

File No. A0-2279-S1

July 5, 1991

City of Hollister Redevelopment Agency
375 Fifth Street
Hollister, CA 95023

Attention: Mr. Christopher M. Reyes, Program Manager

Subject: **Poletti Property**
335 San Benito Street
Hollister, California
FAULT STUDY

Gentlemen:

As you requested, we have completed the fault study for the Poletti property. The purpose of this study was to determine if there was evidence for a trace of the East Branch of the Calaveras fault is within the study area. The following report presents the results of our study.

No evidence for the presence of active fault traces was gathered during the field exploration phase of this study. Based on the results of this study, the site is suitable from an engineering geologic viewpoint for the proposed building improvements, provided that the recommendations presented herein and those of the recommended soil engineering study are incorporated into appropriate construction plans and specifications.

The submission of this report concludes this phase of our contract with the City. We are pleased to have been of service to you on this project.

Sincerely,

APPLIED SOIL MECHANICS, INC.

Written by:

Lewis Rosenberg
Project Geologist

Reviewed by:

Richard T. Gorman, C.E.G. 1325
Consulting Geologist

Copies: 10 to Addressee

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APPENDIX A Exploratory Trench & Boring Logs A2

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INTRODUCTION

This report presents the results of our fault study for the Poletti property in Hollister, California (see Figure 1). The Poletti property is located at 335 Fourth St. (Building Site No. 2) and is shown on Figure 2. Building Sites 1, 3 through 8, and 10 are discussed in other reports (Applied Soil Mechanics, 1991b, 1991c).

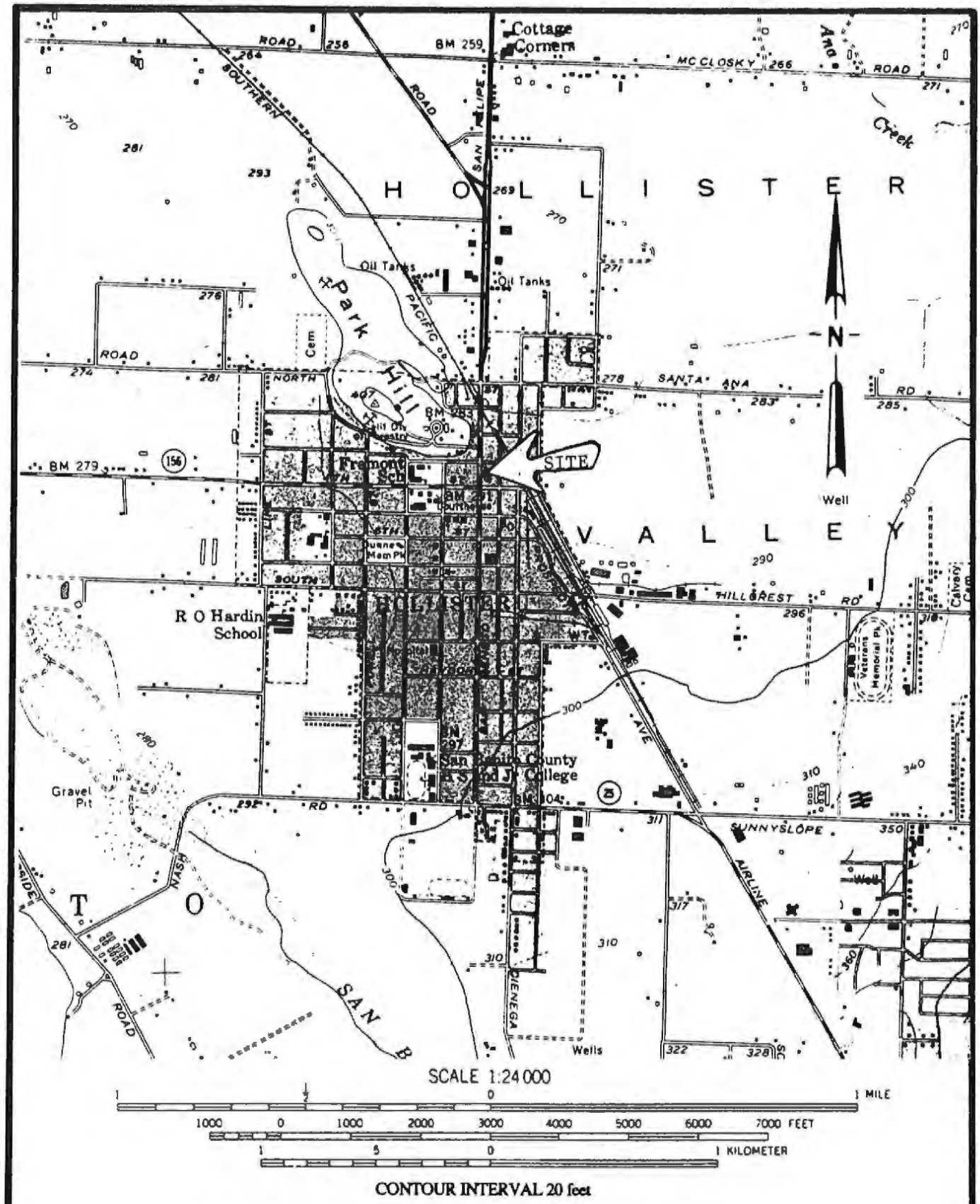
These properties are within a special study zone delineated by the City of Hollister and the California Division of Mines and Geology for the East Branch of the Calaveras fault (Figure 3). City and State laws mandate that geologic studies be performed for properties along known active fault zones (Alquist-Priolo Special Studies Zones). The stated intent of these laws is to evaluate the potential for fault rupture to occur on the property before building, rebuilding or substantial remodeling of structures for human occupancy.

We would like to express our special thanks to the City of Hollister for providing manpower and equipment during the field explorations.

Project Description

The 0.16-acre site consists of a vacant lot at 335 San Benito Street. The former Stevens and Poletti Ambulance building sustained damage as a result of the October 17, 1989 Loma Prieta earthquake and was later demolished.

As shown on Figure 2, the site is bounded by San Benito Street on the west, a parking lot on the east, Hawkins Alley on the north, and an existing building on the south. According to Mr. Poletti, underground fuel tanks at the site were removed . Based on our discussions with Mr. Poletti, it is our understanding that the proposed project will involve building a new structure.



CONTOUR INTERVAL 20 feet

Base: U.S.G.S. topographic map of the Hollister 7.5' Quadrangle, 1955 photorevised 1971.

Figure 1 - Vicinity Map

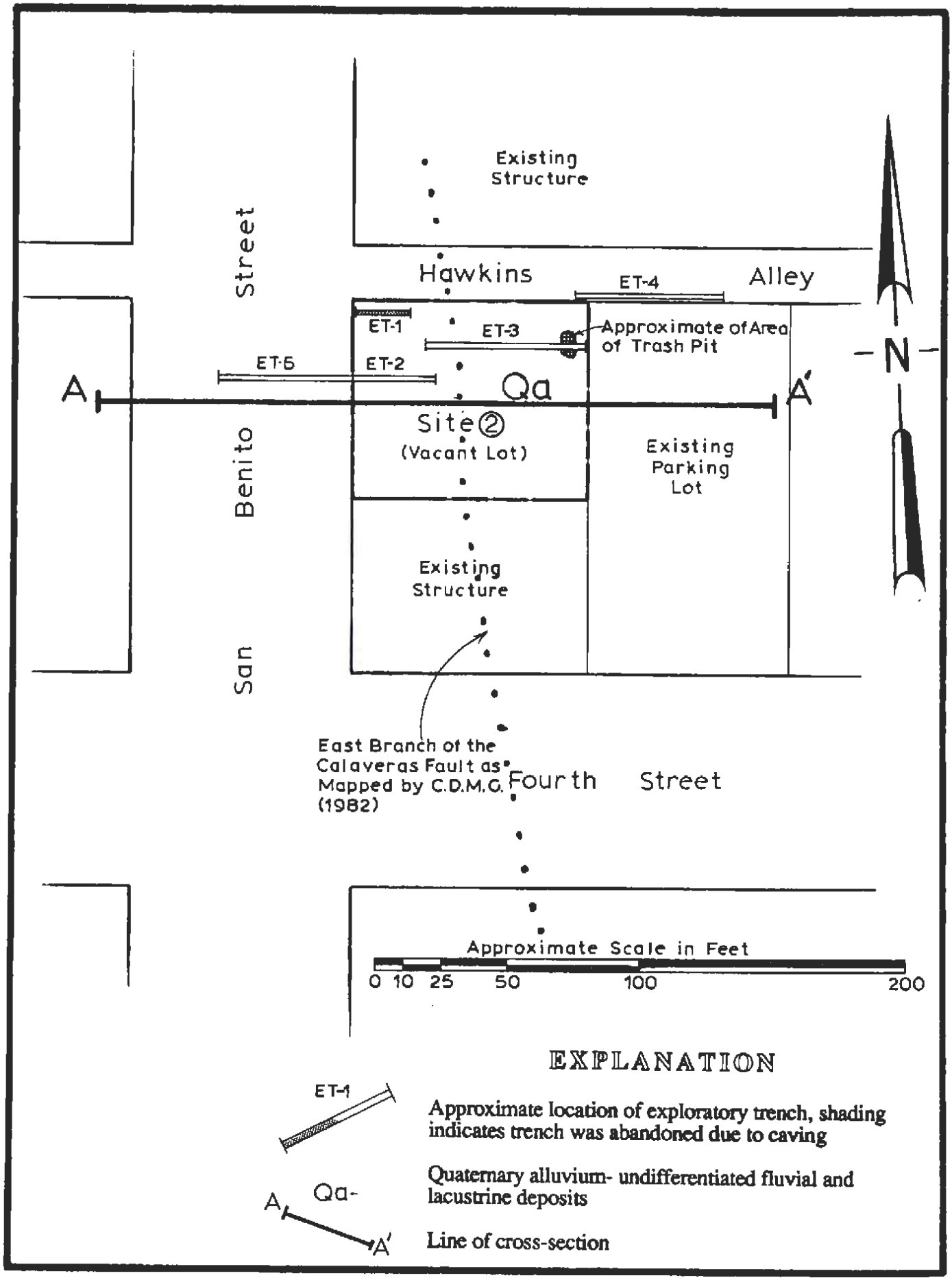
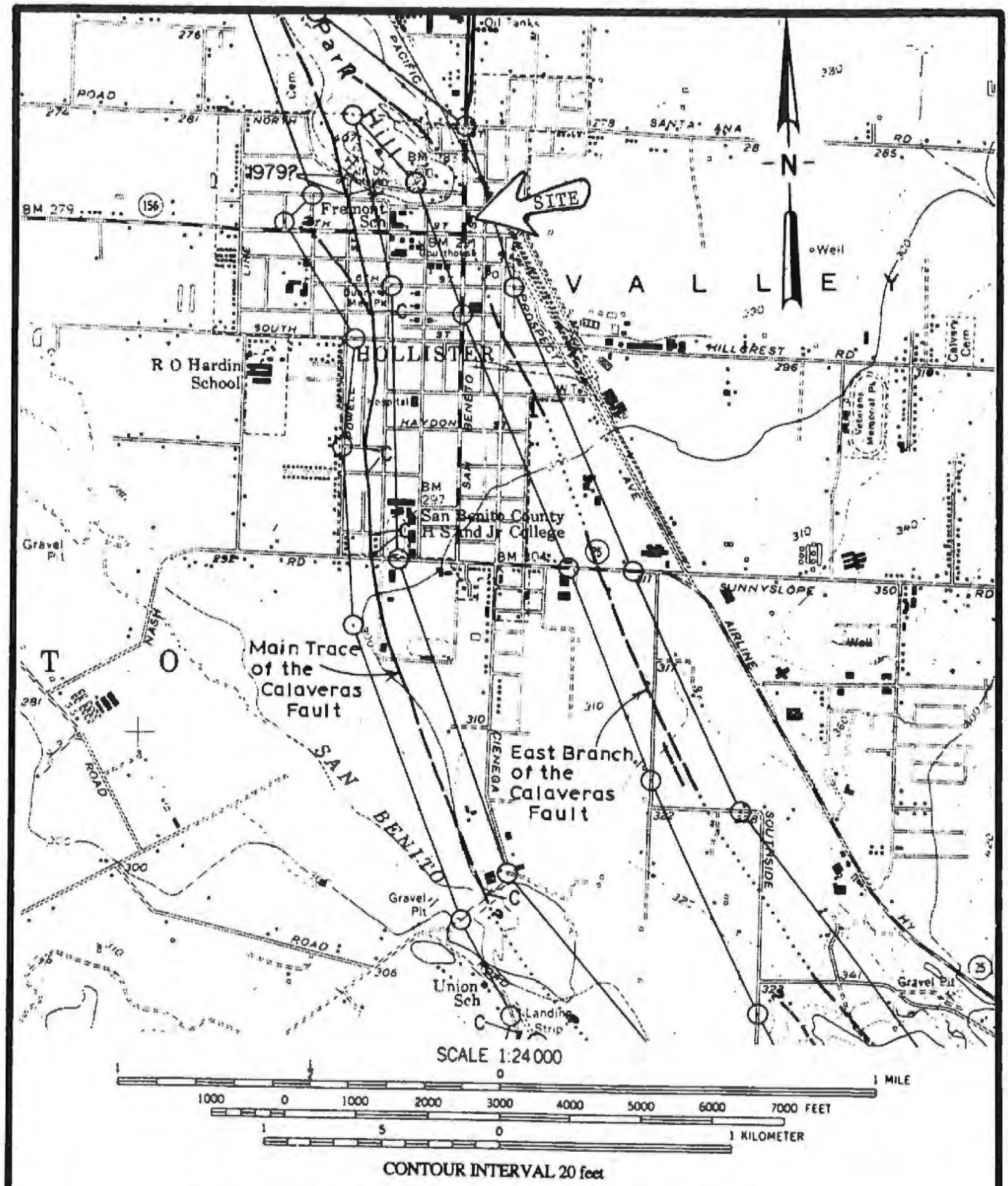


Figure 2 - Site Plan and Geology Map



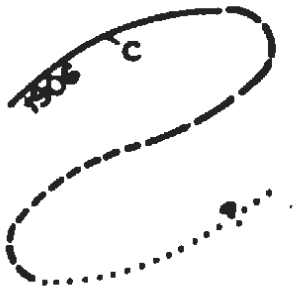
CONTOUR INTERVAL 20 feet

Base: State of California Special Studies Zones Map of the Hollister 7.5' Quadrangle, 1982

Figure 3 - Alquist Priolo Special Studies Zone Map

MAP EXPLANATION

Potentially Active Faults



Faults considered to have been active during Quaternary time; solid line where accurately located, long dash where approximately located, short dash where inferred, dotted where concealed; query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by creep or possible creep.

Aerial photo lineaments (not field checked); based on youthful geomorphic and other features believed to be the results of Quaternary faulting.

Special Studies Zone Boundaries

These are delineated as straight-line segments that connect consecutively numbered turning points so as to define one or more special studies zone segments.

Seaward projection of zone boundary.

Source: California Division of Mines and Geology (1982)

Figure 3a - Explanation for Alquist Priolo Special Studies Zone Map

PURPOSE AND SCOPE OF SERVICES

The purpose of this study was twofold; the first was to identify the geologic conditions and evaluate existing potential geologic and seismic constraints at the site. The second purpose was to provide recommendations for site development from an engineering geologic viewpoint. This study included the following scope of work:

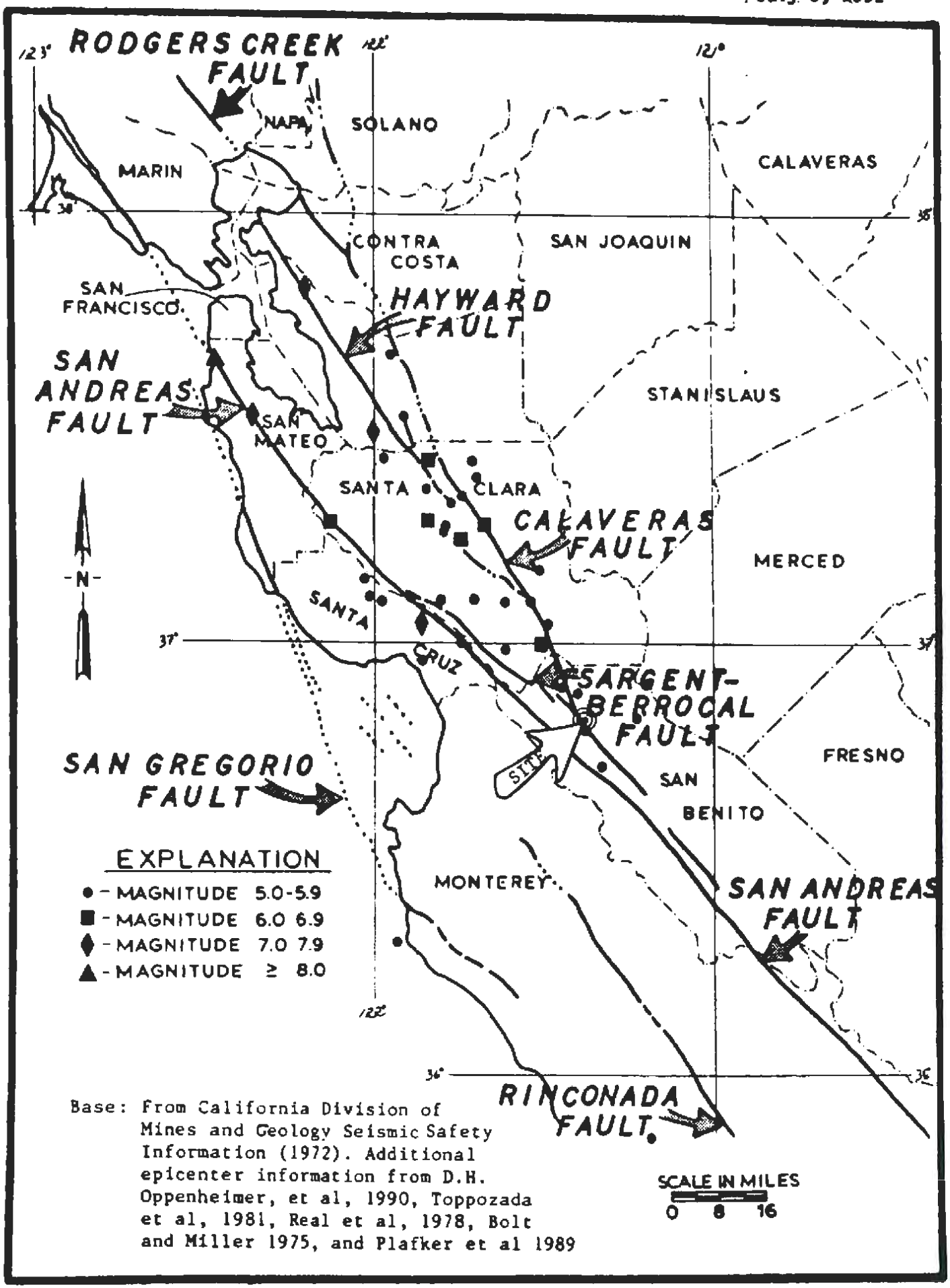
1. Research, review, and evaluate data from published and unpublished geologic and geotechnical reports;
2. Discussions with representatives of the City of Hollister, the California Division of Mines and Geology (CDMG), and the U.S. Geological Survey (USGS);
3. Study of a series of aerial photographs of the site and vicinity;
4. Excavate, shore, clean, and log approximately 225 lineal feet of trenches;
5. Drill and log one exploratory boring to a depth of approximately 20 feet below the ground surface;
6. Geologic analysis of gathered data; and,
7. Preparation of this report, along with appropriate graphics and including the findings of the study and recommendations for development of the proposed building site.

GEOLOGIC SETTING

The Poletti property is situated within the Hollister Valley. The valley boundaries are the Pajaro River on the north, the mountains of the Gabilan Range on the west, the Diablo Range on the east, and the juncture of the Gabilan and Diablo Ranges on the south. The Gabilan Range consists of late Cretaceous age granitic rocks and metamorphic rocks, including marbles, quartzite, and schist (Compton, 1966). Overlying the granitic rocks is a series of Oligocene to middle Miocene age sandstones and shales (Allen, 1946). The Diablo Range consists of Jurassic-Cretaceous age sandstones, limestones, volcanic rocks, and metamorphic rocks which are part of the Franciscan Complex. Associated with the Franciscan rocks are metamorphic rocks of the Gabilan Range which include marble, dolomite, quartzite, and schist. Upper Cretaceous age sandstones, shales and conglomerates overlie the Gabilan metamorphic rocks and Franciscan rocks (Page, 1966).

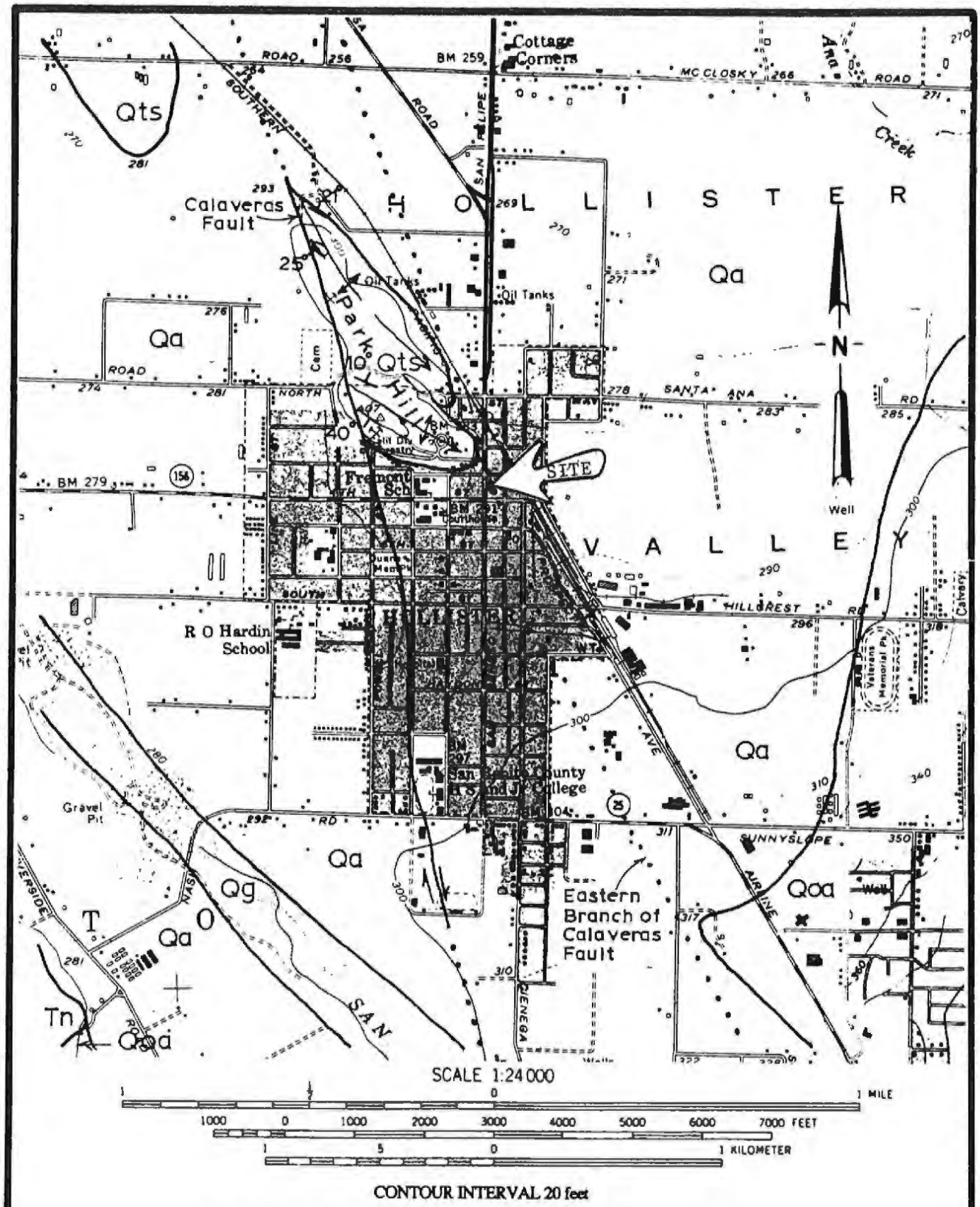
The geologic structure of the Hollister area and the Gabilan and Diablo Ranges is strongly influenced by the active San Andreas and Calaveras faults. These faults strike northwest and are characterized by a combination of strike-slip and reverse displacement. The San Andreas and Calaveras faults are steeply southwest-dipping shear zones that separate Jurassic-Cretaceous Franciscan basement rocks from Cretaceous granitic basement rocks. The Calaveras fault branches off from the San Andreas fault approximately 8 miles south of Hollister (see Figure 4).

Several periods of movement on the San Andreas and Calaveras faults occurred in the Hollister area, causing uplift of the mountains bordering the valley. The combination of faulting and folding resulted a structural basin which was a seaway during the late Miocene to Pliocene (Allen, 1946). During Pliocene and Pleistocene time, extensive floodplain deposits known as the San Benito Gravels were deposited in the valley (Kilburn, 1972). During the Pleistocene, subsidence in the Hollister Valley due to tectonic activity resulted in deposition of a series of sands, silts, and clays over the San Benito Gravels (McMasters and others, 1987). These deposits are interpreted as



Base: From California Division of Mines and Geology Seismic Safety Information (1972). Additional epicenter information from D.H. Oppenheimer, et al, 1990, Toppozada et al, 1981, Real et al, 1978, Bolt and Miller 1975, and Plafker et al 1989

Figure 4 - Regional Fault & Epicenter Map



CONTOUR INTERVAL 20 feet

Base: U.S.G.S. topographic map of the Hollister 7.5' Quadrangle, 1955 photorevised 1971. Geology modified from T.W. Dibblee (1975)

Figure 5 - Regional Geology Map

EXPLANATION

Geologic Units

Qg- Stream gravel and sand (Holocene)

Qa- Alluvium (Holocene)

Qoa- Older alluvium: terrace deposits (Pleistocene)

QTs- Santa Clara Formation (Pliocene-Pleistocene)

Tn- Non-marine sedimentary rocks: greenish gray to rarely reddish claystone, siltstone and interbedded friable buff-gray sandstone

Symbols

Contact

Fault: dashed where indefinite or inferred, dotted where inferred and concealed. Horizontal displacement designated by parallel arrows

Axis of fold (anticlinal): arrow indicates direction of plunge

from T.W. Dibblee (1973)

Figure 5a - Explanation for Regional Geology Map

Pleistocene and Holocene age lake deposits (Jenkins, 1973) or as a group of shallow, short-lived lakes in a fluvial environment (Hoose, 1986; McMasters and others, 1987). Holocene activity consists mostly of down-cutting by the San Benito River and mass wasting of upland areas by landslides and erosion. The regional geology is depicted on Figure 5.

Faulting, Hollister Area

An important structural element in the Hollister area is the Calaveras fault system. Several branches of the Calaveras fault have been mapped in the Hollister area and are shown on Figure 4. The main branch is referred to as the "West Branch" by Bryant (1979). The West Branch has documented creep activity, producing at least 13 inches of right-lateral slip (Rogers and Nason, 1971). In addition, there was at least 5 mm (1/5-inch) of observed slip along the West Branch as a result of sympathetic movement during the Loma Prieta earthquake (McClellan and Hay, 1989). McClellan and Hay (1989) did not study the East Branch, as they stated that it is inactive.

The East Branch was mapped based on geomorphic evidence at Park Hill at the north end of Hollister and on a hill south of Hollister with a benchmark elevation of 668 feet. The fault was inferred between these localities based on a groundwater offset (Ellis, 1952; Kilburn, 1972) and subtle west-facing scarps (Bryant, 1979). The East Branch is mapped as crossing the Poletti site and is considered active by the CDMG (Bryant, 1979) based on offset bedding in trenches excavated by Leighton and Associates (1974) and Woodward-Clyde and McClure & Messinger (1968).

METHODS OF STUDY

Literature and Map Review

As part of our study, we reviewed reports and maps pertaining to the site and vicinity. Most of the published geologic information on this area is preliminary in nature, and is based on reconnaissance techniques and extrapolation of data.

The regional geology was mapped by Taliaferro (1948). Taliaferro's map shows the Calaveras fault north and south of Hollister, but does not have a symbol depicting a location of the fault within downtown Hollister. An eastern branch of the Calaveras fault was mapped by Ellis (1952) based on an offset blue clay layer noted on well logs. The blue clay is offset across the East Branch of the Calaveras fault by approximately 50 feet with the west side up. The wells were spaced hundreds of feet apart with some wells "a few hundred feet on each side of the fault in a few places" and approximately "30 to 40 feet of offset" of the groundwater table (William C. Ellis, oral communication, May 1991).

Detailed mapping of the Calaveras fault within Hollister was performed by Rogers (1967). Rogers mapped the main (west) branch as a right-lateral strike-slip fault which exhibits active creep. The eastern branch of the Calaveras fault in downtown Hollister was mapped using a symbol that denotes uncertainty of existence and/or location by Rogers and others (1968). They show this to be a high-angle fault with the west side upthrown. The East Branch of the Calaveras fault was trenched by Woodward-Clyde & Associates and McClure & Messinger (1968) at a site approximately 3/4-mile south of the Poletti property. They stated, "Evidence was found, and which could possibly be construed as indicating the presence of a fault trace, consisted of several small clay seams and slickensided planes. These did not extend to the ground surface." Woodward-Clyde (1978) reviewed this 1968 study and concluded that the seams could have been due to other causes such as shrinkage cracks, lurch cracking, or liquefaction. They postulated that

the most likely interpretation was that these features could be considered to be conjugate shears and tension fractures developing in a fault zone.

Rogers and Nason (1971) examined streets and other man-made structures in Hollister for evidence of fault displacement. They concluded that the main branch of the Calaveras fault exhibited active creeping movement. The subsidiary branches of the Calaveras fault in Hollister were considered by Rogers and Nason (1971) to be, "...presently dormant because they do not show consistent evidence of curb or sidewalk offset." and "... local subsidence features were more abundant and extreme along the traces of the inferred dormant faults than elsewhere." Kilburn (1972) indicated a groundwater offset of approximately 20 feet with the east side up across the West and East Branches of the Calaveras fault based on well data.

Jenkins (1973) studied the Quaternary deposits in the Hollister Valley and concluded that a large lake (Lake San Benito) covered much of Hollister during the Pleistocene time period. The Hollister area was remapped by Rogers (1973) and Dibblee (1975). They showed the East Branch of the Calaveras fault, but did not identify the relative sense of fault movement. Leighton and Associates (1974) observed offset units in an exploratory trench along the East Branch of the Calaveras fault on hill 668 (approximately 2 miles south of Hollister). As part of the State fault evaluation program, CDMG (1974) considered the East Branch of the Calaveras fault as sufficiently active and well-defined to be included within an Alquist-Priolo Special Studies Zone. Bryant (1979) remapped the East Branch of the Calaveras fault approximately 200 feet west of the location shown on the 1974 Special Studies Zone map. The latest revision of the Special Studies Zone map (CDMG, 1982) incorporates Bryant's modifications.

Site-specific investigations by Terratech (1974, 1976, 1977) within the East Branch Special Studies Zone reported no evidence of faulting. These studies relied on magnetometer traverses and drilling, and did not use exploratory trenching. Other workers have located the East Branch of the

Calaveras fault in Hollister area. Terratech (1978) trenched the fault on the east side of Park Hill, approximately 1/4-mile north of the site. The fault was described on a trench log as consisting of "slickensided striated surfaces on siltstone, fault plane ? N65°W, dip 59°N". The log further discusses fault-like features as shears (up to 1" wide) on either side of the fault plane oriented N0°E, 87°N". Calcium carbonate (caliche) was described as present along the fault plane.

Bay Soils (1981) described the fault as, "... a subtle change in the bedding of silt was noted in Trench No. 1, near the location of the other anomalous factors. This consisted of an upwarping of the bedding from horizontal to 10° to 15°". Earth Systems Consultants (1985) delineated the fault based on, "A gradual vertical material boundary" with dissimilar horizontal beds on either side of the boundary.

Terratech (1987) stated, "All of the trenches exposed evidence of apparent vertical displacement." Units are vertically offset by "about 1-1/2 to 3 feet" along near-vertical discontinuous clay seams with the east side up. The strike of faults in the trenches varied from N-S to N40°E, with steep dips to the east and west. J.V. Lowney & Associates (1990a, 1990b) interpreted, "... abrupt offset of laterally continuous beds, abrupt monoclinal folding of sediments and convoluted bedding." as evidence of faulting.

Applied Soil Mechanics (1991a) located a fault on a property within East Branch Special Studies Zone approximately 1/4 mile south of the downtown area. The fault is characterized by, "... steeply dipping to near-vertical, NNE to NNW-striking fractures ... infilled with loose, fine-grained sand. ... Thin continuous clay layers and entire stratigraphic units are disrupted and offset in this zone. The maximum vertical offset along the fractures was approximately 21 inches..." Applied Soil Mechanics has recently excavated several trenches across the mapped trace of the East Branch of the Calaveras fault in downtown Hollister. Features similar to the well-defined faulting

in trenches studied by Terratech (1978, 1987) and Applied Soil Mechanics (1991a) were not observed in the downtown area. The locations of these earlier studies are shown on Figure 6.

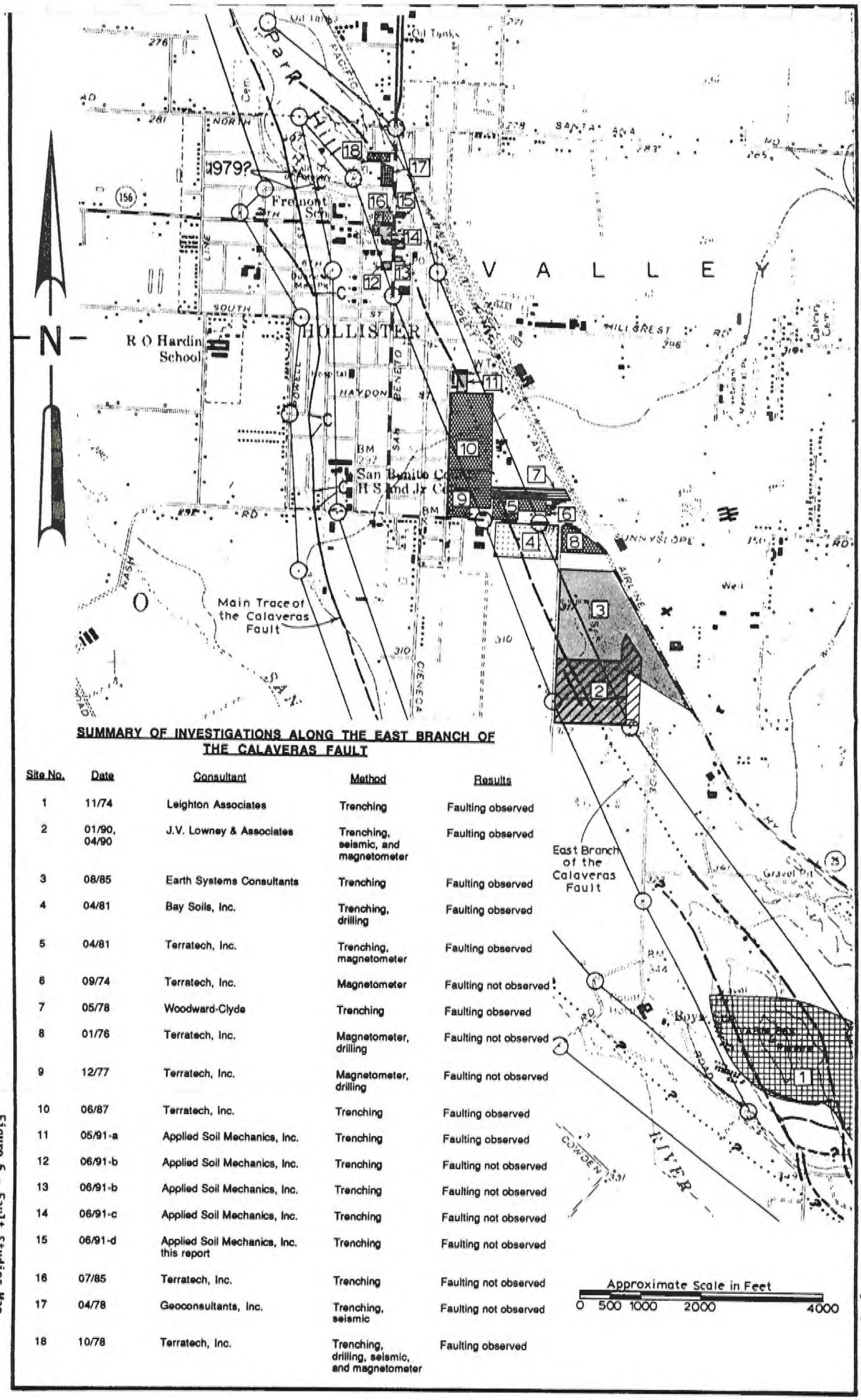
Aerial Photograph Interpretation

We studied aerial photographic stereo pairs taken of the Hollister area from 1967 to 1990. The following aerial photographs of the site and vicinity were used in this study:

Date	Approximate Scale	Type	Source
May 1967	1:20,000	black and white	USDA
May 1980	1:40,000	black and white	USDA
April 1985	1:31,680	black and white	WAC
July 1987	1:33,600	black and white	PAS
June 1989	1:31,680	black and white	WAC
August 1990	1:12,000	black and white	PAS

These photographs were studied for geomorphic evidence that could indicate active faulting. Faults typically appear on aerial photographs as a linear features with tonal differences on either side. These differences could be related to changes in soil and rock type, vegetation, groundwater levels, or bedding characteristics. Lineaments are sometimes associated with topographic features characteristic of fault zones such as linear and shutter ridges, sag ponds, springs, and offset drainages.

Within the downtown area, the aerial photographs were of limited use since development predates historic photography. Outside of town, a distinct northwest-trending lineament was seen on the aerial photographs where there is a narrow band which is lighter in color than the surrounding area in an orchard near Prune and Hawkins Streets . This lineament coincides with the mapped trace of



SUMMARY OF INVESTIGATIONS ALONG THE EAST BRANCH OF THE CALAVERAS FAULT

Site No.	Date	Consultant	Method	Results
1	11/74	Leighton Associates	Trenching	Faulting observed
2	01/90, 04/90	J.V. Lowney & Associates	Trenching, seismic, and magnetometer	Faulting observed
3	08/85	Earth Systems Consultants	Trenching	Faulting observed
4	04/81	Bay Soils, Inc.	Trenching, drilling	Faulting observed
5	04/81	Terratech, Inc.	Trenching, magnetometer	Faulting observed
6	09/74	Terratech, Inc.	Magnetometer	Faulting not observed
7	05/78	Woodward-Clyde	Trenching	Faulting observed
8	01/76	Terratech, Inc.	Magnetometer, drilling	Faulting not observed
9	12/77	Terratech, Inc.	Magnetometer, drilling	Faulting not observed
10	06/87	Terratech, Inc.	Trenching	Faulting observed
11	05/91-a	Applied Soil Mechanics, Inc.	Trenching	Faulting observed
12	06/91-b	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
13	06/91-b	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
14	06/91-c	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
15	06/91-d	Applied Soil Mechanics, Inc. this report	Trenching	Faulting not observed
16	07/85	Terratech, Inc.	Trenching	Faulting not observed
17	04/78	Geoconsultants, Inc.	Trenching, seismic	Faulting not observed
18	10/78	Terratech, Inc.	Trenching, drilling, seismic, and magnetometer	Faulting observed

Figure 6 - Fault Studies Map

the East Branch of the Calaveras fault (Bryant, 1979). The ground slope is not interrupted by the lineament on the air photos. Also, rows of trees in the orchard crossed by the mapped fault are not offset, indicating that fault creep displacement has not occurred since the orchard was planted. At Park Hill at the north end of town, and at hill 668 south of town, geomorphic evidence of faulting is indicated as topographic benches that are modified by erosion.

Subsurface Explorations

As part of this study, approximately 225 lineal feet of exploratory trench was excavated between January 7 and May 7, 1991 using a rubber-tire backhoe with a 24-inch wide bucket. The trenches were located nearly perpendicular to the alignment of the fault trace mapped by the CDMG (1982). The positioning of the trenches was intended to intercept the most likely traces of faults in the area, assuming a regional north to northwest trend.

In addition, one exploratory boring was drilled on April 26, 1991 using a truck-mounted drill rig with 8-inch-diameter hollow stem augers. The locations of the trenches and the boring are shown on Figure 2. The trench and boring logs are included in Appendix A.

The trenches designated as ET-1, ET-2, and ET-3 were located on the empty lot at the southeast corner of Hawkins Alley and San Benito Street. Trench ET-1 measured approximately 22 feet long, trended N90°E, and was excavated to a depth of 15 feet below the ground surface, however, the trench walls caved before they could be logged. Trench ET-2 measured approximately 32 feet long, trended N90°E, and was excavated to a maximum depth of 15 feet. Trench ET-3 measured approximately 67 feet long, trended N90°E, and was excavated to a depth of 12-1/2 feet.

Trench ET-4 was located in San Benito Street north of Fourth Street. Trench ET-4 measured approximately 50 feet long, trended N90°E, and was excavated to a depth of 20 feet. Boring B-1

was located in San Benito Street at the same location as Trench ET-4. Boring B-1 was drilled to a depth of approximately 20 feet below the ground surface.

After excavating, the trenches were shored and the trench walls cleaned. A system of nails and colored flagging was used to mark the various strata. After the trench walls were cleaned and flagged, they were logged at a scale of one inch equals five feet. Critical areas were logged at a more detailed scale. The floor and opposite trench wall were also cleaned and examined in these areas. The trenches were logged by project geologist, Lewis Rosenberg. The trenches were observed by the supervising geologist, Richard Gorman, and the City Geologist, John Kingsley. The logs of the trenches are shown in Appendix A.

After the trench logging operation was completed, the trenches were backfilled with 2-sack grout to within 5 feet of the ground surface. After the grout had set-up, imported sand was placed and compacted over the grout material up to the top of the trench. The sand was compacted using a small compactor. In paved areas, asphaltic concrete was used to match the thickness of the existing pavement section.

An exploratory boring was drilled to evaluate the subsurface conditions at the proposed trench location across San Benito Street. Materials encountered during the drilling indicated that nonsaturated soils having adequate consistencies for trenching were present at the proposed trench location. The drill hole was logged by staff geologist Brian Papurello After the drilling operation was completed, the hole was backfilled with native material. The boring log is included in Appendix A.

Summary of Trench Observations

The upper 1 to 2 feet of the trenches consist of fill. In Trenches ET-1, ET-2, and ET-3, the fill consists of a medium to coarse-grained sand with gravel and debris. In Trenches ET-4 and ET-5,

the fill consists of pavement underlain by road base material. A trash pit was encountered between stations 59 to 65 in ET-1, see Figure 2. Below the fill and road base is a 7 to 8 foot-thick silty clay unit which is interpreted as a shallow lacustrine (lakebed) deposit. This unit had blocky ped structures, and was bioturbated (disturbed by plant roots and animals). Utility trench backfill was present in Trenches ET-4 and ET-5. The trench backfill consisted of compacted sands and/or clays. In Trench ET-5, a 12-foot deep sewer line prevented excavating the westernmost 10 feet of the trench to the same depth as the rest of the trench.

Stratigraphic units exposed in the trenches are nearly flat-laying and are laterally continuous over the length of the trenches. Within these units, several types of sedimentary structures (such as cross-bedding and channels, etc.) were observed. The uppermost fluvial deposit exhibited undisturbed trough cross-bedding. Medium to coarse-grained sand lenses were encountered in the silt and sand units. These lenses represent infilling of small channels.

Clayey silt beds approximately 1 to 2 inches in thickness were noted adjacent to the coarse sand lenses. These beds are traceable with minimal variation in thickness throughout the length of the trench, and are probably a result of waning floodwaters that deposited the coarse sand lenses. Locally, these beds undulate within the sand unit. Since the thickness of the sand unit does not vary appreciably, the undulation is probably due to either deposition into a shallow channel or "soft" (geological sense) sediment deformation.

Between stations 15 to 16 in ET-5 is a near-vertical clay seam within the fluvial unit which is approximately 1 to 2 inches wide. Thin continuous clay layers below the seam are not disrupted or offset. The clay seam protrudes upward from the uppermost clay layer in the fluvial sequence and is truncated by the overlying lacustrine unit. The near-vertical orientation of the seam and the similar composition to the underlying clay bed implies that the vertical seam is due to infilling of cracks.

The clay seam could also be explained by deformation of the fluvial materials under saturated conditions. Flame structures and load casts are features which result from loading of water-saturated mud layers by overlying sand layers (Boggs, 1987, p. 163–175). Since the near-vertical clay seam exhibits similar features to flame structures and load casts, soft sediment deformation is a plausible alternate explanation.

An alternative explanation is that the clay seam is related to tectonic stresses associated with the main trace of the Calaveras fault. Tchalenko (1970) observed similar features in clay deformed in a shear box model. The orientation of these shear features are nearly perpendicular to the direction of motion along the fault (Fig. 5, Tchalenko, 1970). The clay seam in ET-5 was oriented approximately north-south, which is close to the direction of movement along the main trace of the Calaveras fault zone. Therefore, the Tchalenko model does not explain the clay seam as the orientation of the seam does not follow the orientation predicted by the model.

Similar features have been related to prehistoric near-surface ground subsidence in the San Joaquin Valley, California (Fig. 37, Bull, 1972). These clay seams possibly are the result of infilling of subsidence cracks. Evidence of prehistoric tectonic subsidence is supported by detailed stratigraphic studies combined with radiocarbon dating and fossil pollen correlation techniques (McMasters and others, 1987).

The clay seam could also be explained by deformation of the fluvial materials under saturated conditions. Flame structures and load casts are features which result from loading of water-saturated mud layers by overlying sand layers (Boggs, 1987, p. 163–175). Deformation features such as flame structures and load casts would be expected in the depositional environment which existed in the Hollister area during the late Pleistocene-early Holocene. The presence of lake

deposits over poorly consolidated fluvial sands, silts, and clays coupled with forces generated by large earthquakes on nearby faults would provide a mechanism for this soft sediment deformation.

The likelihood of active faulting is not supported by the trench data. Features exposed in the trenches indicate a fluvial and lacustrine environment which experienced soft sediment deformation and regional subsidence.

FINDINGS

Site Geology and Geomorphology

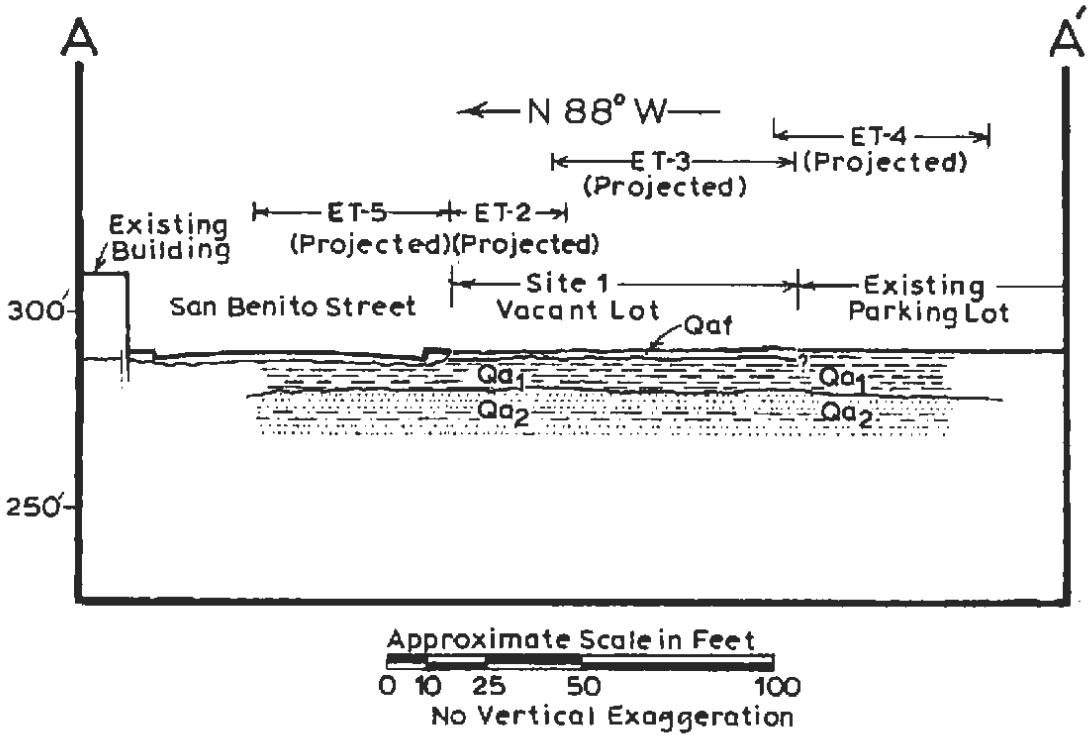
Downtown Hollister is underlain by by a series of Pleistocene and Holocene age lake and stream deposits. The topography is nearly flat. At Sixth Street near Dunne Park there are low ___ in the topography that have been related to active faulting on the main branch of the Calaveras fault by Rogers and Nason (1971). Similar features are also present on Hawkins, Hazel, and South Streets east of Sally Street,. Structures situated along these features do not show the prominent creep-related movement present on the main branch of the fault. The geologic conditions are depicted on the Site Plan and Geology Map, Figure 2. A schematic cross-section through the site is included as Figure 7.

Stratigraphy

There were six stratigraphic units that could be correlated between trenches. The uppermost unit extending from the ground surface (excluding pavement and fill) to a depth of approximately 10 to 11 feet. It consists of a dark olive to dark grayish-brown silty clay. This unit exhibits a blocky ped structure and is bioturbated. This unit is interpreted as a shallow lacustrine (lakebed) deposit. A bulk sample from this unit at approximately 12 feet depth was dated using ^{14}C radiometric analysis at 3,720 ± 90 years before present (YPB) (Applied Soil Mechanics, 1991c). This is a mean residence time date (MRT), indicating a minimum age for the sample.

Below the lakebed deposits are a series of deposits which consist of grayish-brown to olive brown silty sands, sandy silts, and clayey sands. These units are easily traced and vary from 1 to 2 feet in thickness. Faint to distinct trough cross-bedding was visible in the sandy beds. Bedding was indistinct in the silty beds. Other sedimentary structures visible included discontinuous coarse sand lenses, thin (1/4 to 2-inch) continuous clay layers and clay rip-up clasts, suggesting a fluvial

Schematic Cross-Section A-A'



EXPLANATION

Qaf. Artificial Fill: clay to coarse sand (unit 1 from exploratory trench 2, and units 1 & 2 from exploratory trenches 3, 4 & 5)

Qa1. Lacustrine deposits: silty clay (unit 2 from exploratory trench 2 and unit 3 from exploratory trenchs 3, 4 & 5)

Qa2. Fluvial deposits: clayey silt to coarse sand (units 3-5 from exploratory trench 2, units 4 & 5 from exploratory trenches 4 & 5, and units 4-7 from exploratory trench 5)

Figure 7 - Schematic Cross Section

depositional environment. These beds and clay layers were used for stratigraphic correlation and were flagged in the trenches. A bulk sample from a thin organic-rich clay bed from a nearby site at a depth of approximately 17 feet had a mean residence time date of 18,110 ± 190 YPB (Applied Soil Mechanics, 1991b). Assuming relatively continuous deposition, the fluvial sequences encountered in the trenches are probably latest Pleistocene to early Holocene in age.

Groundwater

Damp to very moist conditions were encountered in the drilling and trenching operations; however, free groundwater was not encountered. At the time of this study, central California was experiencing the fifth consecutive year of drought conditions. It is possible that during years of normal or above normal precipitation, that saturated conditions or perched water tables could develop.

SEISMICITY

In assessing the seismic hazards for a given area, it is useful to examine historic records of local earthquake intensities. This information is useful for predicting the recurrence of severe shaking in an area. Within the historic time, significant earthquakes have severely damaged man-made structures over a large part of San Benito County. These include, but are not limited to, the 1906 M 8.3 San Francisco (Lawson, 1908), 1984 M 6.2 Morgan Hill (Stover, 1984), and the 1989 M 7.1 Loma Prieta events.

Although central California is crossed by numerous faults, several regionally active fault systems are most likely to generate earthquakes that could cause damage to the site. These include the active San Andreas, Hayward, Calaveras, and San Gregorio fault systems (Hart, 1988), and the potentially active Sargent-Berrocal fault (Bryant, 1980). Recent statistical studies theorize that a major earthquake on the Calaveras fault (Oppenheimer and others, 1990) or on the San Francisco Peninsula segment of the San Andreas fault (Working Group on California Earthquake Probabilities, 1990) will occur. When this major earthquake will occur is not specified by these groups. An earthquake on one of these faults will result in strong ground shaking at this site.

Recently active fault zones have been mapped by the State as part of the Alquist-Priolo Act of 1972. Under the act (Hart, 1988), recently active faults are defined as displaying sufficient and well-defined evidence of movement within the Holocene Epoch (about the last 11,000 years). No structures for human occupancy are permitted on the trace of an active fault. Unless proven otherwise, the area within 50 feet of an active fault is presumed to be underlain by an active fault. The Alquist-Priolo definition of potentially active is a fault showing evidence of displacement older than 11,000 years and younger than 2,000,000 years (Pleistocene Epoch). "Inactive" faults are classified as not having been active for at least two million years.

Evaluation of maximum earthquakes is a topic with considerable variation. The criteria used within this report include maximum credible and probable earthquakes. The maximum credible earthquake is defined by the California Division of Mines and Geology (1975) as,

> "the maximum earthquake that appears capable of occurring under the presently known tectonic framework. It is a rational and believable event that is in accord with all known geologic and seismic facts. In determining the maximum credible earthquake, little regard is given to its probability of occurrence, except that its likelihood of occurring is great enough to be of concern."

The maximum probable earthquake is, "The maximum earthquake that is likely to occur during a 100-year interval. It is to be regarded as a probable occurrence, not as an assured event that will occur at a specific time" (CDMG, 1975).

Table A lists known regionally active faults and their estimated seismic parameters. These estimates were generated using the EQFAULT computer program (Blake, 1989) using statistical analyses of seismic events reported by Idriss (1987).

TABLE A
ESTIMATED SEISMIC PARAMETERS FOR ACTIVE AND POTENTIALLY ACTIVE FAULTS IN THE HOLLISTER REGION

	San Andreas (Northern segment)[1]	Calaveras	Hayward	San Gregorio-Palo Colorado	Sargent-Berrocal[2]
Distance and direction from site (miles)	16 SW	0.5 W	25 NW	40 SW	8 NW
Maximum credible earthquake[3, 4]	8.0	7.0	7.0	7.75	7.0
Maximum probable earthquake[3, 4]	7.5	6.5	6.75	6.75	5.75
Maximum credible peak ground acceleration[3, 5]	0.25 g	0.51 g	0.13 g	0.12 g	0.27 g
Maximum probable peak ground acceleration[3, 5]	0.21 g	0.47 g	0.10 g	0.06 g	0.15 g

1 Defined as extending from San Juan Bautista north to Shelter Cove (Blake, 1989)
2 Potentially active
3 Assumes that the earthquake will occur at a prescribed depth and at the nearest point to the site.
4 Richter earthquake magnitude
5 From: Idriss (1987)

Primary Earthquake Effects

Fault-Related Ground Rupture – Ground rupture along fault traces can occur during large earthquakes, and zones of high ground rupture potential are delineated by governmental agencies. The site is within the State Alquist-Priolo Special Studies Zone and the City Seismic Zone for the East Branch of the Calaveras fault (CDMG, 1982; Barrett, 1976).

The data gathered and analyzed (including the trench data and the MRT dates) indicate that there is no evidence for an active fault trace to cross the building site studied. Therefore, the potential for ground rupture resulting from fault movement at the building site is considered to be low.

Secondary Earthquake Effects

Ground Shaking – Hollister experienced severe shaking during the 1989 earthquake, according to local accounts (McCann, 1990). Ground shaking from a seismic event is the primary seismic hazard that will have the greatest impact on the proposed development within its design life span. Ground shaking can trigger other secondary seismic hazards that are discussed in following sections.

Strong ground shaking is documented for the following earthquakes: 1906 M 8.3 San Francisco (Lawson, 1908), 1983 M 6.7 Coalinga (Stover, 1983), and the 1984 M 6.2 Morgan Hill (Stover, 1984) and can reasonably be expected in the future. The estimated shaking intensity in the Hollister area during the 1989 Loma Prieta event was VII on the Modified Mercalli scale (Plafker and Galloway, 1989). Wood and Neumann (1931) define Modified Mercalli VII intensity as, "*Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.*"

The Loma Prieta earthquake provided data on ground response in the Hollister area. Three strong-motion seismograph station are located in the Hollister area. These stations record peak ground accelerations (PGA), and the data is summarized below in Table B.

TABLE B
PEAK GROUND ACCELERATIONS RECORDED DURING THE OCTOBER 17, 1989 EARTHQUAKE IN THE HOLLISTER REGION

	Hollister City Hall	South and Pine Streets	Hollister Airport
Approximate distance and direction from site (feet)	600 SW	2,000 SE	10,500 N
Peak horizontal ground acceleration	0.25g	0.38g	0.29g
Peak vertical ground acceleration	0.22g	0.20g	0.16g
Site geology	Alluvium	Alluvium	Alluvium
Source of data	1	2	1

[1] Maley and others (1989)
[2] Shakal and others (1989)

The PGA is one of the factors involved in designing a structure to resist seismic forces. Using the method of Idriss (1987) with the EQFAULT program (Blake, 1989), a maximum probable earthquake of M 6.5 occurring on the nearest point of the Calaveras fault could produce a PGA of 0.47 g at the site. The PGA generated by EQFAULT is an approximate value and does not take into account other factors such as depth to bedrock, ground saturation, and topographic amplification. For wood-frame structures, the PGA tends to be conservative, and the repeatable high ground acceleration (RHGA) is appropriate (Ploessel and Slosson, 1974). For a maximum probable earthquake of M 6.5 occurring on the Calaveras fault, the RHGA is 0.31 g.

Liquefaction – Soil liquefaction is the loss of soil strength during a significant seismic event. It occurs primarily in saturated loose- to medium-dense, fine to medium-grained sands and sandy silts. Liquefaction results in rearrangement of the soil particles into a denser condition, resulting in localized areas of ground failure. Common types of liquefaction-related ground failure include differential settlement and lateral spreading. Secondary ground cracks frequently occur as a result of liquefaction-related ground failure and should not be confused with ground deformation resulting from fault rupture.

No signs of liquefaction such as sand boils were observed in trenches of in the immediate vicinity of the site after the Loma Prieta earthquake (Plafker and Galloway, 1989; McCann, 1990). The native site soils are relatively fine-grained and may be susceptible to liquefaction, if saturated. Groundwater was not encountered in the exploratory trenches or drill hole, and the soils were damp to very moist. If the groundwater table were to rise, or if perched groundwater conditions develop, or if the near-surface granular material becomes saturated, then the risk of liquefaction is moderate. From a geologic viewpoint, the risk of liquefaction in the present environment is considered to be low. A geotechnical study is needed to definitively assess the risk of liquefaction.

Lurching cracks are a variety of ground cracking that could be related to earthquakes. There was no evidence seen in the trenches that lurch cracking occurred at this site as a consequence of an earthquake. Therefore, the potential for lurch cracking to occur at this site is considered to be minimal.

CONCLUSIONS

The conclusions are based on the data gathered and analyzed for this study.

1. Based on trench observations, we conclude that an active fault does not cross the Poletti property nor is there a fault trace within 50 feet of the project.

2. In the trenches excavated as part of this study, nearly flat-lying sediments maintain an almost constant thickness in the trenches. Laterally continuous stratigraphic units could be correlated in the trenches and from trench to trench. No evidence of offset was apparent along these marker units.

3. A near-vertical clay-filled seam crossed laterally continuous clay and sand beds in Trench ET-5. There are several possible explanations for this feature. One explanation is that the seam is a small shear that could be related to lurching. However, thin continuous clay layers are not disrupted or offset by or at the seam.

4. The site could be developed from a geologic point of view.

RECOMMENDATIONS

The subject site is suitable from an engineering geologic viewpoint for the planned building reconstruction, provided that the recommendations in this report are followed.

1. A soil engineering study should be performed for the proposed new structure. The study should address liquefaction potential and associated effects such as differential settlement. The study should also address the possibility of buried features such as old foundations, basements, tanks, and trash pits.

2. The proposed structure should be designed to withstand strong ground shaking. The project structural engineer should determine the appropriate method used for seismic design of the new buildings. If the structural engineer elects to use the design criteria of the Uniform Building Code (1988 edition), we suggest that a seismic zone factor of 0.40 and a site coefficient of 1.0 (Tables 23-I and 23-J, respectively) be used. The selection of the appropriate seismic zone factor and site coefficient are the purview of the structural engineer.

3. The trenches for this study have been backfilled using lean grout. Their position and condition should be taken into consideration in the design of the improvements planned for this study area.

REFERENCES CITED

Allen, J.E., 1946, Geology of the San Juan Bautista quadrangle, California: California Division of Mines Bulletin 133, 75 p., 3 plates, scale 1:62,500.

Applied Soil Mechanics, Inc., 1991a, Geologic evaluation, proposed three-lot subdivision, 49, 53, and 57 Hawkins Street, Hollister, California: unpublished report prepared for Dean Rodrigues. File No. A0-2303-S1.

_____, 1991b, Fault study, Bruhn and Peterson properties, 515, 525, and 530 San Benito Street, San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2281-S1.

_____, 1991c, Fault study, Building Sites 1, 3, 4, 5, 6, and 10: Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2280-S1.

_____, 1991d, Fault study, Poletti property, 335 San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2279-S1.

Barrett, Nestor, 1976, Seismic Safety Element of the General Plan: City of Hollister Planning Department open-file report, 37 p.

Bay Soils, Inc., 1981, Soil and geologic investigation, Hollister shopping center, SWC Nash Road and Southside Road, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-1337, 20 p., 3 appendices.

Blake, T.F., 1989, EQFAULT, a computer program for the deterministic prediction of peak ground acceleration from digitized California faults.

Boggs, Sam, Jr., 1987, Principles of sedimentology and stratigraphy: Merrill Publishing Company, Columbus, Ohio, 784 p.

Bryant, W.A., 1979, Fault evaluation report, Calaveras (Hollister segment) and "Buena Vista Road" faults: California Division of Mines and Geology Fault Evaluation Report FER-94, 14 p., 4 plates, scale 1:24,000.

_____, 1980, Fault evaluation report, SE segments of Sargent and Castro faults: California Division of Mines and Geology Fault Evaluation Report FER-96, 21 p., 11 plates, scale 1:24,000.

Bull, W.B., 1972, Prehistoric near-surface subsidence cracks in western Fresno County, California: U.S Geological Survey Professional Paper 437-C, 85 p.

California Division of Mines and Geology, 1974, Special studies zones map, Hollister 7.5 minute quadrangle: California Department of Conservation, 1 sheet, scale 1:24,000.

_____, 1975, Recommended guidelines for determining the maximum credible and the maximum probable earthquakes: California Division of Mines and Geology Note 43, 1 p.

_____, 1982, Special studies zones map, Hollister 7.5 minute quadrangle: California Department of Conservation, 1 sheet, scale 1:24,000.

Compton, R.R., 1966, Granitic and metamorphic rocks of the Salinian block, California Coast Ranges *in* Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 277–287.

Dibblee, T.W., Jr., 1975, Geologic map of the Hollister quadrangle: U.S. Geological Survey Open-File Report 75-394, 1 map, scale 1:62,500.

Earth Systems Consultants, 1985, Seismic hazard evaluation, Kelly Ranch, Parcel 2, Southside Road, Hollister, California: unpublished report prepared for San Benito Engineering and Surveying, Inc., 22 p.

Ellis, W.C., 1952, Elevations on top of the blue clay zone, Hollister area: U.S. Bureau of Reclamation unpublished map.

Geoconsultants, Inc., 1978, Geologic hazard investigation for proposed commercial development, Park Hill and San Benito Streets, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-742, 12 p.

Hart, E.W., 1988, Fault-rupture hazard zones in California: California Division of Mines and Geology Special Publication 42, 24 p.

Hoose, S.N., 1986, Was there a great Pleistocene Lake San Benito? (M.S. thesis): San Jose State University, 87 p.

Idriss, I.M., 1987, Lecture notes, presentation at the EERI course on strong ground motion, April 10-11, 1987, Pasadena, California, *in* Singh, J.P., Course Organizer, Strong ground motion, seismic analysis, design and code issues: Earthquake Engineering Research Institute, 14 p.

International Conference of Building Officials, 1988, Uniform Building Code: Whittier, California, 926 p.

Jenkins, O.P., 1973, Pleistocene Lake San Benito: California Geology, v. 26, no. 7, p. 151–163.

Kilburn, Chabot, 1972, Ground-water hydrology of the Hollister and San Juan Valleys, San Benito County, California: U.S. Geological Survey Open-File Report 73-144, 5 maps, various scales.

Lawson, A.C., chairman, 1908, The California earthquake of April 18, 1906: Report of the California State Earthquake Investigation Commission: Washington D.C., Carnegie Institution of Washington, Publication 87, v. 1, 2 parts, 451 p.

Leighton and Associates, 1974, Fault hazard study of eastern and western portions of Ridgemark Estates development, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-56, 11 p., 1 appendix.

Lowney, J.V., & Associates, 1990a, Fault location investigation for Kelly Ranch residential development, Southside Road, Hollister, California: City of Hollister Open-File report, 20 p., 2 appendices.

_____, 1990b, Supplemental fault location investigation for Kelly Ranch residential development, Southside Road, Hollister, California: City of Hollister Open-File report, 13 p., 2 appendices.

Maley, R., Acosta, A., Ellis, F., Etheredge, E., Foote, L., Johnson, D., Porcella, R., Salsman, M., and Switzer, J., 1989, U.S. Geologic Survey strong-motion records from the northern California (Loma Prieta) earthquake of October 17, 1989: U.S Geological Survey Open-File Report 89-568, 84 p.

McCann, J.Z., 1990, Aftershock: the Loma Prieta earthquake and its impact on San Benito County: Hollister, California, Seismic Publications, 80 p.

McClellan, P.H., and Hay, E.A., Geologic evidence for triggered slip on the Calaveras fault during the magnitude 7.1 Loma Prieta earthquake of October 17, 1989: U.S Geological Survey Open-File Report 89-641, 37 p.

McMasters, C.R., Herd, D.G., Throckmorton, C.K., and Heusser, L.E., 1987, Subsurface stratigraphy of the eastern Hollister Valley, California: U.S Geological Survey Miscellaneous Field Studies Map MF-1461, 3 sheets, various scales.

Oppenheimer, D.H., Bakun, W.H., and Lindh, A.G., 1990, Slip partitioning of the Calaveras fault, California, and prospects for future earthquakes: Journal of Geophysical Research, v. 95, no. B6, p. 8483–8498.

Page, B.M., 1966, Geology of the Coast Ranges of California *in* Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 255–276.

Plafker, George, and Galloway, J.P., eds., 1989, Lessons learned from the Loma Prieta, California earthquake of October 17, 1989: U.S. Geological Survey Circular 1045, 42 p.

Ploessel M.R., and Slosson, J.E., 1974, Repeatable high ground accelerations from earthquakes: California Geology, v. 27, no.9, p. 195–199.

Rogers, T.H, 1967, Active extensional faulting north of Hollister near the Calaveras fault zone: Bulletin of the Seismological Society of America, v. 57, no. 4, p. 813–816.

_____, 1973, Preliminary geologic map, NE 1/4 Hollister quadrangle: California Division of Mines and Geology unpublished open-file report, 1 sheet, scale 1:12,000

Rogers, T.H., and Nason, R.D., 1971, Active displacement on the Calaveras fault zone at Hollister, California: Bulletin of the Seismological Society of America, v. 61, no. 2, p. 399–416.

Rogers, T.H., Nason, R.D., and Cooper, A.K., 1968, Preliminary map showing traces of the Calaveras fault zone in the City of Hollister, California: California Division of Mines and Geology Open-File Report 68-3, 1 sheet, scale 1 in. = 500 ft.

Shakal, A., Huang, M., Reichle, M., Ventura, C., Cao, R., Sherburne, R., Savage, M., Darragh, R., and Petersen C., 1989, CSMIP strong motion records from the Santa Cruz Mountains (Loma Prieta), California: California Division of Mines and Geology, Office of Strong Motion Studies Report No. OSMS 89-06, 196 p.

Stover, C.W., 1983, Intensity distribution and isoseismal map *in* Bennett, J.H., and Sherburne, R.W., eds., The 1983 Coalinga, California earthquake: California Division of Mines and Geology Special Publication 66, p. 1–4.

_____, 1984, Intensity distribution and isoseismal map for the Morgan Hill, California, earthquake of April 24, 1984 *in* Bennett, J.H., and Sherburne, R.W., eds., The 1984 Morgan Hill, California earthquake: California Division of Mines and Geology Special Publication 68, p. 1–4.

Taliaferro, N.L., 1948, Geologic map of the Hollister quadrangle: California Division of Mines Bulletin 143, 1 sheet, scale 1:62,500.

Terratech, Inc., 1974, Geologic evaluation, proposed commercial building, Alpha Beta shopping center, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-107, 4 p.

_____, 1976, Geotechnical investigation, K & S Market, Southside Road and Nash Road, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-329, 11 p.

_____, 1977, Geotechnical investigation, Royal Court Estates, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-642, 9 p.

_____, 1978, Geologic/geotechnical investigation, First Street commercial property, Hollister, California: City of Hollister Open-File report, 9 p., 2 appendices.

_____, 1981, Geologic investigation, proposed Nob Hill shopping complex, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-1336, 5 p.

_____, 1985, Fault investigation, J.C. Penny building, Hollister, California: City of Hollister Open-File report, 10 p.

_____, 1987, Investigation of the east branch of the Calaveras fault, Prune Street school site (Rancho San Justo Tandem school site), Hollister, California: City of Hollister Open-File report, 5 p.

U.S. Bureau of Reclamation, 1989, Engineering geology field manual: U.S. Department of the Interior, 599 p.

Wood, H.O., and Neumann, Frank, 1931, Modified Mercalli intensity scale of 1931: Bulletin of the Seismological Society of America, v. 21, no. 4, p. 277–283.

Woodward-Clyde Consultants, 1978, Geologic evaluation, Prospect Avenue property, Hollister, California: City of Hollister Open-File report, 5 p.

Woodward-Clyde & Associates and McClure & Messinger, 1968, Earthquake fault and earthquake engineering studies, proposed upper school site, Hollister, California: unpublished report submitted to Hollister School District, Hollister, California.

Working Group on California Earthquake Probabilities, 1990, Probabilities of large earthquakes in the San Francisco Bay region, California: U.S. Geological Survey Circular 1053, 51 p.

AERIAL PHOTOGRAPH REFERENCES

Pacific Aerial Surveys, July 3, 1987, V-SBN-C1-11 to 12, black and white, vertical, approximate scale 1:33,600.

_____, August 29, 1990, SBN-3845 47-54 to 55, black and white, vertical, approximate scale 1:12,000.

U.S. Department of Agriculture, May 15, 1967, BUX–1HH–91 to 93, black and white, vertical, approximate scale 1:20,000.

_____, May 7, 1980, 379–75 to 78, black and white, vertical, approximate scale 1:40,000.

WAC Corporation, April 2, 1985, WAC–85CA 7–45 to 48, black and white, vertical, approximate scale 1:31,680.

_____, June 14, 1989, WAC–90CA, 32–139 to 142, black and white, vertical, approximate scale 1:31,680.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report are based upon the assumption that the subsurface conditions do not deviate substantially from those disclosed in the trenches and borings. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that planned at the present time, Applied Soil Mechanics, Inc. should be notified so that supplemental recommendations can be given.

2. This report is issued with the understanding that it is the responsibility of the owner or of his representative to ensure that the information and recommendations presented herein are called to the attention of the project architect and engineers for the project and incorporated into the project plans and specifications, and that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the present date. Changes in the conditions of a property can occur with the passage of time, however, whether they be due to natural processes or the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or partially, by changes outside of our control. Therefore, this report should not be relied upon after a period of three (3) years without being reviewed by an engineering geologist.

4. This report was prepared upon your request for our services, and in accordance with currently accepted standards of professional engineering geology practice. No warranty as to the contents of this report is intended, and none shall be inferred from the statements or opinions expressed.

5. The scope of our services did not include any environmental assessment or study for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater or air, on or below or around this site. Any statements in this report regarding odors noted or unusual or suspicious items or conditions observed are strictly for the information of our client.

APPENDIX A

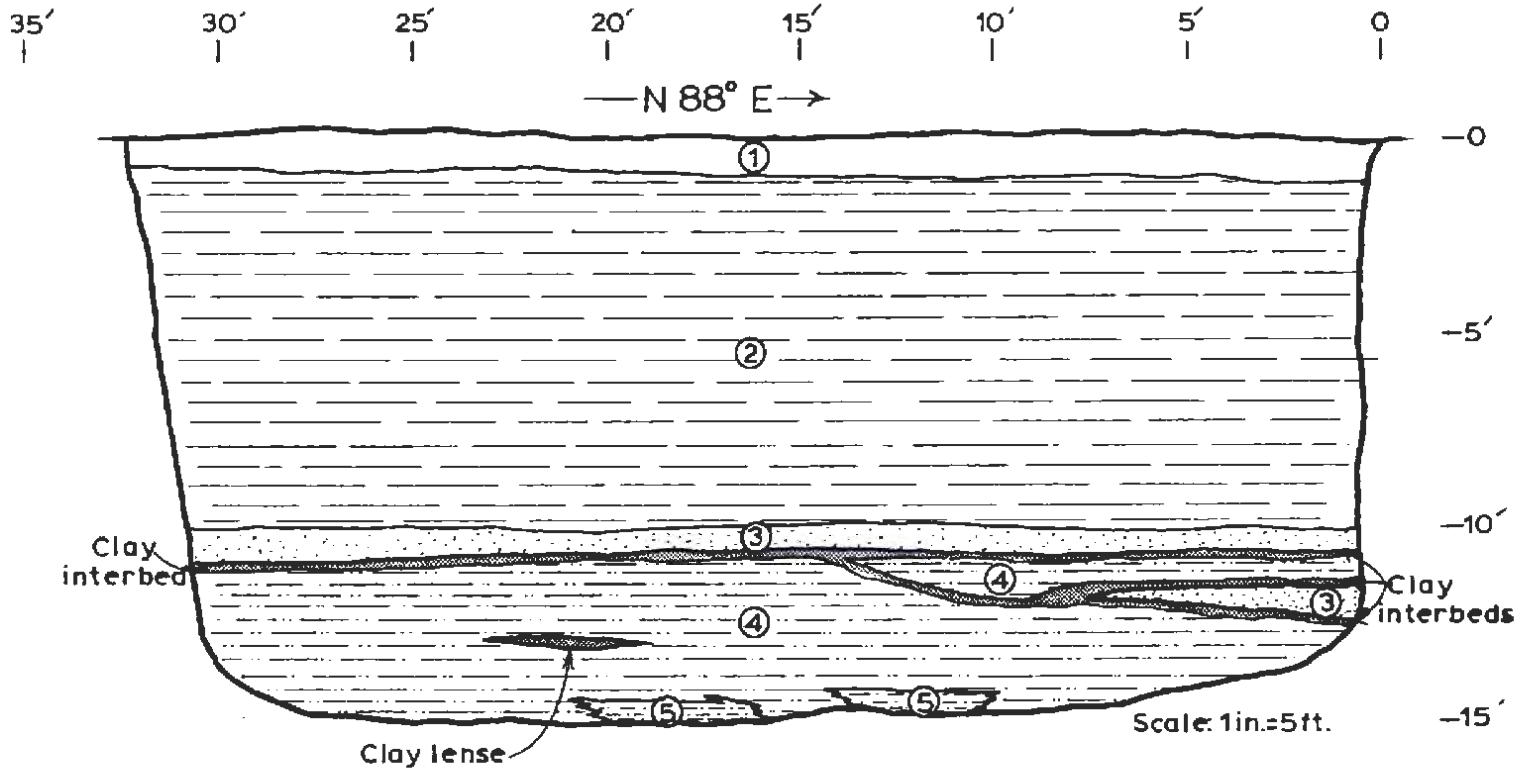
Exploratory Trench Logs

Exploratory Boring Log

Exploratory Trench No. 1

Trench not logged due to caving

Exploratory Trench No. 2



EXPLANATION OF UNITS

Fill:

Unit 1: Light yellowish-brown medium to coarse-grained sand with minor clay binder, gravel, and plaster; damp, loose.

Lacustrine deposits:

Unit 2: Dark olive brown (2.5Y 3/3) to grayish-brown (2.5Y 5/2) silty clay, with thin discontinuous dark brown and light gray streaks; damp to moist, stiff, bioturbated, blocky ped structure. Sharp upper and lower contacts with scattered charcoal fragments along lower contact.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Fluvial deposits:

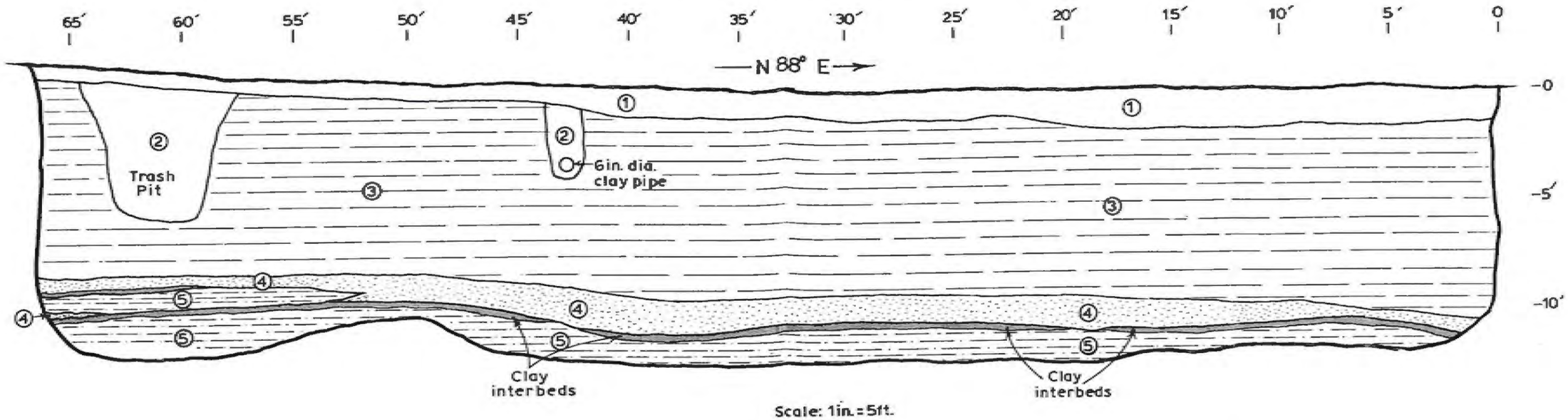
Unit 3: Light olive-brown (2.5Y 5/3) to light brown-gray (2.5Y 6/2) medium-grained silty sand; damp, medium dense, thin subparallel laminations and faint cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay.

Unit 4: Dark grayish-brown (2.5Y 5/2) to olive brown (2.5Y 4/3) sandy silt to silty fine sand, with strong brown (7.5YR 5/6) mottles; moist, medium dense, massive, sharp upper and lower contacts.

Unit 5: Olive-brown (2.5Y 4/3) very fine sandy silt with dark gray (N3) mottles and scattered black flecks; moist, very stiff.

Figure A1 - Log of Test Trench 2

Exploratory Trench No. 3



EXPLANATION OF UNITS

Fill:

Unit 1: Light yellowish-brown medium to coarse-grained sand with minor clay binder, gravel, and plaster; damp, loose.

Unit 2: Mixture of sand and clay placed as utility trench backfill. Includes backfill placed above old garbage pit.

Lacustrine deposits:

Unit 3: Dark olive brown (2.5Y 3/3) to grayish-brown (2.5Y 5/2) silty clay, with thin discontinuous dark brown and light gray streaks; damp to moist, stiff, bioturbated, blocky ped structure. Sharp upper and lower contacts with scattered charcoal fragments along lower contact.

Fluvial deposits:

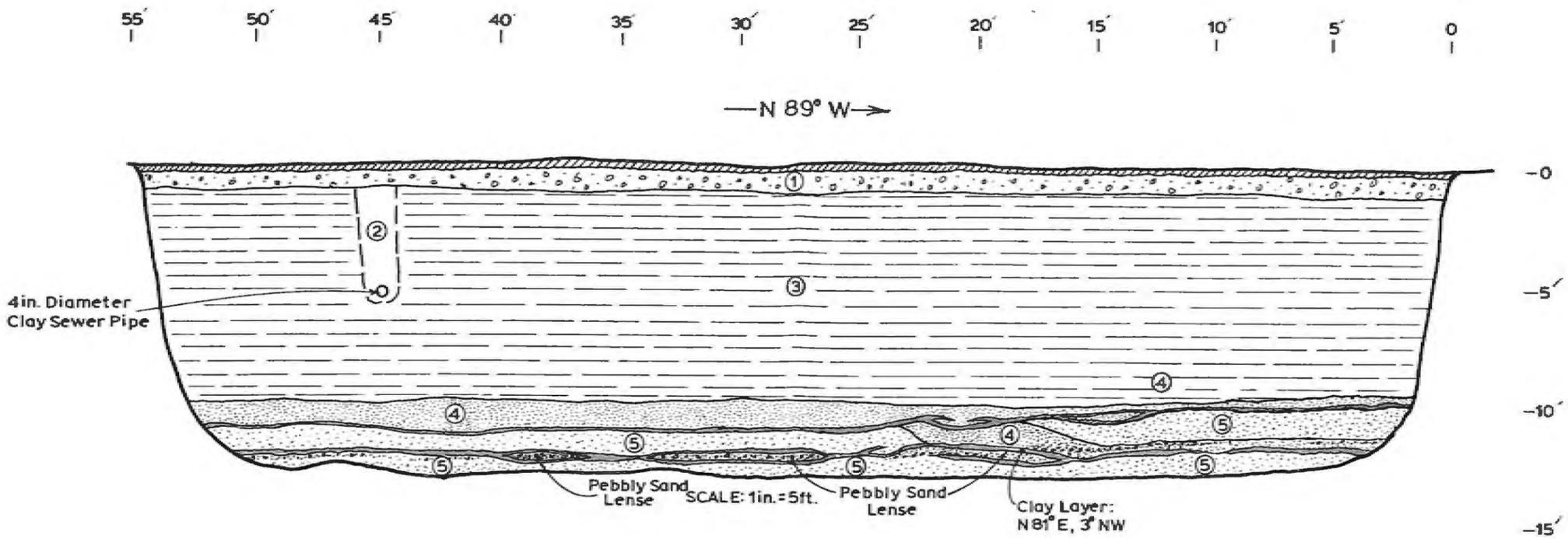
Unit 4: Light olive-brown (2.5Y 5/3) to light brown-gray (2.5Y 6/2) medium-grained silty sand, damp, medium dense, thin subparallel laminations and faint cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay.

Unit 5: Dark grayish-brown (2.5Y 5/2) to olive brown (2.5Y 4/3) sandy silt to silty fine sand, with strong brown (7.5YR 5/6) mottles; moist, medium dense, massive, sharp upper and lower contacts.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A2 - Log of Test Trench 3

Exploratory Trench No. 4



EXPLANATION OF UNITS

Fill:

Unit 1: 4 inches of asphaltic concrete over 8 inches aggregate base material.

Unit 2: Mixture of sand and clay placed as utility trench backfill.

Lacustrine deposits:

Unit 3: Dark grayish-brown (2.5Y 4/4) silty clay, with thin discontinuous dark brown and light gray streaks; very moist, stiff, bioturbated, blocky ped structure. Sharp upper and lower contacts with scattered charcoal fragments along lower contact.

Fluvial deposits:

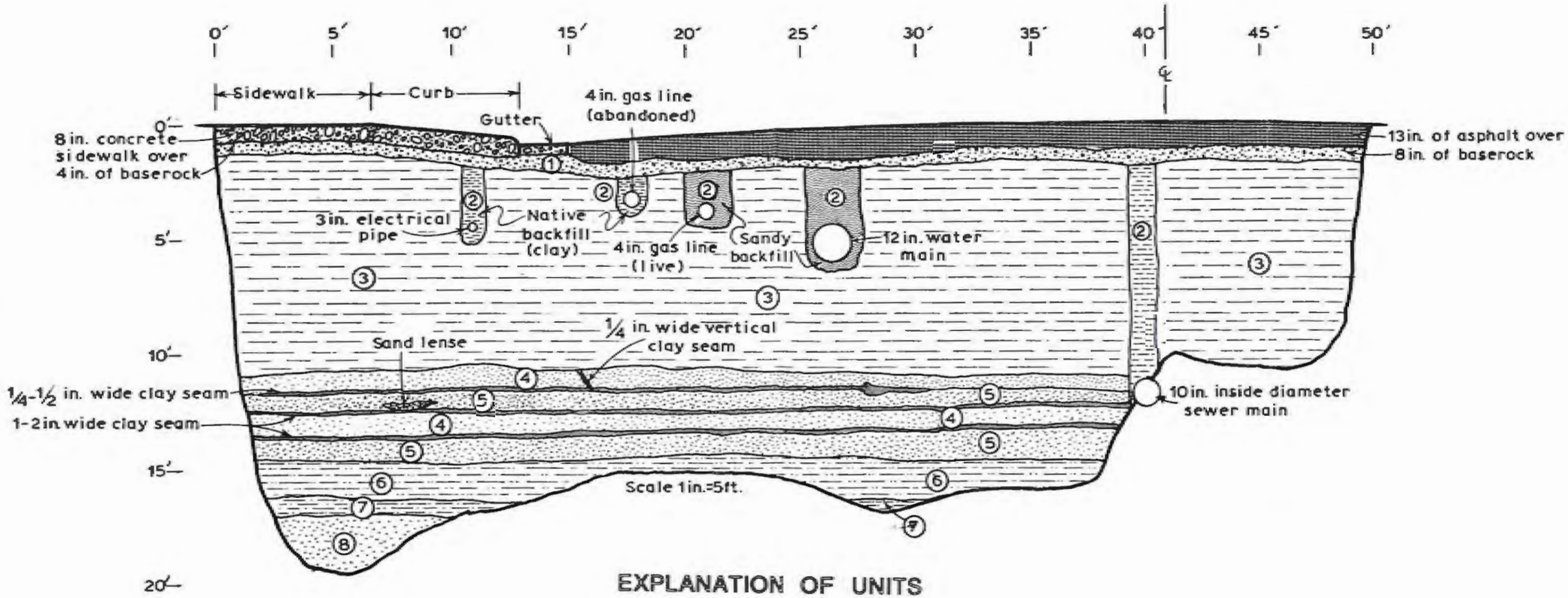
Unit 4: Light olive-brown (2.5Y 5/3) to olive-brown (2.5Y 4/3) medium to coarse-grained clayey sand; moist, medium dense, thin subparallel laminations, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay.

Unit 5: Dark grayish-brown (2.5Y 4/2) silty fine sand; moist, stiff, massive, gradational upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay and medium to coarse-grained well-sorted sand.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A3 - Log of Test Trench 4

Exploratory Trench No. 5



EXPLANATION OF UNITS

Fill

Unit 1: 13 inches of asphaltic concrete over 8 inches aggregate base material.

Unit 2: Mixture of sand and clay placed as utility trench backfill.

Lacustrine deposits

Unit 3: Dark olive brown (2.5Y 3/3) to dark grayish-brown (2.5Y 5/2) silty clay, with thin discontinuous dark brown and light gray streaks; moist, stiff, bioturbated, blocky ped structure. Sharp upper and lower contacts with scattered charcoal fragments along lower contact.

Fluvial deposits

Unit 4: Light olive-brown (2.5Y 5/3) to light brown-gray (2.5Y 6/2) coarse to medium-grained silty sand; damp, medium dense, thin subparallel laminations and faint cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick highly continuous layers of silty clay.

Unit 5: Olive-brown (2.5Y 4/3) to light brown-gray (2.5Y 6/2) very fine silty sand with red (2.5YR 5/8) and strong brown (7.5YR 5/6) mottles; moist, medium dense, massive, sharp upper and lower contacts.

Unit 6: Olive-brown (2.5Y 4/3) very fine sandy silt with strong brown (7.5YR 5/6) mottles and scattered black flecks; moist, stiff, massive, sharp upper and lower contacts.

Unit 7: Olive-brown (2.5Y 4/3) clayey silt with strong brown (7.5YR 5/6) mottles, very moist, stiff, massive, sharp upper and lower contacts.

Unit 8: Olive-brown (2.5Y 4/3) to very dark gray brown (10YR 3/2) silty sand with strong brown (7.5YR 5/6) mottles; damp, medium dense, massive, sharp upper and lower contacts.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A4 - Log of Test Trench 5

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION Drilling Supervised by B. Papurello on 4-26-91	IN-PLACE DRY DENSITY p.c.f.	IN-PLACE MOISTURE CONTENT % dry wt
0						
1				13" of AC		
2				8" Roadway Base (GW)		
3				Clay (CL), dark yellowish brown (10YR4/2), medium stiff, moist, cohesive, slightly silty		
4						
5						
6						
7				Silty CLAY (CL), dark yellowish brown (10YR4/2), medium stiff, moist, cohesive		
8						
9	1-1		14	Very moist		
10	1-2		24			
11				Clayey SAND (SC), dark yellowish brown (10YR4/2), medium dense, slightly moist to moist, very silty, very fine to coarse grained		
12	1-3		21			
13	1-4		25	SAND (SP), pale yellowish brown (10YR6/2), medium dense, slightly moist, trace silt, very fine to fine grained Increasing silt fraction		
14	1-5					

Figure A5 - Log of Test Boring No. 1 (continued of Figure A6)

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f.	IN-PLACE MOISTURE CONTENT % dry wt
14						
	1-5		18	Decrease silt fraction		
15				Silty CLAY (CL), dark yellowish brown (10YR4/2), soft to medium stiff, moist to very moist		
16	1-6		19	SAND (SP), pale yellowish brown (10YR6/2), medium dense, slightly moist, very fine to fine grained		
17				Silty CLAY (CL), dark yellowish brown (10YR4/2), soft to medium stiff, very moist, becomes very silty at 18.0 - 18.5 feet		
18	1-7		14			
19	1-8		18	SILT (ML), dark yellowish brown (10YR4/2), medium stiff, moist, moderate very fine grained sand fraction		
20				Boring terminated at 20.0 feet No groundwater encountered Modified California Sampler		

Figure A6 - Log of Test Boring No. 1 (continued)

Applied Soil Mechanics
INCORPORATED
SOIL AND FOUNDATION ENGINEERS • GEOLOGISTS

FAULT STUDY

Sites 1, 3-6 and 10
City of Hollister, California

JUNE 1991

APPENDIX A.6

Applied Soil Mechanics, Inc.
SOIL AND FOUNDATION ENGINEERS • GEOLOGISTS
400 Park Center Drive, Suite 7 • Hollister, CA 95023
(408) 637-2133 • FAX (408) 637-0510

File No. AO-2280-S1 June 12, 1991

City of Hollister Redevelopment Agency
375 Fifth Street
Hollister, CA 95023

Attention: Mr. Christopher M. Reyes, Program Manager

Subject: Sites 1, 3-6 and 10
City of Hollister, California
FAULT STUDY

Dear Mr. Reyes:

As you requested, we have completed the fault study for the Sites 1, 3-6 and 10. The purpose of this study was to determine if there was evidence for an identifiable trace(s) of the East Branch of the Calaveras fault (CDMG 1982) crossing the sites within the study area. The following report presents the results of our study.

No evidence for the presence of active fault traces was gathered during the field exploration phase of this study. Based on the results of this study, the site is suitable from an engineering geologic viewpoint for the proposed building improvements, provided that the recommendations presented herein and those of the recommended soil engineering study are incorporated into appropriate construction plans and specifications.

The submission of this report concludes this phase of our contract to perform the fault study on the subject sites for the City. We are pleased to have been of service to you on this project.

Sincerely,

APPLIED SOIL MECHANICS, INC.

Written by:

Lewis Rosenberg
Project Geologist

Reviewed by:

Richard T. Gorman, C.E.G. 1325
Consulting Geologist

Copies: 10 to City of Hollister Redevelopment Agency

APPENDIX A.6

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INTRODUCTION

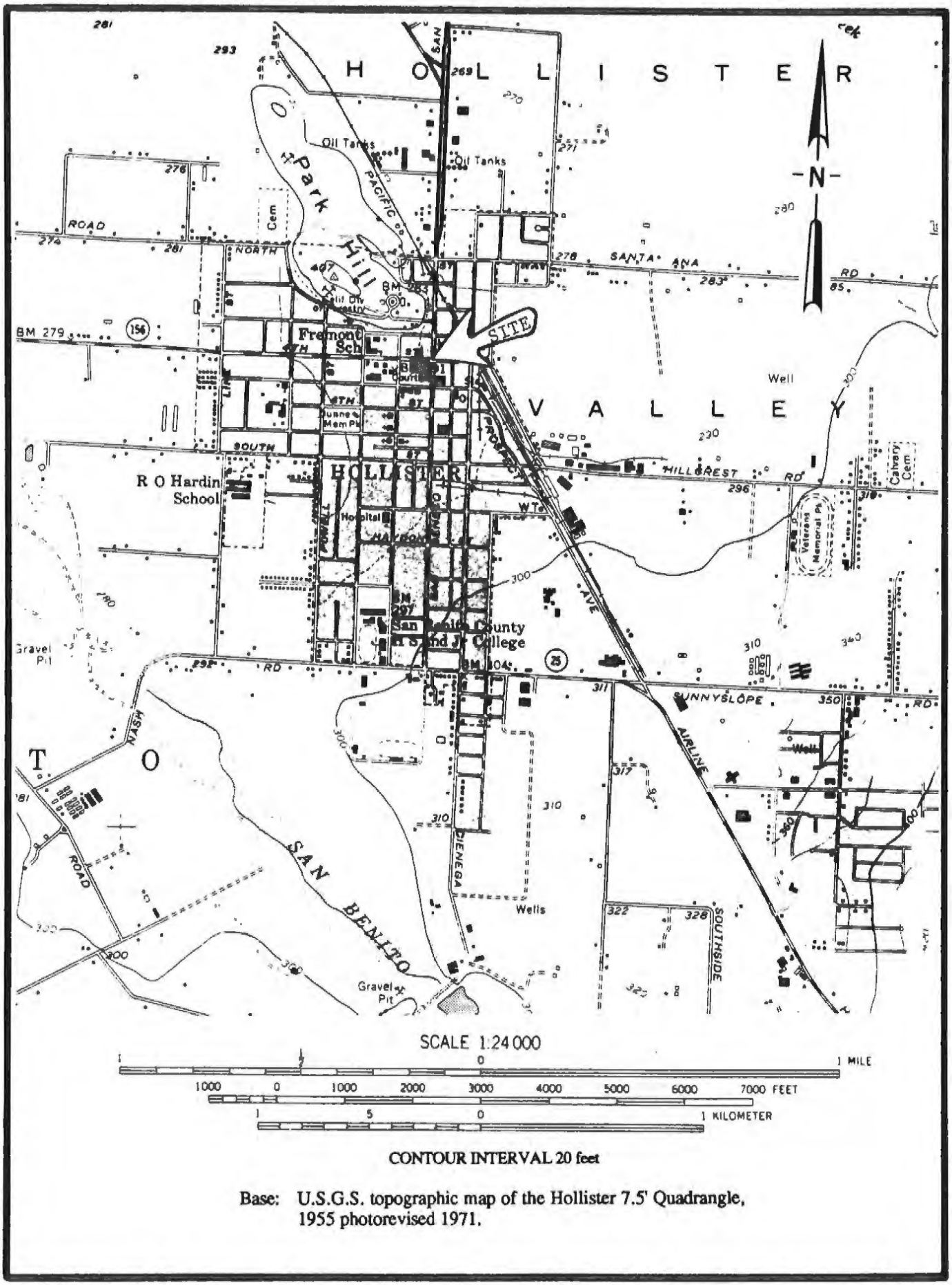
This report presents the results of our fault study for the proposed reconstruction of subject sites 1, 3-6 and 10 in the downtown area of Hollister, California (see Figures 1 and 2). Sites 1, 3-6 and 10 consist of the former I.O.O.F. and Caputo Printing Co. building at 328 and 330 Fourth St. (Building Site No. 1), the Fourth Street Carwash at 345 Fourth St. (Building Site No. 3), the Sunrise Plaza building at 400, 414, 420, 422, and 426 San Benito St. and the former Mauro Stationers building at 430, 434, and 438 San Benito St. (Building Site No. 4), the Mode O'Day and Las Palmas buildings at 449, 451, and 459 San Benito St., and 240 and 244 Fifth Street (Building Sites No. 5 & 6), and.320, 324, and 326 Fifth Street (Building Site No. 10). Figure 2 shows Building Sites 1, 3, 4, 5, 6 and 10. Building Sites 2, 7, 8 and 9 are discussed in other reports (Applied Soil Mechanics, 1991b, 1991d).

The subject properties are within a special study zone delineated by the City of Hollister and the California Division of Mines and Geology for the East Branch of the Calaveras fault (Figure 3). City and State laws mandate that geologic studies be performed for properties along known active fault zones (Alquist-Priolo Special Studies Zones). The stated intent of these laws is to evaluate the potential for fault rupture to occur on the property before building, rebuilding or substantial remodeling of structures for human occupancy.

We would also like to convey our special thanks to the City of Hollister for providing manpower and equipment during the field explorations.

Project Descriptions

The commercial building sites discussed below are shown on Figure 2.



Base: U.S.G.S. topographic map of the Hollister 7.5' Quadrangle, 1955 photorevised 1971.

Figure 1 - Vicinity Map

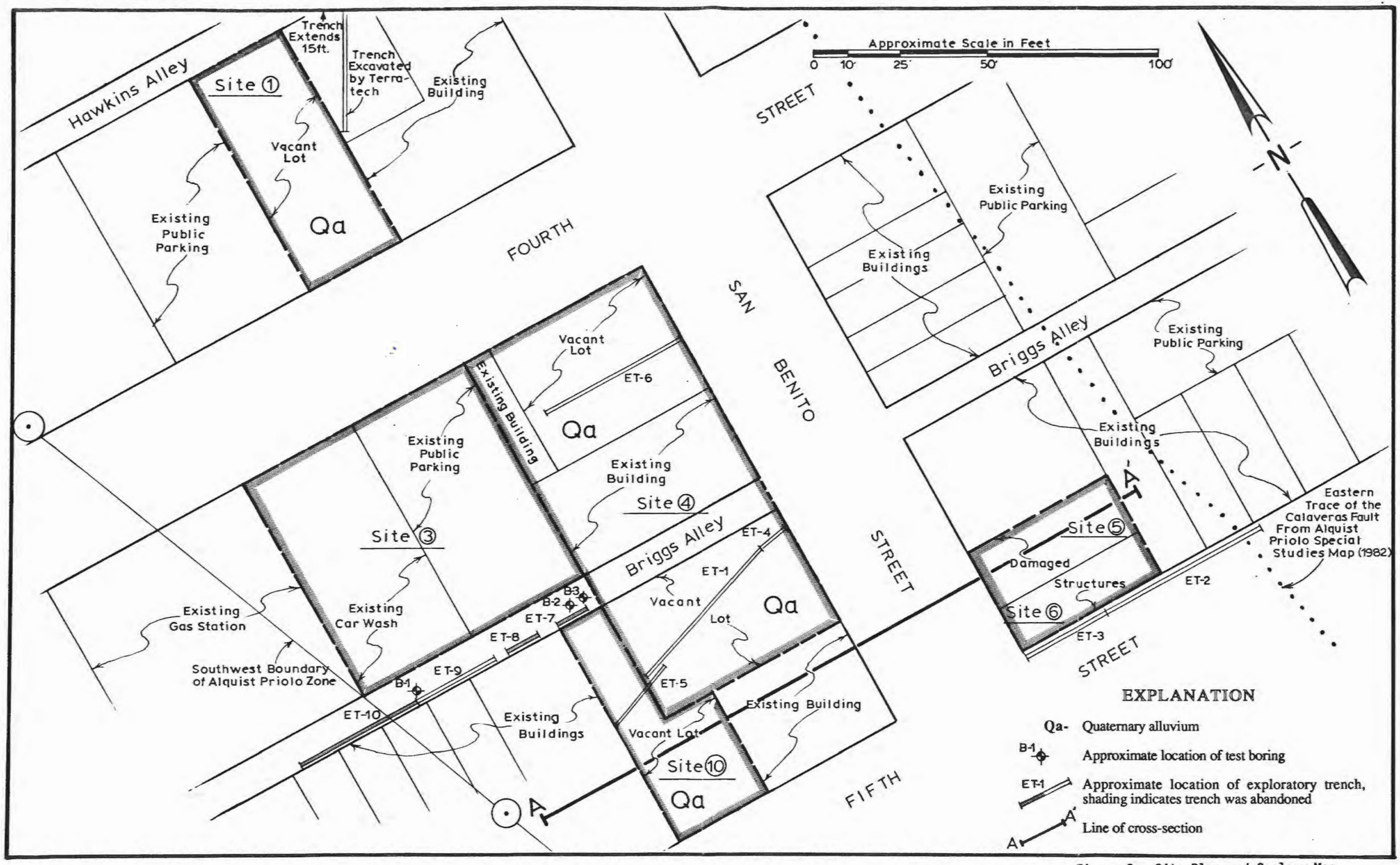
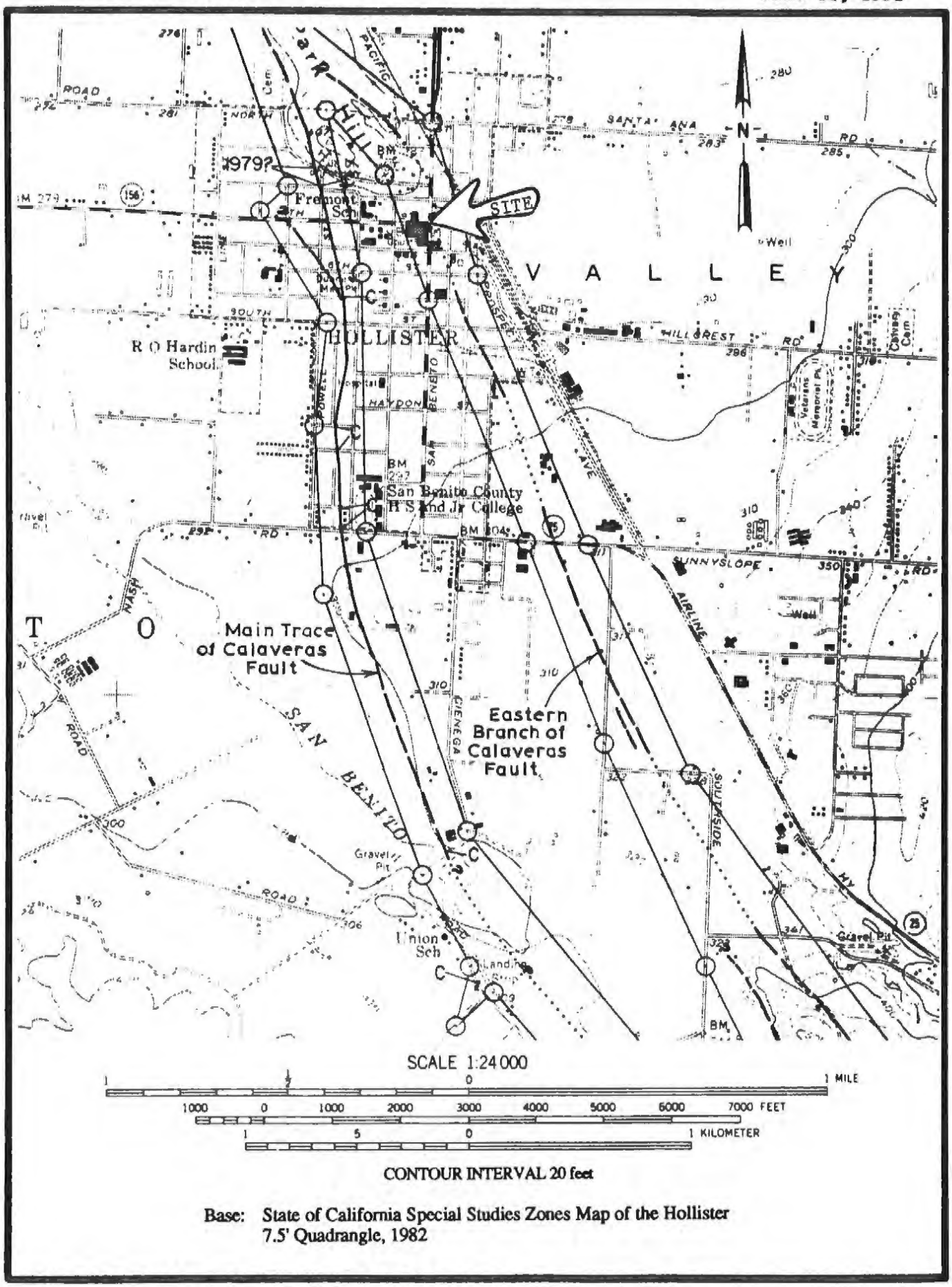


Figure 2 - Site Plan and Geology Map

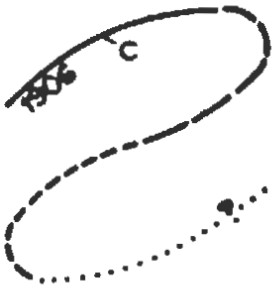


Base: State of California Special Studies Zones Map of the Hollister 7.5' Quadrangle, 1982

Figure 3 - Alquist Priolo Special Studies Zone Map

MAP EXPLANATION

Potentially Active Faults



Faults considered to have been active during Quaternary time; solid line where accurately located, long dash where approximately located, short dash where inferred, dotted where concealed; query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by creep or possible creep.

Aerial photo lineaments (not field checked); based on youthful geomorphic and other features believed to be the results of Quaternary faulting.

Special Studies Zone Boundaries

These are delineated as straight-line segments that connect consecutively numbered turning points so as to define one or more special studies zone segments.

Seaward projection of zone boundary.

Source: California Division of Mines and Geology(1982)

Figure 3a - Explanation for Alquist Priolo Special Studies Zone Map

Building Site 1 – The 0.18-acre site includes the vacant lots at 328 and 330 Fourth Street. The building on the site sustained severe damage as a result of the October 17, 1989 Loma Prieta earthquake and was later demolished. The site is bounded by a parking lot on the west, a commercial building on the east, Hawkins Alley on the north, and Fourth Street on the south. Based on our recent discussions with the City, it is our understanding that the proposed project will consist of building a new structure.

Building Site 3 – The 0.45-acre site includes an existing carwash at 345 Fourth Street and a City of Hollister public parking lot adjacent on the east side of the car wash. No major damage was reported to have occurred at this site as a result of the Loma Prieta earthquake. The site is bounded by a gasoline station on the west, a parking lot on the east, Fourth Street on the north, and Briggs Alley on the south. Based on our recent discussions with the City, it is our understanding that the proposed project will consist of demolishing the existing carwash and building a parking structure.

Building Site 4 – The 0.68-acre site consists of two vacant lots and two older existing buildings in the 400 block of San Benito Street (321 Fourth Street; and 400, 410, 414, 420, 422, 426, 430, 434, and 438 San Benito Street). Buildings at the north and south ends of the site sustained damage as a result of the October 17, 1989 Loma Prieta earthquake and were later demolished. Old foundations and trash pits were encountered during the trenching (see Figures A-1, A-4, A-5 and A-6). The site is bounded by a City of Hollister public parking lot on the west, San Benito Street on the east, Fourth Street on the north, and commercial buildings on the south. Based on our recent discussions with the City, it is our understanding that the proposed project will consist of demolishing the existing structures and building new structures.

Building Sites 5 & 6 – The 0.14-acre site consists of two older existing buildings at 449, 451, and 455 San Benito Street, and 240 and 244 Fifth Street . The buildings sustained damage as a result of the October 17, 1989 Loma Prieta earthquake and are presently under repair. The sites are bounded by commercial buildings on the north and east, San Benito Street on the west, and Fifth Street on the south. Based on our recent discussions with the City, it is our understanding that the proposed project will consist of repairing the existing structures.

Building Site 10 – The 0.13-acre site consists of the vacant lots at 320, 324, and 326 Fifth Street . The building at this site sustained damage as a result of the October 17, 1989 Loma Prieta earthquake and was later demolished. The site is bounded by commercial buildings on the west and east, Briggs Alley on the north, and Fifth Street on the south. Based on our recent discussions with the City, it is our understanding that the proposed project will consist of building a new structure.

PURPOSE AND SCOPE OF SERVICES

The purpose of this study was twofold; the first was to identify the geologic conditions and evaluate existing potential geologic and seismic constraints at the site. The second purpose was to provide recommendations for site development from a engineering geologic viewpoint. This study included the following scope of work:

1. Researching, reviewing, and evaluating data from published and unpublished geologic and geotechnical reports;
2. Discussions with representatives of the City of Hollister, the California Division of Mines and Geology (CDMG), and the U.S. Geological Survey (USGS);
3. Study of a series of aerial photographs of the site and vicinity;
4. Excavating, shoring, cleaning, and logging approximately 630 lineal feet of trenches;
5. Drilling and logging three exploratory borings;
6. Age dating of sediments using radiocarbon dating techniques;
7. Geologic analysis of field and office data; and,
8. Preparing this report, along with appropriate graphics and including the findings of the study and recommendations for development of the various building sites.

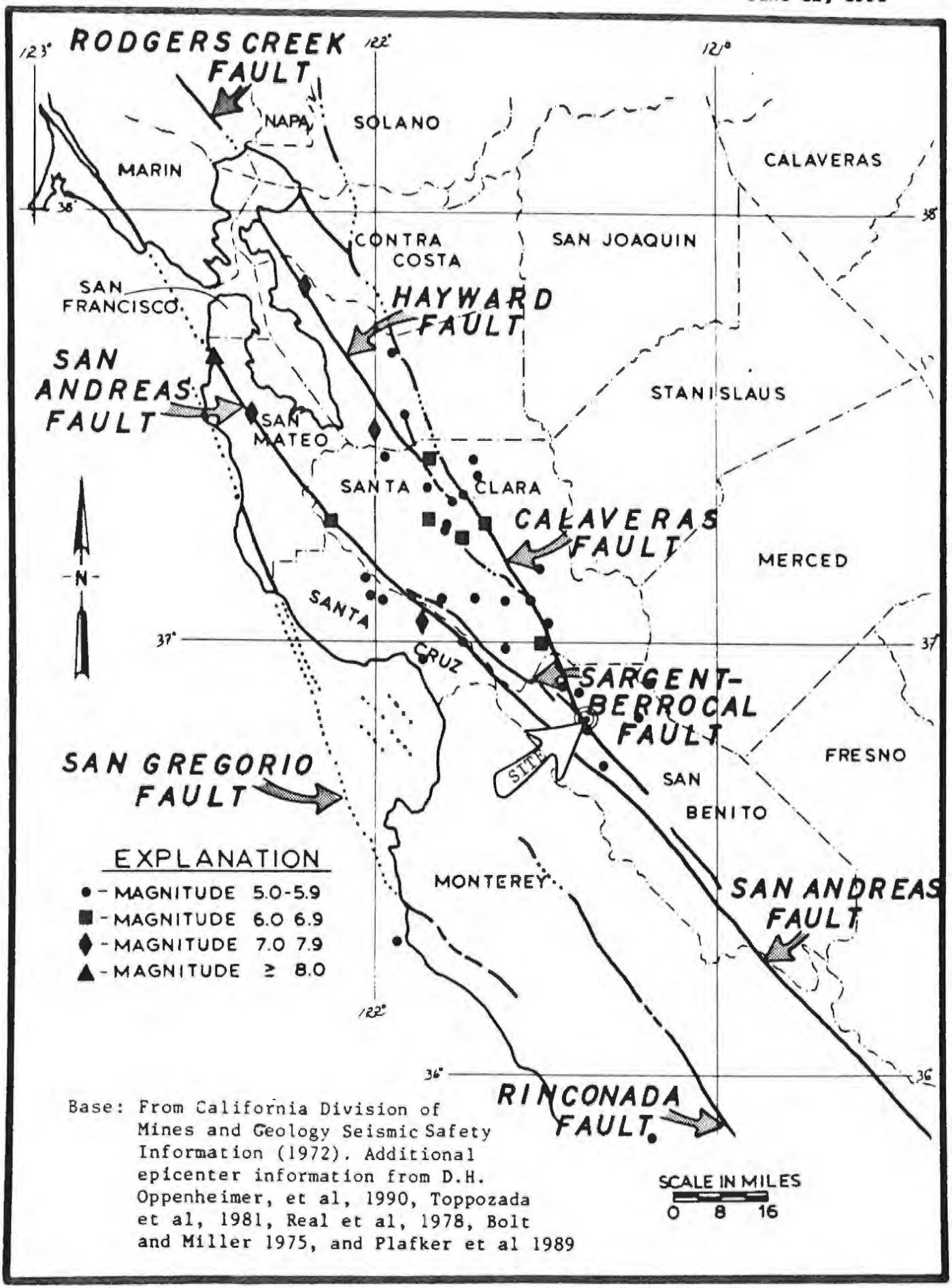
REGIONAL GEOLOGY

Geologic Setting

The subject properties are situated within the Hollister Valley. The valley boundaries are the Pajaro River on the north, and the mountains of the Gabilan Range on the west, the Diablo Range on the east, and the juncture of the Gabilan and Diablo Ranges on the south. The Gabilan Range consists of late Cretaceous age granitic rocks along with metamorphic rocks, including marbles and quartzite (Compton, 1966). Overlying the granitic rocks is a series of Oligocene to middle Miocene age sandstones and shales (Allen, 1946). The Diablo Range consists of Jurassic-Cretaceous age sandstones, limestones, volcanic rocks, and metamorphic rocks which are part of the Franciscan Complex. Blanketing the Franciscan rocks is a series of upper Cretaceous age sandstones, shales and conglomerates (Page, 1966).

The geologic structure of the Hollister area and the Gabilan and Diablo Ranges is strongly influenced by the active San Andreas and Calaveras faults. These faults strike northwest and are characterized by a combination of strike-slip and reverse displacement. One of the main faults in San Benito County region is the San Andreas fault which is a northwest-striking, steeply southwest-dipping shear zone separating Jurassic-Cretaceous Franciscan basement rocks from Cretaceous granitic basement rocks. The other major fault is the Calaveras, which branches off the San Andreas fault approximately 8 miles south of Hollister (see Figure 4).

Several periods of movement on the San Andreas and Calaveras faults occurred in the Hollister area, causing uplift of the mountains bordering the valley. The combination of faulting and folding resulted in a structural basin which was a seaway during the late Miocene to Pliocene (Allen, 1946). During Pliocene and Pleistocene time, extensive floodplain deposits known as the San Benito Gravels were deposited in the valley (Kilburn, 1972). During the Pleistocene, subsidence in the Hollister Valley due to tectonic activity resulted in deposition of a series of sands, silts, and



Base: From California Division of Mines and Geology Seismic Safety Information (1972). Additional epicenter information from D.H. Oppenheimer, et al, 1990, Toppozada et al, 1981, Real et al, 1978, Bolt and Miller 1975, and Plafker et al 1989

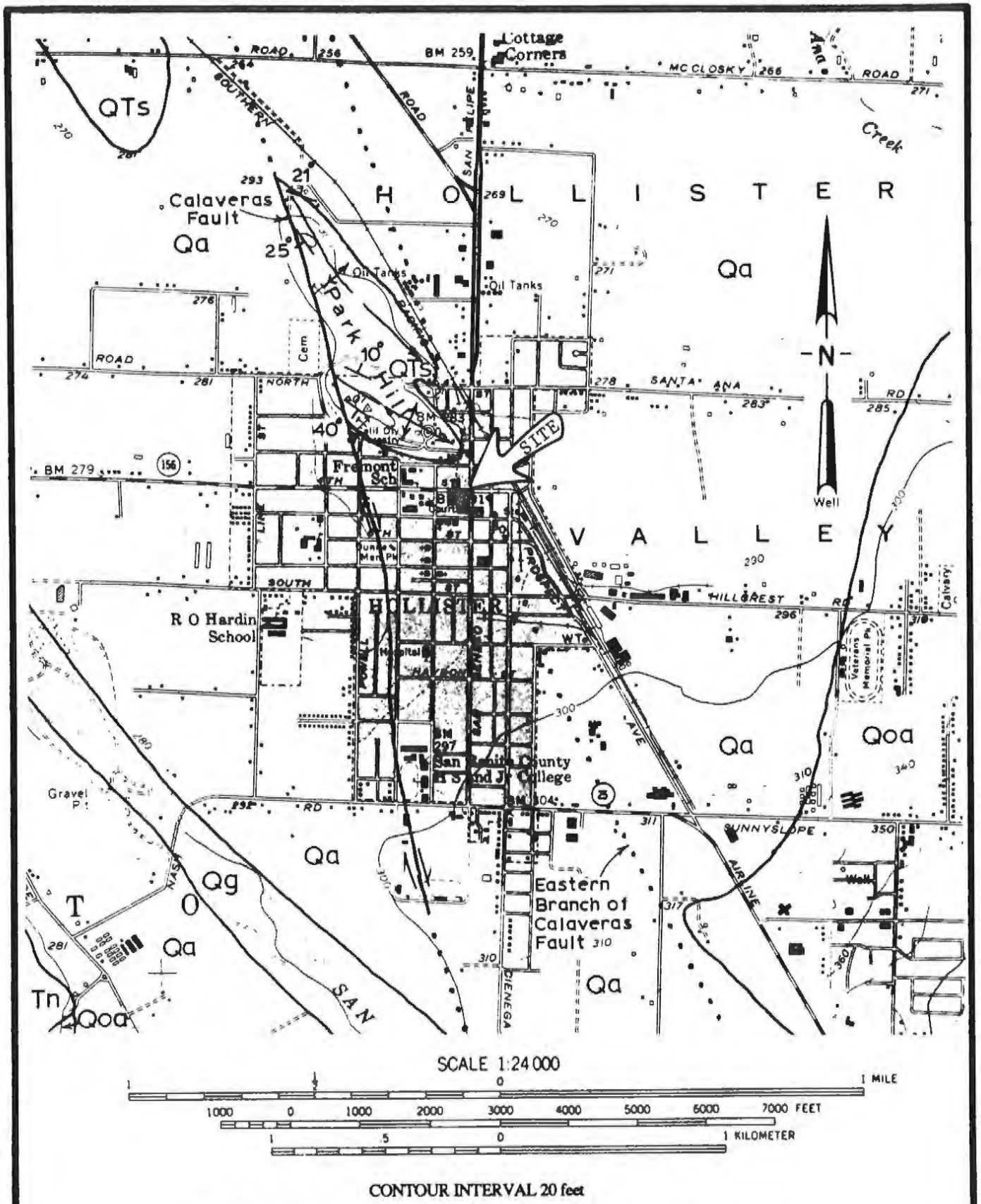
Figure 4 - Regional Fault & Epicenter Map

clays over the San Benito Gravels (McMasters and others, 1987). These deposits are interpreted as Pleistocene and Holocene age lake deposits (Jenkins,1973) or as a group of shallow, short-lived lakes in a fluvial environment (Hoose, 1986; McMasters and others, 1987). Holocene activity consists mostly of down-cutting by the San Benito River and mass wasting of upland areas by landslides and erosion. The regional geology is depicted on Figure 5.

Faulting

An important structural element in the Hollister area is the Calaveras fault system. Several branches of the Calaveras fault have been mapped in the Hollister area and are shown on Figure 4. The main branch is referred to as the "West Branch" by Bryant (1979). The West Branch has documented creep activity, producing at least 13 inches of right-lateral slip (Rogers and Nason, 1971). In addition, there was at least 1/5-inch (5 mm) of observed slip along the West Branch as a result of sympathetic movement during the Loma Prieta earthquake (McClellan and Hay, 1989).

The East Branch was mapped based on geomorphic evidence at Park Hill at the north end of Hollister and on a hill south of Hollister with a benchmark elevation of 668 feet. The fault was inferred between these localities based on a groundwater offset (Ellis, 1952; Kilburn, 1972) and subtle west-facing scarps (Bryant, 1979). The East Branch is mapped within the "400-block" area and considered active by the CDMG (Bryant, 1979) based on offset bedding in trenches excavated by Leighton and Associates (1974) and Woodward-Clyde and McClure & Messinger (1968).



CONTOUR INTERVAL 20 feet

Base: U.S.G.S. topographic map of the Hollister 7.5' Quadrangle, 1955 photorevised 1971. Geology modified from T.W. Dibblee (1973)

Figure 5 - Regional Geology Map

EXPLANATION

Geologic Units

Qg- Stream gravel and sand (Holocene)

Qa- Alluvium (Holocene)

Qoa- Older alluvium: terrace deposits (Pleistocene)

QTs- Santa Clara Formation (Pliocene-Pleistocene)

Tn- Non-marine sedimentary rocks: greenish gray to rarely reddish claystone, siltstone and interbedded friable buff-gray sandstone

Symbols

Contact

Fault: dashed where indefinite or inferred, dotted where inferred and concealed. Horizontal displacement designated by parallel arrows

Axis of fold (anticlinal): arrow indicates direction of plunge

Figure 5a - Explanation for Regional Geology Map

METHODS OF STUDY

Literature and Map Review

As part of our study, we reviewed reports and maps pertaining to the site and vicinity. Most of the previously published geologic information on this area is preliminary in nature, and is based on reconnaissance techniques and extrapolation of data.

The regional geology was mapped by Taliaferro (1948). However, Taliaferro's map shows the Calaveras fault north and south of Hollister, but does not have a symbol depicting a location of the fault within downtown Hollister. An eastern branch of the Calaveras fault was mapped by Ellis (1952) based on an offset blue clay layer noted on well logs. The blue clay is offset across the East Branch of the Calaveras fault by approximately 50 feet with the west side up. The wells were spaced hundreds of feet apart with some wells "a few hundred feet on each side of the fault in a few places" and approximately "30 to 40 feet of offset" of the groundwater table (William C. Ellis, oral communication, May 1991).

Detailed mapping was performed by Rogers (1967), who mapped the Calaveras fault within Hollister as a right-lateral strike-slip fault. An eastern branch of the Calaveras fault in downtown Hollister was mapped by Rogers and others (1968) as a high-angle fault with the west side upthrown. The East Branch of the Calaveras fault was trenched by Woodward-Clyde & Associates and McClure & Messinger (1968) at a site approximately 3/4-mile south of the subject properties. They stated, "Evidence was found, and which could possibly be construed as indicating the presence of a fault trace, consisted of several small clay seams and slickensided planes. These did not extend to the ground surface." Woodward-Clyde (1978) reviewed this 1968 study and concluded that the seams could have been due to other causes such as shrinkage cracks, lurch cracking, or liquefaction. They indicated that the most likely interpretation was that

these features could be considered to be conjugate shears and tension fractures developing in a fault zone.

Rogers and Nason (1971) examined streets and other man-made structures in Hollister for evidence of fault displacement. They concluded that the main branch of the Calaveras fault exhibited active creeping movement. The subsidiary (east) branches of the Calaveras fault in Hollister were considered by Rogers and Nason (1971) to be, "...presently dormant because they do not show consistent evidence of curb or sidewalk offset." and "... local subsidence features were more abundant and extreme along the traces of the inferred dormant faults than elsewhere." Kilburn (1972) indicated a groundwater offset of approximately 20 feet with the east side up across the West and East Branches of the Calaveras fault based on well data.

Jenkins (1973) studied the Quaternary deposits in the Hollister Valley and concluded that a large lake (Lake San Benito) covered much of Hollister during the Pleistocene time period. The Hollister area was remapped by Rogers (1973) and Dibblee (1975). They showed the East Branch of the Calaveras fault, but did not identify the relative sense of fault movement. Leighton and Associates (1974) observed offset units in an exploratory trench along the East Branch of the Calaveras fault on hill 668 (approximately 2 miles south of Hollister). As part of the State fault evaluation program, CDMG (1974) considered the East Branch of the Calaveras fault as sufficiently active and well-defined to be included within an Alquist-Priolo Special Studies Zone. Bryant (1979) remapped the East Branch of the Calaveras fault approximately 200 feet west of the location shown on the 1974 Special Studies Zone map. The latest revision of the Special Studies Zone map (CDMG, 1982) incorporates Bryant's modifications.

Site-specific investigations by Terratech (1974, 1976, 1977) within East Branch Special Studies Zone reported no evidence of faulting. However, these studies relied on magnetometer traverses and drilling, and did not use exploratory trenching. Other workers have located the East Branch of

the Calaveras fault in Hollister area. Terratech (1978) trenched the fault on the east side of Park Hill, approximately 800 feet north of the site. The fault was described on a trench log as consisting of "slickensided striated surfaces on siltstone, fault plane ? N65°W, dip 59°N". The log further discloses fault like features as shears (up to 1" wide) on either side of the fault plane oriented N0°E, 87°N". Calcium carbonate (caliche) was described as present along the fault plane.

Bay Soils (1981) described the fault as, "... a subtle change in the bedding of silt was noted in Trench No. 1, near the location of the other anomalous factors. This consisted of an upwarping of the bedding from horizontal to 10° to 15°". Earth Systems Consultants (1985) delineated the fault based on, "A gradual vertical material boundary" with dissimilar horizontal beds on either side of the boundary.

Terratech (1987) stated, "All of the trenches exposed evidence of apparent vertical displacement." Units are vertically offset by "about 1-1/2 to 3 feet" along near-vertical discontinuous clay seams with the east side up. The strike of faults in the trenches varied from N-S to N40°E, with steep dips to the east and west. J.V. Lowney & Associates (1990a, 1990b) interpreted, "... abrupt offset of laterally continuous beds, abrupt monoclinal folding of sediments and convoluted bedding." as evidence of faulting.

Applied Soil Mechanics (1991a) located a fault on a property within East Branch Special Studies Zone approximately 1/4 mile south of the downtown area. The fault is characterized by, "... steeply dipping to near-vertical, NNE to NNW-striking fractures ... infilled with loose, fine-grained sand. ... Thin continuous clay layers and entire stratigraphic units are disrupted and offset in this zone. The maximum vertical offset along the fractures was approximately 21 inches..." Applied Soil Mechanics has recently excavated several trenches across the mapped trace of the East Branch of the Calaveras fault in downtown Hollister. Features similar to the well-defined faulting

in trenches studied by Terratech (1978, 1987) and Applied Soil Mechanics (1991a) were not observed in the downtown area. The locations of these earlier studies are shown on Figure 6.

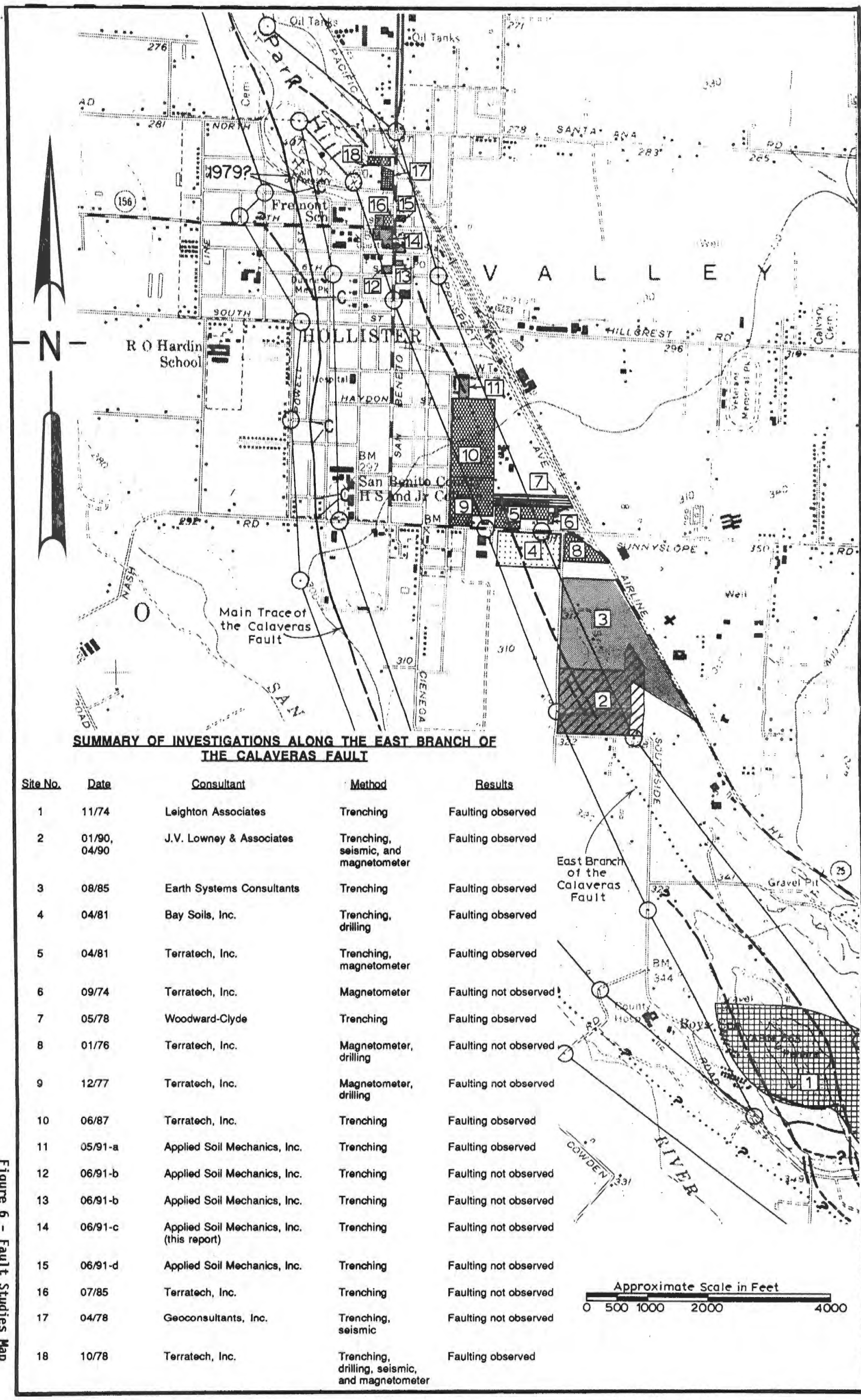
Aerial Photograph Interpretation

We studied aerial photographic stereo pairs taken of the Hollister area from 1985 to 1990. The following aerial photographs of the site and vicinity were used in this study:

Date	Approximate Scale	Type	Source
May 1967	1:20,000	black and white	USDA
May 1980	1:40,000	black and white	USDA
April 1985	1:31,680	black and white	WAC
July 1987	1:33,600	black and white	PAS
June 1989	1:31,680	black and white	WAC
August 1990	1:12,000	black and white	PAS

These photographs were studied for geomorphic evidence that could indicate active faulting. Faults typically appear on aerial photographs as a linear features with tonal differences on either side. These differences could be related to changes in soil and rock type, vegetation, groundwater levels, or bedding characteristics. Lineaments are sometimes associated with topographic features characteristic of fault zones such as linear and shutter ridges, sag ponds, springs, and offset drainages.

Within the downtown area, the aerial photographs were of limited use since development predates historic photography. Outside of town, a distinct northwest-trending lineament was seen on the aerial photographs where there is a narrow band which is lighter in color than the surrounding area in an orchard near Prune and Hawkins Streets. This lineament coincides with the mapped trace of



SUMMARY OF INVESTIGATIONS ALONG THE EAST BRANCH OF THE CALAVERAS FAULT

Site No.	Date	Consultant	Method	Results
1	11/74	Leighton Associates	Trenching	Faulting observed
2	01/90, 04/90	J.V. Lowney & Associates	Trenching, seismic, and magnetometer	Faulting observed
3	08/85	Earth Systems Consultants	Trenching	Faulting observed
4	04/81	Bay Soils, Inc.	Trenching, drilling	Faulting observed
5	04/81	Terratech, Inc.	Trenching, magnetometer	Faulting observed
6	09/74	Terratech, Inc.	Magnetometer	Faulting not observed
7	05/78	Woodward-Clyde	Trenching	Faulting observed
8	01/76	Terratech, Inc.	Magnetometer, drilling	Faulting not observed
9	12/77	Terratech, Inc.	Magnetometer, drilling	Faulting not observed
10	06/87	Terratech, Inc.	Trenching	Faulting observed
11	05/91-a	Applied Soil Mechanics, Inc.	Trenching	Faulting observed
12	06/91-b	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
13	06/91-b	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
14	06/91-c	Applied Soil Mechanics, Inc. (this report)	Trenching	Faulting not observed
15	06/91-d	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
16	07/85	Terratech, Inc.	Trenching	Faulting not observed
17	04/78	Geoconsultants, Inc.	Trenching, seismic	Faulting not observed
18	10/78	Terratech, Inc.	Trenching, drilling, seismic, and magnetometer	Faulting observed

Figure 6 - Fault Studies Map

the East Branch of the Calaveras fault (Bryant, 1979). The ground slope is not interrupted by the lineament on the air photos. Also, rows of trees in the orchard crossed by the fault are not offset, indicating that fault creep or strike-slip displacement has not occurred since the orchard was planted. At Park Hill at the north end of town, and at hill 668 south of town, geomorphic evidence of faulting is indicated as topographic benches that are modified by erosion.

Subsurface Explorations

As part of this study, approximately 630 lineal feet of exploratory trenches were excavated between January 14 and February 25, 1991 using a rubber-tire backhoe with a 24-inch wide bucket. The trenches were located nearly perpendicular to the alignment of the possible fault trace mapped by the California Division of Mines and Geology (1982). In addition, three exploratory borings were drilled on February 12, 1991 using a truck-mounted drill rig with 8-inch-diameter hollow stem augers. The locations of the trenches and borings are shown on Figure 2. The trench and boring logs are included in Appendix A.

The trenches designated as ET-1, ET-4, and ET-5 were located on the empty lot at the southwest corner of Briggs Alley and San Benito Street. Trench ET-1 measured approximately 105 feet long, trended N72°E, and was excavated to a depth of 15-1/2 feet below the ground surface. Trench ET-4 measured approximately 21 feet long, trended N78°E, and was excavated to a maximum depth of 14-1/2 feet. Trench ET-5 measured approximately 45 feet long, trended N71°E, and was excavated to a depth of 17-1/2 feet.

Trenches ET-2 and ET-3 were located in Fifth Street east of San Benito Street. Trench ET-2 measured approximately 100 feet long, trended N90°E, and was excavated to a depth of 15-1/2 feet. Trench ET-3 measured approximately 55 feet long, trended N90°E, and was excavated to a maximum depth of 15-1/2 feet.

Trench ET-6 was located on the empty lot at the southwest corner of Fourth and San Benito Streets. Trench ET-6 measured approximately 84 feet long, trended N90°W, and was excavated to a depth of 16 feet.

Trenches ET-7, ET-8, ET-8, and ET-10 and Drill Holes B-1, B-2, and B-3 were located in Briggs Alley between Monterey and and San Benito Streets. Trenches ET-7 and ET-8 were approximately 20 feet long and 12 feet deep. These trenches were abandoned because of locally created saturated conditions. Trench ET-9 measured approximately 49 feet long, trended N84°W, and was excavated to a maximum depth of 15-1/2 feet. Trench ET-10 measured approximately 55 feet long, trended N84°W, and was excavated to a depth of 15-1/2 feet. Trench ET-10 approximately 55 feet long and was cleaned and flagged, but the trench walls caved before they could be logged. Drill hole B-1 was drilled to a depth of 40 feet, B-2 to a depth of 43 feet, and B-3 to a depth of 31-1/2 feet below the ground surface.

After excavating, the trenches were shored and the trench walls cleaned. A system of nails and colored flagging was used to mark the various strata. After the trench walls were cleaned and flagged, they were logged at a scale of one inch equals five feet. Critical areas were logged at a more detailed scale. The floor and opposite trench wall were also cleaned and examined in these areas. The trenches were logged by project geologist, Lewis Rosenberg, except for Trench ET-9 which was logged by staff geologist Brian Papurello. The trenches were observed by the supervising geologist, Richard Gorman, and the City Geologist, John Kingsley. The logs of the trenches are shown in Appendix A.

After the trench logging operation was completed, the trenches were backfilled with 2-sack grout to within 5 feet of the ground surface. After the grout had set-up, imported sand was placed and compacted over the grout material up to the top of the trench. The sand was compacted using a

small compactor. In paved areas, asphaltic concrete was used to match the thickness of the existing pavement section.

One sample was dated using radiocarbon techniques. The results are included in Appendix B.

The drill holes were logged by staff geologists James Ball and Brian Papurello. The drilling was observed by the supervising geologist, Richard Gorman, and the City Geologist, John Kingsley. After the drilling logging operation was completed, the holes were backfilled with native material. The boring logs are shown in Appendix A.

FINDINGS

Site Geology and Geomorphology

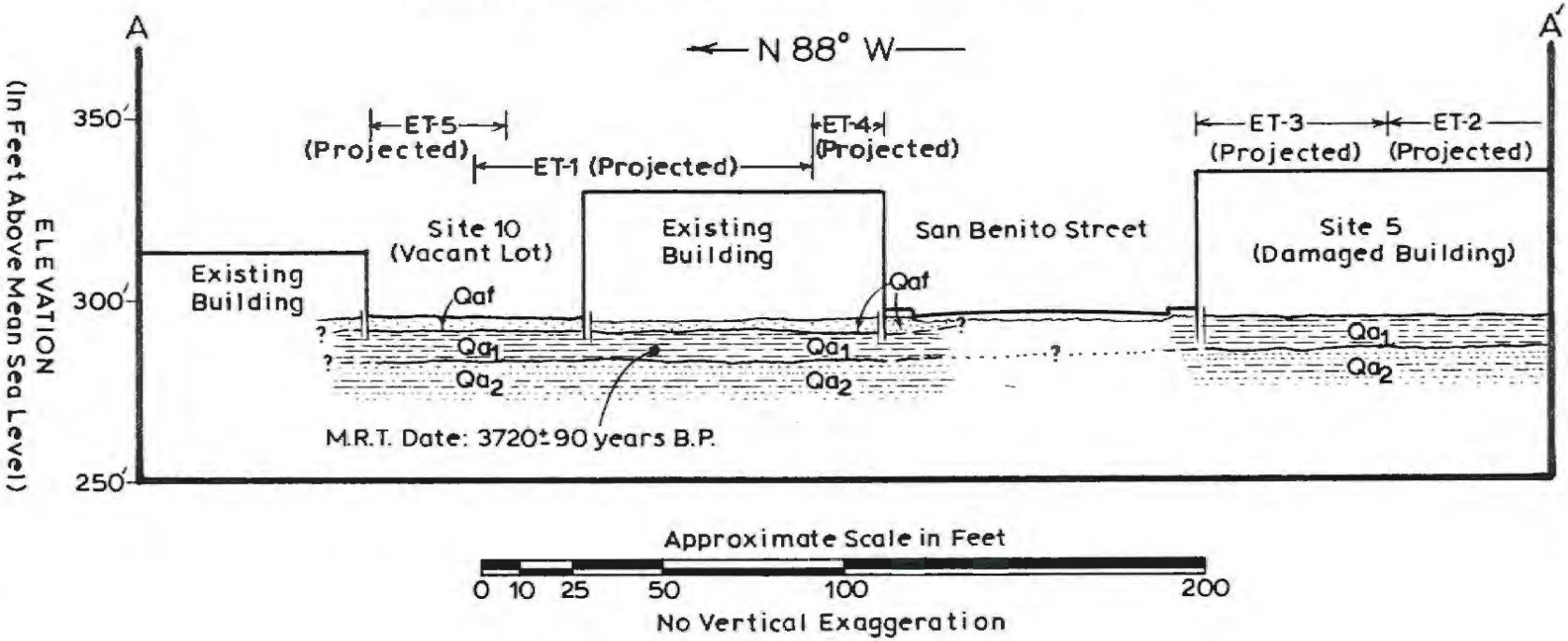
Downtown Hollister is underlain by by a series of Pleistocene and Holocene age lake and stream deposits. The topography is nearly flat. West-facing scarps are visible in Sixth Street near Dunne Park and have been related to active faulting on the main branch of the Calaveras fault by Rogers and Nason (1971). West-facing scarps are also visible on Hawkins, Hazel and South Streets, east of Sally Street, however, structures situated along these features do not show the creep-related movement present on the main branch of the fault. The geologic conditions are depicted on the Site Plan and Geology Map, Figure 2. A schematic cross-section through the site is included as Figure 7.

Stratigraphy

Four stratigraphic units were observed and could be correlated between trenches. The uppermost unit extending from the ground surface (excluding pavement and artificial fill) to a depth of approximately 9-1/2 to 12-1/2 feet is an olive to dark grayish-brown silty clay with thin sandy layers. This unit exhibits a blocky ped structure and is extensively bioturbated. Near the bottom of this unit is a very thin (~1/2 inch) dark reddish-brown layer which may represent a old buried grassline. This unit is interpreted as a shallow lacustrine (lakebed) deposit. A bulk sample from this unit at approximately 12 feet depth was dated using ^{14}C radiometric analysis at 3,720 ± 90 years before present (YPB). These are mean residence time dates (MRT) indicating a minimum age for the samples. The laboratory report and description of test procedures are included as Appendix B.

Below the lakebed deposits are a series of deposits which consist of grayish-brown to olive brown silty sands, clayey silts, and silty clays. These units are easily traced and vary from 1 to 2 feet in

Schematic Cross-Section A-A'



EXPLANATION

Qaf. Artificial Fill: silty clay to sand (units 1 & 2 from exploratory trenches 1, 4 & 5)

Qa1- Lacustrine deposits: silty clay (unit 3 from exploratory trenches 1, 4 & 5 and unit 2 from exploratory trenchs 2 & 3)

Qa2- Fluvial deposits: clayey silt to sand (units 4-6 from exploratory trenches 1 & 4, units 4 & 5 from exploratory trench 5, and units 3& 4 from exploratory trenches 2 &3)

Figure 7 - Schematic Cross Section A-A'

thickness. Faint to distinct trough cross-bedding was visible in the sandy beds. These beds were used for stratigraphic correlation and were flagged in the trenches. Bedding was massive in the silts and clays. Other sedimentary structures visible included discontinuous coarse sand lenses, thin (1/4 to 2-inch) continuous clay layers and clay rip-up clasts, suggesting a fluvial depositional environment. A bulk sample from a thin organic-rich clay bed at at a nearby site from a depth of approximately 17 feet had a mean residence time of 18,110 ± 190 YPB (Applied Soil Mechanics, 1991b). Assuming relatively continuous deposition, the fluvial sequences encountered in the trenches are probably latest Pleistocene to early Holocene age.

A blue clay horizon was encountered at approximately 40-1/2 feet in drill hole B-2. Ellis (1952) shows the top of the blue clay zone to be at approximately 125 feet in this area. Although the data is not conclusive, it suggests the blue clay layer may be stratigraphically higher than implied by Ellis (1952).

Summary of Trench Observations

The upper 3 to 4 feet of Trenches ET-1, ET-4, ET-5, and ET-6 consist of artificial fill. The upper fill which is 1 to 2 feet thick is sand and gravel. The lower fill is a silty clay with brick fragments and is 2 to 3 feet thick. Old brick foundations were encountered between stations 64 to 72 and 94 to 102 in ET-1, and stations 0 to 2 in ET-4. Trash pits were encountered between stations 42 to 50 in ET-1, and stations 28 to 33 in ET-5. The upper 1-1/2 feet of Trenches ET-2, ET-3, and ET-9 consists of pavement and road base. Below the fill and road base is a 7 to 8 foot-thick silty clay unit which is interpreted as a shallow lacustrine (lakebed) deposit. This unit had blocky ped structures, and was bioturbated.

Stratigraphic units exposed in the trenches are nearly flat-laying and are laterally continuous over the length of the trenches. Within these units, several types of sedimentary structures were

observed. The uppermost fluvial deposit exhibited undisturbed trough cross-bedding. Medium to coarse-grained sand lenses were encountered in the silt and sand units. These lenses represent infilling from small channels.

Clayey silt beds approximately 1 to 2 inches in thickness were noted adjacent to the coarse sand lenses. These beds are traceable with minimal variation in thickness throughout the length of the trench, and are probably a result of waning floodwaters that deposited the coarse sand lenses. Locally, these beds undulate within the sand unit. Since the thickness of the sand unit does not vary appreciably, the undulation is probably due to either deposition into a shallow channel or soft sediment deformation.

Between stations 2 to 5 in ET-5, stations 20 to 22 and 90 to 91 in ET-2, stations 40 to 42 in ET-3, and stations 11 to 13 in ET-9 are near-vertical clay seams within the fluvial units. The clay seams are typically 1 to 2 inches wide. A detail of these features is shown on the ET-3 trench log. Thin continuous clay layers above and below the seams are not disrupted or offset. The vertical orientation of the seams and the similar composition to the overlying clay bed implies that the vertical seams are due to infilling. Alternatively, some of these seams are a result of load casting.

Between stations 8 to 11 in ET-1, stations 28 to 33 in ET-5, and stations 28 to 32 in ET-9, there are thin clay-filled fractures which strike northeast and dip steeply northwest. The fractures are approximately 1/8 to 1/2-inch wide and contain two 1/16 to 1/8-inch wide clay layers that show approximately 1/32 to 1/16-inch separation. The cracks are truncated by the lacustrine deposits, extend to the bottom of the trenches, and were traceable on both the trench walls and floor.

Groundwater

Damp to wet conditions were encountered in the drilling and trenching operations; however, free groundwater was not encountered. At the time of this study, central California was experiencing

the fifth consecutive year of drought conditions. It is possible that during years of normal or above normal precipitation, that saturated conditions or perched water tables could develop.

SEISMICITY

In assessing the seismic hazards for a given area, it is useful to examine historic records of local earthquake intensities. This information is useful for predicting the recurrence of severe shaking in an area. Within the historic time, significant earthquakes have severely damaged man-made structures over a large part of San Benito County. These include the 1906 M 8.3 San Francisco (Lawson, 1908), 1984 M 6.2 Morgan Hill (Stover, 1984), and the 1989 M 7.1 Loma Prieta.

Although central California is crossed by numerous faults, several regionally active fault systems are most likely to generate earthquakes that could cause damage to the site. These include the active San Andreas, Hayward, Calaveras, and San Gregorio fault systems (Hart, 1988), and the potentially active Sargent-Berrocal fault (Bryant, 1980). Recent studies indicate that a major earthquake on the Calaveras fault (Oppenheimer and others, 1990) or on the San Francisco Peninsula segment of the San Andreas fault (Working Group on California Earthquake Probabilities, 1990) will occur in the near future. An earthquake on one of these faults will result in strong ground shaking, as shown in historic records.

Recently active fault zones have been mapped by the State as part of the Alquist-Priolo Act of 1972. Under the act (Hart, 1988), recently active faults are defined as displaying sufficient and well-defined evidence of movement within the Holocene Epoch (about the last 11,000 years). No structures for human occupancy are permitted on the trace of an active fault. Unless proven otherwise, the area within 50 feet of an active fault is presumed to be underlain by an active fault. The Alquist-Priolo definition of potentially active is a fault showing evidence of displacement older than 11,000 years and younger than 2,000,000 years (Pleistocene Epoch). "Inactive" faults are classified as not having been active for at least two million years.

Evaluation of maximum earthquakes is a topic with considerable variation. The criteria used within this report include maximum credible and probable earthquakes. The maximum credible earthquake is defined by the California Division of Mines and Geology (1975) as,

> "the maximum earthquake that appears capable of occurring under the presently known tectonic framework. It is a rational and believable event that is in accord with all known geologic and seismic facts. In determining the maximum credible earthquake, little regard is given to its probability of occurrence, except that its likelihood of occurring is great enough to be of concern."

The maximum probable earthquake is, "The maximum earthquake that is likely to occur during a 100-year interval. It is to be regarded as a probable occurrence, not as an assured event that will occur at a specific time." (CDMG, 1975).

Table A lists known regionally active faults and their estimated seismic parameters. These estimates were generated using the EQFAULT computer program (Blake, 1989) using statistical analyses of seismic events reported by Idriss (1987).

TABLE A
SEISMIC PARAMETERS FOR ACTIVE AND POTENTIALLY ACTIVE FAULTS IN THE HOLLISTER REGION

	San Andreas (Northern segment)[1]	Calaveras	Hayward	San Gregorio-Palo Colorado	Sargent-Berrocal*[2]
Distance and direction from site (miles)	16 SW	0.5 W	25 NW	40 SW	8 NW
Maximum credible earthquake[3, 4]	8.0	7.0	7.0	7.75	7.0
Maximum probable earthquake[3, 4]	7.5	6.5	6.75	6.75	5.75
Maximum credible peak ground acceleration [3, 5]	0.25 g	0.51 g	0.13 g	0.12 g	0.27 g
Maximum probable peak ground acceleration [3, 5]	0.21 g	0.47 g	0.10 g	0.06 g	0.15 g

* Potentially active

1 Defined as extending from San Juan Bautista to Shelter Cove (Blake, 1989)

2 Assumes that the earthquake will occur at a prescribed depth and at the nearest point to the site

3 Richter Earthquake Magnitude

4 From: Idriss (1987)

Primary Earthquake Effects

Fault-Related Ground Rupture – Ground rupture along fault traces can occur during large earthquakes, and zones of high ground rupture potential are delineated by governmental agencies. The subject sites are within the State Alquist-Priolo Special Studies Zone and the City Seismic Zone for the East Branch of the Calaveras fault (California Division of Mines and Geology, 1982; Barrett, 1976).

The data gathered and analyzed (including the trench data and the MRT dates) indicate that there is no evidence for an active fault trace to cross the subject sites studied. Therefore, the potential for ground rupture resulting from fault movement at the building sites is considered to be low.

Secondary Earthquake Effects

Ground Shaking – Hollister experienced severe shaking during the 1989 earthquake, according to local accounts (McCann, 1990). Ground shaking from a seismic event is the primary seismic hazard that will have the greatest impact on the proposed development within its design life span. Ground shaking can trigger other secondary seismic hazards that are discussed in following sections.

Strong ground shaking is documented for the following earthquakes: 1906 M 8.3 San Francisco (Lawson, 1908), 1983 M 6.7 Coalinga (Stover, 1983), and the 1984 M 6.2 Morgan Hill (Stover, 1984) and can reasonably be expected in the future. The estimated shaking intensity in the Hollister area during the 1989 Loma Prieta event was VII on the Modified Mercalli scale (Plafker and Galloway, 1989). Wood and Neuman (1931) define Modified Mercalli VII intensity as, "*Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.*"

The Loma Prieta earthquake provided data on ground response in the Hollister area. The closest strong-motion seismograph station to the sites is located at Hollister City Hall (approximately 200 feet southwest) and recorded peak ground accelerations (PGA) of 0.25 gravity (g) horizontal acceleration and 0.22 g vertical acceleration (Maley and others, 1989). Other local seismograph records show accelerations of 0.38 g in the horizontal direction and 0.20 g in the vertical direction at South and Pine Streets (1,500 feet southeast) (Shakal and others, 1989), and 0.29 g horizontal acceleration and 0.16 g vertical at Hollister Airport (2 miles north) (Maley and others, 1989).

The PGA is one of the factors involved in designing a structure to resist seismic forces. Using the method of Idriss (1987) with the EQFAULT program (Blake, 1989), a maximum probable earthquake of M 6.5 occurring on the nearest point of the Calaveras fault could produce a PGA of 0.47 g at the site. The PGA generated by EQFAULT is an approximate value and does not take into account other factors such as depth to bedrock, ground saturation, and topographic amplification. For wood-frame houses, the PGA tends to be over-conservative, and the repeatable high ground acceleration (RHGA) is more appropriate (Ploessel and Slosson, 1974). For a maximum probable earthquake of M 6.5 occurring on the Calaveras fault, the RHGA is 0.31 g.

Liquefaction – Soil liquefaction is the loss of soil strength during a significant seismic event. It occurs primarily in saturated loose- to medium-dense, fine to medium-grained sands and sandy silts. Liquefaction results in rearrangement of the soil particles into a denser condition, resulting in localized areas of ground failure. Common types of liquefaction-related ground failure include differential settlement and lateral spreading. The native site soils are relatively fine-grained and may be susceptible to liquefaction, if saturated. We did not encounter groundwater in the exploratory trenches, and the soils were damp to wet.

No signs of liquefaction such as sand boils were observed in the immediate vicinity of the subject sites after the Loma Prieta earthquake (Plafker and Galloway, 1989; McCann, 1990). From a geologic viewpoint, the risk of liquefaction in the present environment is considered to be low. If the groundwater table were to rise, or perched ground water conditions developed, or if the near-surface granular material were to become saturated then the risk of liquefaction should be considered as moderate. A soil engineering study including test borings is needed to definitively assess the risk of liquefaction.

CONCLUSIONS

Based on trench observations, we conclude that the subject sites 1, 3-6 and 10 are not located within 50 feet of an active fault. We reviewed fault studies conducted along the East Branch of the Calaveras on nearby properties to provide a framework for comparing our findings. The types of features encountered in the trenches excavated as part of this study are different to those where the East Branch of the Calaveras fault was located by Applied Soil Mechanics (1991a), Bay Soils (1981), Earth Systems Consultants (1985), J.V. Lowney & Associates (1990a, 1990b), Terratech (1978, 1987), and Woodward-Clyde and McClure & Messinger (1968).

The nearly flat-lying sediments maintain an almost constant thickness in the trenches. Laterally continuous stratigraphic units could be correlated in the trenches and from trench to trench. No evidence of offset was apparent along these marker units. In Trenches ET-1, ET-5 and ET-9, near-vertical clay-filled cracks cut continuous clay and sand beds. These fractures may be the result of secondary processes such as subsidence or lurching (Bell, 1981). It is possible that the fractures could be related to tectonic stresses associated with the Calaveras fault zone, however, thin continuous clay layers are not disrupted or offset by or at the fracture. Similar features have been related to prehistoric near-surface ground subsidence in the San Joaquin Valley, California (Fig. 37, Bull, 1972). The likelihood of active faulting on the subject sites is not supported by the trench data.

RECOMMENDATIONS

1. The subject sites are suitable from an engineering geologic viewpoint for the planned reconstruction of structures on the properties, provided that the recommendations in this report are followed.

2. A soil engineering study should be performed for proposed new structures or those existing structures that require significant remodeling and reconstruction. The study should address liquefaction potential and associated effects such as settlement. The study should also address the possibility of buried features, such as old foundations, basements, tanks and trash pits.

3. The proposed structures should be designed to withstand strong ground shaking. The project structural engineer should determine the appropriate method used for seismic design of the new buildings. If the Uniform Building Code (1988 edition) is used for design, we recommend that a seismic zone factor of 0.40 and a site coefficient of 1.0 (Tables 23-I and 23-J, respectively) be used.

4. The exploratory trenches for this study have been backfilled using lean two-sack grout concrete for the deep portions of the excavations and compacted clean sand for generally the upper five feet. Their location and condition should be taken into consideration in the design of the improvements planned for this study area.

REFERENCES CITED

Allen, J.E., 1946, Geology of the San Juan Bautista quadrangle, California: California Division of Mines Bulletin 133, 75 p., 3 plates, scale 1:62,500.

Applied Soil Mechanics, Inc., 1991a, Geologic evaluation, proposed three-lot subdivision, 49, 53, and 57 Hawkins Street, Hollister, California: unpublished report prepared for Dean Rodrigues. File No. A0-2303-S1.

_____, 1991b, Fault study, Bruhn and Peterson properties, 515, 525, and 530 San Benito Street, San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2281-S1.

_____, 1991c, Fault study, "400-block" properties: Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2280-S1.

_____, 1991d, Fault study, Polletti property, 335 San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2279-S1.

Barrett, Nestor, 1976, Seismic Safety Element of the General Plan: City of Hollister Planning Department open-file report, 37 p.

Bay Soils, Inc., 1981, Soil and geologic investigation, Hollister shopping center, SWC Nash Road and Southside Road, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-1337, 20 p., 3 appendices.

Bell, J.W., 1981, Subsidence in Las Vegas Valley: Nevada Bureau of Mines and Geology Bulletin 95, 84 p., 1 plate, scale 1:62,500.

Blake, T.F., 1989, EQFAULT, a computer program for the deterministic prediction of peak ground acceleration from digitized California faults.

Bryant, W.A., 1979, Fault evaluation report, Calaveras (Hollister segment) and "Buena Vista Road" faults: California Division of Mines and Geology Fault Evaluation Report FER-94, 14 p., 4 plates, scale 1:24,000.

_____, 1980, Fault evaluation report, SE segments of Sargent and Castro faults: California Division of Mines and Geology Fault Evaluation Report FER-96, 21 p., 11 plates, scale 1:24,000.

Bull, W.B., 1972, Prehistoric near-surface subsidence cracks in western Fresno County, California: U.S Geological Survey Professional Paper 437-C, 85 p.

California Division of Mines and Geology, 1974, Special studies zones map, Hollister 7.5 minute quadrangle: California Department of Conservation, 1 sheet, scale 1:24,000.

_____, 1975, Recommended guidelines for determining the maximum credible and the maximum probable earthquakes: California Division of Mines and Geology Note 43, 1 p.

REFERENCES CITED (continued)

_____, 1982, Special studies zones map, Hollister 7.5 minute quadrangle: California Department of Conservation, 1 sheet, scale 1:24,000.

Compton, R.R., 1966, Granitic and metamorphic rocks of the Salinian block, California Coast Ranges *in* Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 277–287.

Dibblee, T.W., Jr., 1975, Geologic map of the Hollister quadrangle: U.S. Geological Survey Open-File Report 75-394, 1 maps, scale 1:62,500.

Earth Systems Consultants, 1985, Seismic hazard evaluation, Kelly Ranch, Parcel 2, Southside Road, Hollister, California: unpublished report prepared for San Benito Engineering and Surveying, Inc., 22 p.

Ellis, W.C., 1952, Elevations on top of the blue clay zone, Hollister area: U.S. Bureau of Reclamation unpublished map.

Geoconsultants, Inc., 1978, Geologic hazard investigation for proposed commercial development, Park Hill and San Benito Streets, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-742, 12 p.

Hart, E.W., 1988, Fault-rupture hazard zones in California: California Division of Mines and Geology Special Publication 42, 24 p.

Hoose, S.N., 1986, Was there a great Pleistocene Lake San Benito? (M.S. thesis): San Jose State University, 87 p.

Idriss, I.M., 1987, Lecture notes, presentation at the EERI course on strong ground motion, April 10-11, 1987, Pasadena, California, *in* Singh, J.P., Course Organizer, Strong ground motion, seismic analysis, design and code issues: Earthquake Engineering Research Institute, 14 p.

International Conference of Building Officials, 1988, Uniform Building Code: Whittier, California, 926 p.

Jenkins, O.P., 1973, Pleistocene Lake San Benito: California Geology, v. 26, no. 7, p. 151–163.

Kilburn, Chabot, 1972, Ground-water hydrology of the Hollister and San Juan Valleys, San Benito County, California: U.S. Geological Survey Open-File Report 73-144, 5 maps, various scales.

Lawson, A.C., chairman, 1908, The California earthquake of April 18, 1906: Report of the California State Earthquake Investigation Commission: Washington D.C., Carnegie Institution of Washington, Publication 87, v. 1, 2 parts, 451 p.

REFERENCES CITED (continued)

Leighton and Associates, 1974, Fault hazard study of eastern and western portions of Ridgemark Estates development, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-56, 11 p., 1 appendix.

Lowney, J.V., & Associates, 1990a, Fault location investigation for Kelly Ranch residential development, Southside Road, Hollister, California: City of Hollister Open-File report, 20 p., 2 appendices.

_____, 1990b, Supplemental fault location investigation for Kelly Ranch residential development, Southside Road, Hollister, California: City of Hollister Open-File report, 13 p., 2 appendices.

Maley, R., Acosta, A., Ellis, F., Etheredge, E., Foote, L., Johnson, D., Porcella, R., Salsman, M., and Switzer, J., 1989, U.S. Geologic Survey strong-motion records from the northern California (Loma Prieta) earthquake of October 17, 1989: U.S Geological Survey Open-File Report 89-568, 84 p.

McCann, J.Z., 1990, Aftershock: the Loma Prieta earthquake and its impact on San Benito County: Hollister, California, Seismic Publications, 80 p.

McClellan, P.H., and Hay, E.A., Geologic evidence for triggered slip on the Calaveras fault during the magnitude 7.1 Loma Prieta earthquake of October 17, 1989: U.S Geological Survey Open-File Report 89-641, 37 p.

McMasters, C.R., Herd, D.G., Throckmorton, C.K., and Heusser, L.E., 1987, Subsurface stratigraphy of the eastern Hollister Valley, California: U.S Geological Survey Miscellaneous Field Studies Map MF-1461, 3 sheets, various scales.

Oppenheimer, D.H., Bakun, W.H., and Lindh, A.G., 1990, Slip partitioning of the Calaveras fault, California, and prospects for future earthquakes: Journal of Geophysical Research, v. 95, no. B6, p. 8483–8498.

Page, B.M., 1966, Geology of the Coast Ranges of California *in* Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 255–276.

Plafker, George, and Galloway, J.P., eds., 1989, Lessons learned from the Loma Prieta, California earthquake of October 17, 1989: U.S. Geological Survey Circular 1045, 42 p.

Ploessel M.R., and Slosson, J.E., 1974, Repeatable high ground accelerations from earthquakes: California Geology, v. 27, no.9, p. 195–199.

Rogers, T.H, 1967, Active extensional faulting north of Hollister near the Calaveras fault zone: Bulletin of the Seismological Society of America, v. 57, no. 4, p. 813–816.

_____, 1973, Preliminary geologic map, NE 1/4 Hollister quadrangle: California Division of Mines and Geology unpublished open-file report, 1 sheet, scale 1:12,000

REFERENCES CITED (continued)

Rogers, T.H., and Nason, R.D., 1971, Active displacement on the Calaveras fault zone at Hollister, California: Bulletin of the Seismological Society of America, v. 61, no. 2, p. 399–416.

Rogers, T.H., Nason, R.D., and Cooper, A.K., 1968, Preliminary map showing traces of the Calaveras fault zone in the City of Hollister, California: California Division of Mines and Geology Open-File Report 68-3, 1 sheet, scale 1 in. = 500 ft.

Shakal, A., Huang, M., Reichle, M., Ventura, C., Cao, R., Sherburne, R., Savage, M., Darragh, R., and Petersen C., 1989, CSMIP strong motion records from the Santa Cruz Mountains (Loma Prieta), California: California Division of Mines and Geology, Office of Strong Motion Studies Report No. OSMS 89-06, 196 p.

Stover, C.W., 1983, Intensity distribution and isoseismal map *in* Bennett, J.H., and Sherburne, R.W., eds., The 1983 Coalinga, California earthquake: California Division of Mines and Geology Special Publication 66, p. 1–4.

_____, 1984, Intensity distribution and isoseismal map for the Morgan Hill, California, earthquake of April 24, 1984 *in* Bennett, J.H., and Sherburne, R.W., eds., The 1984 Morgan Hill, California earthquake: California Division of Mines and Geology Special Publication 68, p. 1–4.

Taliaferro, N.L., 1948, Geologic map of the Hollister quadrangle: California Division of Mines Bulletin 143, 1 sheet, scale 1:62,500.

Terratech, Inc., 1974, Geologic evaluation, proposed commercial building, Alpha Beta shopping center, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-107, 4 p.

_____, 1976, Geotechnical investigation, K & S Market, Southside Road and Nash Road, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-329, 11 p.

_____, 1977, Geotechnical investigation, Royal Court Estates, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-642, 9 p.

_____, 1978, Geologic/geotechnical investigation, First Street commercial property, Hollister, California: City of Hollister Open-File report, 9 p., 2 appendices.

_____, 1981, Geologic investigation, proposed Nob Hill shopping complex, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-1336, 5 p.

_____, 1985, Fault investigation, J.C. Penny building, Hollister, California: City of Hollister Open-File report, 10 p.

REFERENCES CITED (continued)

_____, 1987, Investigation of the east branch of the Calaveras fault, Prune Street school site (Rancho San Justo Tandem school site), Hollister, California: City of Hollister Open-File report, 5 p.

U.S. Bureau of Reclamation, 1989, Engineering geology field manual: U.S. Department of the Interior, 599 p.

Wood, H.O., and Neumann, Frank, 1931, Modified Mercalli intensity scale of 1931: Bulletin of the Seismological Society of America, v. 21, no. 4, p. 277–283.

Woodward-Clyde Consultants, 1978, Geologic evaluation, Prospect Avenue property, Hollister, California: City of Hollister Open-File report, 5 p.

Woodward-Clyde & Associates and McClure & Messinger, 1968, Earthquake fault and earthquake engineering studies, proposed upper school site, Hollister, California: unpublished report submitted to Hollister School District, Hollister, California.

Working Group on California Earthquake Probabilities, 1990, Probabilities of large earthquakes in the San Francisco Bay region, California: U.S. Geological Survey Circular 1053, 51 p.

AERIAL PHOTOGRAPH REFERENCES

Pacific Aerial Surveys, July 3, 1987, V-SBN-C1-11 to 12, black and white, vertical, approximate scale 1:33,600.

_____, August 29, 1990, SBN-3845 47-54 to 55, black and white, vertical, approximate scale 1:12,000.

WAC Corporation, April 2, 1985, WAC–85CA 7–45 to 48, black and white, vertical, approximate scale 1:31,680.

_____, June 14, 1989, WAC–90CA, 32–139 to 142, black and white, vertical, approximate scale 1:31,680.

U.S. Department of Agriculture, May 15, 1967, BUX–1HH–91 to 93, black and white vertical, approximate scale 1:20,000.

_____, May 7, 1980, 379–75 to 78, black and white, vertical, approximate scale 1:40,000.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report are based upon the assumption that the subsurface conditions do not deviate substantially from those disclosed in the trenches and borings. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that planned at the present time, Applied Soil Mechanics, Inc. should be notified so that supplemental recommendations can be given.

2. This report is issued with the understanding that it is the responsibility of the owner or of his representative to ensure that the information and recommendations presented herein are called to the attention of the project architect and engineers for the project and incorporated into the project plans and specifications, and that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the present date. Changes in the conditions of a property can occur with the passage of time, however, whether they be due to natural processes or the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or partially, by changes outside of our control. Therefore, this report should not be relied upon after a period of three (3) years without being reviewed by an engineering geologist.

4. This report was prepared upon your request for our services, and in accordance with currently accepted standards of professional engineering geology practice. No warranty as to the contents of this report is intended, and none shall be inferred from the statements or opinions expressed.

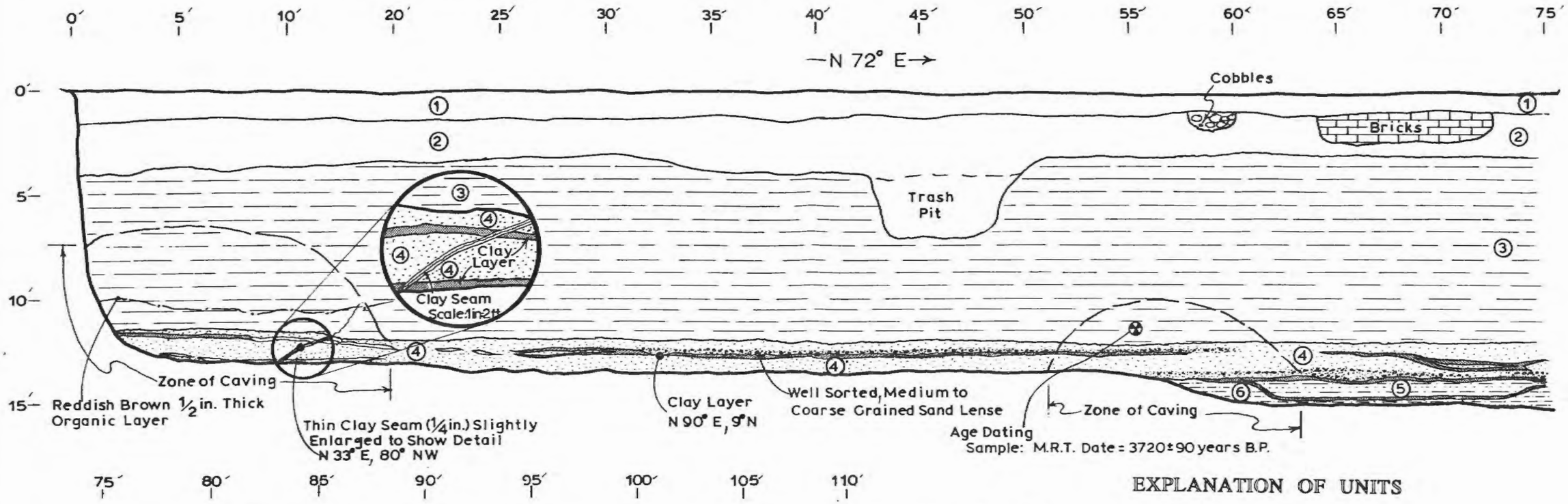
5. The scope of our services did not include any environmental assessment or study for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater or air, on or below or around this site. Any statements in this report regarding odors noted or unusual or suspicious items or conditions observed are strictly for the information of our client.

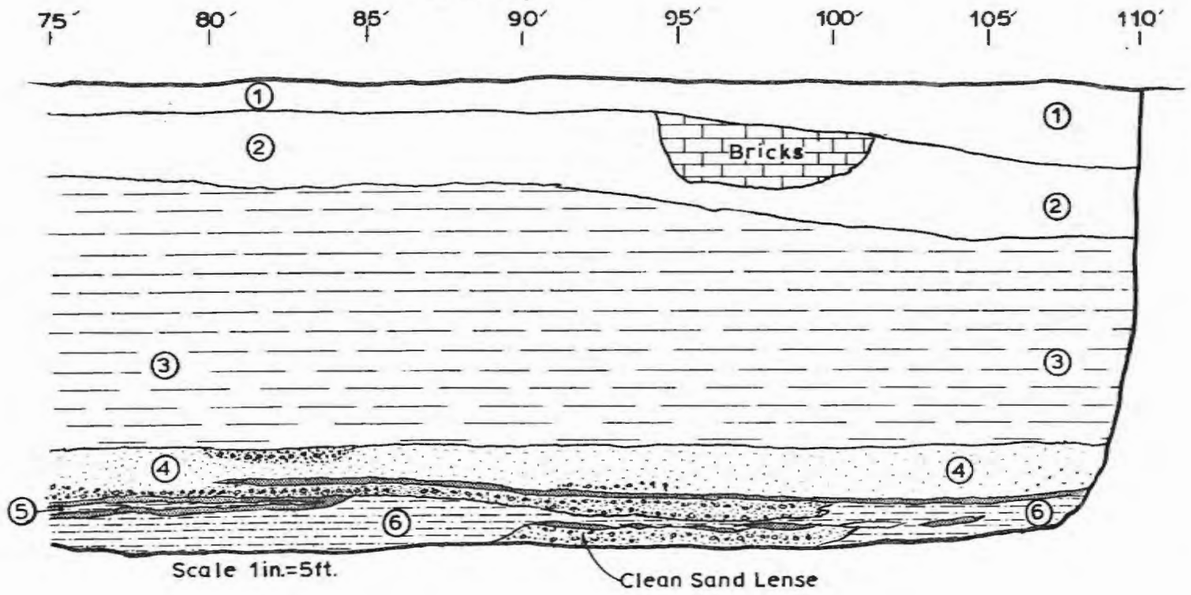
APPENDIX A

Exploratory Trench Logs

Exploratory Boring Logs

Exploratory Trench No. 1





EXPLANATION OF UNITS

0′ **Artificial fill**

Unit 1: Olive (5Y 6/3) coarse to medium-grained sand with fine gravel, damp, loose, well-drained.

Unit 2: Very dark gray (10YR 3/1) silty clay with brick fragments, damp, firm.

5′ **Lacustrine deposits**

Unit 3: Olive brown (2.5Y 4/3) to dark grayish-brown (2.5Y 4/2) silty clay, with thin discontinuous dark reddish-brown (2.5YR 3/4) clay layers, very moist, firm to stiff, extensively bioturbated, blocky ped structure. Sharp upper and lower contacts with scattered charcoal fragments along lower contact.

10′ **Fluvial deposits**

Unit 4: Grayish-brown (2.5Y 5/2) to light olive-brown (2.5Y 6/3) silty fine to medium-grained sand, moist, medium dense to loose, thin subparallel laminations and faint cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay and medium to coarse-grained well-sorted sand.

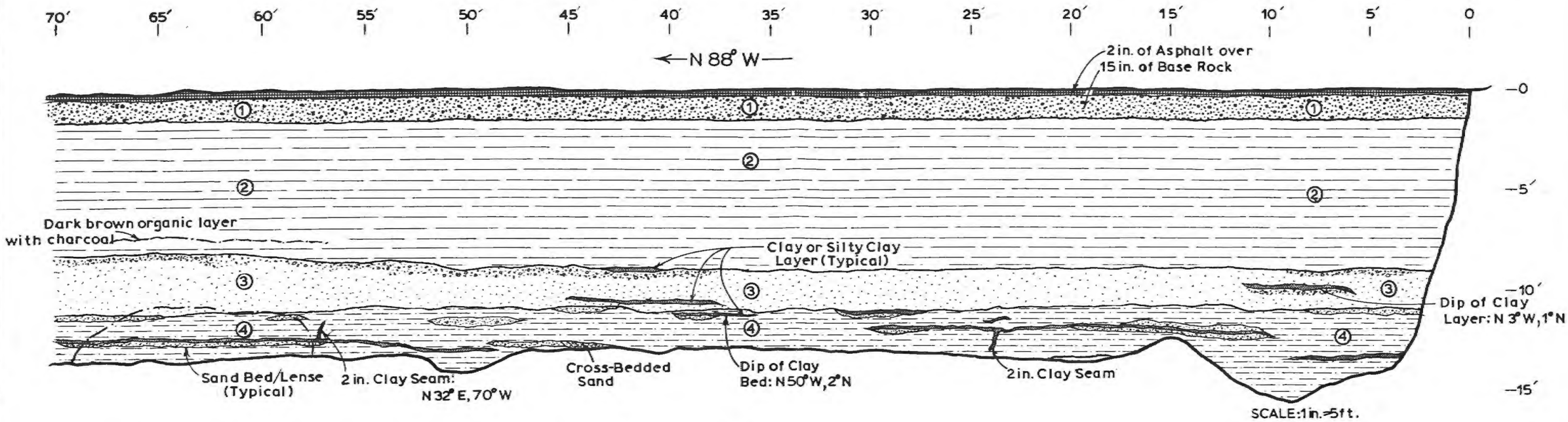
15′ **Unit 5:** Dark grayish-brown (2.5Y 4/2) with brownish-yellow mottles (2.5Y 4/2) clayey silt to silty clay; very moist, stiff, massive, sharp upper and lower contacts.

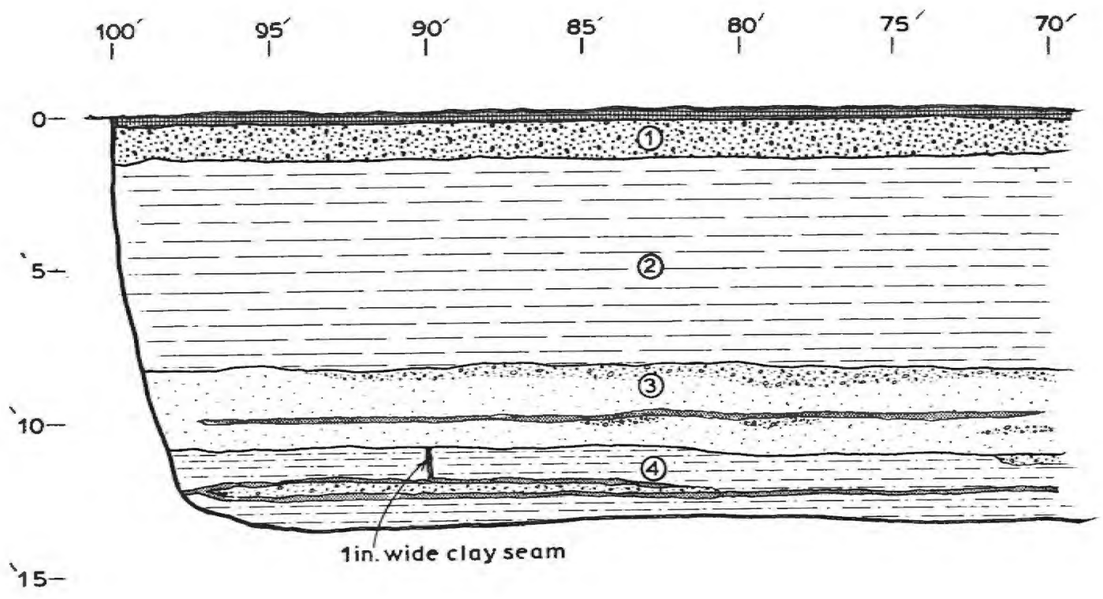
Unit 6: Olive brown (2.5Y 4/3) clayey fine sandy silt, moist, stiff.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A1 - Log of Exploratory Trench No. 1

Exploratory Trench No. 2





EXPLANATION OF UNITS

Artificial fill

Unit 1: 2 inches of asphaltic concrete over 15-inches aggregate base material.

Lacustrine deposits

Unit 2: Olive brown (2.5Y 4/3) to dark grayish-brown (2.5Y 4/2) silty clay, with thin sandy layers, very moist, firm to stiff, extensively bioturbated, blocky ped structure. Sharp upper and lower contacts with charcoal scattered fragments along lower contact.

Fluvial deposits

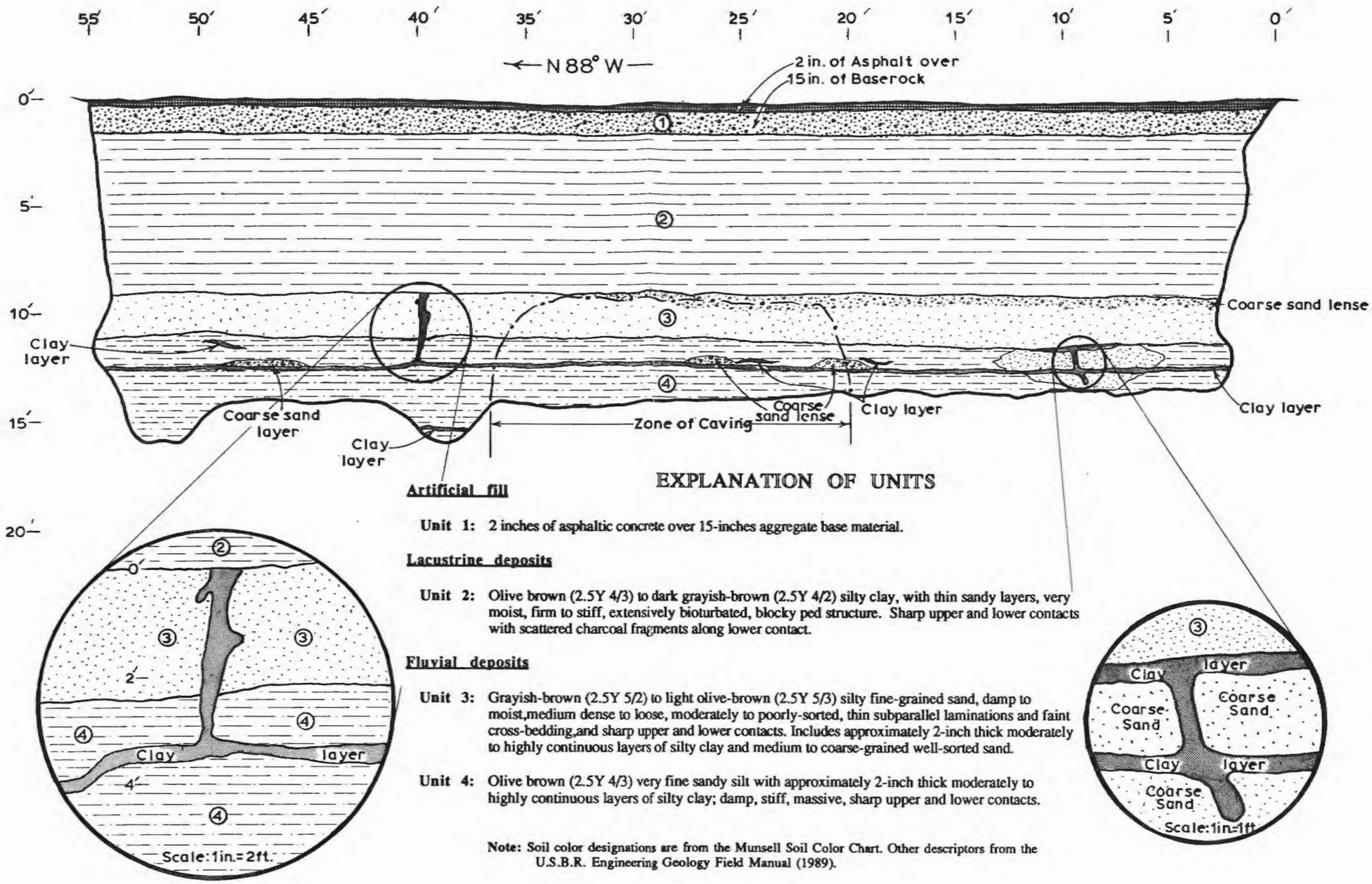
Unit 3: Grayish-brown (2.5Y 5/2) to light olive-brown (2.5Y 5/3) silty fine-grained sand, damp to moist, medium dense to loose, moderately to poorly-sorted, thin subparallel laminations and faint cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay and medium to coarse-grained well-sorted sand.

Unit 4: Olive brown (2.5Y 4/3) very fine sandy silt with approximately 2-inch thick moderately to highly continuous layers of silty clay; damp, stiff, massive, sharp upper and lower contacts.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A2 - Log of Exploratory Trench No. 2

Exploratory Trench No. 3



EXPLANATION OF UNITS

Artificial fill

Unit 1: 2 inches of asphaltic concrete over 15-inches aggregate base material.

Lacustrine deposits

Unit 2: Olive brown (2.5Y 4/3) to dark grayish-brown (2.5Y 4/2) silty clay, with thin sandy layers, very moist, firm to stiff, extensively bioturbated, blocky ped structure. Sharp upper and lower contacts with scattered charcoal fragments along lower contact.

Fluvial deposits

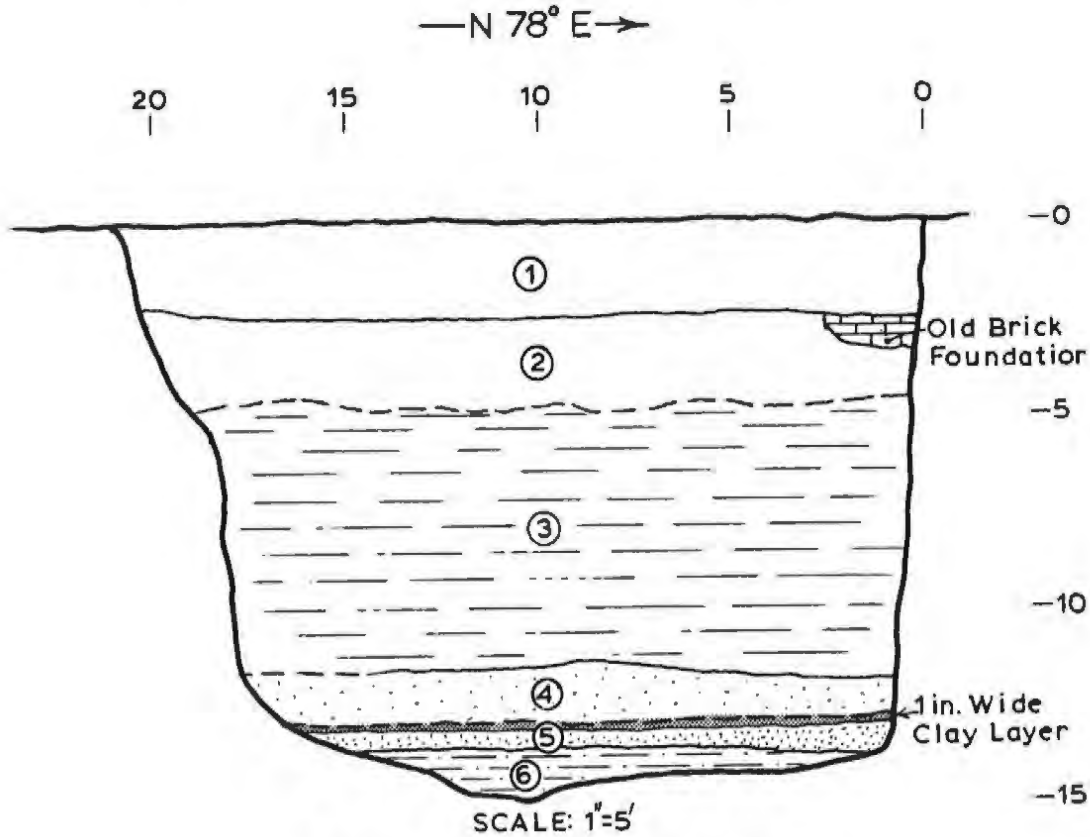
Unit 3: Grayish-brown (2.5Y 5/2) to light olive-brown (2.5Y 5/3) silty fine-grained sand, damp to moist,medium dense to loose, moderately to poorly-sorted, thin subparallel laminations and faint cross-bedding,and sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay and medium to coarse-grained well-sorted sand.

Unit 4: Olive brown (2.5Y 4/3) very fine sandy silt with approximately 2-inch thick moderately to highly continuous layers of silty clay; damp, stiff, massive, sharp upper and lower contacts.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A3 - Log of Exploratory Trench No. 3

Exploratory Trench No. 4



EXPLANATION OF UNITS

Artificial fill

Unit 1: Olive (5Y 6/3) coarse to medium-grained sand with fine gravel, damp, loose, well-drained.

Unit 2: Very dark gray (10YR 3/1) silty clay with brick fragments, damp, firm.

Lacustrine deposits

Unit 3: Olive brown (2.5Y 4/3) to dark grayish-brown (2.5Y 4/2) silty clay, with thin discontinuous dark reddish-brown (2.5YR 3/4) clay layers, very moist, firm to stiff, extensively bioturbated, blocky ped structure. Sharp upper and lower contacts with scattered charcoal fragments along lower contact.

Fluvial deposits

Unit 4: Grayish-brown (2.5Y 5/2) to light olive-brown (2.5Y 6/3) silty fine to medium-grained sand, moist, medium dense to loose, thin subparallel laminations and faint cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay and medium to coarse-grained well-sorted sand.

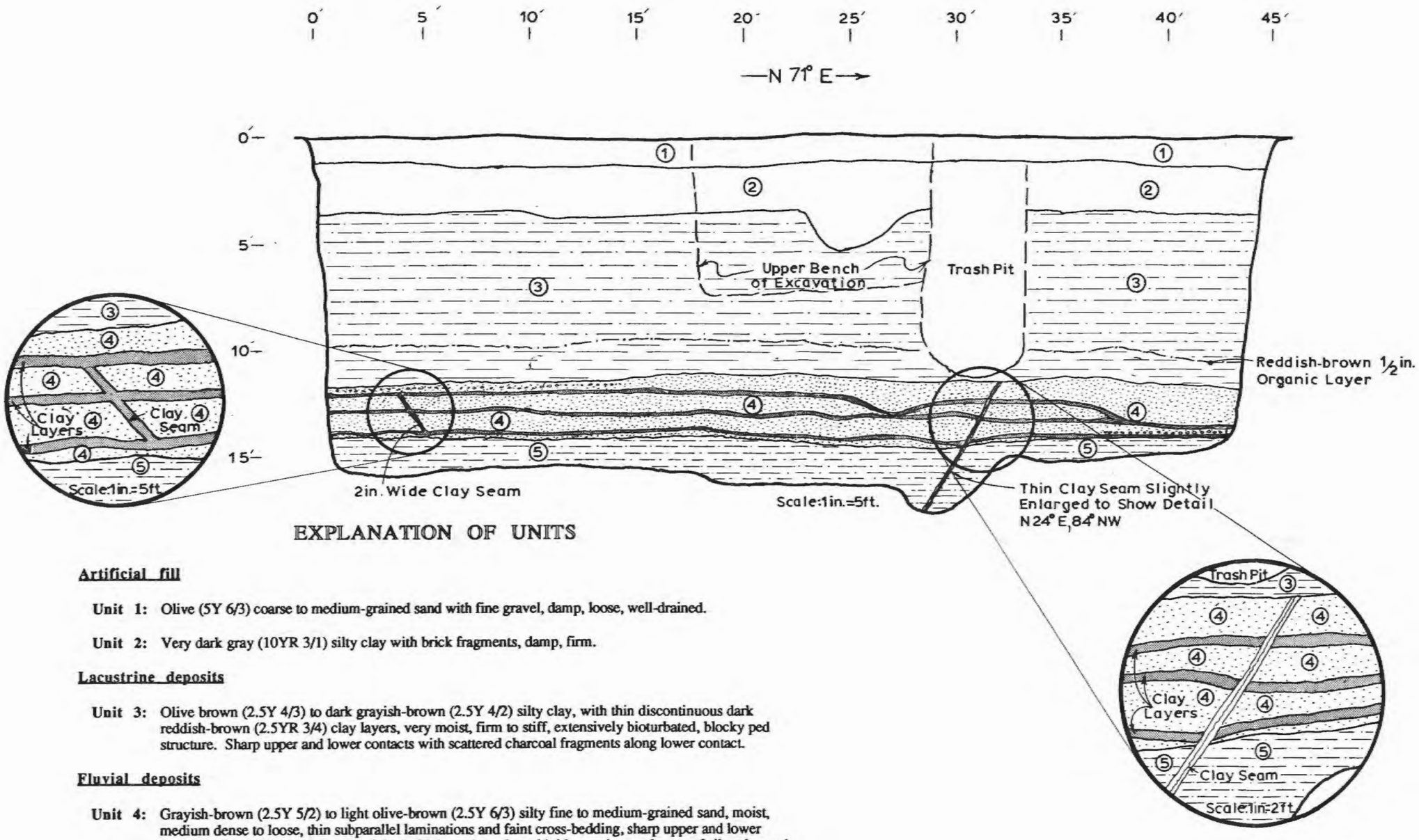
Unit 5: Dark grayish-brown (2.5Y 4/2) with brownish-yellow mottles (2.5Y 4/2) clayey silt to silty clay; very moist, stiff, massive, sharp upper and lower contacts.

Unit 6: Olive brown (2.5Y 4/3) clayey fine sandy silt, moist, stiff.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A4 - Log of Exploratory Trench No. 4

Exploratory Trench No. 5



EXPLANATION OF UNITS

Artificial fill

Unit 1: Olive (5Y 6/3) coarse to medium-grained sand with fine gravel, damp, loose, well-drained.

Unit 2: Very dark gray (10YR 3/1) silty clay with brick fragments, damp, firm.

Lacustrine deposits

Unit 3: Olive brown (2.5Y 4/3) to dark grayish-brown (2.5Y 4/2) silty clay, with thin discontinuous dark reddish-brown (2.5YR 3/4) clay layers, very moist, firm to stiff, extensively bioturbated, blocky ped structure. Sharp upper and lower contacts with scattered charcoal fragments along lower contact.

Fluvial deposits

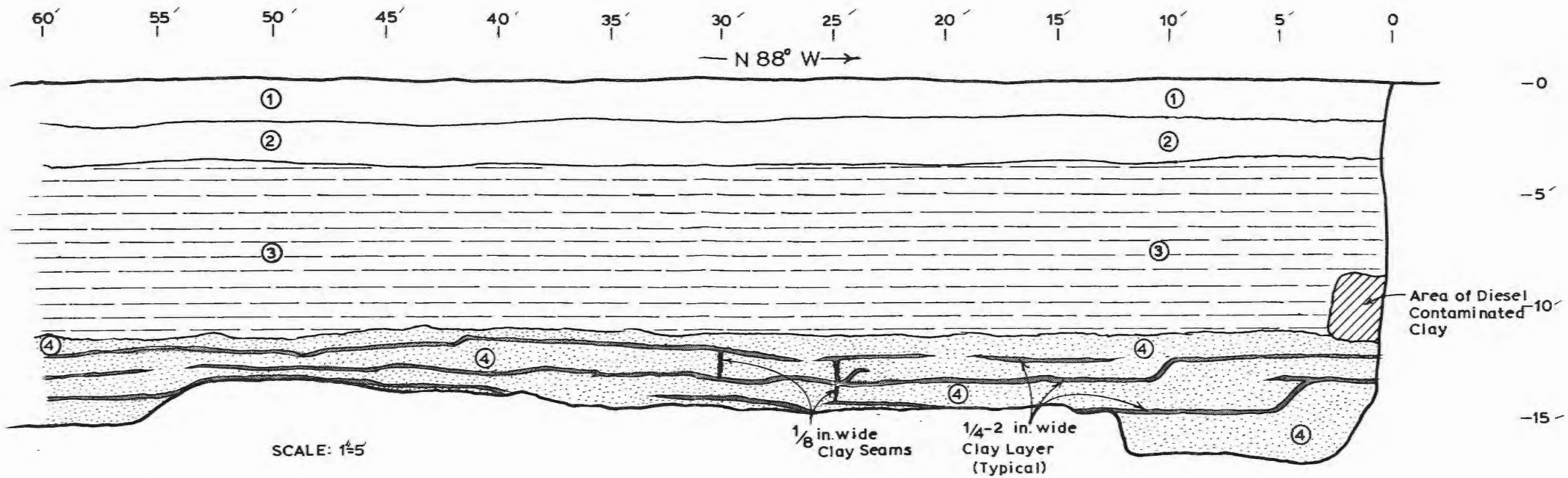
Unit 4: Grayish-brown (2.5Y 5/2) to light olive-brown (2.5Y 6/3) silty fine to medium-grained sand, moist, medium dense to loose, thin subparallel laminations and faint cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay and medium to coarse-grained well-sorted sand.

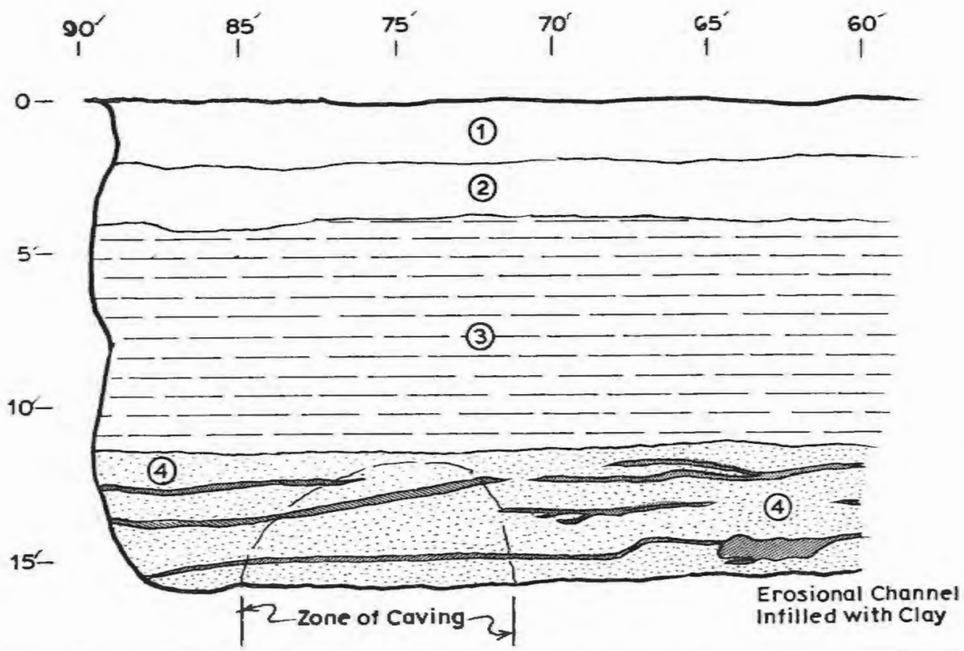
Unit 5: Dark grayish-brown (2.5Y 4/2) with brownish-yellow mottles (2.5Y 4/2) clayey silt to silty clay; very moist, stiff, massive, sharp upper and lower contacts.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A5 - Log of Exploratory Trench No. 5

Exploratory Trench No. 6





EXPLANATION OF UNITS

Artificial fill

Unit 1: Olive (5Y 6/3) coarse to medium-grained sand with fine gravel, damp, loose, well-drained.

Unit 2: Very dark gray (10YR 3/1) silty clay with brick fragments, damp, firm.

Lacustrine deposits

Unit 3: Olive brown (2.5Y 4/3) to dark grayish-brown (2.5Y 4/2) silty clay, with thin discontinuous dark reddish-brown (2.5YR 3/4) clay layers, very moist, firm to stiff, extensively bioturbated, blocky ped structure. Sharp upper and lower contacts with scattered charcoal fragments along lower contact.

Fluvial deposits

Unit 4: Grayish-brown (2.5Y 5/2) to light olive-brown (2.5Y 6/3) silty fine to medium-grained sand, moist, medium dense to loose, thin subparallel laminations and faint cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay and medium to coarse-grained well-sorted sand.

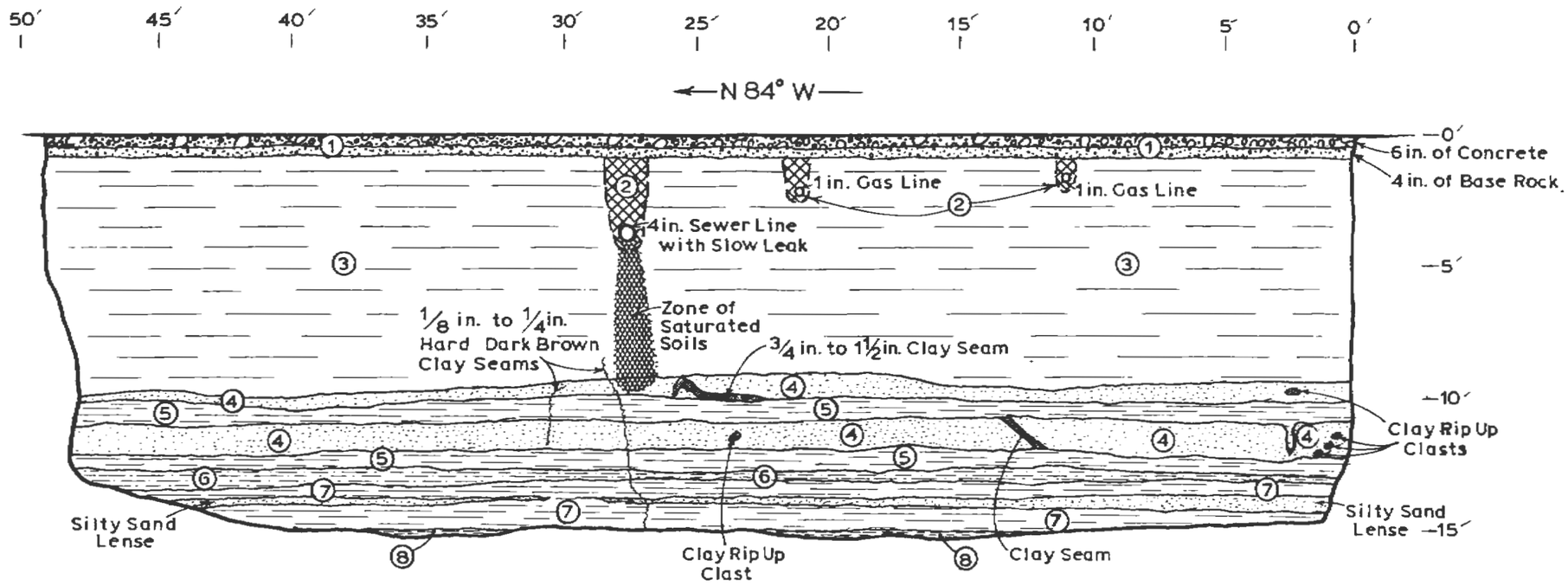
Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A6 - Log of Exploratory Trench No. 6

Exploratory Trenches No. 7&8

Trenches not logged due to caving

Exploratory Trench No. 9



EXPLANATION OF UNITS

Artificial fill

Unit 1: 6 inches of asphaltic concrete over 4 inches aggregate base material.

Unit 2: Silty clay and sand, damp, medium dense.

Lacustrine deposits

Unit 3: Olive gray (5Y 5/2) silty clay, very moist to wet, firm to stiff, bioturbated, small (~1/16-inch) roots to 9 feet depth.

Fluvial deposits

Unit 4: Light olive gray (5Y 6/2) silty very fine-grained sand, very moist, loose to very loose, with scattered clay rip-up clasts.

Unit 5: Olive (5Y 4/2) silty clay; very moist, soft, with scattered caliche pebbles.

Unit 6: Light olive gray (5Y 6/2) silt, very moist, soft.

Unit 7: Light olive gray (5Y 6/2) silty clay, very moist, soft to firm.

Unit 8: Light olive gray (5Y 6/2) sandy clay, very moist to wet, very soft.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A9 - Log of Exploratory Trench No. 9

Exploratory Trench No. 10

Trenches not logged due to caving

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION Drilling Supervised by J.B. on 2-12-91	IN-PLACE DRY DENSITY p.c.f.	IN-PLACE MOISTURE CONTENT % dry wt.
0						
2						
4				Olive brown silty CLAY (CL-CH), moist, stiff		
6						
				Coarse SAND and Gravel in cuttings		
8						
	1-1			Greyish brown to olive brown (2.5Y 5-2/4-4). silty CLAY (CL), moist		
10						
	1-2			Greyish brown (2.5Y 5/2), silty fine SAND (SM), sand, well sorted, slightly moist		
12						
	1-3			Clayey SAND (SC), greyish brown, moist to wet		
14						
	1-4					
16						
	1-5			Olive brown (2.5Y 4-4), silty CLAY (CL-CH), with minor sand fraction, moist		
18						
	1-6			Olive brown (2.5Y 4/4), slightly silty CLAY (CL-CH), moist		
20						
	1-7			Silty CLAY (CL), light olive grey with medium grey mottles, moist		
22						
	1-8					
24						
	1-9			Sandy SILT (ML), light olive grey, slightly clayey, very moist		
26						
	1-10			Silty CLAY (CL), light olive grey with medium grey mottles, very moist		
28						

Figure A10 - Log of Test Boring No. 1

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f.	IN-PLACE MOISTURE CONTENT % dry wt.
30	1-11			decrease in silty fraction		
32	1-12			Clayey SILT (ML), light olive grey, soft, very moist		
34	1-13			CLAY (CL), light olive grey, very moist		
36	1-14			Silty SAND (SM), olive grey, loose, slightly clayey, very fine grained, very moist, abundant mica grains		
38	1-15			Rare medium grains, very silty, wet, trace 1/8" roots, with medium blueish grey mottles		
40	1-16			CLAY (CL), medium blueish grey, very moist, trace 1/8" roots		
42				Boring terminated at 40.0 feet		

Figure A11 - Log of Test Boring No. 1--continued

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION Drilling Supervised by B.P. on 2-12-91	IN-PLACE DRY DENSITY p.c.f.	IN-PLACE MOISTURE CONTENT % dry wt
0						
				Silty CLAY (CL), light olive grey (5Y 5/2), slightly moist		
2						
4						
6				Moist		
8						
	2-1		24			
10	2-2		24			
12	2-3		16	Silty SAND (SM), light olive grey (5Y 5/2), very fine to fine grained, very moist		
	2-4		16			
14				Clay (CL), light olive grey, moist		
	2-5		12	Sandy CLAY (CL), light olive grey, high silt fraction very moist, fine to rare medium grains		
16	2-6		27			
18	2-7		14	CLAY (CL), light olive grey, moist, common root casts, trace of caliche Very moist and soft with increasing silt fraction		
	2-8		13			
20				Silty CLAY (CL), light olive grey, very moist, soft, common medium grey mottles		
	2-9		17			
22	2-10		14			
24	2-11		15			
	2-12		15	Sandy SILT (ML), light olive brown, very moist, very fine grained, clayey		
26	2-13		21	Clayey SILT (ML), light olive brown, moist, common blue grey mottles, abundant mica, very moist common FeO_2 stains		
28	2-14		20			

Figure A12 - Log of Test Boring No. 2

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION Drilling Supervised by B.P. on 2-12-91	IN-PLACE DRY DENSITY p.c.f.	IN-PLACE MOISTURE CONTENT % dry wt.
30	2-15			Silty CLAY (CL), very moist, abundant root casts, abundant blue grey mottles mottles appear to be concentrated concentrically around root casts trace rounded 1/8" caliche		
32	2-16					
34	2-17					
	2-18			Clayey SILT (ML), light olive grey, very moist		
36						
	2-19			Silty SAND (SM), light olive grey, very moist, very fine to fine grained abundant mica, clayey		
38	2-20			decrease clay		
40	2-21					
	2-22					
42	2-23			Clay (CL), light olive brown (5Y 5/6) very moist, common 1/2-1" zones of intense medium bluish grey mottling, trace roots, trace caliche		
44						

Figure A13 - Log of Test Boring No. 2--continued

File No. AO-2280-S1

June 12, 1991

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION Drilling Supervised by B.P. on 2-12-91	IN-PLACE DRY DENSITY p.c.f.	IN-PLACE MOISTURE CONTENT % dry wt.
0						
				2" AC over 10" of Class II Base		
2				Backfill sand		
4						
6						
8				Silty CLAY (CL), moist		
10						
12				Silty SAND (SM), light olive grey, moist, very fine to fine grained		
14				Clayey SAND (SC), light olive grey, very moist to wet, very fine to medium grained		
16	3-1			CLAY (CL), light olive grey, very moist, stiff tract of fine to medium grained sand		▼
	3-2					
18						
	3-3			blue grey mottles, trace caliche		
20	3-4			common root cast beginning at 20.5'		
22	3-5			root casts become abundant, mottles are concentric around root casts		
	3-6					
24				increasing silt fraction at 23.5', abundant sand size grains of caliche		
	3-7			Clayey SILT (ML), light olive brown, trace very fine sand, very moist		
26	3-8					
				CLAY		
28	3-9					
				Clayey SILT (ML), slightly sandy		
30	3-10					
	3-11					
32						
34						

Figure A14 - Log of Test Boring No. 3

APPENDIX B

Radiocarbon Dating Analysis

BETA ANALYTIC INC.

JERRY J. STIPP, PH.D.
MURRY A. TAMERS, PH.D.
CO-DIRECTORS

4985 S.W. 74 COURT
MIAMI, FLORIDA
33155 U.S.A.

Mr. Lew Rosenberg
Applied Soil Mechanics, Inc.
2999 Monterey-Salinas Hwy.
Monterey, CA 93940

January 26, 1991

Dear Mr. Rosenberg:

Please find enclosed our result on the soil sample that you recently sent for PRIORITY radiocarbon dating analysis. We hope the date proves valuable in your research.

The sample was dispersed in hot distilled water. A significant amount of rootlet contamination was present and this was removed by a repeated combination of sieving, floatation and hand-picking. A small amount of charcoal was isolated and this was treated with hot acid and alkali solutions to remove any carbonate or humic acid contamination. The soil was treated with hot acid-only to remove any carbonates. Because the amount of charcoal was so small, it was recombined with the soil and processed on this basis. An adequate amount of carbon was present, and all analytical steps proceeded normally.

We have enclosed our invoice. Would you please forward this to the appropriate office for payment. Please don't hesitate to call us at any time there are questions or problems with which we can be of any assistance. With best regards I remain

Sincerely yours,

Jerry J. Stipp

TELEPHONE: 305-667-5167 / FAX: 305-663-0964 / BITNET: XNRBET22@SERVAX

BETA ANALYTIC INC.
(305) 667-5167
UNIVERSITY BRANCH
P.O. BOX 248113
CORAL GABLES, FLA. 33124

REPORT OF RADIOCARBON DATING ANALYSES

FOR: Lew Rosenberg
Applied Soil Mechanics, Inc.
Monterey-Salinas, CA

DATE RECEIVED: January 21, 1991
DATE REPORTED: January 26, 1991
SUBMITTER'S PURCHASE ORDER #

OUR LAB NUMBER	YOUR SAMPLE NUMBER	C-14 AGE YEARS B.P. ± 1σ	
Beta-42524	None	3,720 +/- 90	Soil/charcoal

These dates are reported as RCYBP (radiocarbon years before 1950 A.D.). By international convention, the half-life of radiocarbon is taken as 5568 years and 95% of the activity of the National Bureau of Standards Oxalic Acid (original batch) used as the modern standard. The quoted errors are from the counting of the modern standard, background, and sample being analyzed. They represent one standard deviation statistics (68% probability), based on the random nature of the radioactive disintegration process. Also by international convention, no corrections are made for DeVries effect, reservoir effect, or isotope fractionation in nature, unless specifically noted above. Stable carbon ratios are measured on request and are calculated relative to the PDB-1 international standard; the adjusted ages are normalized to -25 per mil carbon 13.

Applied Soil Mechanics
INCORPORATED
SOIL AND FOUNDATION ENGINEERS • GEOLOGISTS

FAULT STUDY

Building Sites 7 & 8
Bruhn and Peterson Properties
515, 525, and 530 San Benito Street
Hollister, California

JULY 1991

APPENDIX A.7

Applied Soil Mechanics, Inc.
SOIL AND FOUNDATION ENGINEERS • GEOLOGISTS
400 Park Center Drive, Suite 7 • Hollister, CA 95023
(408) 637-2133 • FAX (408) 637-0510

File No. A0-2281-S1 July 12, 1991

City of Hollister Redevelopment Agency
375 Fifth Street
Hollister, CA 95023

Attention: Mr. Christopher M. Reyes, Program Manager

Subject: **Bruhn and Peterson Properties, Building Sites 7 & 8**
515, 525, and 530 San Benito Street
Hollister, California
FAULT STUDY

Gentlemen:

As you requested, we have completed the fault study for the Bruhn and Peterson properties. The purpose of this study was to determine if there was evidence for a trace of the East Branch of the Calaveras fault is within the study area. The following report presents the results of our study.

No evidence for the presence of active fault traces was gathered during the field exploration phase of this study. Based on the results of this study, the site is suitable from an engineering geologic viewpoint for the proposed building improvements, provided that the recommendations presented herein and those of the recommended soil engineering study are incorporated into appropriate construction plans and specifications.

The submission of this report concludes this phase of our contract with the City. We are pleased to have been of service to you on this project.

Sincerely,

APPLIED SOIL MECHANICS, INC.

Written by:

Lewis Rosenberg/wc

Lewis Rosenberg
Project Geologist

Reviewed by:

Richard T. Gorman

Richard T. Gorman, C.E.G. 1325
Consulting Geologist

cc: Addressee (10)

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INTRODUCTION

This report presents the results of our fault study for the Bruhn and Peterson properties in Hollister, California (see Figure 1). The Bruhn and Peterson properties are located at 515 and 525 San Benito Street (Building Site No. 7), and the former Hollister Travel building at 530 San Benito Street (Building Site No. 8) and are shown on Figure 2. Building Sites 1 through 6 and 9 to 10 are discussed in other reports (Applied Soil Mechanics, 1991c, 1991d).

These properties are within a special study zone delineated by the City of Hollister and the California Division of Mines and Geology for the East Branch of the Calaveras fault (Figure 3). City and State laws mandate that geologic studies be performed for properties along known active fault zones (Alquist-Priolo Special Studies Zones). The stated intent of these laws is to evaluate the potential for fault rupture to occur on the property before building, rebuilding or substantial remodeling of structures for human occupancy.

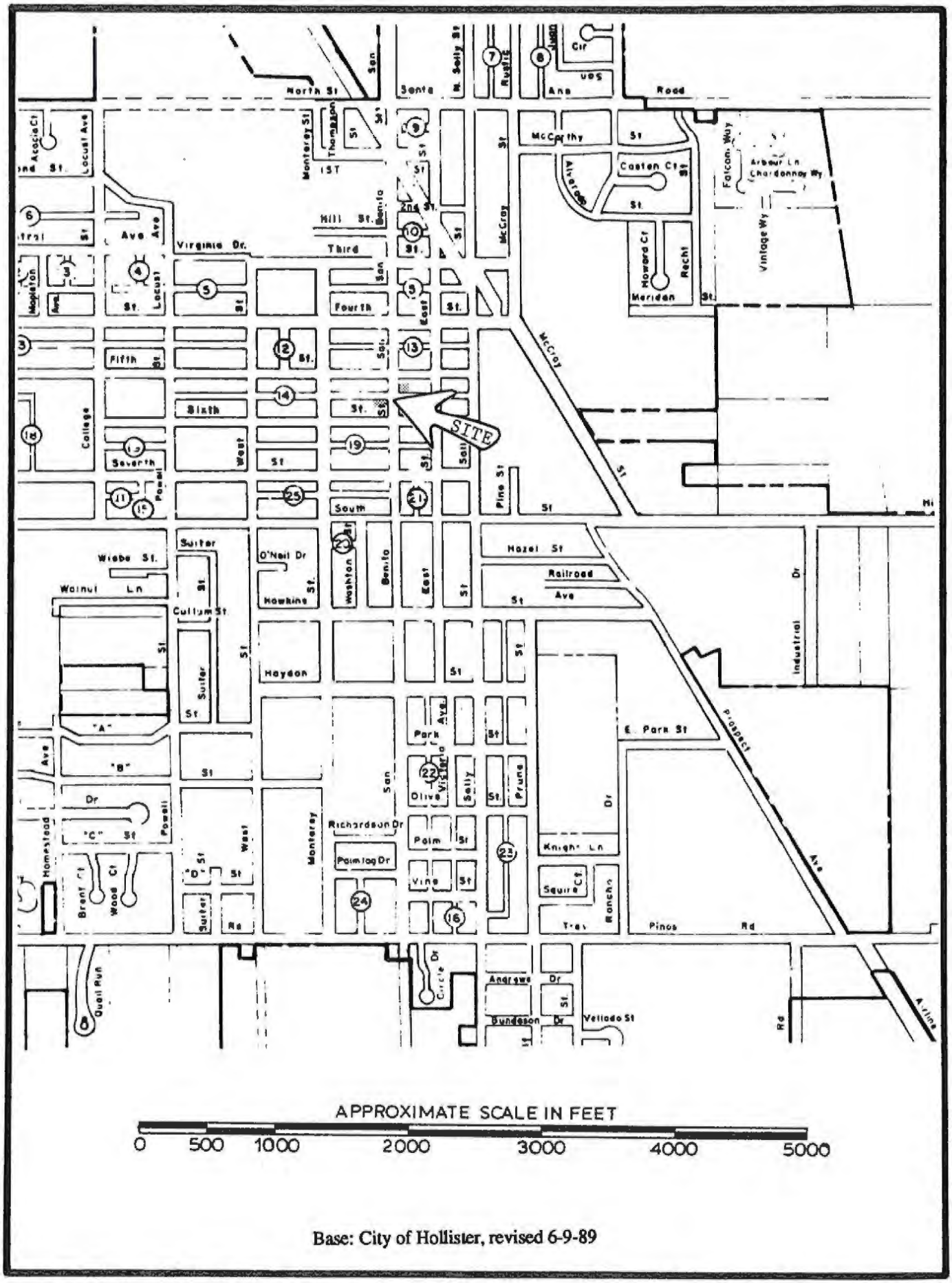
We would like to express our special thanks to the City of Hollister for providing manpower and equipment during the field explorations.

Project Description

The commercial building sites discussed below are shown on Figure 2.

Building Site 7 – The 0.17-acre site includes the vacant lots at 515 and 525 San Benito Street. The building on the site sustained damage as a result of the October 17, 1989 Loma Prieta earthquake and was later demolished. The site is bounded by San Benito Street on the west, commercial buildings on the north and east, and Wentz Alley on the south. Based on our recent discussions with the City, it is our understanding that the proposed project will consist of building a new structure.

Building Site 8 – The 0.06-acre site includes the vacant lot at 530 San Benito Street. The building on the site sustained damage as a result of the October 17, 1989 Loma Prieta earthquake and was later demolished. The site is bounded by a commercial building on the west, San Benito Street on the east, Wentz Alley on the north, and a commercial building on the south. Based on our recent discussions with the City, it is our understanding that the proposed project will consist of building a new structure.



APPROXIMATE SCALE IN FEET

0 500 1000 2000 3000 4000 5000

Base: City of Hollister, revised 6-9-89

Figure 1 - Vicinity Map

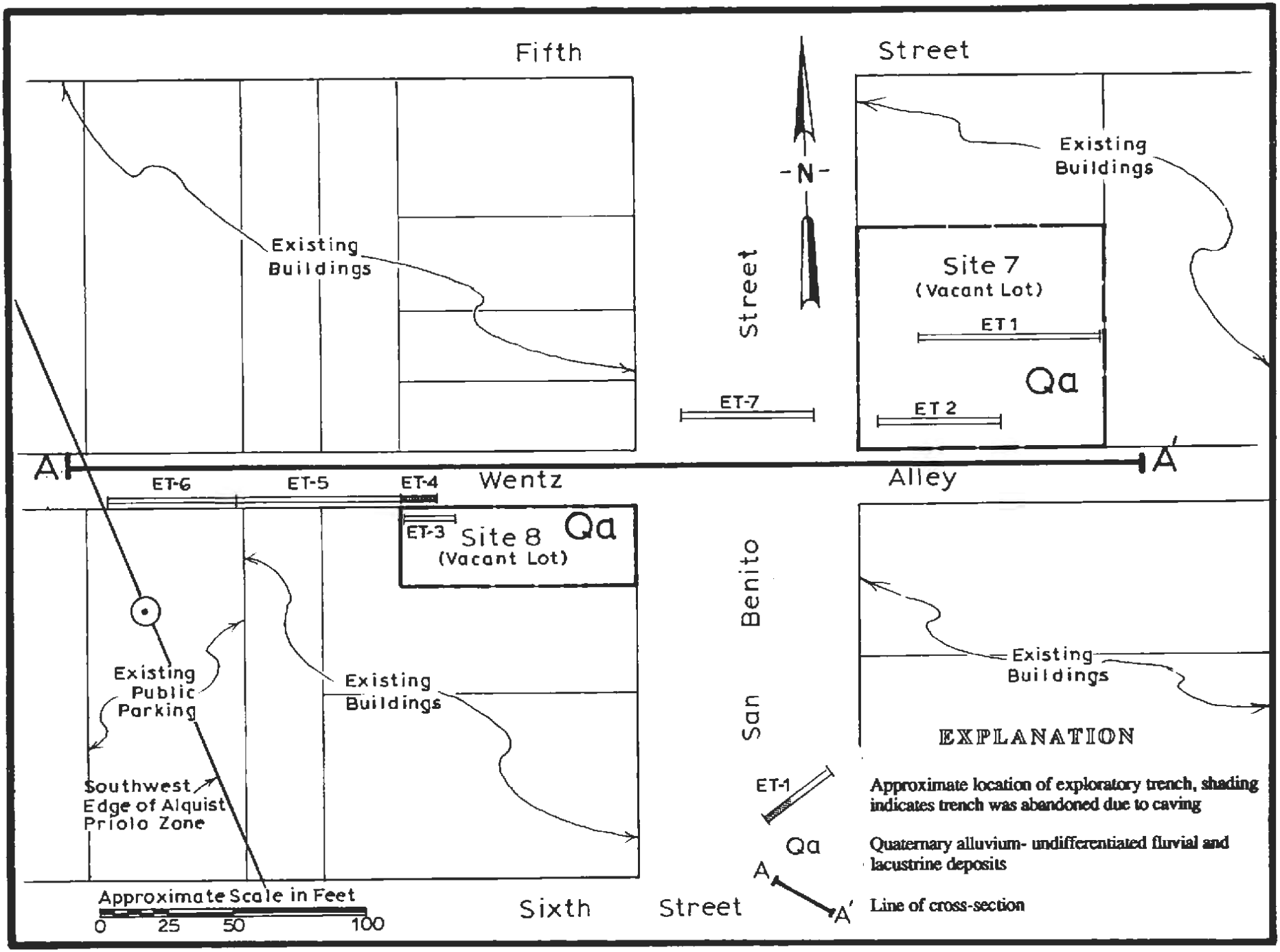
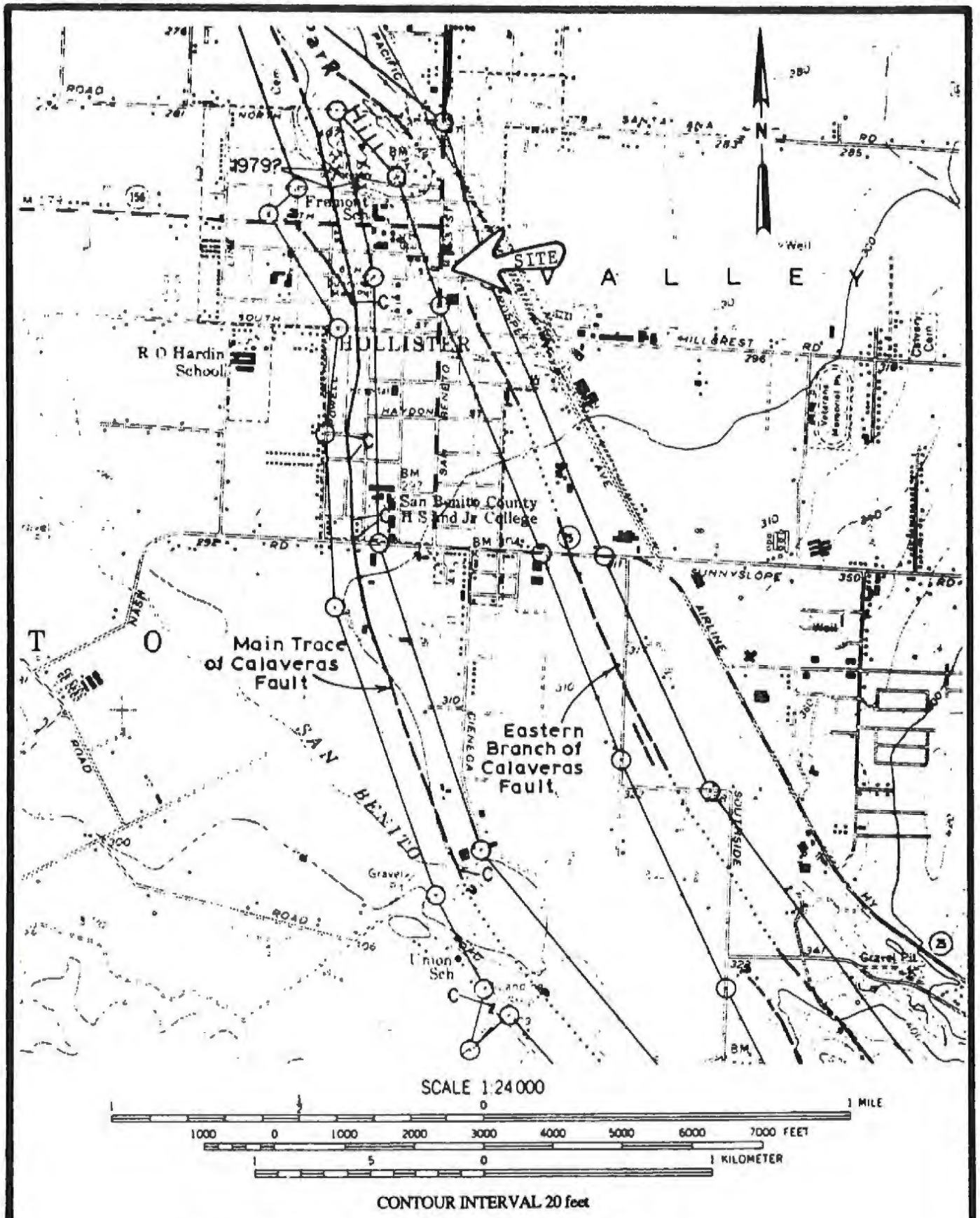


Figure 2 - Site Plan and Geology Map



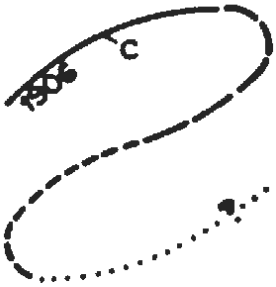
CONTOUR INTERVAL 20 feet

Base: U.S.G.S. topographic map of the Hollister 7.5' Quadrangle, 1955 photorevised 1971. Geology modified from T.W. Dibblee (1975)

Figure 3 - Alquist Priolo Special Studies Zone Map

MAP EXPLANATION

Potentially Active Faults

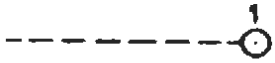


Faults considered to have been active during Quaternary time; solid line where accurately located, long dash where approximately located, short dash where inferred, dotted where concealed; query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by creep or possible creep.

Aerial photo lineaments (not field checked); based on youthful geomorphic and other features believed to be the results of Quaternary faulting.

Special Studies Zone Boundaries

These are delineated as straight-line segments that connect consecutively numbered turning points so as to define one or more special studies zone segments.



Seaward projection of zone boundary.

From: California Division of Mines and Geology (1982)

Figure 3a - Explanation for Alquist Priolo Special Studies Zone Map

PURPOSE AND SCOPE OF SERVICES

The purpose of this study was twofold; the first was to identify the geologic conditions and evaluate existing potential geologic and seismic constraints at the site. The second purpose was to provide recommendations for site development from an engineering geologic viewpoint. This study included the following scope of work:

1. Research, review, and evaluate data from published and unpublished geologic and geotechnical reports;
2. Discussions with representatives of the City of Hollister, the California Division of Mines and Geology (CDMG), and the U.S. Geological Survey (USGS);
3. Study of a series of aerial photographs of the site and vicinity;
4. Excavating, shoring, cleaning, and logging approximately 310 lineal feet of trenches;
5. Drilling and logging one exploratory boring to a depth of approximately 20 feet below the ground surface;
6. Age dating of sediments using radiocarbon dating techniques;
7. Geologic analysis of field and office data; and,
8. Preparing this report, along with appropriate graphics and including the findings of the study and recommendations for development of the proposed building sites.

GEOLOGIC SETTING

The Bruhn and Peterson properties, Building Sites 7 & 8, are situated within the Hollister Valley. The valley boundaries are the Pajaro River on the north, the mountains of the Gabilan Range on the west, the Diablo Range on the east, and the juncture of the Gabilan and Diablo Ranges on the south. The Gabilan Range consists of late Cretaceous age granitic rocks and metamorphic rocks, including marbles, quartzite, and schist (Compton, 1966). Overlying the granitic rocks is a series of Oligocene to middle Miocene age sandstones and shales (Allen, 1946). The Diablo Range consists of Jurassic-Cretaceous age sandstones, limestones, volcanic rocks, and metamorphic rocks which are part of the Franciscan Complex. Associated with the Franciscan rocks are metamorphic rocks of the Gabilan Range which include marble, dolomite, quartzite, and schist. Upper Cretaceous age sandstones, shales and conglomerates overlie the Gabilan metamorphic rocks and Franciscan rocks (Page, 1966).

The geologic structure of the Hollister area and the Gabilan and Diablo Ranges is strongly influenced by the active San Andreas and Calaveras faults. These faults strike northwest and are characterized by a combination of strike-slip and reverse displacement. The San Andreas and Calaveras faults are steeply southwest-dipping shear zones that separate Jurassic-Cretaceous Franciscan basement rocks from Cretaceous granitic basement rocks. The Calaveras fault branches off from the San Andreas fault approximately 8 miles south of Hollister (see Figure 4).

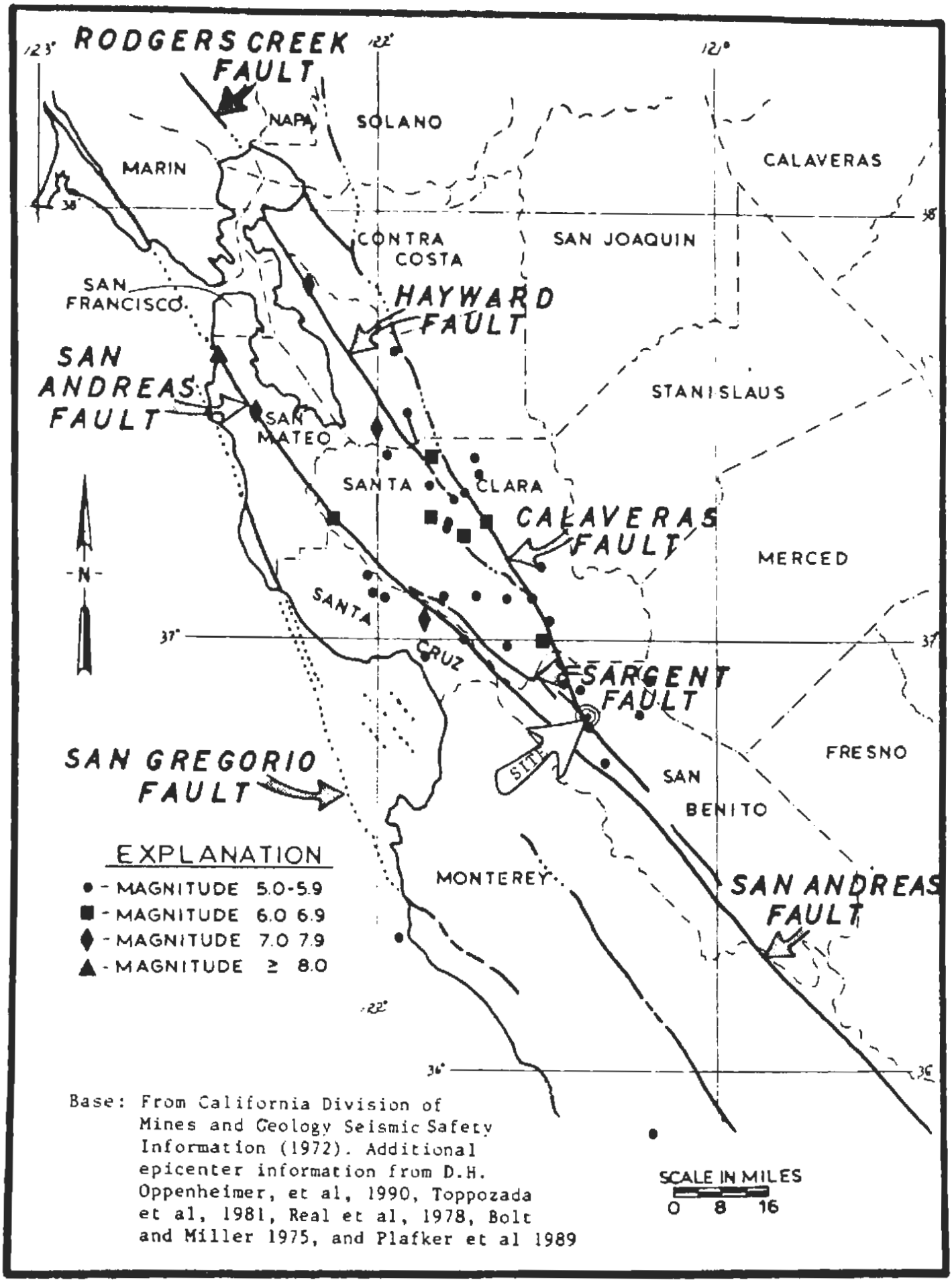
Several periods of movement on the San Andreas and Calaveras faults occurred in the Hollister area, causing uplift of the mountains bordering the valley. The combination of faulting and folding resulted a structural basin which was a seaway during the late Miocene to Pliocene (Allen, 1946). During Pliocene and Pleistocene time, extensive floodplain deposits known as the San Benito Gravels were deposited in the valley (Kilburn, 1972). During the Pleistocene, subsidence in the Hollister Valley due to tectonic activity resulted in deposition of a series of sands, silts, and clays

over the San Benito Gravels (McMasters and others, 1987). These deposits are interpreted as Pleistocene and Holocene age lake deposits (Jenkins, 1973) or as a group of shallow, short-lived lakes in a fluvial environment (Hoose, 1986; McMasters and others, 1987). Holocene activity consists mostly of down-cutting by the San Benito River and mass wasting of upland areas by landslides and erosion. The regional geology is depicted on Figure 5.

Faulting, Hollister Area

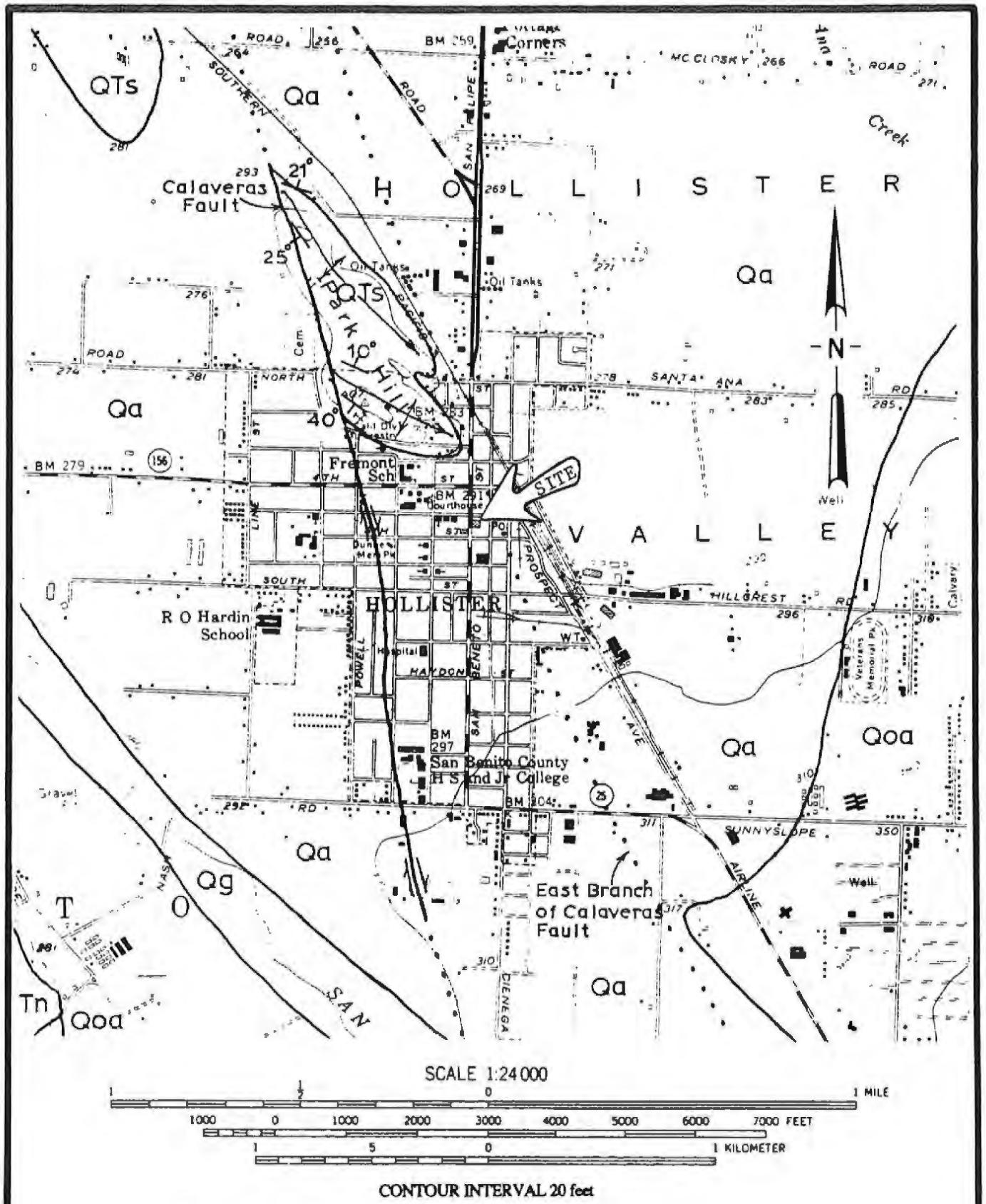
An important structural element in the Hollister area is the Calaveras fault system. Several branches of the Calaveras fault have been mapped in the Hollister area and are shown on Figure 4. The main branch is referred to as the "West Branch" by Bryant (1979). The West Branch has documented creep activity, producing at least 13 inches of right-lateral slip (Rogers and Nason, 1971). In addition, there was at least 5 mm (1/5-inch) of observed slip along the West Branch as a result of sympathetic movement during the Loma Prieta earthquake (McClellan and Hay, 1989). McClellan and Hay (1989) did not study the East Branch, as they stated that it is inactive.

The East Branch was mapped based on geomorphic evidence at Park Hill at the north end of Hollister and on a hill south of Hollister with a benchmark elevation of 668 feet. The fault was inferred between these localities based on a groundwater offset (Ellis, 1952; Kilburn, 1972) and subtle west-facing scarps (Bryant, 1979). The East Branch is mapped approximately 100 feet east of the Bruhn site and is considered active by the CDMG (Bryant, 1979) based on offset bedding in trenches excavated by Leighton and Associates (1974) and Woodward-Clyde and McClure & Messinger (1968).



Base: From California Division of Mines and Geology Seismic Safety Information (1972). Additional epicenter information from D.H. Oppenheimer, et al, 1990, Toppozada et al, 1981, Real et al, 1978, Bolt and Miller 1975, and Plafker et al 1989

Figure 4 - Regional Fault & Epicenter Map



CONTOUR INTERVAL 20 feet

Base: U.S.G.S. topographic map of the Hollister 7.5' Quadrangle, 1955 photorevised 1971. Geology modified from T.W. Dibblee (1973)

Figure 5 - Regional Geology Map

EXPLANATION

Geologic Units

Qg- Stream gravel and sand (Holocene)

Qa- Alluvium (Holocene)

Qoa- Older alluvium: terrace deposits (Pleistocene)

QTs- Santa Clara Formation (Pliocene-Pleistocene)

Tn- Non-marine sedimentary rocks: greenish gray to rarely reddish claystone, siltstone and interbedded friable buff-gray sandstone

Symbols

Contact

Fault: dashed where indefinite or inferred, dotted where inferred and concealed. Horizontal displacement designated by parallel arrows

Axis of fold (anticlinal): arrow indicates direction of plunge

Figure 5a - Explanation for Regional Geology Map

METHODS OF STUDY

Literature and Map Review

As part of our study, we reviewed reports and maps pertaining to the site and vicinity. Most of the published geologic information on this area is preliminary in nature, and is based on reconnaissance techniques and extrapolation of data.

The regional geology was mapped by Taliaferro (1948). Taliaferro's map shows the Calaveras fault north and south of Hollister, but does not have a symbol depicting a location of the fault within downtown Hollister. An eastern branch of the Calaveras fault was mapped by Ellis (1952) based on an offset blue clay layer noted on well logs. The blue clay is offset across the East Branch of the Calaveras fault by approximately 50 feet with the west side up. The wells were spaced hundreds of feet apart with some wells "a few hundred feet on each side of the fault in a few places" and approximately "30 to 40 feet of offset" of the groundwater table (William C. Ellis, oral communication, May 1991).

Detailed mapping of the Calaveras fault within Hollister was performed by Rogers (1967). Rogers mapped the main (west) branch as a right-lateral strike-slip fault which exhibits active creep. The eastern branch of the Calaveras fault in downtown Hollister was mapped using a symbol that denotes uncertainty of existence and/or location by Rogers and others (1968). They show this to be a high-angle fault with the west side upthrown. The East Branch of the Calaveras fault was trenched by Woodward-Clyde & Associates and McClure & Messinger (1968) at a site approximately 3/4-mile south of the Bruhn and Peterson properties. They stated, "Evidence was found, and which could possibly be construed as indicating the presence of a fault trace, consisted of several small clay seams and slickensided planes. These did not extend to the ground surface." Woodward-Clyde (1978) reviewed this 1968 study and concluded that the seams could have been due to other causes such as shrinkage cracks, lurch cracking, or liquefaction. They postulated that

the most likely interpretation was that these features could be considered to be conjugate shears and tension fractures developing in a fault zone.

Rogers and Nason (1971) examined streets and other man-made structures in Hollister for evidence of fault displacement. They concluded that the main branch of the Calaveras fault exhibited active creeping movement. The subsidiary branches of the Calaveras fault in Hollister were considered by Rogers and Nason (1971) to be, "...presently dormant because they do not show consistent evidence of curb or sidewalk offset." and "... local subsidence features were more abundant and extreme along the traces of the inferred dormant faults than elsewhere." Kilburn (1972) indicated a groundwater offset of approximately 20 feet with the east side up across the West and East Branches of the Calaveras fault based on well data.

Jenkins (1973) studied the Quaternary deposits in the Hollister Valley and concluded that a large lake (Lake San Benito) covered much of Hollister during the Pleistocene time period. The Hollister area was remapped by Rogers (1973) and Dibblee (1975). They showed the East Branch of the Calaveras fault, but did not identify the relative sense of fault movement. Leighton and Associates (1974) observed offset units in an exploratory trench along the East Branch of the Calaveras fault on hill 668 (approximately 2 miles south of Hollister). As part of the State fault evaluation program, CDMG (1974) considered the East Branch of the Calaveras fault as sufficiently active and well-defined to be included within an Alquist-Priolo Special Studies Zone. Bryant (1979) remapped the East Branch of the Calaveras fault approximately 200 feet west of the location shown on the 1974 Special Studies Zone map. The latest revision of the Special Studies Zone map (CDMG, 1982) incorporates Bryant's modifications.

Site-specific investigations by Terratech (1974, 1976, 1977) within the East Branch Special Studies Zone reported no evidence of faulting. These studies relied on magnetometer traverses and drilling, and did not use exploratory trenching. Other workers have located the East Branch of the

Calaveras fault in Hollister area. Terratech (1978) trenched the fault on the east side of Park Hill, approximately 1/4-mile north of the site. The fault was described on a trench log as consisting of "slickensided striated surfaces on siltstone, fault plane ? N65°W, dip 59°N". The log further discusses fault-like features as shears (up to 1" wide) on either side of the fault plane oriented N0°E, 87°N". Calcium carbonate (caliche) was described as present along the fault plane.

Bay Soils (1981) described the fault as, "... a subtle change in the bedding of silt was noted in Trench No. 1, near the location of the other anomalous factors. This consisted of an upwarping of the bedding from horizontal to 10° to 15°". Earth Systems Consultants (1985) delineated the fault based on, "A gradual vertical material boundary" with dissimilar horizontal beds on either side of the boundary.

Terratech (1987) stated, "All of the trenches exposed evidence of apparent vertical displacement." Units are vertically offset by "about 1-1/2 to 3 feet" along near-vertical discontinuous clay seams with the east side up. The strike of faults in the trenches varied from N-S to N40°E, with steep dips to the east and west. J.V. Lowney & Associates (1990a, 1990b) interpreted, "... abrupt offset of laterally continuous beds, abrupt monoclinal folding of sediments and convoluted bedding." as evidence of faulting.

Applied Soil Mechanics (1991a) located a fault on a property within East Branch Special Studies Zone approximately 1/4 mile south of the downtown area. The fault is characterized by, "... steeply dipping to near-vertical, NNE to NNW-striking fractures ... infilled with loose, fine-grained sand. ... Thin continuous clay layers and entire stratigraphic units are disrupted and offset in this zone. The maximum vertical offset along the fractures was approximately 21 inches..." Applied Soil Mechanics has recently excavated several trenches across the mapped trace of the East Branch of the Calaveras fault in downtown Hollister. Features similar to the well-defined faulting

in trenches studied by Terratech (1978, 1987) and Applied Soil Mechanics (1991a) were not observed in the downtown area. The locations of these earlier studies are shown on Figure 6.

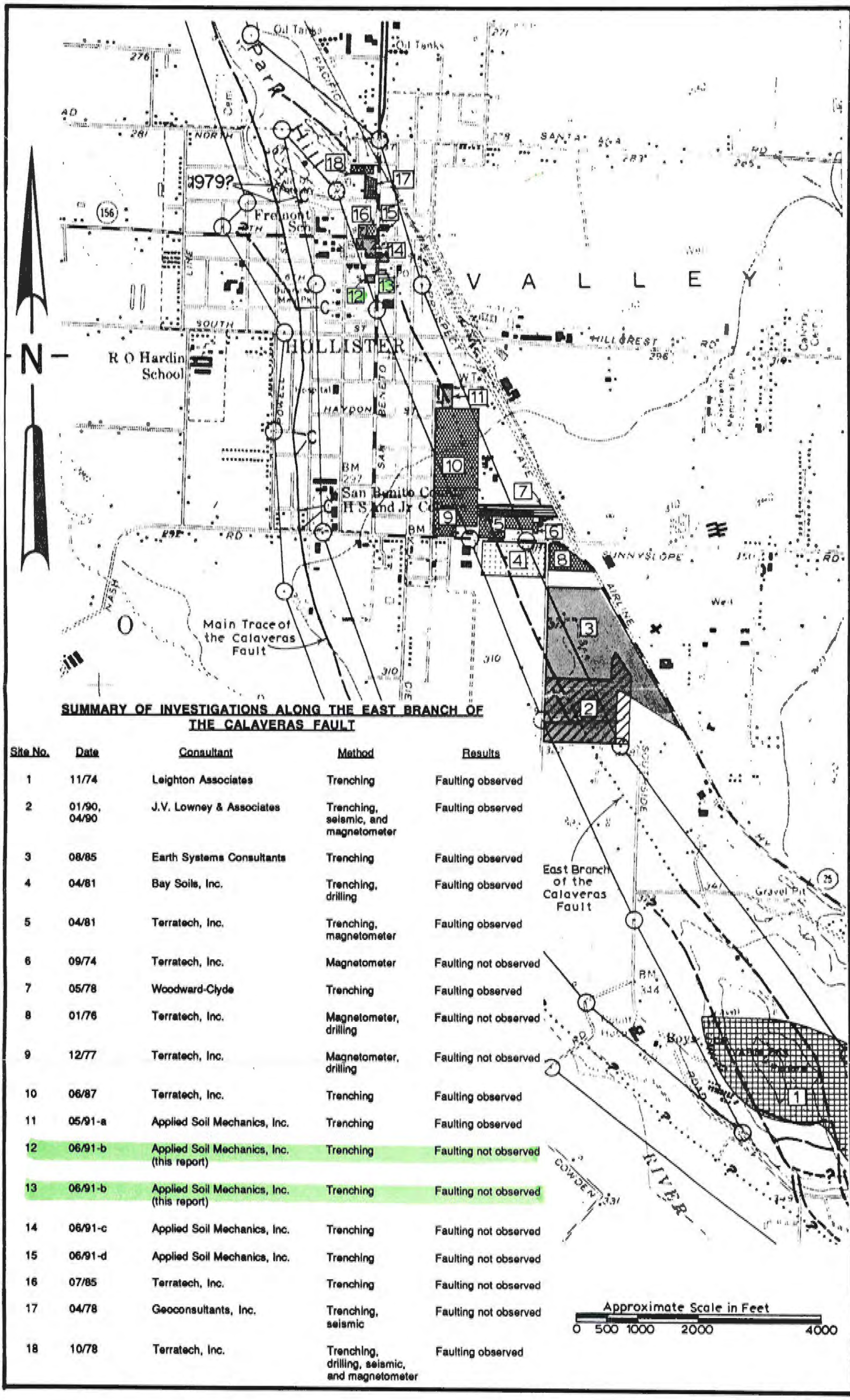
Aerial Photograph Interpretation

We studied aerial photographic stereo pairs taken of the Hollister area from 1967 to 1990. The following aerial photographs of the site and vicinity were used in this study:

Date	Approximate Scale	Type	Source
May 1967	1:20,000	black and white	USDA
May 1980	1:40,000	black and white	USDA
April 1985	1:31,680	black and white	WAC
July 1987	1:33,600	black and white	PAS
June 1989	1:31,680	black and white	WAC
August 1990	1:12,000	black and white	PAS

These photographs were studied for geomorphic evidence that could indicate active faulting. Faults typically appear on aerial photographs as a linear features with tonal differences on either side. These differences could be related to changes in soil and rock type, vegetation, groundwater levels, or bedding characteristics. Lineaments are sometimes associated with topographic features characteristic of fault zones such as linear and shutter ridges, sag ponds, springs, and offset drainages.

Within the downtown area, the aerial photographs were of limited use since development predates historic photography. Outside of town, a distinct northwest-trending lineament was seen on the aerial photographs where there is a narrow band which is lighter in color than the surrounding area in an orchard near Prune and Hawkins Streets . This lineament coincides with the mapped trace of



SUMMARY OF INVESTIGATIONS ALONG THE EAST BRANCH OF THE CALAVERAS FAULT

Site No.	Date	Consultant	Method	Results
1	11/74	Leighton Associates	Trenching	Faulting observed
2	01/90, 04/90	J.V. Lowney & Associates	Trenching, seismic, and magnetometer	Faulting observed
3	08/85	Earth Systems Consultants	Trenching	Faulting observed
4	04/81	Bay Soils, Inc.	Trenching, drilling	Faulting observed
5	04/81	Terratech, Inc.	Trenching, magnetometer	Faulting observed
6	09/74	Terratech, Inc.	Magnetometer	Faulting not observed
7	05/78	Woodward-Clyde	Trenching	Faulting observed
8	01/76	Terratech, Inc.	Magnetometer, drilling	Faulting not observed
9	12/77	Terratech, Inc.	Magnetometer, drilling	Faulting not observed
10	06/87	Terratech, Inc.	Trenching	Faulting observed
11	05/91-a	Applied Soil Mechanics, Inc.	Trenching	Faulting observed
12	06/91-b	Applied Soil Mechanics, Inc. (this report)	Trenching	Faulting not observed
13	06/91-b	Applied Soil Mechanics, Inc. (this report)	Trenching	Faulting not observed
14	06/91-c	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
15	06/91-d	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
16	07/85	Terratech, Inc.	Trenching	Faulting not observed
17	04/78	Geoconsultants, Inc.	Trenching, seismic	Faulting not observed
18	10/78	Terratech, Inc.	Trenching, drilling, seismic, and magnetometer	Faulting observed

Figure 6 - Fault Studies Map

the East Branch of the Calaveras fault (Bryant, 1979). The ground slope is not interrupted by the lineament on the air photos. Also, rows of trees in the orchard crossed by the mapped fault are not offset, indicating that fault creep displacement has not occurred since the orchard was planted. At Park Hill at the north end of town, and at hill 668 south of town, geomorphic evidence of faulting is indicated as topographic benches that are modified by erosion.

Subsurface Explorations

As part of this study, approximately 310 lineal feet of exploratory trench was excavated between February 13 and May 1, 1991 using a rubber-tire backhoe with a 24-inch wide bucket. The trenches were located nearly perpendicular to the alignment of the fault trace mapped by the CDMG (1982). The positioning of the trenches was intended to intercept the most likely traces of faults in the area, assuming a regional north to northwest trend.

In addition, one exploratory boring was drilled on April 25, 1991 using a truck-mounted drill rig with 8-inch-diameter hollow stem augers. The locations of the trenches and the boring are shown on Figure 2. The trench and boring logs are included in Appendix A.

The trenches designated as ET-1 and ET-2 were located on the empty lot at the northeast corner of Wentz Alley and San Benito Street. Trench ET-1 was approximately 72 feet long, trended N90°E, and extended to a depth of 13 feet below the ground surface. Trench ET-2 measured approximately 38 feet long, trended N90°E, and extended to a depth of 19-1/2 feet.

Trench ET-3 was located on the empty lot at the southwest corner of Wentz Alley and San Benito Street. Trench ET-3 was approximately 20 feet long, trended N90°E, and extended to a depth of 14-1/2 feet.

Trenches ET-4, ET-5, and ET-6 were located in Wentz Alley west of San Benito Street. Trench ET-4 was approximately 10 feet long, trended N90°E, and extended to a depth of 15 feet below the ground surface, however, the trench walls caved before they could be logged. Trench ET-5 was approximately 60 feet long, trended N90°E, and extended to a depth of 15 feet. Trench ET-5 was approximately 55 feet long, trended N90°E, and extended to a depth of 14-1/2 feet.

Trench ET-7 was located in San Benito Street north of Wentz Alley. Trench ET-7 was approximately 53 feet long, trended N90°E, and extended to a depth of 16-1/2 feet. Boring B-1 was located in San Benito Street at the same location as Trench ET-7. Boring B-1 was drilled to a depth of approximately 20 feet below the ground surface.

After excavating, the trenches were shored and the trench walls cleaned. A system of nails and colored flagging was used to mark the various strata. After the trench walls were cleaned and flagged, they were logged at a scale of one inch equals five feet. Critical areas were logged at a more detailed scale. The floor and opposite trench wall were also cleaned and examined in these areas. The trenches were logged by project geologist, Lewis Rosenberg. The trenches were observed by the supervising geologist, Richard Gorman, and the City Geologist, John Kingsley. Trench ET-2 was observed by Chris Wills of the CDMG. The logs of the trenches are shown in Appendix A. One sample was collected and dated using radiocarbon techniques. The results are included in Appendix B.

After the trench logging operation was completed, the trenches were backfilled with 2-sack grout to within 5 feet of the ground surface. After the grout had set-up, imported sand was placed and compacted over the grout material up to the top of the trench. The sand was compacted using a small compactor. In paved areas, asphaltic concrete was used to match the thickness of the existing pavement section.

An exploratory boring was drilled to evaluate the subsurface conditions at the proposed trench location across San Benito Street. Materials encountered during the drilling indicated that nonsaturated soils having adequate consistencies for trenching were present at the proposed trench location. The drill hole was logged by staff geologist Brian Papurello After the drilling operation was completed, the hole was backfilled with native material. The boring log is included in Appendix A.

Summary of Trench Observations

Various amounts of fill were encountered in most of the trenches. In Trench ET-3, the fill consists of approximately 8 feet of silty clay with debris. A concrete slab was also encountered at the bottom of the fill (see trench log ET-3). In Trenches ET-4, ET-5, ET-6, and ET-7, asphaltic pavement underlain by road base material was encountered. Utility trench backfill was present in Trenches ET-5, ET-6, and ET-7. The trench backfill consisted of compacted sands and/or clays. A 13-foot deep sewer line was encountered near the midpoint of Trench ET-7. The width of the backfill was approximately 3 feet. Below the fill and road base is a 7 to 8 foot-thick silty clay unit which is interpreted as a shallow lacustrine (lakebed) deposit. This unit had blocky ped structures, and was bioturbated (disturbed by plant roots and animals).

Stratigraphic units exposed in the trenches are nearly flat-laying and are laterally continuous over the length of the trenches. Within these units, several types of sedimentary structures (such as cross-bedding and channels, etc.) were observed. The uppermost fluvial deposit exhibited undisturbed trough cross-bedding. Medium to coarse-grained sand lenses were encountered in the silt and sand units. These lenses represent infilling of small channels.

Clayey silt beds approximately 1 to 2 inches in thickness were noted adjacent to the coarse sand lenses. These beds are traceable with minimal variation in thickness throughout the length of the

trench, and are probably a result of waning floodwaters that deposited the coarse sand lenses. Locally, these beds undulate within the sand unit. Since the thickness of the sand unit does not vary appreciably, the undulation is probably due to either deposition into a shallow channel or "soft" (geological sense) sediment deformation. The deep sewer trench backfill crossed these clay marker beds. However, the lateral continuity of these beds and of the lacustrine/fluvial contact was maintained across the trench backfill.

A clay bed at a depth of approximately 13 feet in Trench ET-2 dips steeply to the east (see p. A-3). The trench was deepened to a depth of 19-1/2 feet to observe the geometry and structural relations of this bed. In the deepened section, this bed dips gently east. Thinly-laminated alternating sequences of silt and clay maintain a near-horizontal orientation beneath this clay bed. Since the underlying thinly-laminated silts and clays are not disturbed, the change in dip of this bed is related to deposition rather than faulting. Another feature observed in the deepened area was a clay layer which split into two thinner segments. The geometry and stratigraphy of this feature imply that this feature is an old channel bank which was infilled with sand. The upper over-riding clay bed was deposited subsequent to the channel sand, hence, acquiring the geologic name rider bed.

Between stations 8 to 10 and 53 to 55 in ET-1, stations 12 to 13 in ET-2, and stations 28 to 30 in ET-5 are near-vertical clay seams within the fluvial unit which are approximately 1 to 2 inches wide. Thin continuous clay layers below the seams are not disrupted or offset. The near-vertical orientation of the seams and the similar composition to the underlying clay bed implies that the vertical seams are due to infilling.

Similar features have been related to prehistoric near-surface ground subsidence in the San Joaquin Valley, California (Fig. 37, Bull, 1972). These clay seams are possibly the result of infilling of subsidence cracks. Evidence of prehistoric tectonic subsidence is supported by detailed

stratigraphic studies combined with radiocarbon dating and fossil pollen correlation techniques (McMasters and others, 1987).

The clay seam could also be explained by deformation of the fluvial materials under saturated conditions. Flame structures and load casts are features which result from loading of water-saturated mud layers by overlying sand layers (Boggs, 1987, p. 163–175). Deformation features such as flame structures and load casts would be expected in the depositional environment which existed in the Hollister area during the late Pleistocene-early Holocene. The presence of lake deposits over poorly consolidated fluvial sands, silts, and clays coupled with forces generated by large earthquakes on nearby faults would provide a mechanism for this soft sediment deformation.

FINDINGS

Site Geology and Geomorphology

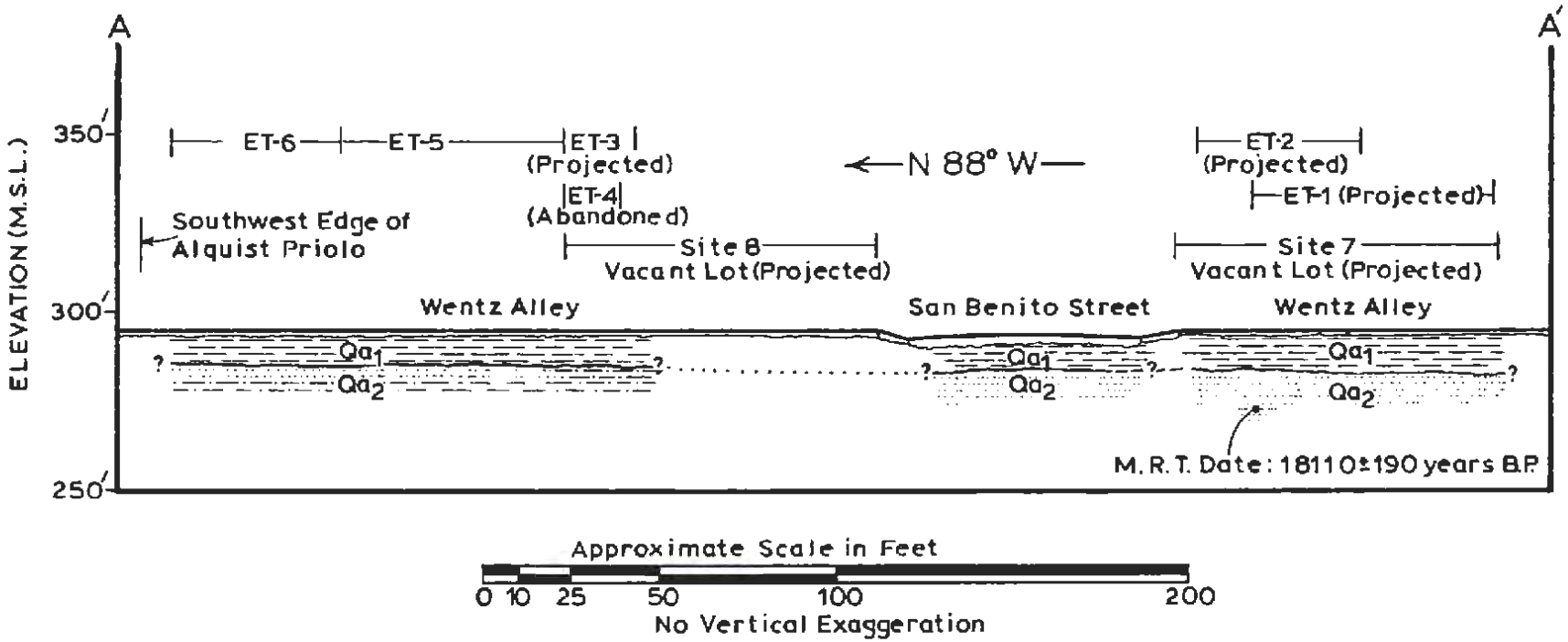
Downtown Hollister is underlain by a series of Pleistocene and Holocene age lake and stream deposits. The topography is nearly flat. At Sixth Street near Dunne Park there are low rises in the topography that have been related to active faulting on the main branch of the Calaveras fault by Rogers and Nason (1971). Similar features are also present on Hawkins, Hazel, and South Streets east of Sally Street. Structures situated along these features do not show the prominent creep-related movement present on the main branch of the fault. The geologic conditions are depicted on the Site Plan and Geology Map, Figure 2. A schematic cross-section through the site is included as Figure 7.

Stratigraphy

There were six stratigraphic units that could be correlated between trenches. The uppermost unit extending from the ground surface (excluding pavement and fill) to a depth of approximately 10 to 11 feet. It consists of a dark olive to dark grayish-brown silty clay. This unit exhibits a blocky ped structure and is bioturbated. This unit is interpreted as a shallow lacustrine (lakebed) deposit. A bulk sample from this unit at approximately 12 feet depth was dated using ^{14}C radiometric analysis at 3,720 ± 90 years before present (YBP) (Applied Soil Mechanics, 1991c). This is a mean residence time date (MRT), indicating a minimum age for the sample.

Below the lakebed deposits are a series of deposits which consist of grayish-brown to olive brown silty sands, sandy silts, and clayey sands. These units are easily traced and vary from 1 to 2 feet in thickness. Faint to distinct trough cross-bedding was visible in the sandy beds. Bedding was indistinct in the silty beds. Other sedimentary structures visible included discontinuous coarse sand lenses, thin (1/4 to 2-inch) continuous clay layers and clay rip-up clasts, suggesting a fluvial

Schematic Cross-Section A-A'



EXPLANATION

Qa1- Lacustrine deposits: silty clay (unit 1 from exploratory trenches 1 & 2 and unit 3 from exploratory trenches 5, 6 & 7)

Qa2- Fluvial deposits: sandy silt to coarse sand (units 2-4 from exploratory trench 1, units 2-7 from exploratory trench 2, units 4-6 from exploratory trenches 5 & 6, and unit 4 from exploratory trench 7)

Figure 7 - Schematic Cross Section A-A'

depositional environment. These beds and clay layers were used for stratigraphic correlation and were flagged in the trenches. A bulk sample from a thin organic-rich clay bed from Trench ET-2 at a depth of approximately 17 feet had a mean residence time date of 18,110 ± 190 YBP. Assuming relatively continuous deposition, the fluvial sequences encountered in the trenches are probably latest Pleistocene to early Holocene in age.

Groundwater

Damp to very moist conditions were encountered in the drilling and trenching operations; however, free groundwater was not encountered. At the time of this study, central California was experiencing the fifth consecutive year of drought conditions. It is possible that during years of normal or above normal precipitation, that saturated conditions or perched water tables could develop.

SEISMICITY

In assessing the seismic hazards for a given area, it is useful to examine historic records of local earthquake intensities. This information is useful for predicting the recurrence of severe shaking in an area. Within the historic time, significant earthquakes have severely damaged man-made structures over a large part of San Benito County. These include, but are not limited to, the 1906 M 8.3 San Francisco (Lawson, 1908), 1984 M 6.2 Morgan Hill (Stover, 1984), and the 1989 M 7.1 Loma Prieta events.

Although central California is crossed by numerous faults, several regionally active fault systems are most likely to generate earthquakes that could cause damage to the site. These include the active San Andreas, Hayward, Calaveras, and San Gregorio fault systems (Hart, 1988), and the potentially active Sargent-Berrocal fault (Bryant, 1980). Recent statistical studies theorize that a major earthquake on the Calaveras fault (Oppenheimer and others, 1990) or on the San Francisco Peninsula segment of the San Andreas fault (Working Group on California Earthquake Probabilities, 1990) will occur. When this major earthquake will occur is not specified by these groups. An earthquake on one of these faults will result in strong ground shaking at this site.

Recently active fault zones have been mapped by the State as part of the Alquist-Priolo Act of 1972. Under the act (Hart, 1988), recently active faults are defined as displaying sufficient and well-defined evidence of movement within the Holocene Epoch (about the last 11,000 years). No structures for human occupancy are permitted on the trace of an active fault. Unless proven otherwise, the area within 50 feet of an active fault is presumed to be underlain by an active fault. The Alquist-Priolo definition of potentially active is a fault showing evidence of displacement older than 11,000 years and younger than 2,000,000 years (Pleistocene Epoch). "Inactive" faults are classified as not having been active for at least two million years.

Evaluation of maximum earthquakes is a topic with considerable variation. The criteria used within this report include maximum credible and probable earthquakes. The maximum credible earthquake is defined by the California Division of Mines and Geology (1975) as,

> "the maximum earthquake that appears capable of occurring under the presently known tectonic framework. It is a rational and believable event that is in accord with all known geologic and seismic facts. In determining the maximum credible earthquake, little regard is given to its probability of occurrence, except that its likelihood of occurring is great enough to be of concern."

The maximum probable earthquake is, "The maximum earthquake that is likely to occur during a 100-year interval. It is to be regarded as a probable occurrence, not as an assured event that will occur at a specific time" (CDMG, 1975).

Table A lists known regionally active faults and their estimated seismic parameters. These estimates were generated using the EQFAULT computer program (Blake, 1989) using statistical analyses of seismic events reported by Idriss (1987).

TABLE A
ESTIMATED SEISMIC PARAMETERS FOR ACTIVE AND POTENTIALLY ACTIVE FAULTS IN THE HOLLISTER REGION

	San Andreas (Northern segment)[1]	Calaveras (Main Trace)	Hayward	San Gregorio-Palo Colorado	Sargent-Berrocal[2]
Distance and direction from site (miles)	16 SW	0.5 W	25 NW	40 SW	8 NW
Maximum credible earthquake[3, 4]	8.0	7.0	7.0	7.75	7.0
Maximum probable earthquake[3, 4]	7.5	6.5	6.75	6.75	5.75
Maximum credible peak ground acceleration[3, 5]	0.25 g	0.51 g	0.13 g	0.12 g	0.27 g
Maximum probable peak ground acceleration[3, 5]	0.21 g	0.47 g	0.10 g	0.06 g	0.15 g

1 Defined as extending from San Juan Bautista north to Shelter Cove (Blake, 1989)
2 Potentially active
3 Assumes that the earthquake will occur at a prescribed depth and at the nearest point to the site.
4 Richter earthquake magnitude
5 From: Idriss (1987)

Primary Earthquake Effects

Fault-Related Ground Rupture – Ground rupture along fault traces can occur during large earthquakes, and zones of high ground rupture potential are delineated by governmental agencies. The site is within the State Alquist-Priolo Special Studies Zone and the City Seismic Zone for the East Branch of the Calaveras fault (CDMG, 1982; Barrett, 1976).

The data gathered and analyzed (including the trench data and the MRT dates) indicate that there is no evidence for an active fault trace to cross the building site studied. Therefore, the potential for ground rupture resulting from fault movement at the building site is considered to be low.

Secondary Earthquake Effects

Ground Shaking – Hollister experienced severe shaking during the 1989 earthquake, according to local accounts (McCann, 1990). Ground shaking from a seismic event is the primary seismic hazard that will have the greatest impact on the proposed development within its design life span. Ground shaking can trigger other secondary seismic hazards that are discussed in following sections.

Strong ground shaking is documented for the following earthquakes: 1906 M 8.3 San Francisco (Lawson, 1908), 1983 M 6.7 Coalinga (Stover, 1983), and the 1984 M 6.2 Morgan Hill (Stover, 1984) and can reasonably be expected in the future. The estimated shaking intensity in the Hollister area during the 1989 Loma Prieta event was VII on the Modified Mercalli scale (Plafker and Galloway, 1989). Wood and Neumann (1931) define Modified Mercalli VII intensity as, "*Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.*"

The Loma Prieta earthquake provided data on ground response in the Hollister area. Three strong-motion seismograph station are located in the Hollister area. These stations record peak ground accelerations (PGA), and the data is summarized below in Table B.

TABLE B
PEAK GROUND ACCELERATIONS RECORDED DURING THE OCTOBER 17, 1989 EARTHQUAKE IN THE HOLLISTER REGION

	Hollister City Hall	South and Pine Streets	Hollister Airport
Approximate distance and direction from site (feet)	300 W	1,200 SE	11,000 N
Peak horizontal ground acceleration	0.25g	0.38g	0.29g
Peak vertical ground acceleration	0.22g	0.20g	0.16g
Site geology	Alluvium	Alluvium	Alluvium
Source of data	1	2	1

[1] Maley and others (1989)
[2] Shakal and others (1989)

The PGA is one of the factors involved in designing a structure to resist seismic forces. Using the method of Idriss (1987) with the EQFAULT program (Blake, 1989), a maximum probable earthquake of M 6.5 occurring on the nearest point of the Calaveras fault could produce a PGA of 0.47 g at the site. The PGA generated by EQFAULT is an approximate value and does not take into account other factors such as depth to bedrock, ground saturation, and topographic amplification. For wood-frame structures, the PGA tends to be conservative, and the repeatable high ground acceleration (RHGA) is appropriate (Ploessel and Slosson, 1974). For a maximum probable earthquake of M 6.5 occurring on the Calaveras fault, the RHGA is 0.31 g.

Liquefaction – Soil liquefaction is the loss of soil strength during a significant seismic event. It occurs primarily in saturated loose- to medium-dense, fine to medium-grained sands and sandy silts. Liquefaction results in rearrangement of the soil particles into a denser condition, resulting in localized areas of ground failure. Common types of liquefaction-related ground failure include differential settlement and lateral spreading. Secondary ground cracks frequently occur as a result of liquefaction-related ground failure and should not be confused with ground deformation resulting from fault rupture.

No signs of liquefaction such as sand boils were observed in trenches of in the immediate vicinity of the site after the Loma Prieta earthquake (Plafker and Galloway, 1989; McCann, 1990). The native site soils are relatively fine-grained and may be susceptible to liquefaction, if saturated. Groundwater was not encountered in the exploratory trenches or drill hole, and the soils were damp to very moist. If the groundwater table were to rise, or if perched groundwater conditions develop, or if the near-surface granular material becomes saturated, then the risk of liquefaction is moderate. From a geologic viewpoint, the risk of liquefaction in the present environment is considered to be low. A geotechnical study is needed to definitively assess the risk of liquefaction.

Lurching cracks are a variety of ground cracking that could be related to earthquakes. There was no evidence seen in the trenches that lurch cracking occurred at this site as a consequence of an earthquake. Therefore, the potential for lurch cracking to occur at this site is considered to be minimal.

CONCLUSIONS

The conclusions are based on the data gathered and analyzed for this study.

1. Based on trench observations, we conclude that an active fault does not cross the Peterson and Bruhn properties, Sites 7 & 8, nor is there a fault trace within 50 feet of the sites.

2. In the trenches excavated as part of this study, nearly flat-lying sediments maintain an almost constant thickness in the trenches. Laterally continuous stratigraphic units could be correlated in the trenches and from trench to trench. No evidence of offset was apparent along these marker units.

3. Several near-vertical clay-filled seams crossed laterally continuous clay and sand beds in Trenches ET-1, ET-2, and ET-5. These features are probably due to one of the following geologic processes: infilling as a result of ground cracking from subsidence; depositional features such as load casting; flame structures and intrusive clay dikes.

4. The sites could be developed from a geologic point of view.

RECOMMENDATIONS

The subject sites 7 and 8 are suitable from an engineering geologic viewpoint for the planned building reconstruction, provided that the recommendations in this report are followed.

1. A soil engineering study should be performed for the proposed new structures. The study should address liquefaction potential and associated effects such as differential settlement. The study should also address the possibility of buried features such as old foundations, basements, tanks, and trash pits.

2. The proposed structures should be designed to withstand strong ground shaking. The project structural engineer should determine the appropriate method used for seismic design of the new buildings. If the structural engineer elects to use the design criteria of the Uniform Building Code (1988 edition), we suggest that a seismic zone factor of 0.40 and a site coefficient of 1.0 (Tables 23-I and 23-J, respectively) be used. The selection of the appropriate seismic zone factor and site coefficient are the purview of the structural engineer.

3. The geologic trenches for this study have been backfilled using lean grout, compacted sand and native soil. Their position and condition should be taken into consideration in the design of the improvements planned for this study area on sites 7 and 8.

REFERENCES CITED

Allen, J.E., 1946, Geology of the San Juan Bautista quadrangle, California: California Division of Mines Bulletin 133, 75 p., 3 plates, scale 1:62,500.

Applied Soil Mechanics, Inc., 1991a, Geologic evaluation, proposed three-lot subdivision, 49, 53, and 57 Hawkins Street, Hollister, California: unpublished report prepared for Dean Rodrigues. File No. A0-2303-S1.

_____, 1991b, Fault study, Showcase Theatre, 705 San Benito Street, San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2282-S1.

_____, 1991c, Fault study, "600-block" properties, SE Corner of Sixth and San Benito Streets, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2323-S1.

_____, 1991d, Fault study, Bruhn and Peterson properties, 515, 525 and 530 San Benito Street, San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2281-S1.

_____, 1991e, Fault study, Building Sites 1, 3, 4, 5, 6, and 10: Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2280-S1.

_____, 1991f, Fault study, Poletti property, 335 San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2279-S1.

Barrett, Nestor, 1976, Seismic Safety Element of the General Plan: City of Hollister Planning Department open-file report, 37 p.

Bay Soils, Inc., 1981, Soil and geologic investigation, Hollister shopping center, SWC Nash Road and Southside Road, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-1337, 20 p., 3 appendices.

Blake, T.F., 1989, EQFAULT, a computer program for the deterministic prediction of peak ground acceleration from digitized California faults.

Boggs, Sam, Jr., 1987, Principles of sedimentology and stratigraphy: Merrill Publishing Company, Columbus, Ohio, 784 p.

Bryant, W.A., 1979, Fault evaluation report, Calaveras (Hollister segment) and "Buena Vista Road" faults: California Division of Mines and Geology Fault Evaluation Report FER-94, 14 p., 4 plates, scale 1:24,000.

_____, 1980, Fault evaluation report, SE segments of Sargent and Castro faults: California Division of Mines and Geology Fault Evaluation Report FER-96, 21 p., 11 plates, scale 1:24,000.

_____, 1975, Recommended guidelines for determining the maximum credible and the maximum probable earthquakes: California Division of Mines and Geology Note 43, 1 p.

_____, 1982, Special studies zones map, Hollister 7.5 minute quadrangle: California Department of Conservation, 1 sheet, scale 1:24,000.

Compton, R.R., 1966, Granitic and metamorphic rocks of the Salinian block, California Coast Ranges *in* Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 277–287.

Dibblee, T.W., Jr., 1975, Geologic map of the Hollister quadrangle: U.S. Geological Survey Open-File Report 75-394, 1 map, scale 1:62,500.

Earth Systems Consultants, 1985, Seismic hazard evaluation, Kelly Ranch, Parcel 2, Southside Road, Hollister, California: unpublished report prepared for San Benito Engineering and Surveying, Inc., 22 p.

Ellis, W.C., 1952, Elevations on top of the blue clay zone, Hollister area: U.S. Bureau of Reclamation unpublished map.

Geoconsultants, Inc., 1978, Geologic hazard investigation for proposed commercial development, Park Hill and San Benito Streets, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-742, 12 p.

Hart, E.W., 1988, Fault-rupture hazard zones in California: California Division of Mines and Geology Special Publication 42, 24 p.

Hoose, S.N., 1986, Was there a great Pleistocene Lake San Benito? (M.S. thesis): San Jose State University, 87 p.

Idriss, I.M., 1987, Lecture notes, presentation at the EERI course on strong ground motion, April 10-11, 1987, Pasadena, California, *in* Singh, J.P., Course Organizer, Strong ground motion, seismic analysis, design and code issues: Earthquake Engineering Research Institute, 14 p.

International Conference of Building Officials, 1988, Uniform Building Code: Whittier, California, 926 p.

Jenkins, O.P., 1973, Pleistocene Lake San Benito: California Geology, v. 26, no. 7, p. 151–163.

Kilburn, Chabot, 1972, Ground-water hydrology of the Hollister and San Juan Valleys, San Benito County, California: U.S. Geological Survey Open-File Report 73-144, 5 maps, various scales.

Lawson, A.C., chairman, 1908, The California earthquake of April 18, 1906: Report of the California State Earthquake Investigation Commission: Washington D.C., Carnegie Institution of Washington, Publication 87, v. 1, 2 parts, 451 p.

Leighton and Associates, 1974, Fault hazard study of eastern and western portions of Ridgemark Estates development, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-56, 11 p., 1 appendix.

Lowney, J.V., & Associates, 1990a, Fault location investigation for Kelly Ranch residential development, Southside Road, Hollister, California: City of Hollister Open-File report, 20 p., 2 appendices.

_____, 1990b, Supplemental fault location investigation for Kelly Ranch residential development, Southside Road, Hollister, California: City of Hollister Open-File report, 13 p., 2 appendices.

Maley, R., Acosta, A., Ellis, F., Etheredge, E., Foote, L., Johnson, D., Porcella, R., Salsman, M., and Switzer, J., 1989, U.S. Geologic Survey strong-motion records from the northern California (Loma Prieta) earthquake of October 17, 1989: U.S Geological Survey Open-File Report 89-568, 84 p.

McCann, J.Z., 1990, Aftershock: the Loma Prieta earthquake and its impact on San Benito County: Hollister, California, Seismic Publications, 80 p.

McClellan, P.H., and Hay, E.A., Geologic evidence for triggered slip on the Calaveras fault during the magnitude 7.1 Loma Prieta earthquake of October 17, 1989: U.S Geological Survey Open-File Report 89-641, 37 p.

McMasters, C.R., Herd, D.G., Throckmorton, C.K., and Heusser, L.E., 1987, Subsurface stratigraphy of the eastern Hollister Valley, California: U.S Geological Survey Miscellaneous Field Studies Map MF-1461, 3 sheets, various scales.

Oppenheimer, D.H., Bakun, W.H., and Lindh, A.G., 1990, Slip partitioning of the Calaveras fault, California, and prospects for future earthquakes: Journal of Geophysical Research, v. 95, no. B6, p. 8483–8498.

Page, B.M., 1966, Geology of the Coast Ranges of California *in* Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 255–276.

Plafker, George, and Galloway, J.P., eds., 1989, Lessons learned from the Loma Prieta, California earthquake of October 17, 1989: U.S. Geological Survey Circular 1045, 42 p.

Ploessel M.R., and Slosson, J.E., 1974, Repeatable high ground accelerations from earthquakes: California Geology, v. 27, no.9, p. 195–199.

Rogers, T.H, 1967, Active extensional faulting north of Hollister near the Calaveras fault zone: Bulletin of the Seismological Society of America, v. 57, no. 4, p. 813–816.

_____, 1973, Preliminary geologic map, NE 1/4 Hollister quadrangle: California Division of Mines and Geology unpublished open-file report, 1 sheet, scale 1:12,000

Rogers, T.H., and Nason, R.D., 1971, Active displacement on the Calaveras fault zone at Hollister, California: Bulletin of the Seismological Society of America, v. 61, no. 2, p. 399–416.

Rogers, T.H., Nason, R.D., and Cooper, A.K., 1968, Preliminary map showing traces of the Calaveras fault zone in the City of Hollister, California: California Division of Mines and Geology Open-File Report 68-3, 1 sheet, scale 1 in. = 500 ft.

Shakal, A., Huang, M., Reichle, M., Ventura, C., Cao, R., Sherburne, R., Savage, M., Darragh, R., and Petersen C., 1989, CSMIP strong motion records from the Santa Cruz Mountains (Loma Prieta), California: California Division of Mines and Geology, Office of Strong Motion Studies Report No. OSMS 89-06, 196 p.

Stover, C.W., 1983, Intensity distribution and isoseismal map *in* Bennett, J.H., and Sherburne, R.W., eds., The 1983 Coalinga, California earthquake: California Division of Mines and Geology Special Publication 66, p. 1–4.

_____, 1984, Intensity distribution and isoseismal map for the Morgan Hill, California, earthquake of April 24, 1984 *in* Bennett, J.H., and Sherburne, R.W., eds., The 1984 Morgan Hill, California earthquake: California Division of Mines and Geology Special Publication 68, p. 1–4.

Taliaferro, N.L., 1948, Geologic map of the Hollister quadrangle: California Division of Mines Bulletin 143, 1 sheet, scale 1:62,500.

Terratech, Inc., 1974, Geologic evaluation, proposed commercial building, Alpha Beta shopping center, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-107, 4 p.

_____, 1976, Geotechnical investigation, K & S Market, Southside Road and Nash Road, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-329, 11 p.

_____, 1977, Geotechnical investigation, Royal Court Estates, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-642, 9 p.

_____, 1978, Geologic/geotechnical investigation, First Street commercial property, Hollister, California: City of Hollister Open-File report, 9 p., 2 appendices.

_____, 1981, Geologic investigation, proposed Nob Hill shopping complex, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-1336, 5 p.

_____, 1985, Fault investigation, J.C. Penney building, Hollister, California: City of Hollister Open-File report, 10 p.

_____, 1987, Investigation of the east branch of the Calaveras fault, Prune Street school site (Rancho San Justo Tandem school site), Hollister, California: City of Hollister Open-File report, 5 p.

U.S. Bureau of Reclamation, 1989, Engineering geology field manual: U.S. Department of the Interior, 599 p.

Wood, H.O., and Neumann, Frank, 1931, Modified Mercalli intensity scale of 1931: Bulletin of the Seismological Society of America, v. 21, no. 4, p. 277–283.

Woodward-Clyde Consultants, 1978, Geologic evaluation, Prospect Avenue property, Hollister, California: City of Hollister Open-File report, 5 p.

Woodward-Clyde & Associates and McClure & Messinger, 1968, Earthquake fault and earthquake engineering studies, proposed upper school site, Hollister, California: unpublished report submitted to Hollister School District, Hollister, California.

Working Group on California Earthquake Probabilities, 1990, Probabilities of large earthquakes in the San Francisco Bay region, California: U.S. Geological Survey Circular 1053, 51 p.

AERIAL PHOTOGRAPH REFERENCES

Pacific Aerial Surveys, July 3, 1987, V-SBN-C1-11 to 12, black and white, vertical, approximate scale 1:33,600.

_____, August 29, 1990, SBN-3845 47-54 to 55, black and white, vertical, approximate scale 1:12,000.

U.S. Department of Agriculture, May 15, 1967, BUX–1HH–91 to 93, black and white, vertical, approximate scale 1:20,000.

_____, May 7, 1980, 379–75 to 78, black and white, vertical, approximate scale 1:40,000.

WAC Corporation, April 2, 1985, WAC–85CA 7–45 to 48, black and white, vertical, approximate scale 1:31,680.

_____, June 14, 1989, WAC–90CA, 32–139 to 142, black and white, vertical, approximate scale 1:31,680.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report are based upon the assumption that the subsurface conditions do not deviate substantially from those disclosed in the trenches and borings. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that planned at the present time, Applied Soil Mechanics, Inc. should be notified so that supplemental recommendations can be given.

2. This report is issued with the understanding that it is the responsibility of the owner or of his representative to ensure that the information and recommendations presented herein are called to the attention of the project architect and engineers for the project and incorporated into the project plans and specifications, and that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the present date. Changes in the conditions of a property can occur with the passage of time, however, whether they be due to natural processes or the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or partially, by changes outside of our control. Therefore, this report should not be relied upon after a period of three (3) years without being reviewed by an engineering geologist.

4. This report was prepared upon your request for our services, and in accordance with currently accepted standards of professional engineering geology practice. No warranty as to the contents of this report is intended, and none shall be inferred from the statements or opinions expressed.

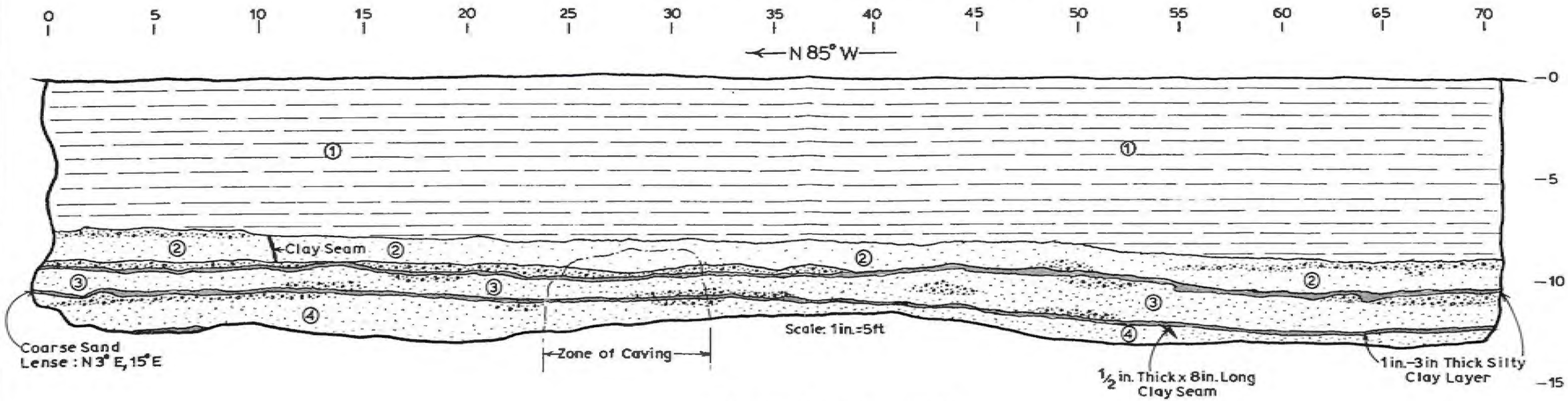
5. The scope of our services did not include any environmental assessment or study for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater or air, on or below or around this site. Any statements in this report regarding odors noted or unusual or suspicious items or conditions observed are strictly for the information of our client.

APPENDIX A

Exploratory Trench Logs

Exploratory Boring Log

Exploratory Trench No. 1



EXPLANATION OF UNITS

Lacustrine deposits:

Unit 1: Olive brown (2.5Y 4/3) to grayish-brown (2.5Y 5/2) silty clay, with thin discontinuous dark brown and light gray streaks; damp to moist, stiff, bioturbated, blocky ped structure. Sharp lower contact with scattered charcoal fragments.

Fluvial deposits:

Unit 2: Light olive-brown (2.5Y 5/3) fine-grained silty sand; damp, medium dense, thin subparallel laminations, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay.

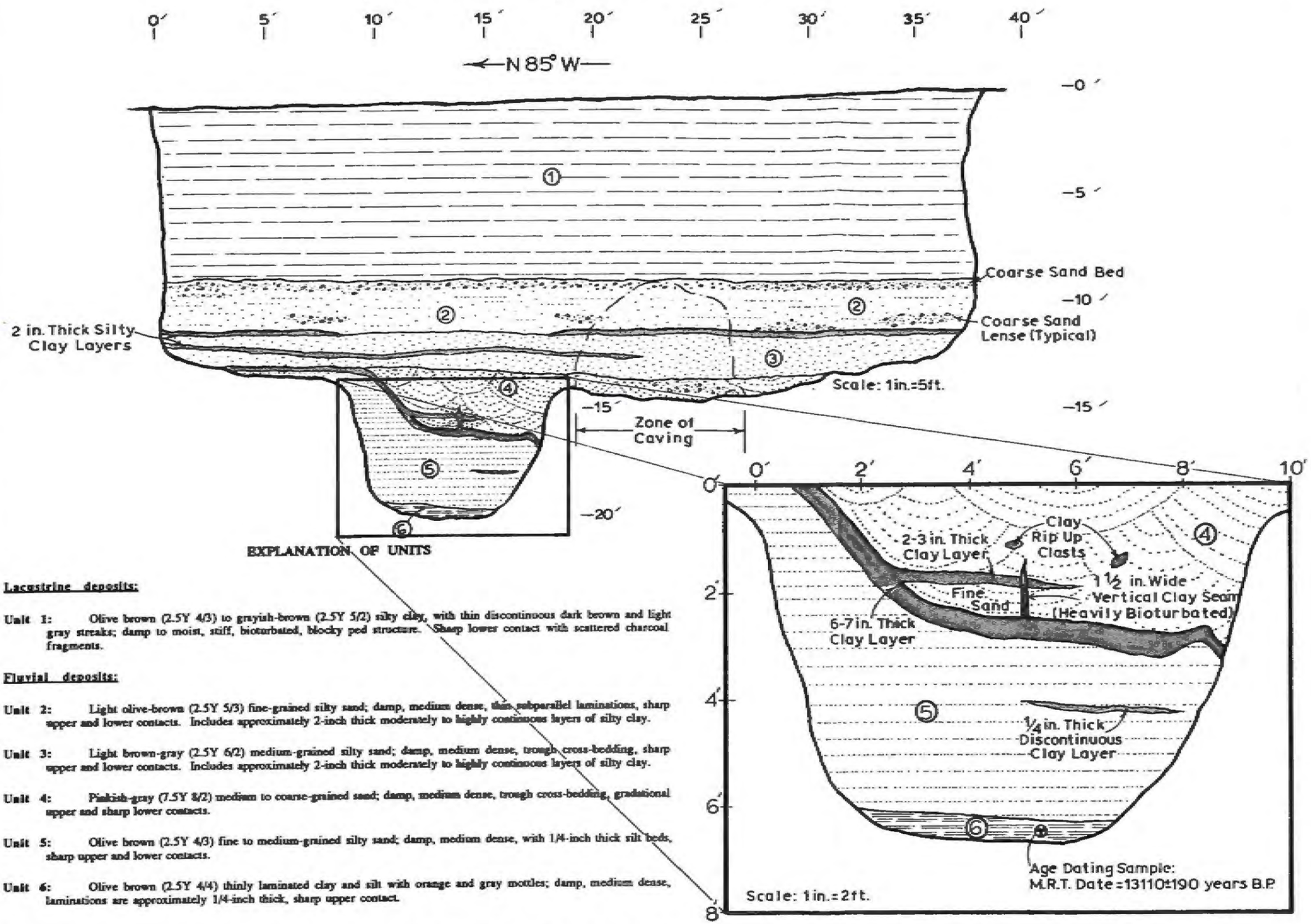
Unit 3: Light brown-gray (2.5Y 6/2) medium-grained silty sand; damp, medium dense, trough cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay.

Unit 4: Dark grayish-brown (2.5Y 5/2) to olive brown (2.5Y 4/3) sandy silt to silty fine sand; damp, medium dense, massive, sharp upper and gradational lower contacts.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A1 - Log of Trench No. 1

Exploratory Trench No. 2



EXPLANATION OF UNITS

Lacustrine deposits:

Unit 1: Olive brown (2.5Y 4/3) to grayish-brown (2.5Y 5/2) silty clay, with thin discontinuous dark brown and light gray streaks; damp to moist, stiff, bioturbated, blocky ped structure. Sharp lower contact with scattered charcoal fragments.

Fluvial deposits:

Unit 2: Light olive-brown (2.5Y 5/3) fine-grained silty sand; damp, medium dense, thin subparallel laminations, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay.

Unit 3: Light brown-gray (2.5Y 6/2) medium-grained silty sand; damp, medium dense, trough cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay.

Unit 4: Pinkish-gray (7.5Y 8/2) medium to coarse-grained sand; damp, medium dense, trough cross-bedding, gradational upper and sharp lower contacts.

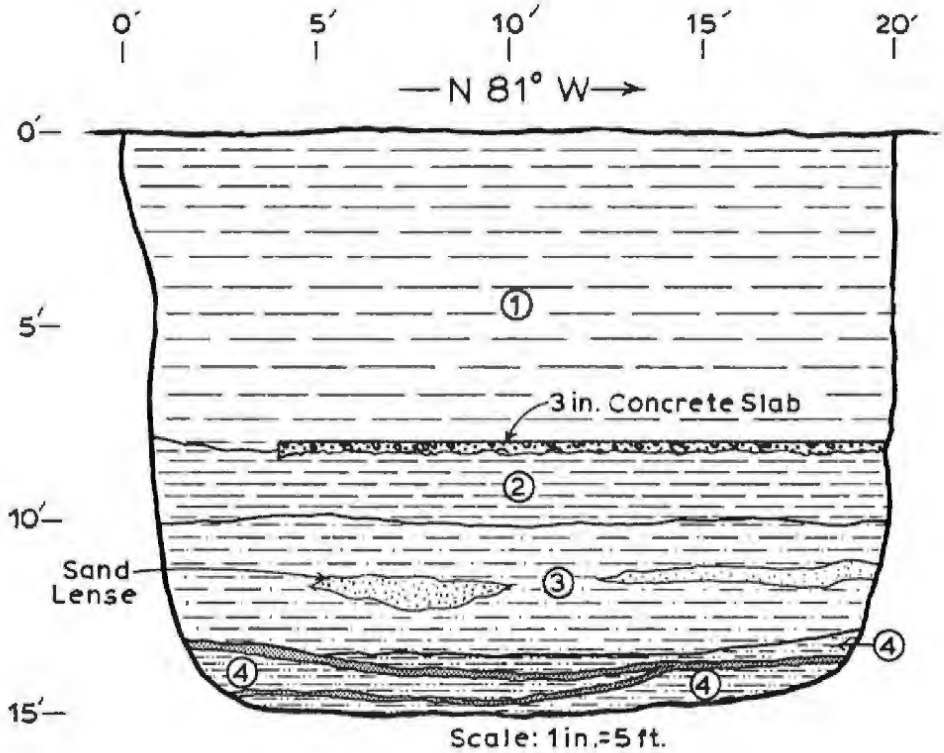
Unit 5: Olive brown (2.5Y 4/3) fine to medium-grained silty sand; damp, medium dense, with 1/4-inch thick silt beds, sharp upper and lower contacts.

Unit 6: Olive brown (2.5Y 4/4) thinly laminated clay and silt with orange and gray mottles; damp, medium dense, laminations are approximately 1/4-inch thick, sharp upper contact.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A2 - Log of Trench No. 2

Exploratory Trench No. 3



EXPLANATION OF UNITS

Fill:

Unit 1: Dark brown (7.5YR 3/2) silty clay with debris; moist, firm.

Lacustrine deposits:

Unit 2: Olive brown (2.5Y 4/3) silty clay, with thin discontinuous dark brown and light gray streaks; damp to moist, stiff, bioturbated, blocky ped structure. Sharp upper and lower contacts with scattered charcoal fragments along lower contact.

Fluvial deposits:

Unit 4: Light olive-brown (2.5Y 5/3) sandy silt, damp, medium dense, thin subparallel laminations and faint cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick moderately continuous layers of silty clay.

Unit 5: Olive brown (2.5Y 4/3) clayey silt; moist, medium dense, massive, sharp upper contacts.

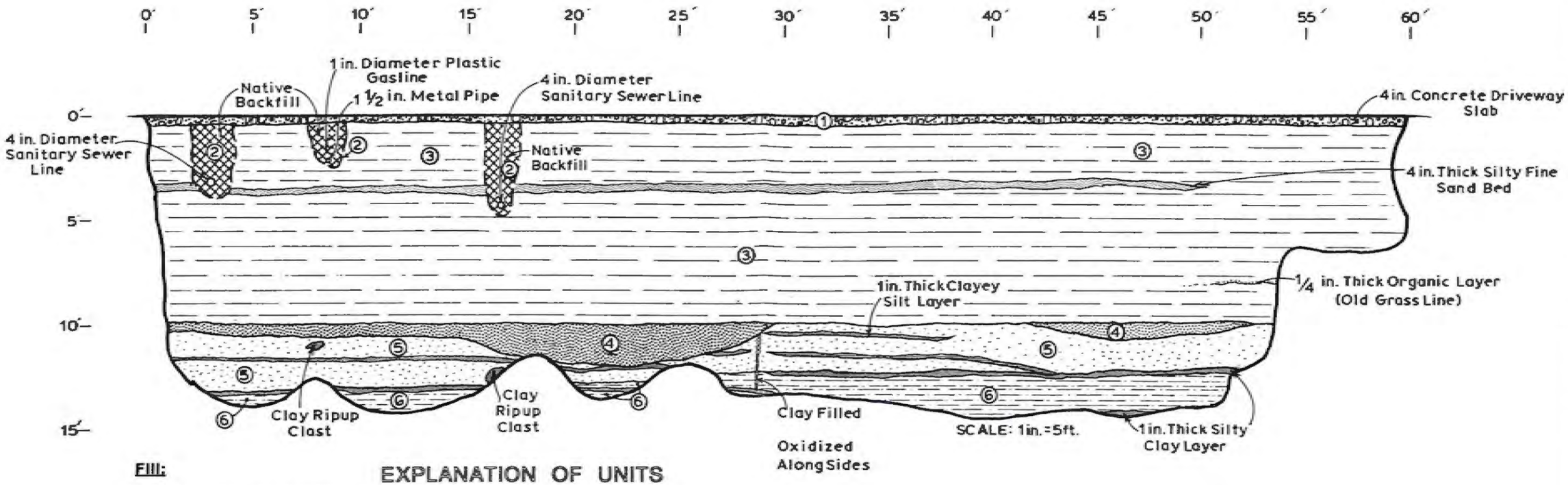
Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A3 - Log of Trench No. 3

Exploratory Trench No. 4

Trench not logged due to caving

Exploratory Trench No. 5



EXPLANATION OF UNITS

Fill:

Unit 1: 4 inches of asphaltic concrete.

Unit 2: Silty clay placed as utility trench backfill.

Lacustrine deposits:

Unit 3: Very dark grayish-brown (2.5Y 3/2) silty clay, with thin discontinuous dark reddish-brown (2.5YR 3/4) clay layers; moist to very moist, firm, bioturbated, blocky ped structure. Sharp lower contact with scattered charcoal fragments.

Fluvial deposits:

Unit 4: Light brownish-gray (2.5Y 6/2) to dark grayish-brown (2.5Y 4/2) medium-grained sand; very moist, medium dense, faint cross-bedding, sharp upper and lower contacts.

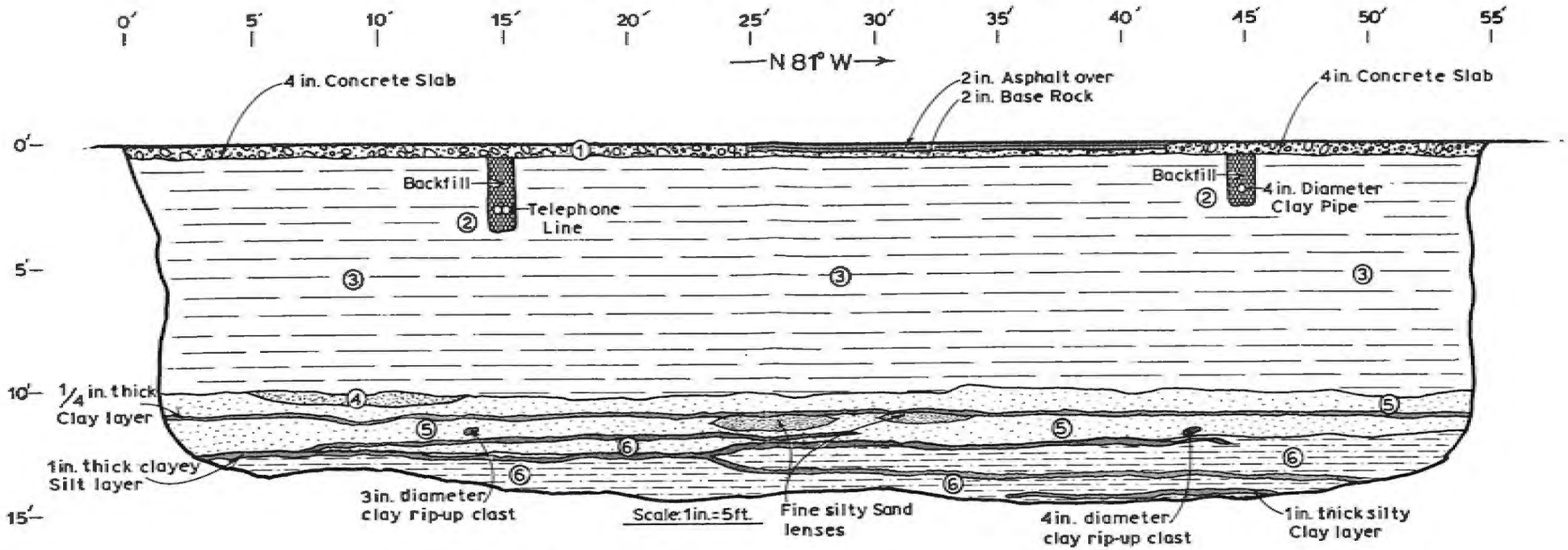
Unit 5: Light brownish-gray (2.5Y 6/2) to olive-brown (2.5Y 4/3) silty fine-grained sand; very moist, medium dense, thin subparallel laminations and faint cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay and lenses of fine silty sand.

Unit 6: Light olive-gray (5Y 6/2) fine sandy silt; very moist, stiff, massive, sharp upper contact. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A4 - Log of Trench No. 5

Exploratory Trench No. 6



EXPLANATION OF UNITS

Fill:

Unit 1: 4 inches of asphaltic concrete.

Unit 2: Silty clay placed as utility trench backfill.

Lacustrine deposits:

Unit 3: Very dark grayish-brown (2.5Y 3/2) silty clay, with thin discontinuous dark reddish-brown (2.5YR 3/4) clay layers; moist to very moist, firm, bioturbated, blocky ped structure. Sharp lower contact with scattered charcoal fragments.

Fluvial deposits:

Unit 4: Light brownish-gray (2.5Y 6/2) to dark grayish-brown (2.5Y 4/2) medium-grained sand; very moist, medium dense, faint cross-bedding, sharp upper and lower contacts.

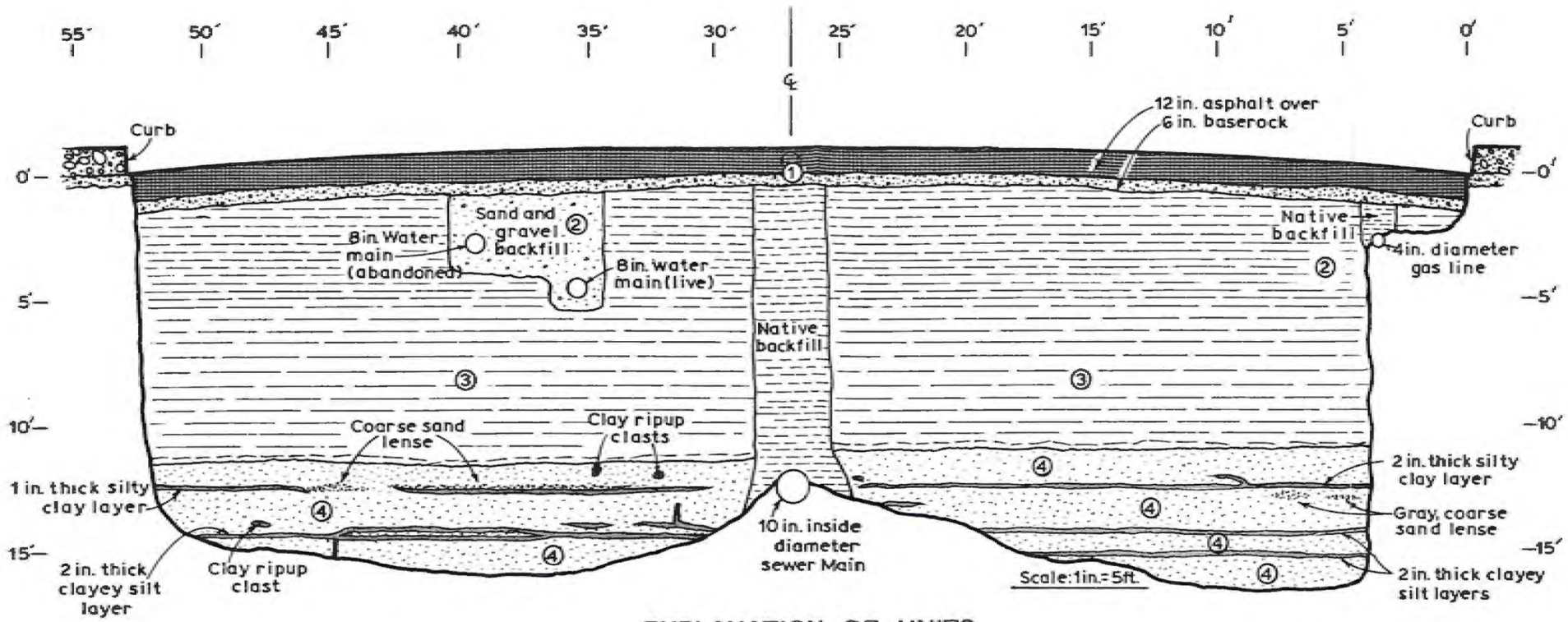
Unit 5: Light brownish-gray (2.5Y 6/2) to olive-brown (2.5Y 4/3) silty fine-grained sand; very moist, medium dense, thin subparallel laminations and faint cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay.

Unit 6: Light olive-gray (5Y 6/2) to olive-brown (2.5Y 4/3) fine sandy silt; very moist, stiff, massive, sharp upper contact. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay and lenses of fine silty sand.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A5 - Log of Trench No. 6

Exploratory Trench No. 7



EXPLANATION OF UNITS

Fill:

Unit 1: 12 inches of asphaltic concrete over 6 inches aggregate base material.

Unit 2: Mixture of sand and clay placed as utility trench backfill.

Lacustrine deposits:

Unit 3: Very dark grayish-brown (2.5Y 3/2) silty clay, with thin discontinuous dark reddish-brown (2.5YR 3/4) clay layers; moist to very moist, firm, bioturbated, blocky ped structure. Sharp lower contact with scattered charcoal fragments.

Fluvial deposits:

Unit 4: Light olive-brown (2.5Y 5/3) to light brown-gray (2.5Y 6/2) silty fine-grained sand; damp, medium dense, massive, sharp upper and lower contacts. Includes approximately 2-inch thick highly continuous layers of silty clay and lenses of coarse sand.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A6 - Log of Trench No. 7

DEPTH IN FEET	SAMPLE NO	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f.	IN-PLACE MOISTURE CONTENT % dry wt
				Drilling supervised by BEP on 4/25/91		
0						
				12" asphalt pavement		
1				6" roadway base (GW)		
2				Clay (CL), dark yellowish brown (10YR4/2) soft, moist, moderately cohesive, slightly silty		
3						
4						
5				Silty CLAY (CL), pale yellowish brown (10YR6/2), soft, very moist, moderately plastic, slightly cohesive		
6						
7						
8						
9	1-1		15	2" silt layer, slightly moist to moist		
10	1-2		11	Very moist from 10.0 to 10.5 feet		
11						
12	1-3		18	Silt (ML), pale yellowish brown (10YR6/2) medium stiff, slightly moist		
13	1-4		14	Increase in fine sand fraction		
14	1-5		11	Silty Sand (SM), pale yellowish brown (10YR6/2), loose to med. dense, slightly moist, variable silt fraction		

Figure A7 - Log of Test Boring No. 1 (0-14 feet)

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f.	IN-PLACE MOISTURE CONTENT % dry wt
14				Boring 1 continued		
15	1-5			Continued- see page 1		
16	1-6		14	Silty CLAY (CL), dark yellowish brown (10YR4/2), soft to medium stiff, very moist to nearly wet @ 16 ft.		
17	1-7		16	Silty SAND (SM), pale yellowish brown (10YR6/2), medium dense, slightly moist, very fine to fine grained		
18						
19	1-8		10	Silty CLAY (CL), dark yellowish brown (10YR4/2), soft, very moist, very high silt fraction		
20						
				Boring terminated at 20.0 feet		
				No groundwater encountered		
				Modified California Sampler		

Figure A8 - Log of Test Boring No. 1-continued (14-20 feet)

APPENDIX B

Radiocarbon Dating Analysis

BETA ANALYTIC INC.

MURRY A. TAMERS, PH.D.
JERRY J. STIPP, PH.D.
CO-DIRECTORS

4985 S.W. 74 COURT
MIAMI, FLORIDA
33155 U.S.A.

March 7, 1991

Mr. Lew Rosenberg
Applied Soil Mechanics, Inc.
2999 Monterey-Salinas Hwy.
Monterey, California 93940

Dear Mr. Rosenberg:

Please find enclosed the result on your soil sample recently submitted for radiocarbon dating analysis on the Rush Priority basis. We trust this date will be interesting for your work.

As before, the soil was pretreated by first examining for rootlets. It was then given our acid soaking to remove carbonates. The material was rinsed to neutrality, brought to dryness and given multiple combustions in an enclosed line. The following benzene synthesis and counting went normally. The sample was given extended counting time to reduce the statistical error.

We are enclosing our invoice. As always, if there are any questions or if you would like to discuss the date, call us at any time.

Sincerely yours,

Murry Tamers

Murry Tamers, Ph.D.
Co-director

P.S. We are sending this letter and the date report sheet by fax in addition to regular air mail.

TELEPHONE: 305-667-5167 / FAX: 305-663-0964 / BITNET: XNRBET22@SERVAX

BETA ANALYTIC INC.
(305) 667-5167
UNIVERSITY BRANCH
P.O. BOX 248113
CORAL GABLES, FLA. 33124

REPORT OF RADIOCARBON DATING ANALYSES

FOR: Lew Rosenberg
Applied Soil Mechanics, Inc.

DATE RECEIVED: February 28, 1991
DATE REPORTED: March 7, 1991
SUBMITTER'S PURCHASE ORDER #

OUR LAB NUMBER	YOUR SAMPLE NUMBER	C-14 AGE YEARS B.P. ± 1σ	
Beta-43350	Hollister #2	18110 +/- 190 BP	(bulk soil)

These dates are reported as RCYBP (radiocarbon years before 1950 A.D.). By international convention, the half-life of radiocarbon is taken as 5568 years and 95% of the activity of the National Bureau of Standards Oxalic Acid (original batch) used as the modern standard. The quoted errors are from the counting of the modern standard, background, and sample being analyzed. They represent one standard deviation statistics (68% probability), based on the random nature of the radioactive disintegration process. Also by international convention, no corrections are made for DeVries effect, reservoir effect, or isotope fractionation in nature, unless specifically noted above. Stable carbon ratios are measured on request and are calculated relative to the PDB-1 international standard; the adjusted ages are normalized to -25 per mil carbon 13.

FAULT STUDY

Building Site 9
Showcase Theatre
705 San Benito Street
Hollister, California

JULY 1991

APPENDIX A.8

Applied Soil Mechanics, Inc.
SOIL AND FOUNDATION ENGINEERS • GEOLOGISTS
400 Park Center Drive, Suite 7 • Hollister, CA 95023
(408) 637-2133 • FAX (408) 637-0510

File No. A0-2282-S1 July 22, 1991

City of Hollister Redevelopment Agency
375 Fifth Street
Hollister, CA 95023

Attention: Mr. Christopher M. Reyes, Program Manager

Subject: **Building Site 9, Showcase Theatre**
705 San Benito Street
Hollister, California
FAULT STUDY

Gentlemen:

As you requested, we have completed the fault study for the Showcase Theatre property. The purpose of this study was to determine if there was evidence for a trace of the East Branch of the Calaveras fault is within the study area. The following report presents the results of our study.

No evidence for the presence of active fault traces was gathered during the field exploration phase of this study. Based on the results of this study, the site is suitable from an engineering geologic viewpoint for the proposed building improvements, provided that the recommendations presented herein and those of the recommended soil engineering study are incorporated into appropriate construction plans and specifications.

The submission of this report concludes this phase of our contract with the City. We are pleased to have been of service to you on this project.

Sincerely,

APPLIED SOIL MECHANICS, INC.

Written by:

Lewis Rosenberg/ms

Lewis Rosenberg
Project Geologist

Reviewed by:

Richard T. Gorman, C.E.G. 1325
Consulting Geologist

Copies: 5 to Addressee

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INTRODUCTION

This report presents the results of our fault study for the Showcase Theatre property in Hollister, California (see Figure 1). The Showcase Theatre property (Building Site No. 9) is located at 705 San Benito Street and is shown on Figure 2. Building Sites 1 through 8 and 10 are discussed in other reports (Applied Soil Mechanics, 1991b, 1991c, 1991d).

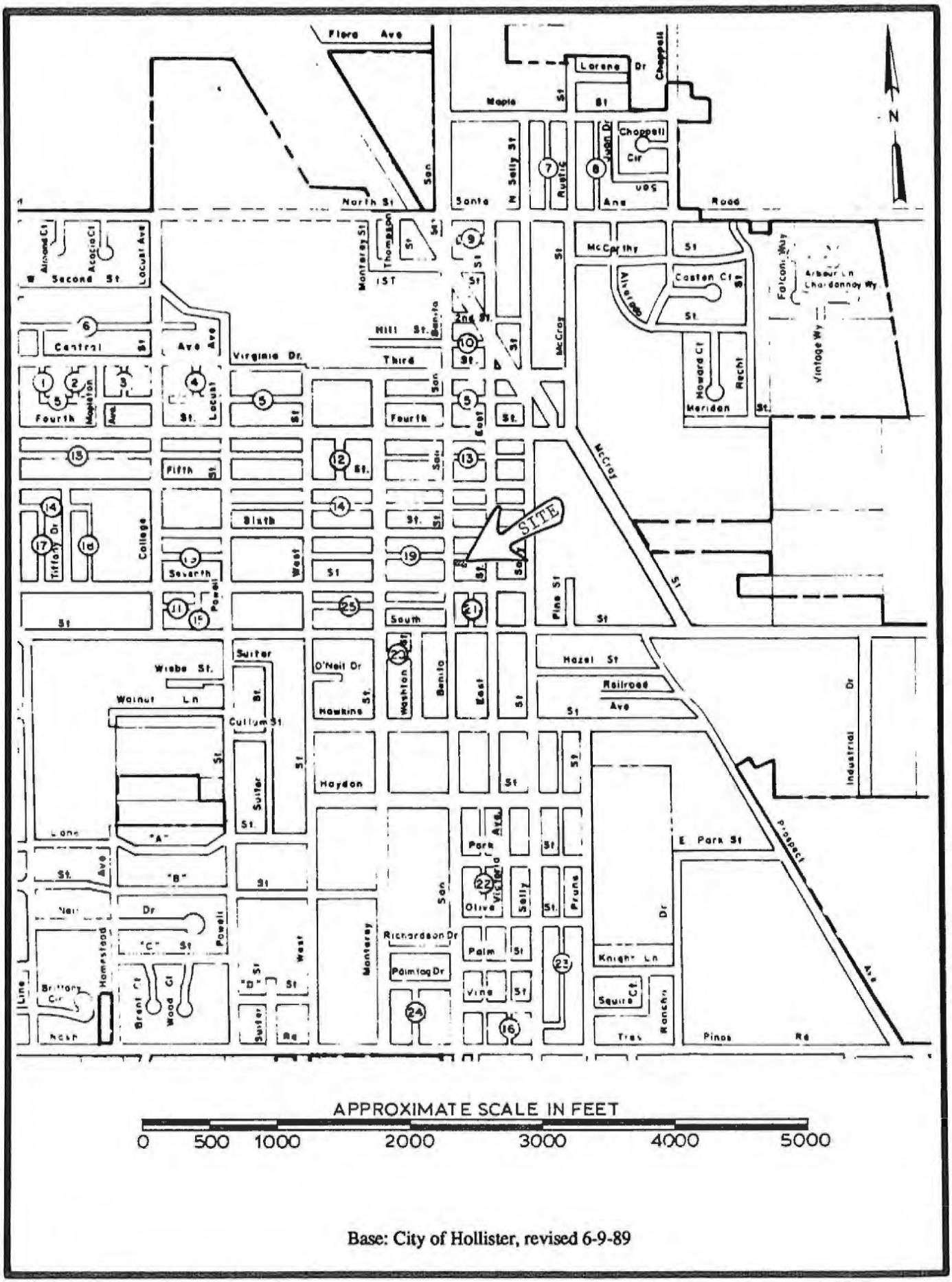
These properties are within a special study zone delineated by the City of Hollister and the California Division of Mines and Geology for the East Branch of the Calaveras fault (Figure 3). City and State laws mandate that geologic studies be performed for properties along known active fault zones (Alquist-Priolo Special Studies Zones). The stated intent of these laws is to evaluate the potential for fault rupture to occur on the property before building, rebuilding or substantial remodeling of structures for human occupancy.

We would like to express our special thanks to the City of Hollister for providing manpower and equipment during the field explorations.

Project Description

The 0.15-acre site consists of the vacant lot at 705 San Benito Street. The former Showcase Theatre building sustained damage as a result of the October 17, 1989 Loma Prieta earthquake and was later demolished. The theatre had a basement which was approximately 12-feet-deep which was backfilled during the demolition operation.

As shown on Figure 2, the site is bounded by San Benito Street on the west, Swope Alley on the east, Seventh Street on the north, and an existing building on the south. Based on our recent discussions with the City, it is our understanding that the proposed project will involve building a new structure.



Base: City of Hollister, revised 6-9-89

Figure 1 - Vicinity Map

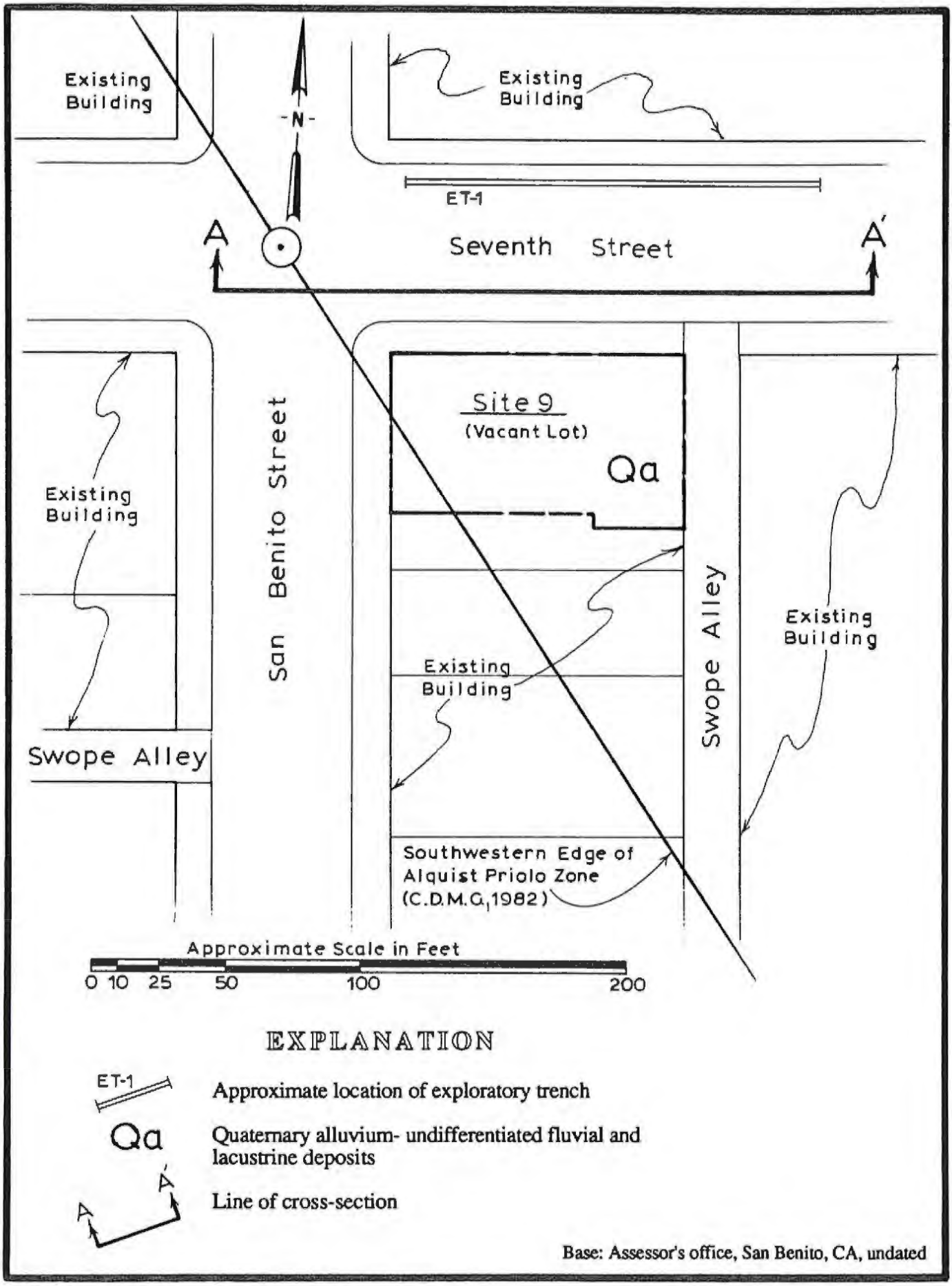
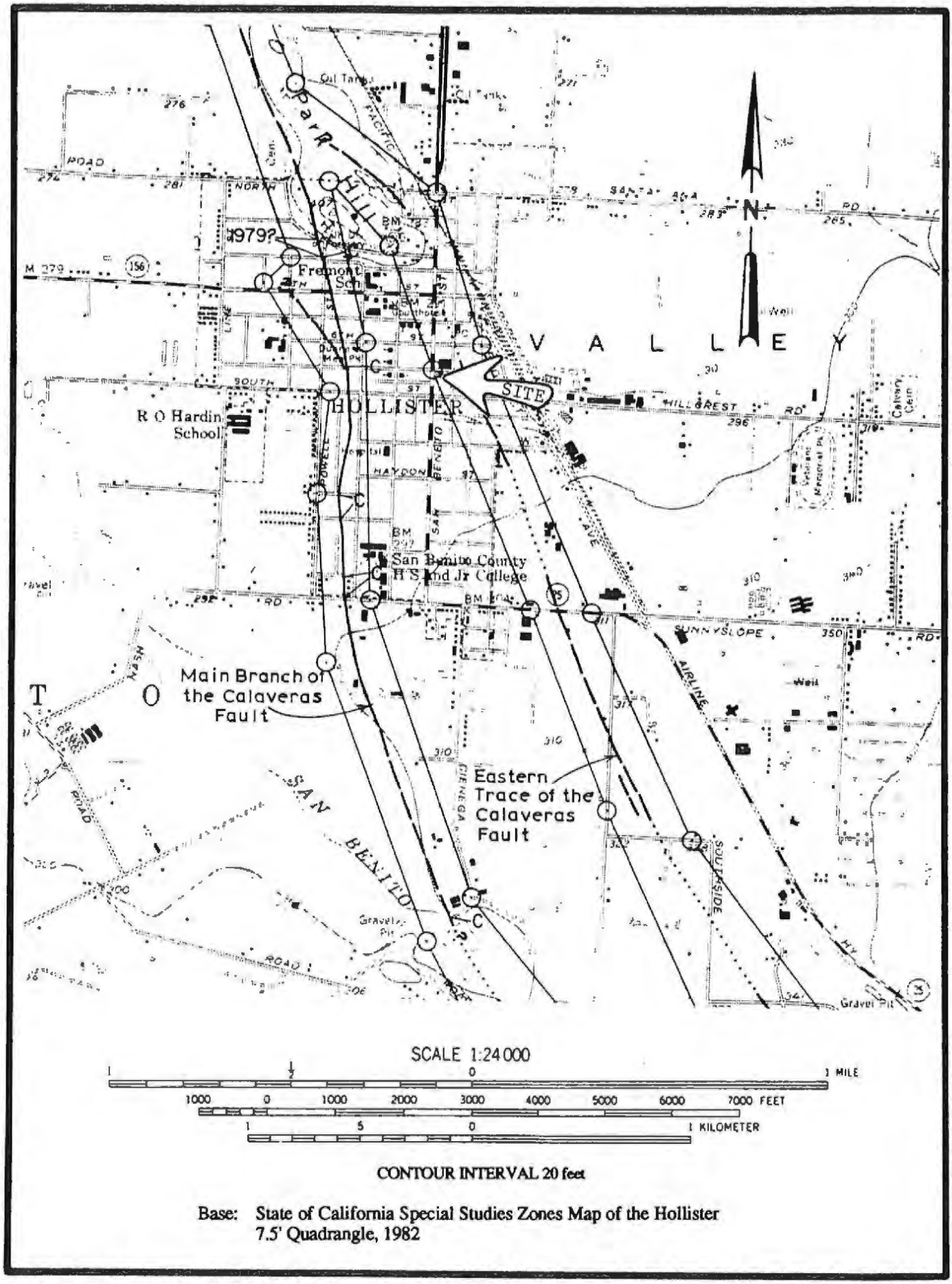


Figure 2 - Site Plan and Geology Map

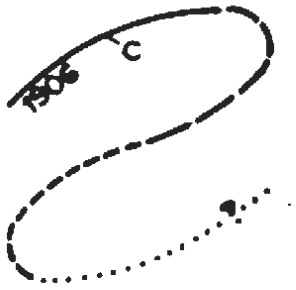


Base: State of California Special Studies Zones Map of the Hollister 7.5' Quadrangle, 1982

Figure 3 - Alquist Priolo Special Studies Zone Map

MAP EXPLANATION

Potentially Active Faults

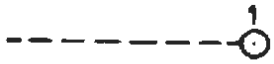


Faults considered to have been active during Quaternary time; solid line where accurately located, long dash where approximately located, short dash where inferred, dotted where concealed; query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by creep or possible creep.

Aerial photo lineaments (not field checked); based on youthful geomorphic and other features believed to be the results of Quaternary faulting.

Special Studies Zone Boundaries

These are delineated as straight-line segments that connect consecutively numbered turning points so as to define one or more special studies zone segments.



Seaward projection of zone boundary.

Source: California Division of Mines and Geology (1982)

Figure 3a - Explanation for Alquist Priolo Special Studies Zone Map

PURPOSE AND SCOPE OF SERVICES

The purpose of this study was twofold; the first was to identify the geologic conditions and evaluate existing potential geologic and seismic constraints at the site. The second purpose was to provide recommendations for site development from an engineering geologic viewpoint. This study included the following scope of work:

1. Research, review, and evaluate data from published and unpublished geologic and geotechnical reports;
2. Discussions with representatives of the City of Hollister, the California Division of Mines and Geology (CDMG), and the U.S. Geological Survey (USGS);
3. Study of a series of aerial photographs of the site and vicinity;
4. Excavate, shore, clean, and log approximately 155 lineal feet of trench;
5. Geologic analysis of field and office data; and,
6. Preparing this report, along with appropriate graphics and including the findings of the study and recommendations for development of the proposed building site.

GEOLOGIC SETTING

The Showcase Theatre property is situated within the Hollister Valley. The valley boundaries are the Pajaro River on the north, the mountains of the Gabilan Range on the west, the Diablo Range on the east, and the juncture of the Gabilan and Diablo Ranges on the south. The Gabilan Range consists of late Cretaceous age granitic rocks and metamorphic rocks, including marbles, quartzite, and schist (Compton, 1966). Overlying the granitic rocks is a series of Oligocene to middle Miocene age sandstones and shales (Allen, 1946). The Diablo Range consists of Jurassic-Cretaceous age sandstones, limestones, volcanic rocks, and metamorphic rocks which are part of the Franciscan Complex. Associated with the Franciscan rocks are metamorphic rocks of the Gabilan Range which include marble, dolomite, quartzite, and schist. Upper Cretaceous age sandstones, shales and conglomerates overlie the Gabilan metamorphic rocks and Franciscan rocks (Page, 1966).

The geologic structure of the Hollister area and the Gabilan and Diablo Ranges is strongly influenced by the active San Andreas and Calaveras faults. These faults strike northwest and are characterized by a combination of strike-slip and reverse displacement. The San Andreas and Calaveras faults are steeply southwest-dipping shear zones that separate Jurassic-Cretaceous Franciscan basement rocks from Cretaceous granitic basement rocks. The Calaveras fault branches off from the San Andreas fault approximately 8 miles south of Hollister (see Figure 4).

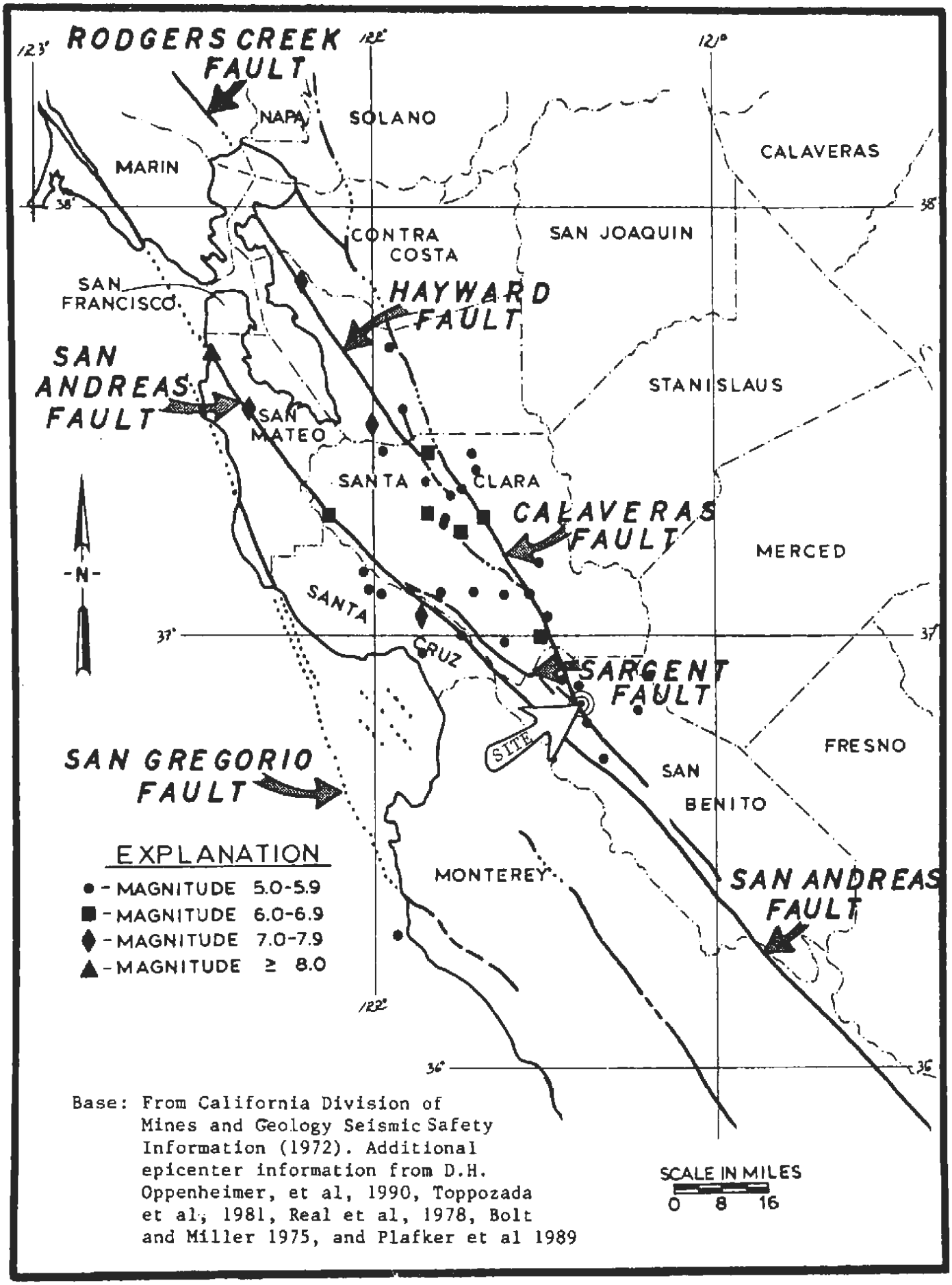
Several periods of movement on the San Andreas and Calaveras faults occurred in the Hollister area, causing uplift of the mountains bordering the valley. The combination of faulting and folding resulted a structural basin which was a seaway during the late Miocene to Pliocene (Allen, 1946). During Pliocene and Pleistocene time, extensive floodplain deposits known as the San Benito Gravels were deposited in the valley (Kilburn, 1972). During the Pleistocene, subsidence in the Hollister Valley due to tectonic activity resulted in deposition of a series of sands, silts, and clays

over the San Benito Gravels (McMasters and others, 1987). These deposits are interpreted as Pleistocene and Holocene age lake deposits (Jenkins, 1973) or as a group of shallow, short-lived lakes in a fluvial environment (Hoose, 1986; McMasters and others, 1987). Holocene activity consists mostly of down-cutting by the San Benito River and mass wasting of upland areas by landslides and erosion. The regional geology is depicted on Figure 5.

Faulting, Hollister Area

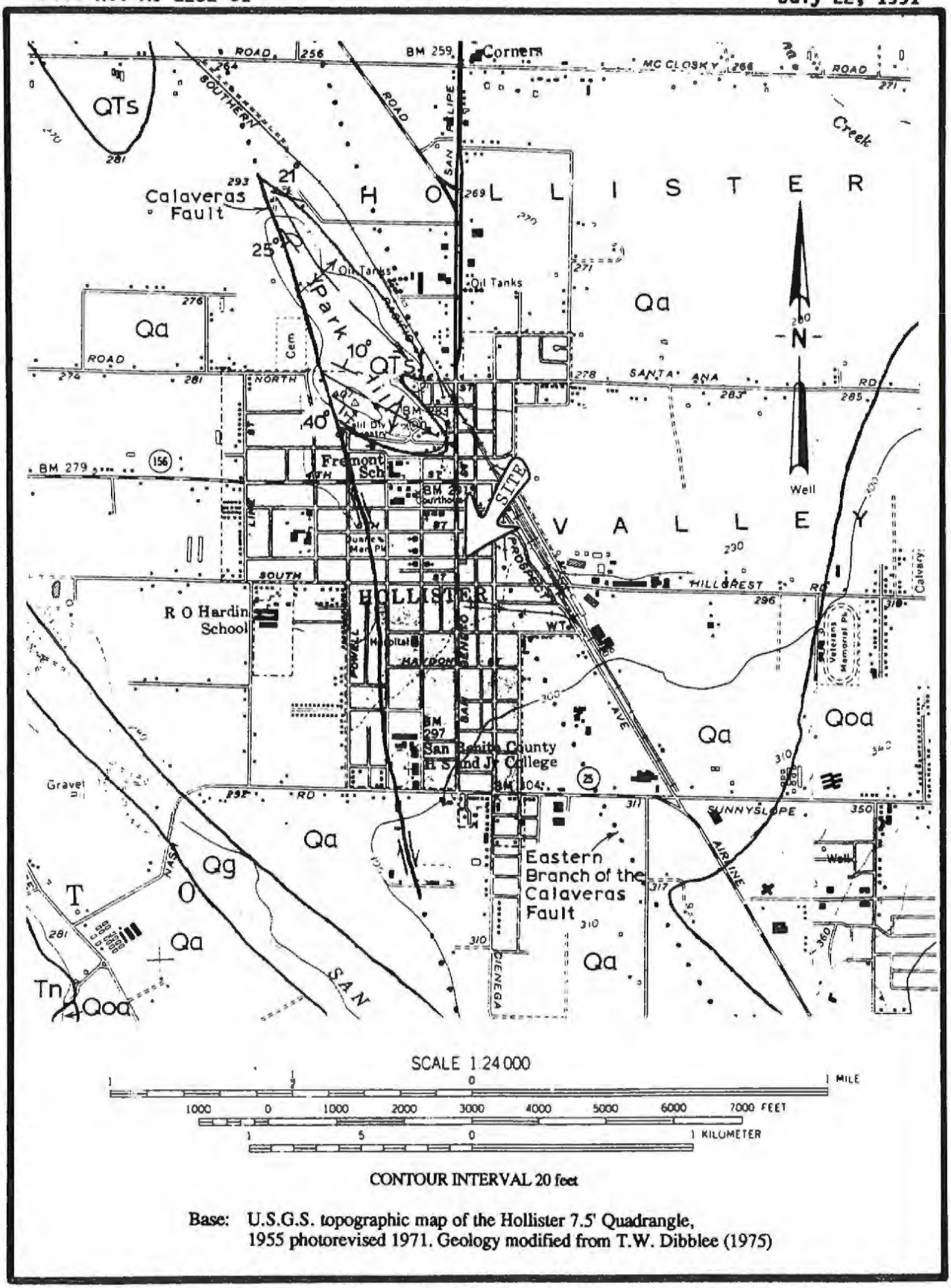
An important structural element in the Hollister area is the Calaveras fault system. Several branches of the Calaveras fault have been mapped in the Hollister area and are shown on Figure 4. The main branch is referred to as the "West Branch" by Bryant (1979). The West Branch has documented creep activity, producing at least 13 inches of right-lateral slip (Rogers and Nason, 1971). In addition, there was at least 5 mm (1/5-inch) of observed slip along the West Branch as a result of sympathetic movement during the Loma Prieta earthquake (McClellan and Hay, 1989). McClellan and Hay (1989) did not study the East Branch, as they stated that it is inactive.

The East Branch was mapped based on geomorphic evidence at Park Hill at the north end of Hollister and on a hill south of Hollister with a benchmark elevation of 668 feet. The fault was inferred between these localities based on a groundwater offset (Ellis, 1952; Kilburn, 1972) and subtle west-facing scarps (Bryant, 1979). The East Branch is mapped approximately 400 feet east of the site and is considered active by the CDMG (Bryant, 1979) based on offset bedding in trenches excavated by Leighton and Associates (1974) and Woodward-Clyde and McClure & Messinger (1968).



Base: From California Division of Mines and Geology Seismic Safety Information (1972). Additional epicenter information from D.H. Oppenheimer, et al, 1990, Toppozada et al, 1981, Real et al, 1978, Bolt and Miller 1975, and Plafker et al 1989

Figure 4 - Regional Fault and Epicenter Map



CONTOUR INTERVAL 20 feet

Base: U.S.G.S. topographic map of the Hollister 7.5' Quadrangle, 1955 photorevised 1971. Geology modified from T.W. Dibblee (1975)

Figure 5 - Regional Geology Map

EXPLANATION

Geologic Units

Qg- Stream gravel and sand (Holocene)

Qa- Alluvium (Holocene)

Qoa- Older alluvium: terrace deposits (Pleistocene)

QTs- Santa Clara Formation (Pliocene-Pleistocene)

Tn- Non-marine sedimentary rocks: greenish gray to rarely reddish claystone, siltstone and interbedded friable buff-gray sandstone

Symbols

Contact

Fault: dashed where indefinite or inferred, dotted where inferred and concealed. Horizontal displacement designated by parallel arrows

Axis of fold (anticlinal): arrow indicates direction of plunge

Figure 5a - Explanation for Regional Geology Map

METHODS OF STUDY

Literature and Map Review

As part of our study, we reviewed reports and maps pertaining to the site and vicinity. Most of the published geologic information on this area is preliminary in nature, and is based on reconnaissance techniques and extrapolation of data.

The regional geology was mapped by Taliaferro (1948). Taliaferro's map shows the Calaveras fault north and south of Hollister, but does not have a symbol depicting a location of the fault within downtown Hollister. An eastern branch of the Calaveras fault was mapped by Ellis (1952) based on an offset blue clay layer noted on well logs. The blue clay is offset across the East Branch of the Calaveras fault by approximately 50 feet with the west side up. The wells were spaced hundreds of feet apart with some wells "a few hundred feet on each side of the fault in a few places" and approximately "30 to 40 feet of offset" of the groundwater table (William C. Ellis, oral communication, May 1991).

Detailed mapping of the Calaveras fault within Hollister was performed by Rogers (1967). Rogers mapped the main (west) branch as a right-lateral strike-slip fault which exhibits active creep. The eastern branch of the Calaveras fault in downtown Hollister was mapped using a symbol that denotes uncertainty of existence and/or location by Rogers and others (1968). They show this to be a high-angle fault with the west side upthrown. The East Branch of the Calaveras fault was trenched by Woodward-Clyde & Associates and McClure & Messinger (1968) at a site approximately 3/4-mile south of the Showcase Theatre property. They stated, "Evidence was found, and which could possibly be construed as indicating the presence of a fault trace, consisted of several small clay seams and slickensided planes. These did not extend to the ground surface." Woodward-Clyde (1978) reviewed this 1968 study and concluded that the seams could have been due to other causes such as shrinkage cracks, lurch cracking, or liquefaction. They postulated that

the most likely interpretation was that these features could be considered to be conjugate shears and tension fractures developing in a fault zone.

Rogers and Nason (1971) examined streets and other man-made structures in Hollister for evidence of fault displacement. They concluded that the main branch of the Calaveras fault exhibited active creeping movement. The subsidiary branches of the Calaveras fault in Hollister were considered by Rogers and Nason (1971) to be, "...presently dormant because they do not show consistent evidence of curb or sidewalk offset." and "... local subsidence features were more abundant and extreme along the traces of the inferred dormant faults than elsewhere." Kilburn (1972) indicated a groundwater offset of approximately 20 feet with the east side up across the West and East Branches of the Calaveras fault based on well data.

Jenkins (1973) studied the Quaternary deposits in the Hollister Valley and concluded that a large lake (Lake San Benito) covered much of Hollister during the Pleistocene time period. The Hollister area was remapped by Rogers (1973) and Dibblee (1975). They showed the East Branch of the Calaveras fault, but did not identify the relative sense of fault movement. Leighton and Associates (1974) observed offset units in an exploratory trench along the East Branch of the Calaveras fault on hill 668 (approximately 2 miles south of Hollister). As part of the State fault evaluation program, CDMG (1974) considered the East Branch of the Calaveras fault as sufficiently active and well-defined to be included within an Alquist-Priolo Special Studies Zone. Bryant (1979) remapped the East Branch of the Calaveras fault approximately 200 feet west of the location shown on the 1974 Special Studies Zone map. The latest revision of the Special Studies Zone map (CDMG, 1982) incorporates Bryant's modifications.

Site-specific investigations by Terratech (1974, 1976, 1977) within the East Branch Special Studies Zone reported no evidence of faulting. These studies relied on magnetometer traverses and drilling, and did not use exploratory trenching. Other workers have located the East Branch of the

Calaveras fault in Hollister area. Terratech (1978) trenched the fault on the east side of Park Hill, approximately 1/2-mile north of the site. The fault was described on a trench log as consisting of "slickensided striated surfaces on siltstone, fault plane ? N65°W, dip 59°N". The log further discusses fault-like features as shears (up to 1" wide) on either side of the fault plane oriented N0°E, 87°N". Calcium carbonate (caliche) was described as present along the fault plane.

Bay Soils (1981) described the fault as, "... a subtle change in the bedding of silt was noted in Trench No. 1, near the location of the other anomalous factors. This consisted of an upwarping of the bedding from horizontal to 10° to 15°". Earth Systems Consultants (1985) delineated the fault based on, "A gradual vertical material boundary" with dissimilar horizontal beds on either side of the boundary.

Terratech (1987) stated, "All of the trenches exposed evidence of apparent vertical displacement." Units are vertically offset by "about 1-1/2 to 3 feet" along near-vertical discontinuous clay seams with the east side up. The strike of faults in the trenches varied from N-S to N40°E, with steep dips to the east and west. J.V. Lowney & Associates (1990a, 1990b) interpreted, "... abrupt offset of laterally continuous beds, abrupt monoclinal folding of sediments and convoluted bedding." as evidence of faulting.

Applied Soil Mechanics (1991a) located a fault on a property within East Branch Special Studies Zone approximately 1/4 mile south of the downtown area. The fault is characterized by, "... steeply dipping to near-vertical, NNE to NNW-striking fractures ... infilled with loose, fine-grained sand. ... Thin continuous clay layers and entire stratigraphic units are disrupted and offset in this zone. The maximum vertical offset along the fractures was approximately 21 inches..." Applied Soil Mechanics has recently excavated several trenches across the mapped trace of the East Branch of the Calaveras fault in downtown Hollister. Features similar to the well-defined faulting

in trenches studied by Terratech (1978, 1987) and Applied Soil Mechanics (1991a) were not observed in the downtown area. The locations of these earlier studies are shown on Figure 6.

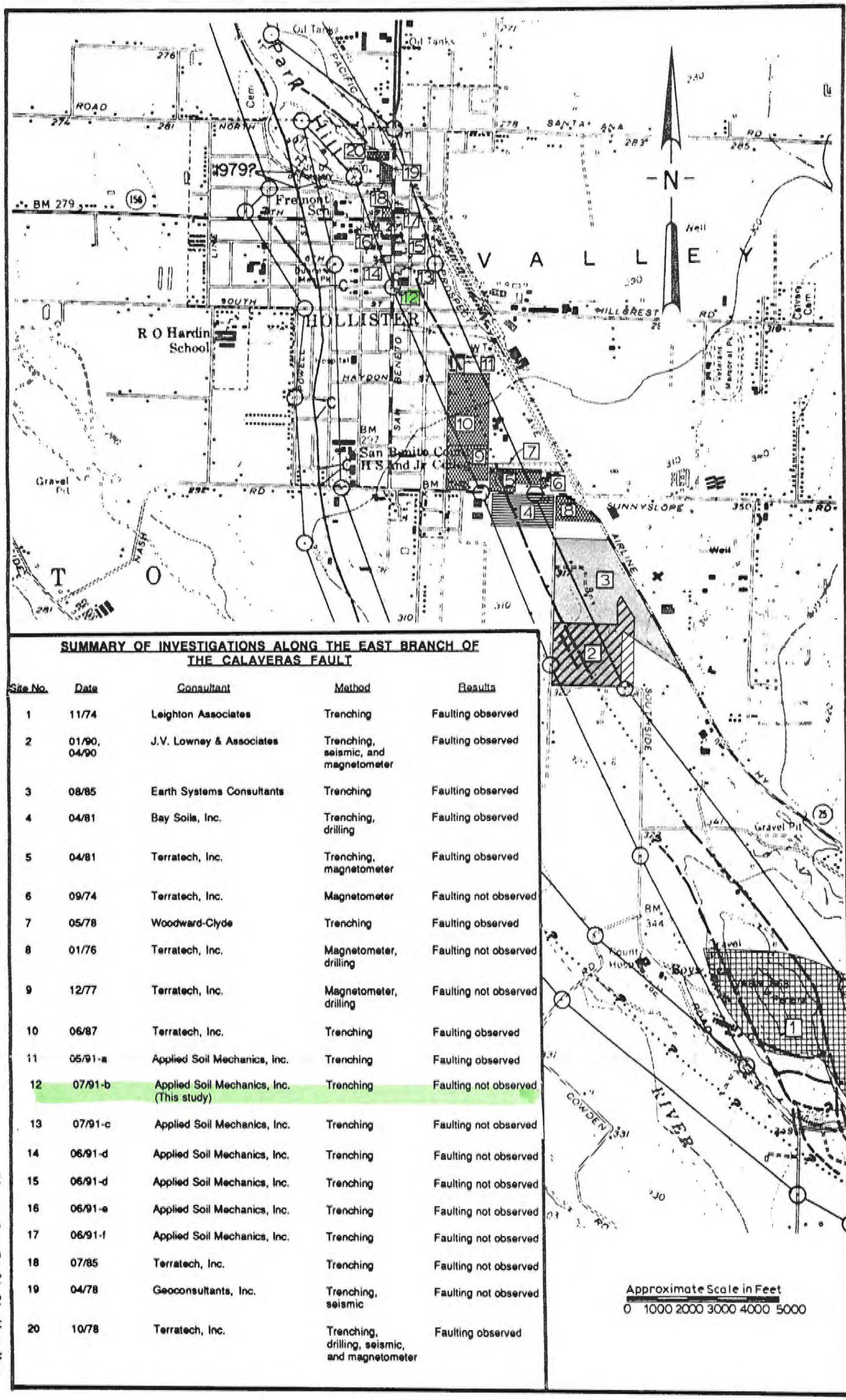
Aerial Photograph Interpretation

We studied aerial photographic stereo pairs taken of the Hollister area from 1967 to 1990. The following aerial photographs of the site and vicinity were used in this study:

Date	Approximate Scale	Type	Source
May 1967	1:20,000	black and white	USDA
May 1980	1:40,000	black and white	USDA
April 1985	1:31,680	black and white	WAC
July 1987	1:33,600	black and white	PAS
June 1989	1:31,680	black and white	WAC
August 1990	1:12,000	black and white	PAS

These photographs were studied for geomorphic evidence that could indicate active faulting. Faults typically appear on aerial photographs as a linear features with tonal differences on either side. These differences could be related to changes in soil and rock type, vegetation, groundwater levels, or bedding characteristics. Lineaments are sometimes associated with topographic features characteristic of fault zones such as linear and shutter ridges, sag ponds, springs, and offset drainages.

Within the downtown area, the aerial photographs were of limited use since development predates historic photography. Outside of town, a distinct northwest-trending lineament was seen on the aerial photographs where there is a narrow band which is lighter in color than the surrounding area in an orchard near Prune and Hawkins Streets. This lineament coincides with the mapped trace of



SUMMARY OF INVESTIGATIONS ALONG THE EAST BRANCH OF THE CALAVERAS FAULT

Site No.	Date	Consultant	Method	Results
1	11/74	Leighton Associates	Trenching	Faulting observed
2	01/90, 04/90	J.V. Lowney & Associates	Trenching, seismic, and magnetometer	Faulting observed
3	08/85	Earth Systems Consultants	Trenching	Faulting observed
4	04/81	Bay Soils, Inc.	Trenching, drilling	Faulting observed
5	04/81	Terratech, Inc.	Trenching, magnetometer	Faulting observed
6	09/74	Terratech, Inc.	Magnetometer	Faulting not observed
7	05/78	Woodward-Clyde	Trenching	Faulting observed
8	01/76	Terratech, Inc.	Magnetometer, drilling	Faulting not observed
9	12/77	Terratech, Inc.	Magnetometer, drilling	Faulting not observed
10	06/87	Terratech, Inc.	Trenching	Faulting observed
11	05/91-a	Applied Soil Mechanics, Inc.	Trenching	Faulting observed
12	07/91-b	Applied Soil Mechanics, Inc. (This study)	Trenching	Faulting not observed
13	07/91-c	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
14	06/91-d	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
15	06/91-d	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
16	06/91-e	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
17	06/91-f	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
18	07/85	Terratech, Inc.	Trenching	Faulting not observed
19	04/78	Geoconsultants, Inc.	Trenching, seismic	Faulting not observed
20	10/78	Terratech, Inc.	Trenching, drilling, seismic, and magnetometer	Faulting observed

Figure 6 - Fault Studies Map

the East Branch of the Calaveras fault (Bryant, 1979). The ground slope is not interrupted by the lineament on the air photos. Also, rows of trees in the orchard crossed by the mapped fault are not offset, indicating that fault creep displacement has not occurred since the orchard was planted. At Park Hill at the north end of town, and at hill 668 south of town, geomorphic evidence of faulting is indicated as topographic benches that are modified by erosion.

Subsurface Explorations

As part of this study, approximately 155 lineal feet of exploratory trench was excavated between June 24 and 27, 1991 using a rubber-tire backhoe with a 24-inch-wide bucket. The trench was located nearly perpendicular to the alignment of the fault trace mapped by the CDMG (1982). The positioning of the trenches was intended to intercept the most likely traces of faults in the area, assuming a regional north to northwest trend. As a result of the Showcase demolition, the building basement was filled. This dictated an off-site trench location. Underground utility lines are located along and parallel to the south side of Seventh Street. Because of these considerations, Trench ET-1 was located across from the site on the north side of Seventh Street. The trench location is shown on Figure 2. The trench logs are included in Appendix A.

The trench designated as ET-1 was located in Seventh Street east of San Benito Street. The trench was approximately 155 feet long, trended N90°E, and extended to a depth of 15-1/2 feet. After excavating, the trench was shored and the trench walls cleaned. A system of nails and colored flagging was used to mark the various strata. After the trench walls were cleaned and flagged, they were logged at a scale of one inch equals five feet. Critical areas were logged at a more detailed scale. The floor and opposite trench wall were also cleaned and examined in these areas. The trench was logged by the project geologist, Lewis Rosenberg. The trenches were observed by the

supervising geologist, Richard Gorman, and the City Geologist, John Kingsley. The logs of the trenches are shown in Appendix A.

After the trench logging operation was completed, the trench was backfilled with 2-sack grout to within 5 feet of the ground surface. After the grout had set-up, imported sand was placed and compacted over the grout material up to near the top of the trench. The sand was compacted using a small compactor. Asphaltic concrete was used to match the thickness of the existing pavement section.

Summary of Trench Observations

The uppermost part of the trench consists of asphaltic concrete pavement underlain by road base material. Utility trench backfill is present between stations 59 to 61 and consists of compacted sand. Below the fill and road base is a 7 to 8-foot-thick silty clay unit which is interpreted as a shallow lacustrine (lakebed) deposit. This unit had blocky ped structures, and was bioturbated (disturbed by plant roots and animals).

Stratigraphic units exposed in the trenches are nearly flat-laying and are laterally continuous over the length of the trenches. Within these units, several types of sedimentary structures (such as cross-bedding and channels, etc.) were observed. The uppermost fluvial deposit exhibited undisturbed trough cross-bedding. Medium to coarse-grained sand lenses were encountered in the silt and sand units. These lenses represent infilling of small channels.

Clayey silt beds approximately 1 to 2 inches in thickness were noted adjacent to the coarse sand lenses. These beds are traceable with minimal variation in thickness throughout the length of the trench, and are probably a result of waning floodwaters that deposited the coarse sand lenses. Locally, these beds undulate within the sand unit. Since the thickness of the sand unit does not

vary appreciably, the undulation is probably due to either deposition into a shallow channel or "soft" (geological sense) sediment deformation.

Deformation features such as flame structures and load casts would be expected in the depositional environment which existed in the Hollister area during the late Pleistocene-early Holocene. The presence of lake deposits over poorly consolidated fluvial sands, silts, and clays coupled with forces generated by large earthquakes on nearby faults would provide a mechanism for this soft sediment deformation. These features were found in other trenches excavated as part of the downtown fault study (Applied Soil Mechanics; 1991c, 1991d, 1991e, 1991f), but were not observed in Trench ET-1 (this study).

FINDINGS

Site Geology and Geomorphology

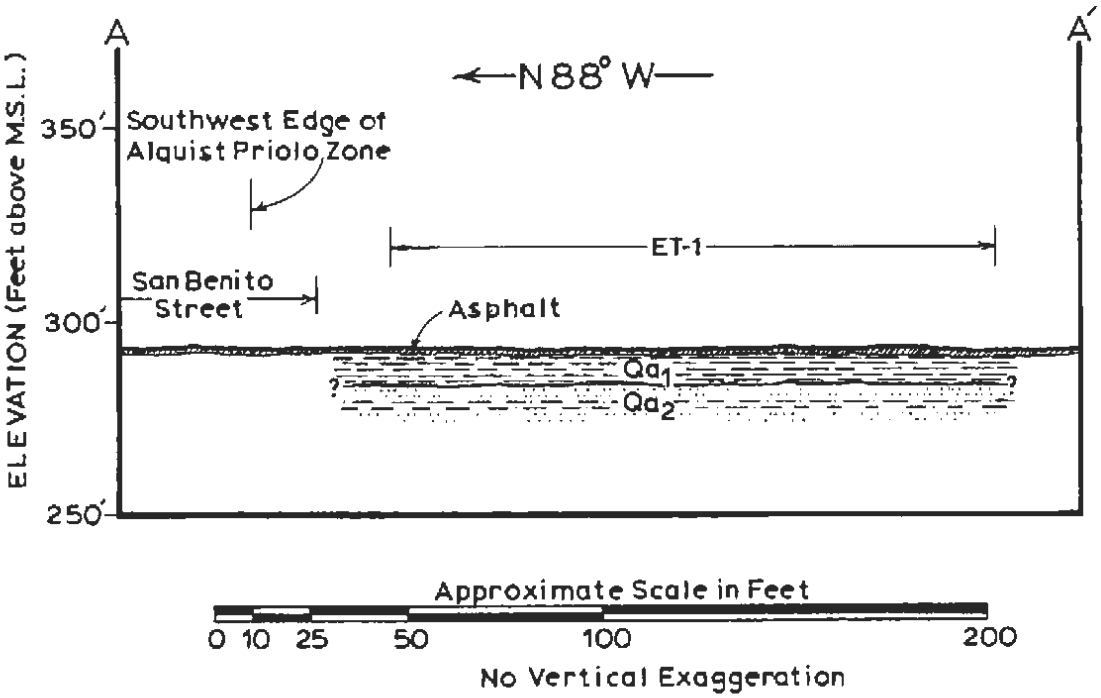
Downtown Hollister is underlain by a series of Pleistocene and Holocene age lake and stream deposits. The topography is nearly flat. At Sixth Street near Dunne Park there are low rises in the topography that have been related to active faulting on the main branch of the Calaveras fault by Rogers and Nason (1971). Similar features are also present on Hawkins, Hazel, and South Streets east of Sally Street. Structures situated along these features do not show the prominent creep-related movement present on the main branch of the fault. The geologic conditions are depicted on the Site Plan and Geology Map, Figure 2. A schematic cross-section through the site is included as Figure 7.

Stratigraphy

There were five stratigraphic units present in Trench ET-1. The uppermost unit extending from the ground surface (excluding pavement and fill) to a depth of approximately 10 to 11 feet. It consists of a dark olive to dark grayish-brown silty clay. This unit exhibits a blocky ped structure and is bioturbated. This unit is interpreted as a shallow lacustrine (lakebed) deposit. A bulk sample from this unit at approximately 12 feet depth was dated using ^{14}C radiometric analysis at 3,720 ± 90 years before present (YBP) (Applied Soil Mechanics, 1991e). This is a mean residence time date (MRT), indicating a minimum age for the sample.

Below the lakebed deposits are a series of deposits which consist of grayish-brown to olive brown silty sands, sandy silts, and clayey sands. These units are easily traced and vary from 1 to 2 feet in thickness. Faint to distinct trough cross-bedding was visible in the sandy beds. Bedding was indistinct in the silty beds. Other sedimentary structures visible included discontinuous coarse sand lenses, thin (1/4 to 2-inch) continuous clay layers and clay rip-up clasts, suggesting a fluvial

Schematic Cross-Section A-A'



EXPLANATION

Qa1- Lacustrine deposits: silty clay (unit 3&4 from exploratory trenches 1)

Qa2- Fluvial deposits: sandy silt to coarse sand (units 5-7 from exploratory trench)

Figure 7 - Schematic Cross Section

depositional environment. These beds and clay layers were used for stratigraphic correlation and were flagged in the trenches. A bulk sample from a thin organic-rich clay bed from a nearby site at a depth of approximately 17 feet had a mean residence time date of 18,110± 190 YBP (Applied Soil Mechanics, 1991d) Assuming relatively continuous deposition, the fluvial sequences encountered in the trenches are probably latest Pleistocene to early Holocene in age.

Groundwater

Damp to very moist conditions were encountered in the drilling and trenching operations; however, free groundwater was not encountered. At the time of this study, central California was experiencing the fifth consecutive year of drought conditions. It is possible that during years of normal or above normal precipitation, that saturated conditions or perched water tables could develop.

SEISMICITY

In assessing the seismic hazards for a given area, it is useful to examine historic records of local earthquake intensities. This information is useful for predicting the recurrence of severe shaking in an area. Within the historic time, significant earthquakes have severely damaged man-made structures over a large part of San Benito County. These include, but are not limited to, the 1906 M 8.3 San Francisco (Lawson, 1908), 1984 M 6.2 Morgan Hill (Stover, 1984), and the 1989 M 7.1 Loma Prieta events.

Although central California is crossed by numerous faults, several regionally active fault systems are most likely to generate earthquakes that could cause damage to the site. These include the active San Andreas, Hayward, Calaveras, and San Gregorio fault systems (Hart, 1988), and the potentially active Sargent-Berrocal fault (Bryant, 1980). Recent statistical studies theorize that a major earthquake on the Calaveras fault (Oppenheimer and others, 1990) or on the San Francisco Peninsula segment of the San Andreas fault (Working Group on California Earthquake Probabilities, 1990) will occur. When this major earthquake will occur is not specified by these groups. An earthquake on one of these faults will result in strong ground shaking at this site.

Recently active fault zones have been mapped by the State as part of the Alquist-Priolo Act of 1972. Under the act (Hart, 1988), recently active faults are defined as displaying sufficient and well-defined evidence of movement within the Holocene Epoch (about the last 11,000 years). No structures for human occupancy are permitted on the trace of an active fault. Unless proven otherwise, the area within 50 feet of an active fault is presumed to be underlain by an active fault. The Alquist-Priolo definition of potentially active is a fault showing evidence of displacement older than 11,000 years and younger than 2,000,000 years (Pleistocene Epoch). "Inactive" faults are classified as not having been active for at least two million years.

Evaluation of maximum earthquakes is a topic with considerable variation. The criteria used within this report include maximum credible and probable earthquakes. The maximum credible earthquake is defined by the California Division of Mines and Geology (1975) as,

> "the maximum earthquake that appears capable of occurring under the presently known tectonic framework. It is a rational and believable event that is in accord with all known geologic and seismic facts. In determining the maximum credible earthquake, little regard is given to its probability of occurrence, except that its likelihood of occurring is great enough to be of concern."

The maximum probable earthquake is, "The maximum earthquake that is likely to occur during a 100-year interval. It is to be regarded as a probable occurrence, not as an assured event that will occur at a specific time" (CDMG, 1975).

Table A lists known regionally active faults and their estimated seismic parameters. These estimates were generated using the EQFAULT computer program (Blake, 1989) using statistical analyses of seismic events reported by Idriss (1987).

TABLE A
ESTIMATED SEISMIC PARAMETERS FOR ACTIVE AND POTENTIALLY ACTIVE FAULTS IN THE HOLLISTER REGION

	San Andreas (Northern segment)[1]	Calaveras (Main Branch)	Hayward	San Gregorio-Palo Colorado	Sargent-Berrocal[2]
Distance and direction from site (miles)	16 SW	0.5 W	25 NW	40 SW	8 NW
Maximum credible earthquake[3, 4]	8.0	7.0	7.0	7.75	7.0
Maximum probable earthquake[3, 4]	7.5	6.5	6.75	6.75	5.75
Maximum credible peak ground acceleration[3, 5]	0.25 g	0.51 g	0.13 g	0.12 g	0.27 g
Maximum probable peak ground acceleration[3, 5]	0.21 g	0.47 g	0.10 g	0.06 g	0.15 g

[1] Defined as extending from San Juan Bautista north to Shelter Cove (Blake, 1989)
[2] Potentially active.
[3] Assumes that the earthquake will occur at a prescribed depth and at the nearest point to the site.
[4] Richter earthquake magnitude
[5] From: Idriss (1987)

Primary Earthquake Effects

Fault-Related Ground Rupture – Ground rupture along fault traces can occur during large earthquakes, and zones of high ground rupture potential are delineated by governmental agencies. The site is within the State Alquist-Priolo Special Studies Zone and the City Seismic Zone for the East Branch of the Calaveras fault (CDMG, 1982; Barrett, 1976).

The data gathered and analyzed (including the trench data and the MRT dates) indicate that there is no evidence for an active fault trace to cross the building site studied. Therefore, the potential for ground rupture resulting from fault movement at the building site is considered to be low.

Secondary Earthquake Effects

Ground Shaking – Hollister experienced severe shaking during the 1989 earthquake, according to local accounts (McCann, 1990). Ground shaking from a seismic event is the primary seismic hazard that will have the greatest impact on the proposed development within its design life span. Ground shaking can trigger other secondary seismic hazards that are discussed in following sections.

Strong ground shaking is documented for the following earthquakes: 1906 M 8.3 San Francisco (Lawson, 1908), 1983 M 6.7 Coalinga (Stover, 1983), and the 1984 M 6.2 Morgan Hill (Stover, 1984) and can reasonably be expected in the future. The estimated shaking intensity in the Hollister area during the 1989 Loma Prieta event was VII on the Modified Mercalli scale (Plafker and Galloway, 1989). Wood and Neumann (1931) define Modified Mercalli VII intensity as, "*Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.*"

The Loma Prieta earthquake provided data on ground response in the Hollister area. Three strong-motion seismograph station are located in the Hollister area. These stations record peak ground accelerations (PGA), and the data is summarized below in Table B.

TABLE B
PEAK GROUND ACCELERATIONS RECORDED DURING THE OCTOBER 17, 1989 EARTHQUAKE IN THE HOLLISTER REGION

	Hollister City Hall	South and Pine Streets	Hollister Airport
Approximate distance and direction from site (feet)	800 NW	1,000 SE	12,000 N
Peak horizontal ground acceleration	0.25g	0.38g	0.29g
Peak vertical ground acceleration	0.22g	0.20g	0.16g
Site geology	Alluvium	Alluvium	Alluvium
Source of data	1	2	1

[1] Maley and others (1989)
[2] Shakal and others (1989)

The PGA is one of the factors involved in designing a structure to resist seismic forces. Using the method of Idriss (1987) with the EQFAULT program (Blake, 1989), a maximum probable earthquake of M 6.5 occurring on the nearest point of the Calaveras fault could produce a PGA of 0.47 g at the site. The PGA generated by EQFAULT is an approximate value and does not take into account other factors such as depth to bedrock, ground saturation, and topographic amplification. For wood-frame structures, the PGA tends to be conservative, and the repeatable high ground acceleration (RHGA) is appropriate (Ploessel and Slosson, 1974). For a maximum probable earthquake of M 6.5 occurring on the Calaveras fault, the RHGA is 0.31 g.

Liquefaction – Soil liquefaction is the loss of soil strength during a significant seismic event. It occurs primarily in saturated loose- to medium-dense, fine to medium-grained sands and sandy silts. Liquefaction results in rearrangement of the soil particles into a denser condition, resulting in localized areas of ground failure. Common types of liquefaction-related ground failure include differential settlement and lateral spreading. Secondary ground cracks frequently occur as a result of liquefaction-related ground failure and should not be confused with ground deformation resulting from fault rupture.

No signs of liquefaction such as sand boils were observed in trenches in the immediate vicinity of the site after the Loma Prieta earthquake (Plafker and Galloway, 1989; McCann, 1990). The native site soils are relatively fine-grained and may be susceptible to liquefaction, if saturated. Groundwater was not encountered in the exploratory trench, and the soils were damp to very moist. If the groundwater table were to rise, or if perched groundwater conditions develop, or if the near-surface granular material becomes saturated, then the risk of liquefaction is moderate. From a geologic viewpoint, the risk of liquefaction in the present environment is considered to be low. A geotechnical study is needed to definitively assess the risk of liquefaction.

Lurching cracks are a variety of ground cracking that could be related to earthquakes. There was no evidence seen in the trench that lurch cracking occurred at this site as a consequence of an earthquake. Therefore, the potential for lurch cracking to occur at this site is considered to be minimal.

CONCLUSIONS

The conclusions are based on the data gathered and analyzed for this study.

1. Based on trench observations, we conclude that an active fault does not cross the Showcase Theatre property (Sites 9), nor is there a fault trace within 50 feet of the site.

2. In the trenches excavated as part of this study, nearly flat-lying sediments maintain an almost constant thickness in the trenches. Laterally continuous stratigraphic units could be correlated in the trenches and from trench to trench. No evidence of offset was apparent along these marker units.

3. Development of the site is feasible from a geologic point of view.

RECOMMENDATIONS

The Showcase Theatre (Sites 9) is suitable from an engineering geologic viewpoint for the planned building reconstruction, provided that the recommendations in this report are followed.

1. A soil engineering study should be performed for the proposed new structure. The study should address liquefaction potential and associated effects such as differential settlement. The study should also address the possibility of buried features such as old foundations, basements, tanks, and trash pits.

2. The proposed structures should be designed to withstand strong ground shaking. The project structural engineer should determine the appropriate method used for seismic design of the new buildings. If the structural engineer elects to use the design criteria of the Uniform Building Code (1988 edition), we suggest that a seismic zone factor of 0.40 and a site coefficient of 1.0 (Tables 23-I and 23-J, respectively) be used. The selection of the appropriate seismic zone factor and site coefficient are the purview of the structural engineer.

3. The geologic trenches for this study have been backfilled using lean grout, compacted sand and native soil. Their position and condition should be taken into consideration in the design of the improvements planned for this site.

REFERENCES CITED

Allen, J.E., 1946, Geology of the San Juan Bautista quadrangle, California: California Division of Mines Bulletin 133, 75 p., 3 plates, scale 1:62,500.

Applied Soil Mechanics, Inc., 1991a, Geologic evaluation, proposed three-lot subdivision, 49, 53, and 57 Hawkins Street, Hollister, California: unpublished report prepared for Dean Rodrigues. File No. A0-2303-S1.

_____, 1991b, Fault study, Showcase Theatre, 705 San Benito Street, San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2282-S1.

_____, 1991c, Fault study, "600-block" properties, SE Corner of Sixth and San Benito Streets: Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2323-S1.

_____, 1991d, Fault study, Bruhn and Peterson properties, 515, 525, and 530 San Benito Street, San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2281-S1.

_____, 1991e, Fault study, Building Sites 1, 3, 4, 5, 6, and 10: Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2280-S1.

_____, 1991f, Fault study, Poletti property, 335 San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2279-S1.

Barrett, Nestor, 1976, Seismic Safety Element of the General Plan: City of Hollister Planning Department open-file report, 37 p.

Bay Soils, Inc., 1981, Soil and geologic investigation, Hollister shopping center, SWC Nash Road and Southside Road, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-1337, 20 p., 3 appendices.

Blake, T.F., 1989, EQFAULT, a computer program for the deterministic prediction of peak ground acceleration from digitized California faults.

Boggs, Sam, Jr., 1987, Principles of sedimentology and stratigraphy: Merrill Publishing Company, Columbus, Ohio, 784 p.

Bryant, W.A., 1979, Fault evaluation report, Calaveras (Hollister segment) and "Buena Vista Road" faults: California Division of Mines and Geology Fault Evaluation Report FER-94, 14 p., 4 plates, scale 1:24,000.

_____, 1980, Fault evaluation report, SE segments of Sargent and Castro faults: California Division of Mines and Geology Fault Evaluation Report FER-96, 21 p., 11 plates, scale 1:24,000.

California Division of Mines and Geology, 1974, Special studies zones map, Hollister 7.5 minute quadrangle: California Department of Conservation, 1 sheet, scale 1:24,000.

_____, 1975, Recommended guidelines for determining the maximum credible and the maximum probable earthquakes: California Division of Mines and Geology Note 43, 1 p.

_____, 1982, Special studies zones map, Hollister 7.5 minute quadrangle: California Department of Conservation, 1 sheet, scale 1:24,000.

Compton, R.R., 1966, Granitic and metamorphic rocks of the Salinian block, California Coast Ranges *in* Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 277–287.

Dibblee, T.W., Jr., 1975, Geologic map of the Hollister quadrangle: U.S. Geological Survey Open-File Report 75-394, 1 map, scale 1:62,500.

Earth Systems Consultants, 1985, Seismic hazard evaluation, Kelly Ranch, Parcel 2, Southside Road, Hollister, California: unpublished report prepared for San Benito Engineering and Surveying, Inc., 22 p.

Ellis, W.C., 1952, Elevations on top of the blue clay zone, Hollister area: U.S. Bureau of Reclamation unpublished map.

Geoconsultants, Inc., 1978, Geologic hazard investigation for proposed commercial development, Park Hill and San Benito Streets, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-742, 12 p.

Hart, E.W., 1988, Fault-rupture hazard zones in California: California Division of Mines and Geology Special Publication 42, 24 p.

Hoose, S.N., 1986, Was there a great Pleistocene Lake San Benito? (M.S. thesis): San Jose State University, 87 p.

Idriss, I.M., 1987, Lecture notes, presentation at the EERI course on strong ground motion, April 10-11, 1987, Pasadena, California, *in* Singh, J.P., Course Organizer, Strong ground motion, seismic analysis, design and code issues: Earthquake Engineering Research Institute, 14 p.

International Conference of Building Officials, 1988, Uniform Building Code: Whittier, California, 926 p.

Jenkins, O.P., 1973, Pleistocene Lake San Benito: California Geology, v. 26, no. 7, p. 151–163.

Kilburn, Chabot, 1972, Ground-water hydrology of the Hollister and San Juan Valleys, San Benito County, California: U.S. Geological Survey Open-File Report 73-144, 5 maps, various scales.

Lawson, A.C., chairman, 1908, The California earthquake of April 18, 1906: Report of the California State Earthquake Investigation Commission: Washington D.C., Carnegie Institution of Washington, Publication 87, v. 1, 2 parts, 451 p.

Leighton and Associates, 1974, Fault hazard study of eastern and western portions of Ridgemark Estates development, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-56, 11 p., 1 appendix.

Lowney, J.V., & Associates, 1990a, Fault location investigation for Kelly Ranch residential development, Southside Road, Hollister, California: City of Hollister Open-File report, 20 p., 2 appendices.

_____, 1990b, Supplemental fault location investigation for Kelly Ranch residential development, Southside Road, Hollister, California: City of Hollister Open-File report, 13 p., 2 appendices.

Maley, R., Acosta, A., Ellis, F., Etheredge, E., Foote, L., Johnson, D., Porcella, R., Salsman, M., and Switzer, J., 1989, U.S. Geologic Survey strong-motion records from the northern California (Loma Prieta) earthquake of October 17, 1989: U.S Geological Survey Open-File Report 89-568, 84 p.

McCann, J.Z., 1990, Aftershock: the Loma Prieta earthquake and its impact on San Benito County: Hollister, California, Seismic Publications, 80 p.

McClellan, P.H., and Hay, E.A., Geologic evidence for triggered slip on the Calaveras fault during the magnitude 7.1 Loma Prieta earthquake of October 17, 1989: U.S Geological Survey Open-File Report 89-641, 37 p.

McMasters, C.R., Herd, D.G., Throckmorton, C.K., and Heusser, L.E., 1987, Subsurface stratigraphy of the eastern Hollister Valley, California: U.S Geological Survey Miscellaneous Field Studies Map MF-1461, 3 sheets, various scales.

Oppenheimer, D.H., Bakun, W.H., and Lindh, A.G., 1990, Slip partitioning of the Calaveras fault, California, and prospects for future earthquakes: Journal of Geophysical Research, v. 95, no. B6, p. 8483–8498.

Page, B.M., 1966, Geology of the Coast Ranges of California *in* Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 255–276.

Plafker, George, and Galloway, J.P., eds., 1989, Lessons learned from the Loma Prieta, California earthquake of October 17, 1989: U.S. Geological Survey Circular 1045, 42 p.

Ploessel M.R., and Slosson, J.E., 1974, Repeatable high ground accelerations from earthquakes: California Geology, v. 27, no.9, p. 195–199.

Rogers, T.H, 1967, Active extensional faulting north of Hollister near the Calaveras fault zone: Bulletin of the Seismological Society of America, v. 57, no. 4, p. 813–816.

_____, 1973, Preliminary geologic map, NE 1/4 Hollister quadrangle: California Division of Mines and Geology unpublished open-file report, 1 sheet, scale 1:12,000

Rogers, T.H., and Nason, R.D., 1971, Active displacement on the Calaveras fault zone at Hollister, California: Bulletin of the Seismological Society of America, v. 61, no. 2, p. 399–416.

Rogers, T.H., Nason, R.D., and Cooper, A.K., 1968, Preliminary map showing traces of the Calaveras fault zone in the City of Hollister, California: California Division of Mines and Geology Open-File Report 68-3, 1 sheet, scale 1 in. = 500 ft.

Shakal, A., Huang, M., Reichle, M., Ventura, C., Cao, R., Sherburne, R., Savage, M., Darragh, R., and Petersen C., 1989, CSMIP strong motion records from the Santa Cruz Mountains (Loma Prieta), California: California Division of Mines and Geology, Office of Strong Motion Studies Report No. OSMS 89-06, 196 p.

Stover, C.W., 1983, Intensity distribution and isoseismal map *in* Bennett, J.H., and Sherburne, R.W., eds., The 1983 Coalinga, California earthquake: California Division of Mines and Geology Special Publication 66, p. 1–4.

_____, 1984, Intensity distribution and isoseismal map for the Morgan Hill, California, earthquake of April 24, 1984 *in* Bennett, J.H., and Sherburne, R.W., eds., The 1984 Morgan Hill, California earthquake: California Division of Mines and Geology Special Publication 68, p. 1–4.

Taliaferro, N.L., 1948, Geologic map of the Hollister quadrangle: California Division of Mines Bulletin 143, 1 sheet, scale 1:62,500.

Terratech, Inc., 1974, Geologic evaluation, proposed commercial building, Alpha Beta shopping center, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-107, 4 p.

_____, 1976, Geotechnical investigation, K & S Market, Southside Road and Nash Road, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-329, 11 p.

_____, 1977, Geotechnical investigation, Royal Court Estates, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-642, 9 p.

_____, 1978, Geologic/geotechnical investigation, First Street commercial property, Hollister, California: City of Hollister Open-File report, 9 p., 2 appendices.

_____, 1981, Geologic investigation, proposed Nob Hill shopping complex, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-1336, 5 p.

_____, 1985, Fault investigation, J.C. Penney building, Hollister, California: City of Hollister Open-File report, 10 p.

_____, 1987, Investigation of the east branch of the Calaveras fault, Prune Street school site (Rancho San Justo Tandem school site), Hollister, California: City of Hollister Open-File report, 5 p.

U.S. Bureau of Reclamation, 1989, Engineering geology field manual: U.S. Department of the Interior, 599 p.

Wood, H.O., and Neumann, Frank, 1931, Modified Mercalli intensity scale of 1931: Bulletin of the Seismological Society of America, v. 21, no. 4, p. 277–283.

Woodward-Clyde Consultants, 1978, Geologic evaluation, Prospect Avenue property, Hollister, California: City of Hollister Open-File report, 5 p.

Woodward-Clyde & Associates and McClure & Messinger, 1968, Earthquake fault and earthquake engineering studies, proposed upper school site, Hollister, California: unpublished report submitted to Hollister School District, Hollister, California.

Working Group on California Earthquake Probabilities, 1990, Probabilities of large earthquakes in the San Francisco Bay region, California: U.S. Geological Survey Circular 1053, 51 p.

AERIAL PHOTOGRAPH REFERENCES

Pacific Aerial Surveys, July 3, 1987, V-SBN-C1-11 to 12, black and white, vertical, approximate scale 1:33,600.

_____, August 29, 1990, SBN-3845 47-54 to 55, black and white, vertical, approximate scale 1:12,000.

U.S. Department of Agriculture, May 15, 1967, BUX–1HH–91 to 93, black and white, vertical, approximate scale 1:20,000.

_____, May 7, 1980, 379–75 to 78, black and white, vertical, approximate scale 1:40,000.

WAC Corporation, April 2, 1985, WAC–85CA 7–45 to 48, black and white, vertical, approximate scale 1:31,680.

_____, June 14, 1989, WAC–90CA, 32–139 to 142, black and white, vertical, approximate scale 1:31,680.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report are based upon the assumption that the subsurface conditions do not deviate substantially from those disclosed in the trenches and borings. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that planned at the present time, Applied Soil Mechanics, Inc. should be notified so that supplemental recommendations can be given.

2. This report is issued with the understanding that it is the responsibility of the owner or of his representative to ensure that the information and recommendations presented herein are called to the attention of the project architect and engineers for the project and incorporated into the project plans and specifications, and that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the present date. Changes in the conditions of a property can occur with the passage of time, however, whether they be due to natural processes or the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or partially, by changes outside of our control. Therefore, this report should not be relied upon after a period of three (3) years without being reviewed by an engineering geologist.

4. This report was prepared upon your request for our services, and in accordance with currently accepted standards of professional engineering geology practice. No warranty as to the contents of this report is intended, and none shall be inferred from the statements or opinions expressed.

5. The scope of our services did not include any environmental assessment or study for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater or air, on or below or around this site. Any statements in this report regarding odors noted or unusual or suspicious items or conditions observed are strictly for the information of our client.

APPENDIX A

Exploratory Trench Logs

Exploratory Trench No. 1

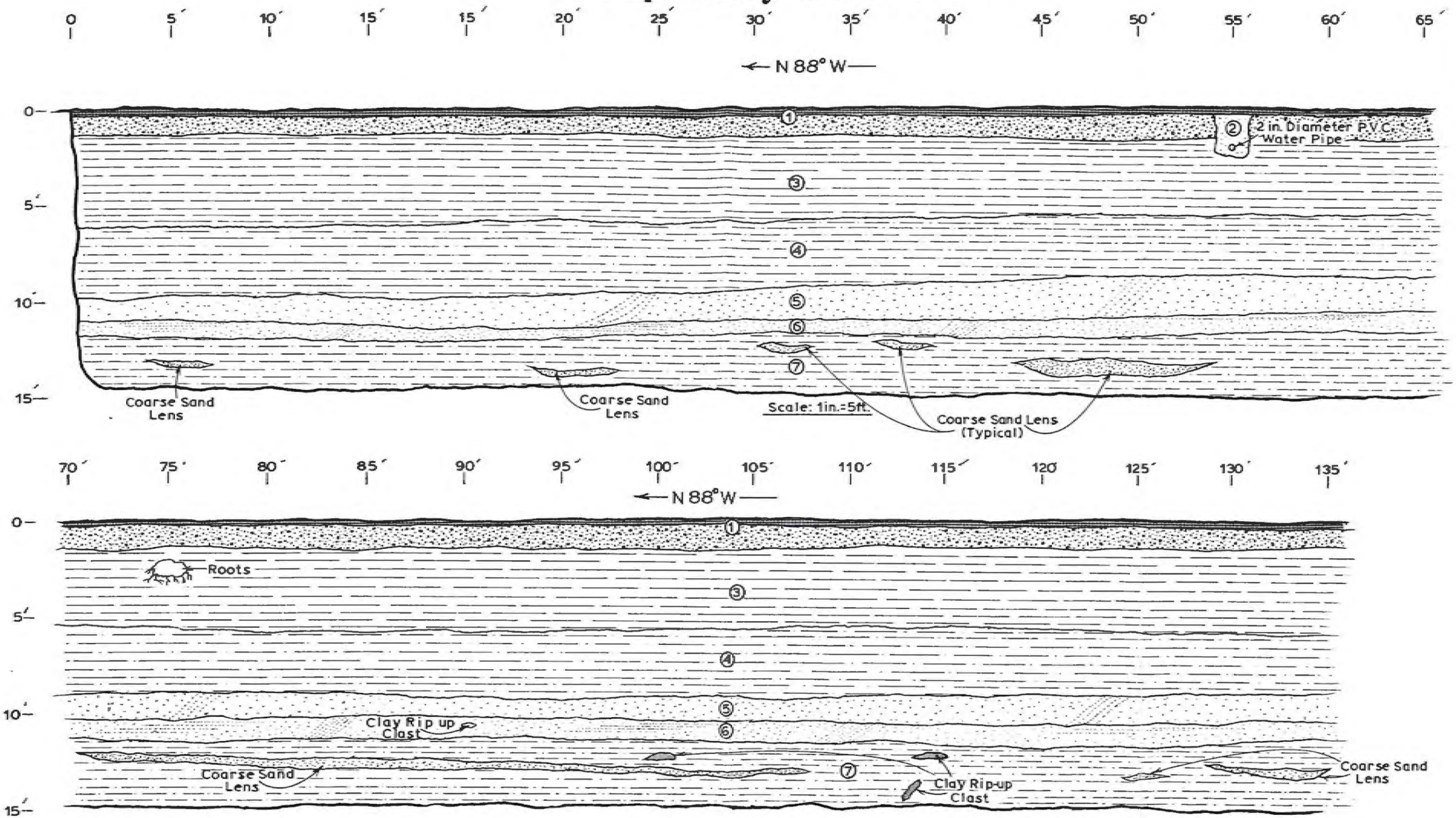
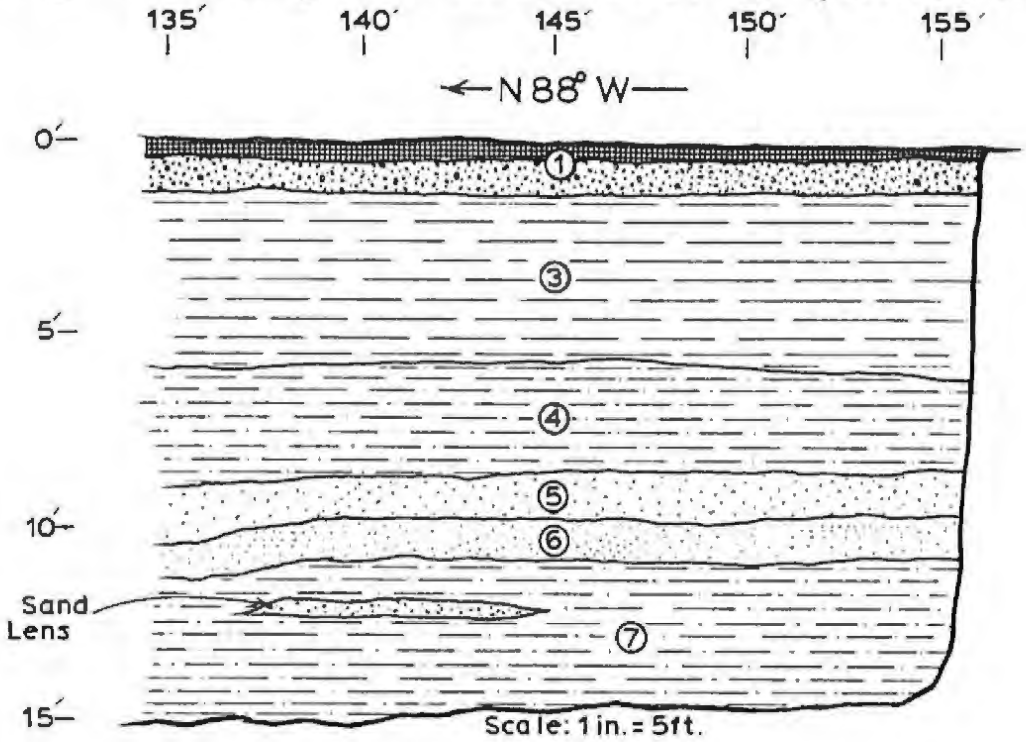


Figure A1 - Log of Trench No. 1 (0-135 feet)

Exploratory Trench No. 1 (Continued)



EXPLANATION

Fill:

Unit 1: 4 inches of asphaltic concrete over 8 inches aggregate base material.

Unit 2: Sand placed as utility trench backfill.

Lacustrine deposits:

Unit 3: Olive brown (2.5Y 4/3) silty clay with thin (1/8-1/4 inch thick) light gray laminations, damp, very stiff, bioturbated, gradational contacts.

Unit 4: Light olive brown clayey silt (2.5Y 5/3) with scattered charcoal fragments; damp, very stiff, massive, wavy upper and lower contacts.

Fluvial deposits:

Unit 5: Olive brown (2.5Y 4/3) medium-grained sand; very moist, medium dense, faint cross-bedding, sharp upper and lower contacts.

Unit 6: Light brownish-gray (2.5Y 6/2) to olive-brown (2.5Y 4/3) silty fine-grained sand; very moist, medium dense, thin subparallel laminations and faint cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay.

Unit 7: Light olive-gray (5Y 6/2) to olive-brown (2.5Y 4/3) fine sandy silt; very moist, stiff, massive, sharp upper contact. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay and lenses of fine silty sand.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A2 - Log of Trench No. 1--continued (135-155 feet)

Applied Soil Mechanics, Inc.
SOIL AND FOUNDATION ENGINEERS • GEOLOGISTS
400 Park Center Drive, Suite 7 • Hollister, CA 95023
(408) 637-2133 • FAX (408) 637-0510

File No. A0-2323-S1 July 17, 1991

City of Hollister Redevelopment Agency
375 Fifth Street
Hollister, CA 95023

Attention: Mr. Christopher M. Reyes, Program Manager

Subject: **"600-block" Properties**
SE Corner of Sixth and San Benito Streets
Hollister, California
FAULT STUDY

Gentlemen:

As you requested, we have completed the fault study for the "600-block" properties. The purpose of this study was to determine if there was evidence for a trace of the East Branch of the Calaveras fault is within the study area. The following report presents the results of our study.

No evidence for the presence of active fault traces was gathered during the field exploration phase of this study. Based on the results of this study, the site is considered suitable from an engineering geologic viewpoint for the proposed building improvements, provided that the recommendations presented herein and those of the recommended soil engineering study are incorporated into appropriate construction plans and specifications.

The submission of this report concludes this geologic phase of our contract with the City. We are pleased to have been of service to you on this project.

Sincerely,

APPLIED SOIL MECHANICS, INC.

Written by:

Lewis Rosenberg/RG

Lewis Rosenberg
Project Geologist

Reviewed by:

Richard T. Gorman

Richard T. Gorman, C.E.G. 1325
Consulting Geologist

Copies: 5 to Addressee

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INTRODUCTION

This report presents the results of our fault study for the "600-block" properties in Hollister, California (see Figure 1). The "600-block" properties consist of the former buildings at 609, 611, 615, and 623 San Benito Street., and the former building at 257, 243, 223, and 221 Sixth Street and are shown on Figure 2.

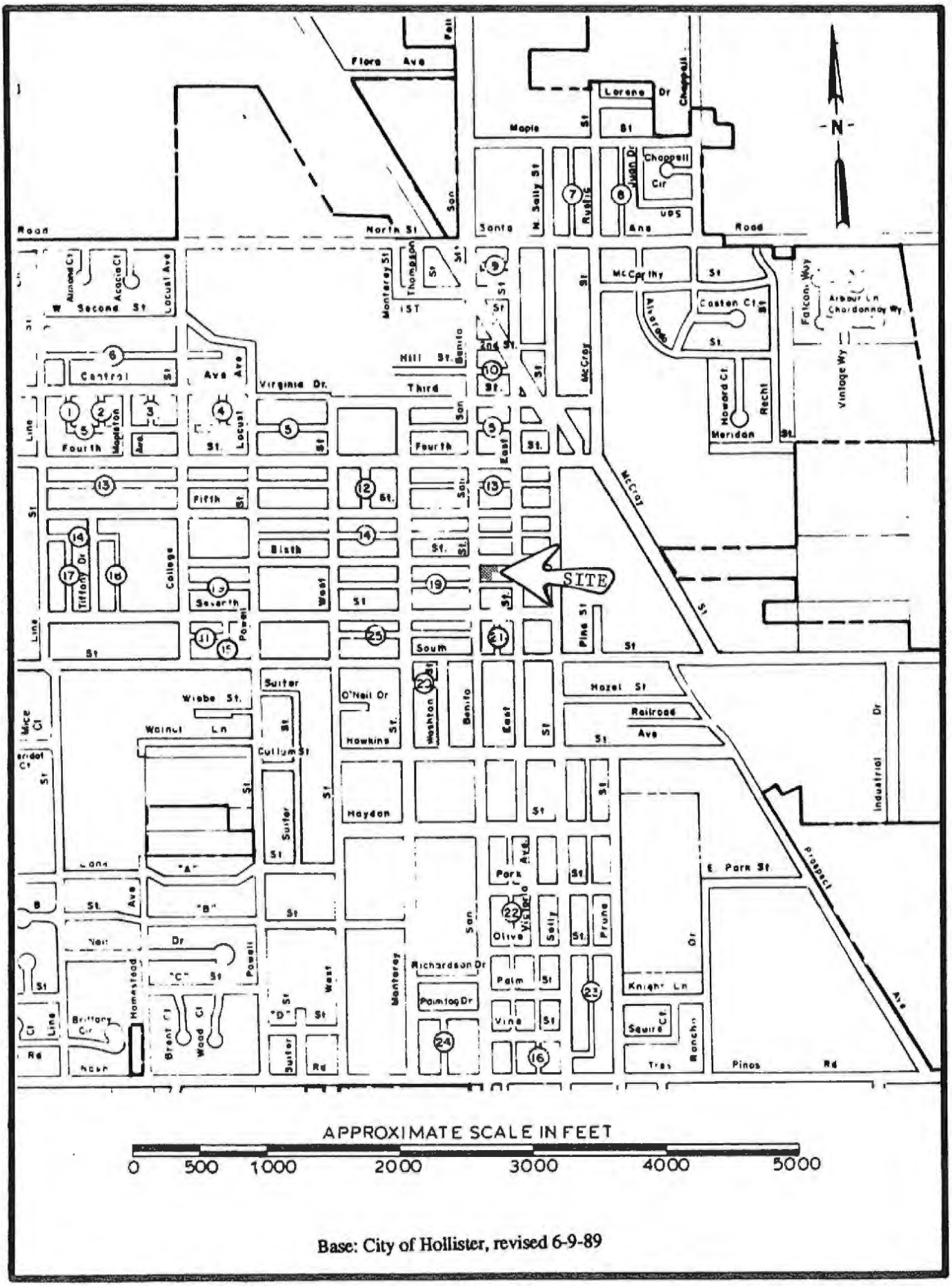
These properties are within a special study zone delineated by the City of Hollister and the California Division of Mines and Geology for the East Branch of the Calaveras fault (Figure 3). City and State laws mandate that geologic studies be performed for properties along known active fault zones (Alquist-Priolo Special Studies Zones). The stated intent of these laws is to evaluate the potential for fault rupture to occur on the property before building, rebuilding or substantial remodeling of structures for human occupancy.

We would like to express our special thanks to the City of Hollister for providing manpower and equipment during the field explorations.

Project Description

The 0.33-acre site consists of the vacant lot at 609, 611, 615, and 623 San Benito Street, and 243, and 257 Sixth Street. The buildings at these addresses were damaged as a result of a fire and were later demolished. The portion of the building at 221 and 223 Sixth Street did not burn down and is currently in use.

As shown on Figure 2, the site is bounded by San Benito Street on the west, a parking lot and existing building on the east, Sixth Street on the north, and Brown Alley on the south. Based on our recent discussions with the City, it is our understanding that the proposed project will consist of building new structures.



APPROXIMATE SCALE IN FEET

0 500 1000 2000 3000 4000 5000

Base: City of Hollister, revised 6-9-89

Figure 1 - Vicinity Map

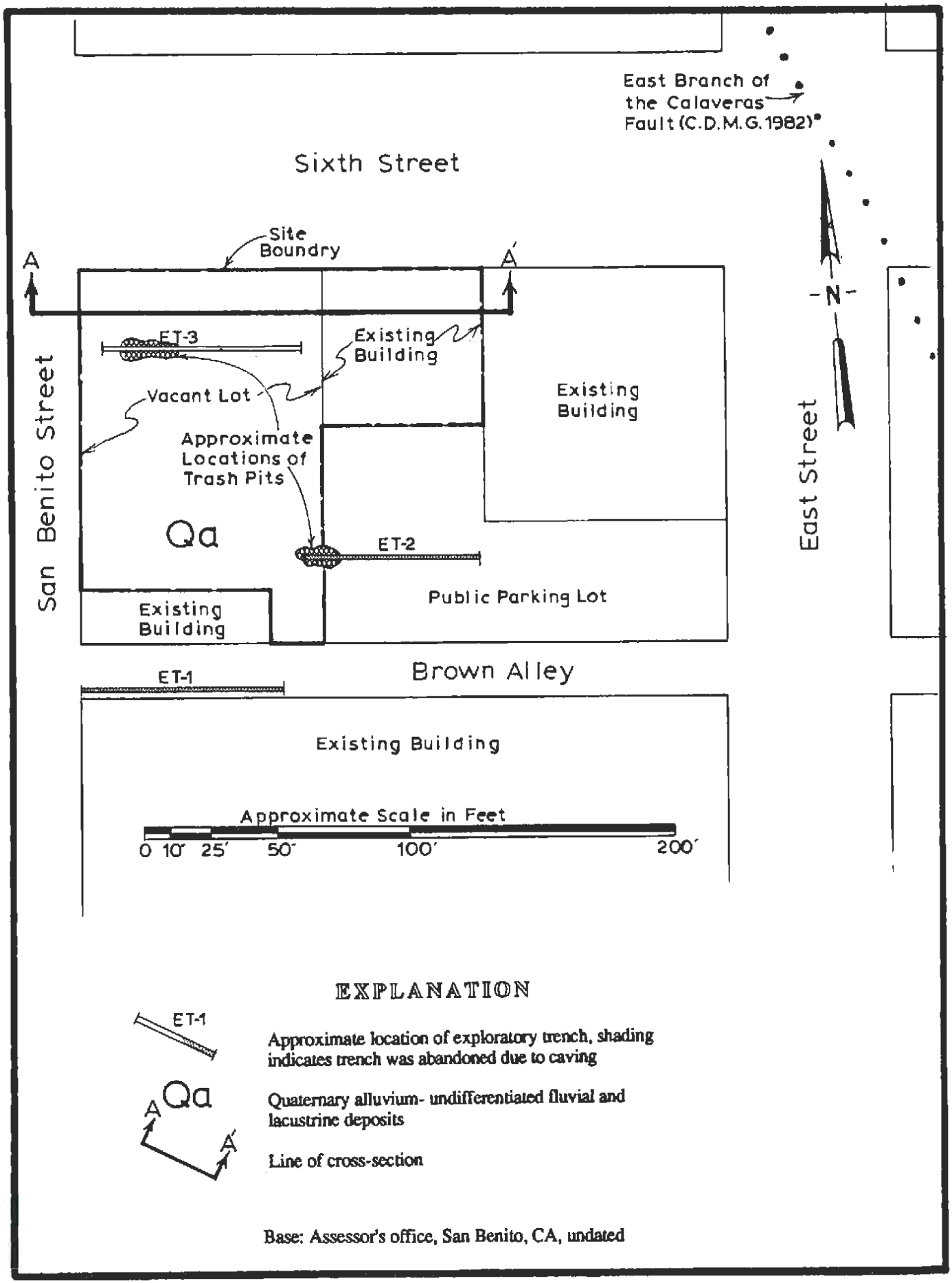


Figure 2 - Site Plan and Geology Map

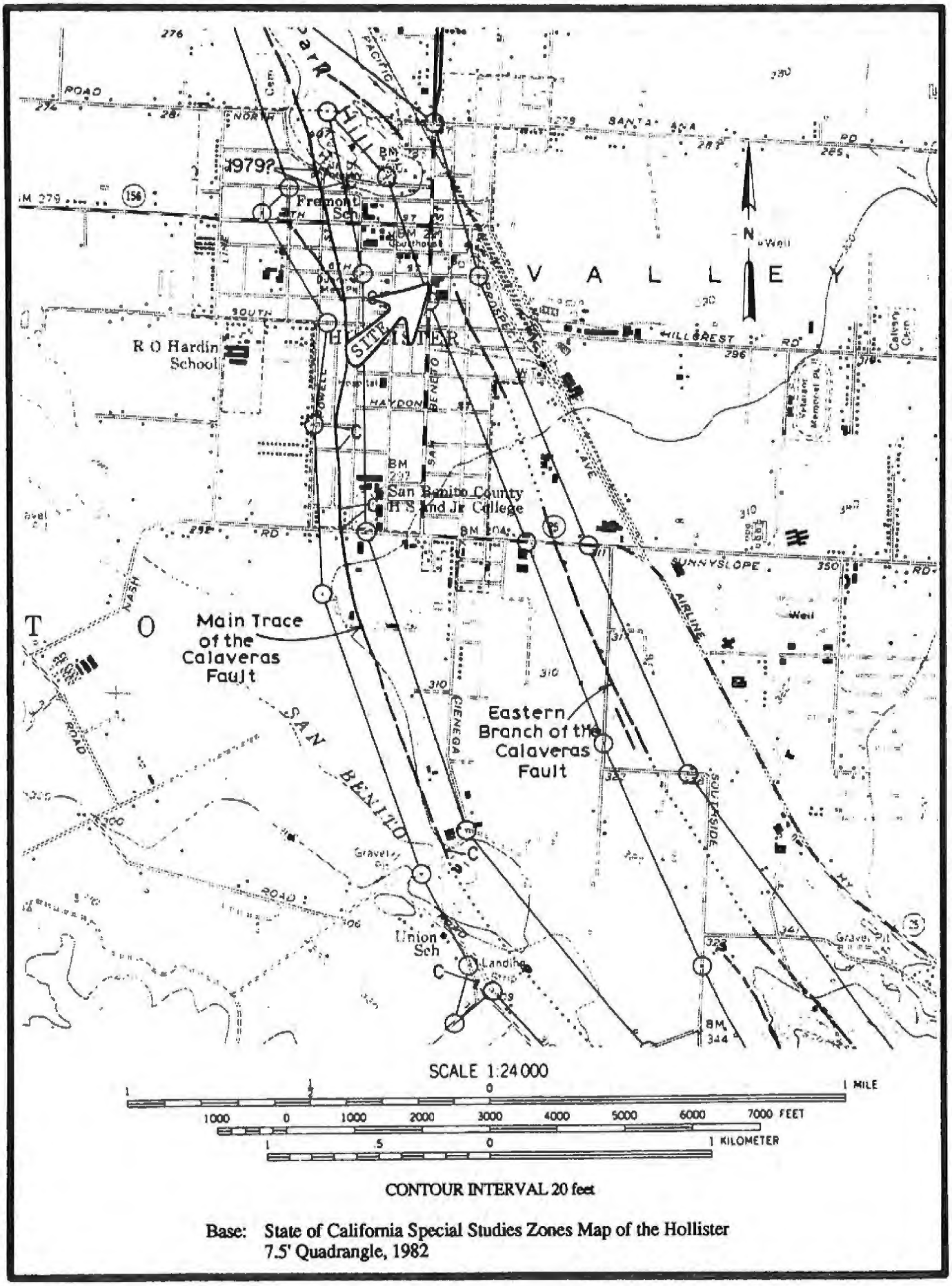
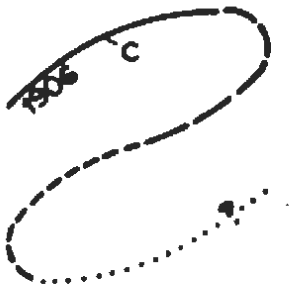


Figure 3 - Alquist Priolo Special Studies Zone Map

MAP EXPLANATION

Potentially Active Faults



Faults considered to have been active during Quaternary time; solid line where accurately located, long dash where approximately located, short dash where inferred, dotted where concealed; query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by creep or possible creep.

Aerial photo lineaments (not field checked); based on youthful geomorphic and other features believed to be the results of Quaternary faulting.

Special Studies Zone Boundaries

These are delineated as straight-line segments that connect consecutively numbered turning points so as to define one or more special studies zone segments.

Source: California Division of Mines and Geology (1982)

Figure 3a - Explanation for Alquist Priolo Special Studies Zone Map

PURPOSE AND SCOPE OF SERVICES

The purpose of this study was twofold; the first was to identify the geologic conditions and evaluate existing potential geologic and seismic constraints at the site. The second purpose was to provide recommendations for site development from an engineering geologic viewpoint. This study included the following scope of work:

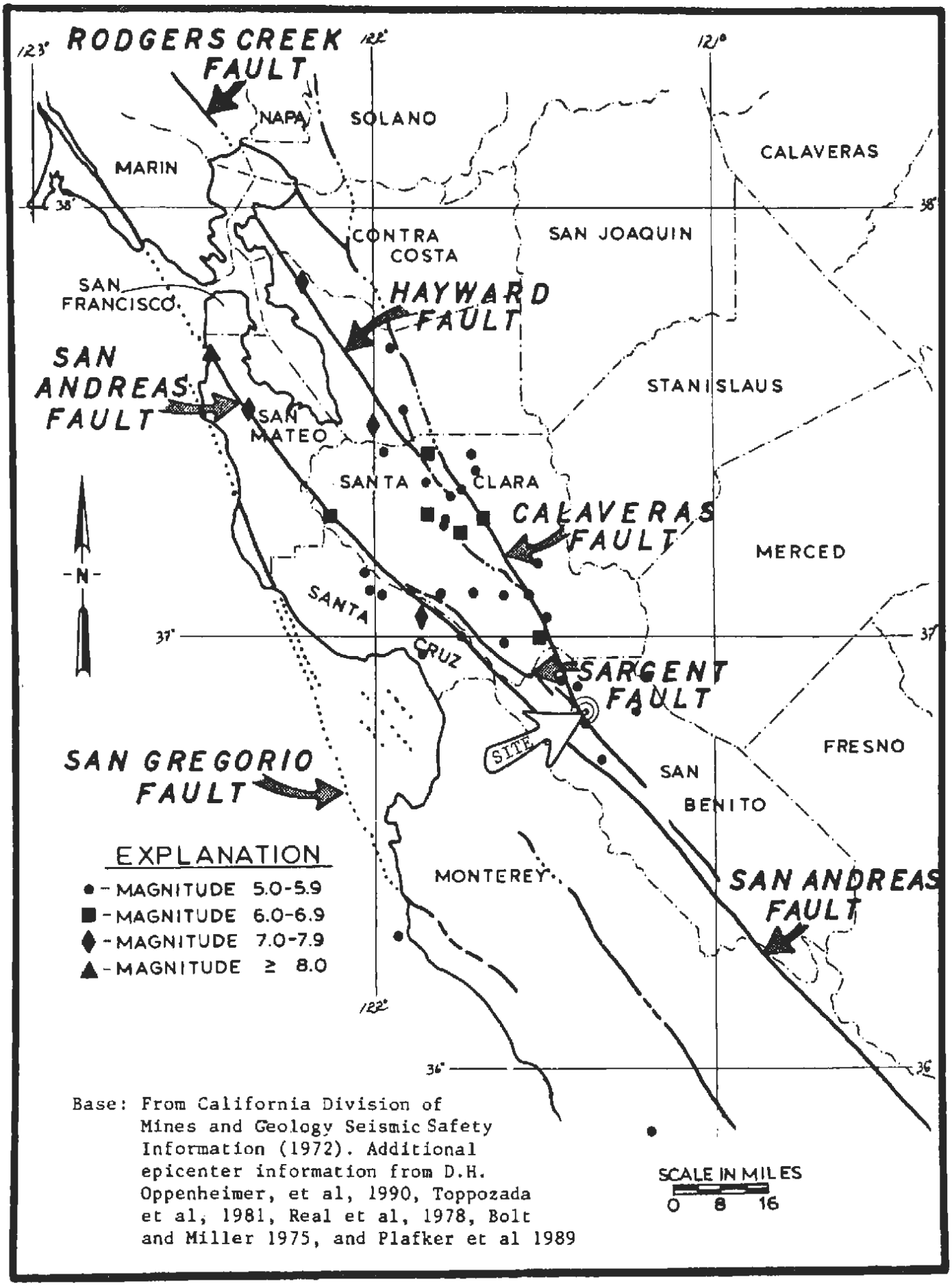
1. Research, review, and evaluate data from published and unpublished geologic and geotechnical reports;
2. Discussions with representatives of the City of Hollister, the California Division of Mines and Geology (CDMG), and the U.S. Geological Survey (USGS);
3. Study of a series of aerial photographs of the site and vicinity;
4. Excavating, shoring, cleaning, and logging approximately 148 lineal feet of trenches;
5. Geologic analysis of field and office data; and,
6. Preparing this report, along with appropriate graphics and including the findings of the study and recommendations for development of the proposed building sites.

GEOLOGIC SETTING

The "600-block" properties are situated within the Hollister Valley. The valley boundaries are the Pajaro River on the north, the mountains of the Gabilan Range on the west, the Diablo Range on the east, and the juncture of the Gabilan and Diablo Ranges on the south. The Gabilan Range consists of late Cretaceous age granitic rocks and metamorphic rocks, including marbles, quartzite, and schist (Compton, 1966). Overlying the granitic rocks is a series of Oligocene to middle Miocene age sandstones and shales (Allen, 1946). The Diablo Range consists of Jurassic-Cretaceous age sandstones, limestones, volcanic rocks, and metamorphic rocks which are part of the Franciscan Complex. Associated with the Franciscan rocks are metamorphic rocks of the Gabilan Range which include marble, dolomite, quartzite, and schist. Upper Cretaceous age sandstones, shales and conglomerates overlie the Gabilan metamorphic rocks and Franciscan rocks (Page, 1966).

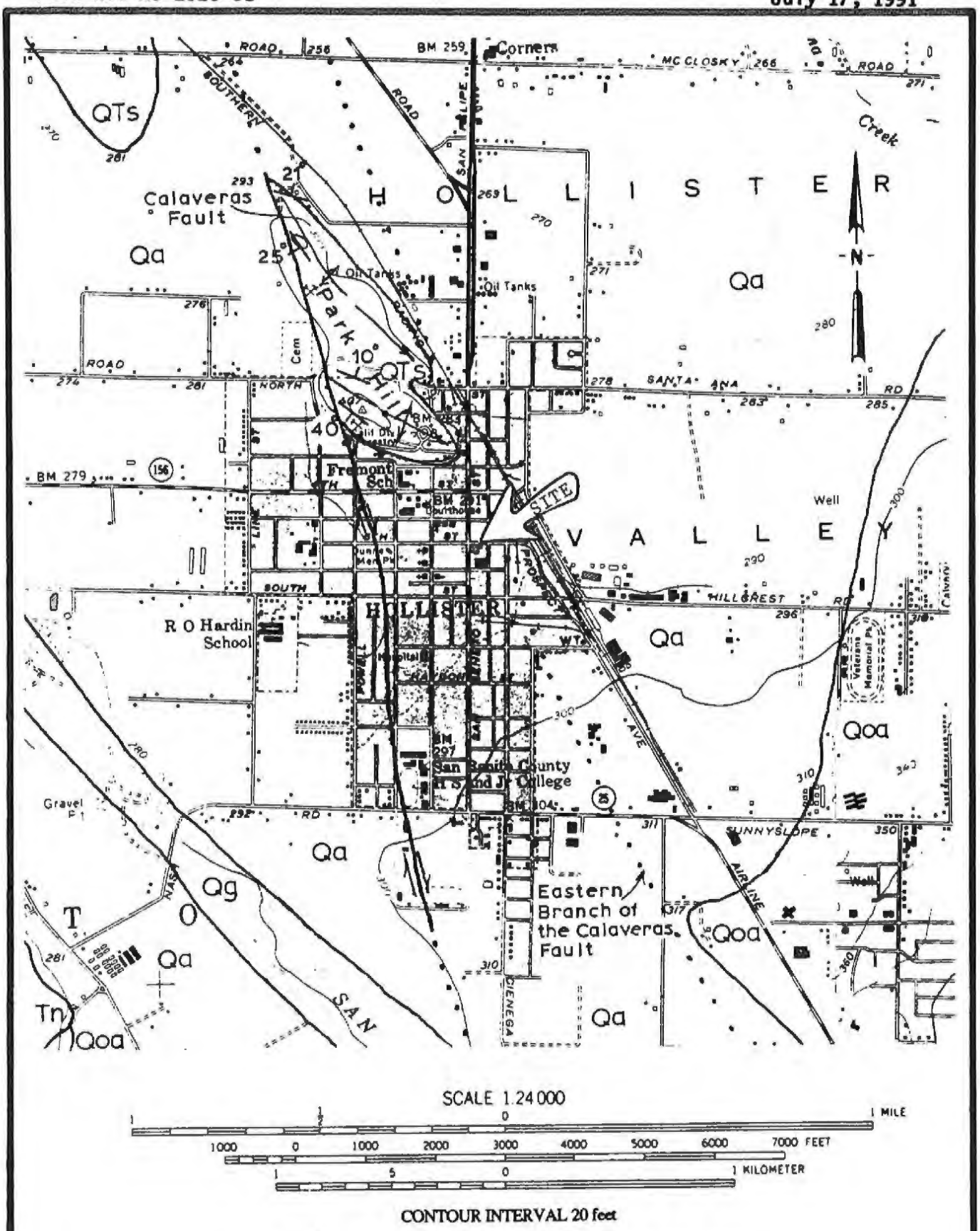
The geologic structure of the Hollister area and the Gabilan and Diablo Ranges is strongly influenced by the active San Andreas and Calaveras faults. These faults strike northwest and are characterized by a combination of strike-slip and reverse displacement. The San Andreas and Calaveras faults are steeply southwest-dipping shear zones that separate Jurassic-Cretaceous Franciscan basement rocks from Cretaceous granitic basement rocks. The Calaveras fault branches off from the San Andreas fault approximately 8 miles south of Hollister (see Figure 4).

Several periods of movement on the San Andreas and Calaveras faults occurred in the Hollister area, causing uplift of the mountains bordering the valley. The combination of faulting and folding resulted a structural basin which was a seaway during the late Miocene to Pliocene (Allen, 1946). During Pliocene and Pleistocene time, extensive floodplain deposits known as the San Benito Gravels were deposited in the valley (Kilburn, 1972). During the Pleistocene, subsidence in the Hollister Valley due to tectonic activity resulted in deposition of a series of sands, silts, and clays



Base: From California Division of Mines and Geology Seismic Safety Information (1972). Additional epicenter information from D.H. Oppenheimer, et al, 1990, Toppozada et al, 1981, Real et al, 1978, Bolt and Miller 1975, and Plafker et al 1989

Figure 4 - Regional Fault & Epicenter Map



Base: U.S.G.S. topographic map of the Hollister 7.5' Quadrangle, 1955 photorevised 1971. Geology modified from T.W. Dibblee (1975)

Figure 5 - Regional Geology Map

EXPLANATION

Geologic Units

Qg- Stream gravel and sand (Holocene)

Qa- Alluvium (Holocene)

Qoa- Older alluvium: terrace deposits (Pleistocene)

QTs- Santa Clara Formation (Pliocene-Pleistocene)

Tn- Non-marine sedimentary rocks: greenish gray to rarely reddish claystone, siltstone and interbedded friable buff-gray sandstone

Symbols

Contact

Fault: dashed where indefinite or inferred, dotted where inferred and concealed. Horizontal displacement designated by parallel arrows

Axis of fold (anticlinal): arrow indicates direction of plunge

Figure 5a - Explanation for Regional Geology Map

over the San Benito Gravels (McMasters and others, 1987). These deposits are interpreted as Pleistocene and Holocene age lake deposits (Jenkins, 1973) or as a group of shallow, short-lived lakes in a fluvial environment (Hoose, 1986; McMasters and others, 1987). Holocene activity consists mostly of down-cutting by the San Benito River and mass wasting of upland areas by landslides and erosion. The regional geology is depicted on Figure 5.

Faulting, Hollister Area

An important structural element in the Hollister area is the Calaveras fault system. Several branches of the Calaveras fault have been mapped in the Hollister area and are shown on Figure 4. The main branch is referred to as the "West Branch" by Bryant (1979). The West Branch has documented creep activity, producing at least 13 inches of right-lateral slip (Rogers and Nason, 1971). In addition, there was at least 5 mm (1/5-inch) of observed slip along the West Branch as a result of sympathetic movement during the Loma Prieta earthquake (McClellan and Hay, 1989). McClellan and Hay (1989) did not study the East Branch, as they stated that it is inactive.

The East Branch was mapped based on geomorphic evidence at Park Hill at the north end of Hollister and on a hill south of Hollister with a benchmark elevation of 668 feet. The fault was inferred between these localities based on a groundwater offset (Ellis, 1952; Kilburn, 1972) and subtle west-facing scarps (Bryant, 1979). The East Branch is mapped approximately 150 feet east of the "600-block" site and is considered active by the CDMG (Bryant, 1979) based on offset bedding in trenches excavated by Leighton and Associates (1974) and Woodward-Clyde and McClure & Messinger (1968).

METHODS OF STUDY

Literature and Map Review

As part of our study, we reviewed reports and maps pertaining to the site and vicinity. Most of the published geologic information on this area is preliminary in nature, and is based on reconnaissance techniques and extrapolation of data.

The regional geology was mapped by Taliaferro (1948). Taliaferro's map shows the Calaveras fault north and south of Hollister, but does not have a symbol depicting a location of the fault within downtown Hollister. An eastern branch of the Calaveras fault was mapped by Ellis (1952) based on an offset blue clay layer noted on well logs. The blue clay is offset across the East Branch of the Calaveras fault by approximately 50 feet with the west side up. The wells were spaced hundreds of feet apart with some wells "a few hundred feet on each side of the fault in a few places" and approximately "30 to 40 feet of offset" of the groundwater table (William C. Ellis, oral communication, May 1991).

Detailed mapping of the Calaveras fault within Hollister was performed by Rogers (1967). Rogers mapped the main (west) branch as a right-lateral strike-slip fault which exhibits active creep. The eastern branch of the Calaveras fault in downtown Hollister was mapped using a symbol that denotes uncertainty of existence and/or location by Rogers and others (1968). They show this to be a high-angle fault with the west side upthrown. The East Branch of the Calaveras fault was trenched by Woodward-Clyde & Associates and McClure & Messinger (1968) at a site approximately 3/4-mile south of the "600-block" properties. They stated, "Evidence was found, and which could possibly be construed as indicating the presence of a fault trace, consisted of several small clay seams and slickensided planes. These did not extend to the ground surface." Woodward-Clyde (1978) reviewed this 1968 study and concluded that the seams could have been due to other causes such as shrinkage cracks, lurch cracking, or liquefaction. They postulated that

the most likely interpretation was that these features could be considered to be conjugate shears and tension fractures developing in a fault zone.

Rogers and Nason (1971) examined streets and other man-made structures in Hollister for evidence of fault displacement. They concluded that the main branch of the Calaveras fault exhibited active creeping movement. The subsidiary branches of the Calaveras fault in Hollister were considered by Rogers and Nason (1971) to be, "...presently dormant because they do not show consistent evidence of curb or sidewalk offset." and "... local subsidence features were more abundant and extreme along the traces of the inferred dormant faults than elsewhere." Kilburn (1972) indicated a groundwater offset of approximately 20 feet with the east side up across the West and East Branches of the Calaveras fault based on well data.

Jenkins (1973) studied the Quaternary deposits in the Hollister Valley and concluded that a large lake (Lake San Benito) covered much of Hollister during the Pleistocene time period. The Hollister area was remapped by Rogers (1973) and Dibblee (1975). They showed the East Branch of the Calaveras fault, but did not identify the relative sense of fault movement. Leighton and Associates (1974) observed offset units in an exploratory trench along the East Branch of the Calaveras fault on hill 668 (approximately 2 miles south of Hollister). As part of the State fault evaluation program, CDMG (1974) considered the East Branch of the Calaveras fault as sufficiently active and well-defined to be included within an Alquist-Priolo Special Studies Zone. Bryant (1979) remapped the East Branch of the Calaveras fault approximately 200 feet west of the location shown on the 1974 Special Studies Zone map. The latest revision of the Special Studies Zone map (CDMG, 1982) incorporates Bryant's modifications.

Site-specific investigations by Terratech (1974, 1976, 1977) within the East Branch Special Studies Zone reported no evidence of faulting. These studies relied on magnetometer traverses and drilling, and did not use exploratory trenching. Other workers have located the East Branch of the

Calaveras fault in Hollister area. Terratech (1978) trenched the fault on the east side of Park Hill, approximately 1/4-mile north of the site. The fault was described on a trench log as consisting of "slickensided striated surfaces on siltstone, fault plane ? N65°W, dip 59°N". The log further discusses fault-like features as shears (up to 1" wide) on either side of the fault plane oriented N0°E, 87°N". Calcium carbonate (caliche) was described as present along the fault plane.

Bay Soils (1981) described the fault as, "... a subtle change in the bedding of silt was noted in Trench No. 1, near the location of the other anomalous factors. This consisted of an upwarping of the bedding from horizontal to 10° to 15°". Earth Systems Consultants (1985) delineated the fault based on, "A gradual vertical material boundary" with dissimilar horizontal beds on either side of the boundary.

Terratech (1987) stated, "All of the trenches exposed evidence of apparent vertical displacement." Units are vertically offset by "about 1-1/2 to 3 feet" along near-vertical discontinuous clay seams with the east side up. The strike of faults in the trenches varied from N-S to N40°E, with steep dips to the east and west. J.V. Lowney & Associates (1990a, 1990b) interpreted, "... abrupt offset of laterally continuous beds, abrupt monoclinal folding of sediments and convoluted bedding." as evidence of faulting.

Applied Soil Mechanics (1991a) located a fault on a property within East Branch Special Studies Zone approximately 1/4 mile south of the downtown area. The fault is characterized by, "... steeply dipping to near-vertical, NNE to NNW-striking fractures ... infilled with loose, fine-grained sand. ... Thin continuous clay layers and entire stratigraphic units are disrupted and offset in this zone. The maximum vertical offset along the fractures was approximately 21 inches..." Applied Soil Mechanics has recently excavated several trenches across the mapped trace of the East Branch of the Calaveras fault in downtown Hollister. Features similar to the well-defined faulting

in trenches studied by Terratech (1978, 1987) and Applied Soil Mechanics (1991a) were not observed in the downtown area. The locations of these earlier studies are shown on Figure 6.

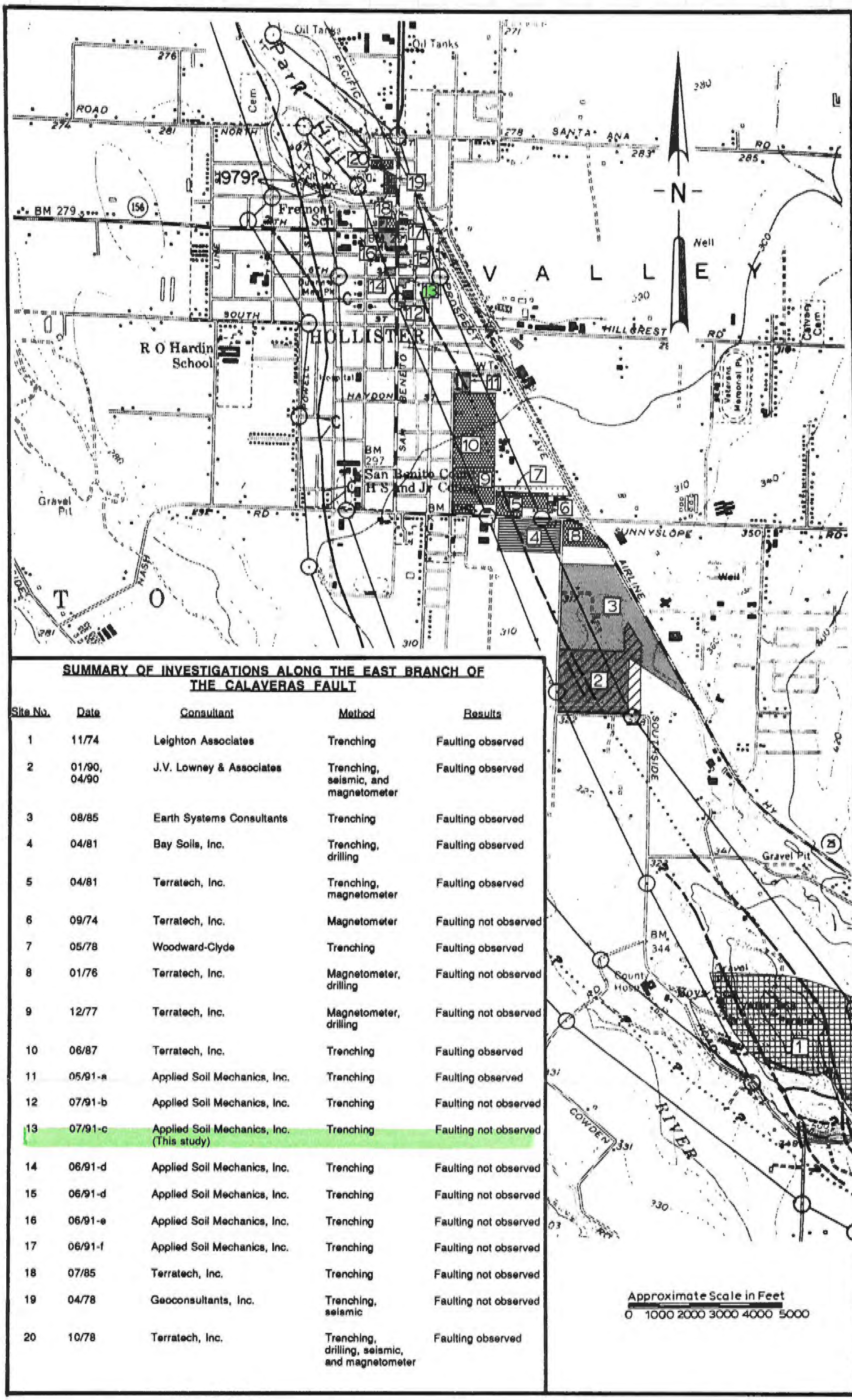
Aerial Photograph Interpretation

We studied aerial photographic stereo pairs taken of the Hollister area from 1967 to 1990. The following aerial photographs of the site and vicinity were used in this study:

Date	Approximate Scale	Type	Source
May 1967	1:20,000	black and white	USDA
May 1980	1:40,000	black and white	USDA
April 1985	1:31,680	black and white	WAC
July 1987	1:33,600	black and white	PAS
June 1989	1:31,680	black and white	WAC
August 1990	1:12,000	black and white	PAS

These photographs were studied for geomorphic evidence that could indicate active faulting. Faults typically appear on aerial photographs as a linear features with tonal differences on either side. These differences could be related to changes in soil and rock type, vegetation, groundwater levels, or bedding characteristics. Lineaments are sometimes associated with topographic features characteristic of fault zones such as linear and shutter ridges, sag ponds, springs, and offset drainages.

Within the downtown area, the aerial photographs were of limited use since development predates historic photography. Outside of town, a distinct northwest-trending lineament was seen on the aerial photographs where there is a narrow band which is lighter in color than the surrounding area in an orchard near Prune and Hawkins Streets. This lineament coincides with the mapped trace of



SUMMARY OF INVESTIGATIONS ALONG THE EAST BRANCH OF THE CALAVERAS FAULT

Site No.	Date	Consultant	Method	Results
1	11/74	Leighton Associates	Trenching	Faulting observed
2	01/90, 04/90	J.V. Lowney & Associates	Trenching, seismic, and magnetometer	Faulting observed
3	08/85	Earth Systems Consultants	Trenching	Faulting observed
4	04/81	Bay Soils, Inc.	Trenching, drilling	Faulting observed
5	04/81	Terratech, Inc.	Trenching, magnetometer	Faulting observed
6	09/74	Terratech, Inc.	Magnetometer	Faulting not observed
7	05/78	Woodward-Clyde	Trenching	Faulting observed
8	01/76	Terratech, Inc.	Magnetometer, drilling	Faulting not observed
9	12/77	Terratech, Inc.	Magnetometer, drilling	Faulting not observed
10	06/87	Terratech, Inc.	Trenching	Faulting observed
11	05/91-a	Applied Soil Mechanics, Inc.	Trenching	Faulting observed
12	07/91-b	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
13	07/91-c	Applied Soil Mechanics, Inc. (This study)	Trenching	Faulting not observed
14	06/91-d	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
15	06/91-d	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
16	06/91-e	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
17	06/91-f	Applied Soil Mechanics, Inc.	Trenching	Faulting not observed
18	07/85	Terratech, Inc.	Trenching	Faulting not observed
19	04/78	Geoconsultants, Inc.	Trenching, seismic	Faulting not observed
20	10/78	Terratech, Inc.	Trenching, drilling, seismic, and magnetometer	Faulting observed

Figure 6 - Fault Studies Map

the East Branch of the Calaveras fault (Bryant, 1979). The ground slope is not interrupted by the lineament on the air photos. Also, rows of trees in the orchard crossed by the mapped fault are not offset, indicating that fault creep displacement has not occurred since the orchard was planted. At Park Hill at the north end of town, and at hill 668 south of town, geomorphic evidence of faulting is indicated as topographic benches that are modified by erosion.

Subsurface Explorations

As part of this study, approximately 212 lineal feet of exploratory trench was excavated between April 15 and May 30, 1991 using a rubber-tire backhoe with a 24-inch wide bucket. The trenches were located nearly perpendicular to the alignment of the fault trace mapped by the CDMG (1982). The positioning of the trenches was intended to intercept the most likely traces of faults in the area, assuming a regional north to northwest trend. The locations of the trenches is shown on Figure 2. The trench logs are included in Appendix A.

The trench designated as ET-1 was located in Brown Alley between San Benito and East Streets. Trench ET-1 was approximately 73 feet long, trended N90°E, and was excavated to a depth of 14 feet below the ground surface. Trench ET-2 was located in the City of Hollister public parking lot at the southwest corner of East Street and Brown Alley. Trench ET-2 was approximately 64 feet long, trended N90°W, and was excavated to a depth of 15 feet. In these two trenches, locally created saturated conditions caused the trench walls to cave before they could be logged. Trench ET-3 was located on the vacant lot at the southeast corner of San Benito and Sixth Streets. Trench ET-3 was approximately 75 feet long, trended N90°W, and was excavated to a depth of 15 feet.

After excavating, the trenches were shored and the trench walls cleaned. A system of nails and colored flagging was used to mark the various strata. After the trench walls were cleaned and flagged, they were logged at a scale of one inch equals five feet. Critical areas were logged at a

more detailed scale. The floor and opposite trench wall were also cleaned and examined in these areas. The trenches were logged by staff geologist, Brian Papurello. The trenches were observed by the supervising geologist, Richard Gorman, and the City Geologist, John Kingsley.

After the trench logging operation was completed, the trenches were backfilled with 2-sack grout to within 5 feet of the ground surface. After the grout had set-up, imported sand was placed and compacted over the grout material up to the top of the trench. The sand was compacted using a small compactor. In paved areas, asphaltic concrete was used to match the thickness of the existing pavement section.

An exploratory boring was drilled on April 26, 1991 to evaluate the subsurface conditions at the proposed trench location on the vacant lot Materials encountered during the drilling indicated that nonsaturated soils having adequate consistencies for trenching were present at the proposed trench location. The drill hole was logged by staff geologist Brian Papurello After the drilling operation was completed, the hole was backfilled with native material. The boring log is included in Appendix A.

Summary of Trench Observations

In Trench ET-1, the materials were soft and wet. This was due recent heavy rainfall infiltrating through open cracks in Brown Alley. The contact between the lacustrine and fluvial deposits was at approximately 12 feet below the ground surface and was not offset.

The stratigraphy in Trench ET-2 was similar to that exposed in Trench ET-3. A trash pit approximately 7 feet deep and 13 feet long was encountered at the west edge of ET-2. Loose and very moist materials caved at four locations and the trench was abandoned. No offset in the lacustrine/fluvial contact was observed.

In Trench ET-3, the upper 1-1/2 feet consists of silty clay fill with construction debris. A trash pit approximately 5 feet deep was also encountered between stations 5 and 27 (see trench log ET-3). Below the fill is a 8-1/2 to 9-1/2 foot-thick silty clay unit which is interpreted as a shallow lacustrine (lakebed) deposit. This unit had blocky ped structures, and was bioturbated (disturbed by plant roots and animals).

Stratigraphic units exposed in the trenches are nearly flat-laying and are laterally continuous over the length of the trenches. Within these units, several types of sedimentary structures (such as cross-bedding and channels, etc.) were observed. Medium to coarse-grained sand lenses with undisturbed trough cross-bedding were encountered in the silt and sand units. These lenses represent infilling of small channels.

Clayey silt beds approximately 1 to 2 inches in thickness were noted adjacent to the coarse sand lenses. These beds are traceable with minimal variation in thickness throughout the length of the trench, and are probably a result of waning floodwaters that deposited the coarse sand lenses. Locally, these beds undulate within the sand unit. Since the thickness of the sand unit does not vary appreciably, the undulation is probably due to either deposition into a shallow channel or "soft" (geological sense) sediment deformation.

Between stations 2 to 3 and 8 to 10 in ET-3 are near-vertical clay seams within the fluvial unit which are approximately 1 to 2 inches wide. Thin continuous clay layers below the seams are not disrupted or offset. The near-vertical orientation of the seams and the similar composition to the underlying clay bed implies that the vertical seams are due to infilling.

Similar features have been related to prehistoric near-surface ground subsidence in the San Joaquin Valley, California (Fig. 37, Bull, 1972). These clay seams are possibly the result of infilling of subsidence cracks. Evidence of prehistoric tectonic subsidence is supported by detailed

stratigraphic studies combined with radiocarbon dating and fossil pollen correlation techniques (McMasters and others, 1987).

The clay seam could also be explained by deformation of the fluvial materials under saturated conditions. Flame structures and load casts are features which result from loading of water-saturated mud layers by overlying sand layers (Boggs, 1987, p. 163–175). Deformation features such as flame structures and load casts would be expected in the depositional environment which existed in the Hollister area during the late Pleistocene-early Holocene. The presence of lake deposits over poorly consolidated fluvial sands, silts, and clays coupled with forces generated by large earthquakes on nearby faults would provide a mechanism for this soft sediment deformation.

The likelihood of active faulting is not supported by the trench data. Features exposed in the trenches indicate a fluvial and lacustrine environment which experienced soft sediment deformation and regional subsidence.

FINDINGS

Site Geology and Geomorphology

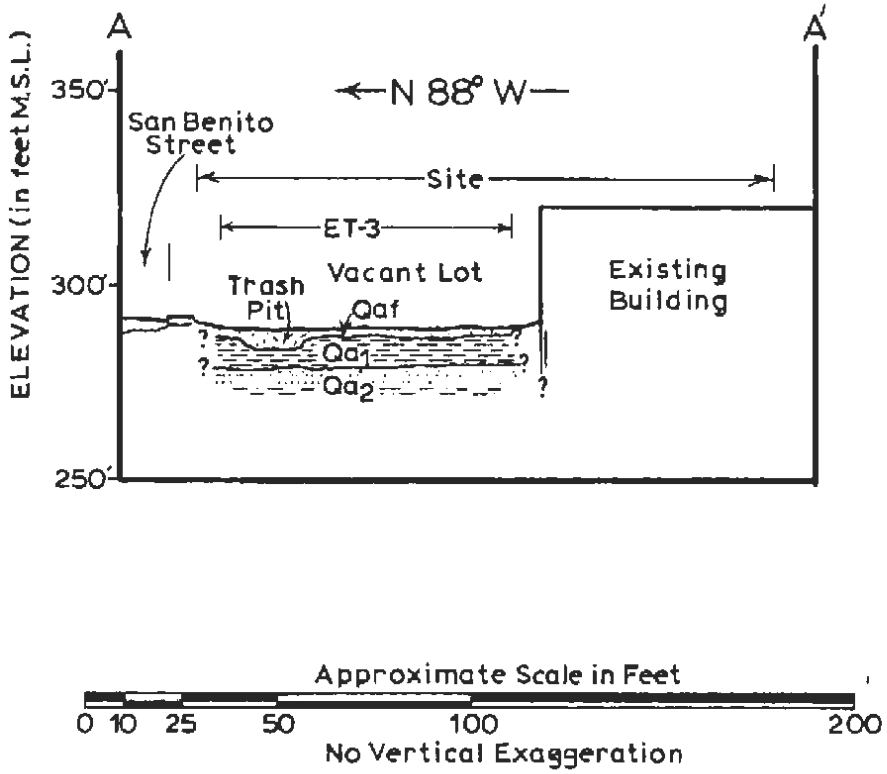
Downtown Hollister is underlain by a series of Pleistocene and Holocene age lake and stream deposits. The topography is nearly flat. At Sixth Street near Dunne Park there are low rises in the topography that have been related to active faulting on the main branch of the Calaveras fault by Rogers and Nason (1971). Similar features are also present on Hawkins, Hazel, and South Streets east of Sally Street. Structures situated along these features do not show the prominent creep-related movement present on the main branch of the fault. The geologic conditions are depicted on the Site Plan and Geology Map, Figure 2. A schematic cross-section through the site is included as Figure 7.

Stratigraphy

There were six stratigraphic units that could be correlated between trenches. The uppermost unit extending from the ground surface (excluding pavement and fill) to a depth of approximately 10 to 11 feet. It consists of a dark olive to dark grayish-brown silty clay. This unit exhibits a blocky ped structure and is bioturbated. This unit is interpreted as a shallow lacustrine (lakebed) deposit. A bulk sample from this unit at approximately 12 feet depth was dated using ^{14}C radiometric analysis at 3,720 ± 90 years before present (YBP) (Applied Soil Mechanics, 1991c). This is a mean residence time date (MRT), indicating a minimum age for the sample.

Below the lakebed deposits are a series of deposits which consist of grayish-brown to olive brown silty sands, sandy silts, and clayey sands. These units are easily traced and vary from 1 to 2 feet in thickness. Faint to distinct trough cross-bedding was visible in the sandy beds. Bedding was indistinct in the silty beds. Other sedimentary structures visible included discontinuous coarse sand lenses, thin (1/4 to 2-inch) continuous clay layers and clay rip-up clasts, suggesting a fluvial

Schematic Cross-Section A-A'



EXPLANATION

Qaf. Artificial Fill: silty clay to sand (units 1 from exploratory trench 3)

Qa_1- Lacustrine deposits: silty clay (unit 2 from exploratory trench)

Qa_2- Fluvial deposits: silt to coarse sand (units 3-6 from exploratory trench 3)

Figure 7 - Schematic Cross Section

depositional environment. These beds and clay layers were used for stratigraphic correlation and were flagged in the trenches. A bulk sample from a thin organic-rich clay bed a depth of approximately 17 feet had a mean residence time date of 18,110 ± 190 YBP (Applied Soil Mechanics, 1991b). Assuming relatively continuous deposition, the fluvial sequences encountered in the trenches are probably latest Pleistocene to early Holocene in age.

Groundwater

Damp to very moist conditions were encountered in the drilling and trenching operations; however, free groundwater was not encountered. At the time of this study, central California was experiencing the fifth consecutive year of drought conditions. It is possible that during years of normal or above normal precipitation, that saturated conditions or perched water tables could develop.

SEISMICITY

In assessing the seismic hazards for a given area, it is useful to examine historic records of local earthquake intensities. This information is useful for predicting the recurrence of severe shaking in an area. Within the historic time, significant earthquakes have severely damaged man-made structures over a large part of San Benito County. These include, but are not limited to, the 1906 M 8.3 San Francisco (Lawson, 1908), 1984 M 6.2 Morgan Hill (Stover, 1984), and the 1989 M 7.1 Loma Prieta events.

Although central California is crossed by numerous faults, several regionally active fault systems are most likely to generate earthquakes that could cause damage to the site. These include the active San Andreas, Hayward, Calaveras, and San Gregorio fault systems (Hart, 1988), and the potentially active Sargent-Berrocal fault (Bryant, 1980). Recent statistical studies theorize that a major earthquake on the Calaveras fault (Oppenheimer and others, 1990) or on the San Francisco Peninsula segment of the San Andreas fault (Working Group on California Earthquake Probabilities, 1990) will occur. When this major earthquake will occur is not specified by these groups. An earthquake on one of these faults will result in strong ground shaking at this site.

Recently active fault zones have been mapped by the State as part of the Alquist-Priolo Act of 1972. Under the act (Hart, 1988), recently active faults are defined as displaying sufficient and well-defined evidence of movement within the Holocene Epoch (about the last 11,000 years). No structures for human occupancy are permitted on the trace of an active fault. Unless proven otherwise, the area within 50 feet of an active fault is presumed to be underlain by an active fault. The Alquist-Priolo definition of potentially active is a fault showing evidence of displacement older than 11,000 years and younger than 2,000,000 years (Pleistocene Epoch). "Inactive" faults are classified as not having been active for at least two million years.

Evaluation of maximum earthquakes is a topic with considerable variation. The criteria used within this report include maximum credible and probable earthquakes. The maximum credible earthquake is defined by the California Division of Mines and Geology (1975) as,

> "the maximum earthquake that appears capable of occurring under the presently known tectonic framework. It is a rational and believable event that is in accord with all known geologic and seismic facts. In determining the maximum credible earthquake, little regard is given to its probability of occurrence, except that its likelihood of occurring is great enough to be of concern."

The maximum probable earthquake is, "The maximum earthquake that is likely to occur during a 100-year interval. It is to be regarded as a probable occurrence, not as an assured event that will occur at a specific time" (CDMG, 1975).

Table A lists known regionally active faults and their estimated seismic parameters. These estimates were generated using the EQFAULT computer program (Blake, 1989) using statistical analyses of seismic events reported by Idriss (1987).

TABLE A
ESTIMATED SEISMIC PARAMETERS FOR ACTIVE AND POTENTIALLY ACTIVE FAULTS IN THE HOLLISTER REGION

	San Andreas (Northern segment)[1]	Calaveras (Western Main Trace)	Hayward	San Gregorio-Palo Colorado	Sargent-Berrocal[2]
Distance and direction from site (miles)	16 SW	0.5 W	25 NW	40 SW	8 NW
Maximum credible earthquake[3, 4]	8.0	7.0	7.0	7.75	7.0
Maximum probable earthquake[3, 4]	7.5	6.5	6.75	6.75	5.75
Maximum credible peak ground acceleration[3, 5]	0.25 g	0.51 g	0.13 g	0.12 g	0.27 g
Maximum probable peak ground acceleration[3, 5]	0.21 g	0.47 g	0.10 g	0.06 g	0.15 g

1 Defined as extending from San Juan Bautista north to Shelter Cove (Blake, 1989)
2 Potentially active
3 Assumes that the earthquake will occur at a prescribed depth and at the nearest point to the site.
4 Richter earthquake magnitude
5 From: Idriss (1987)

Primary Earthquake Effects

Fault-Related Ground Rupture – Ground rupture along fault traces can occur during large earthquakes, and zones of high ground rupture potential are delineated by governmental agencies. The site is within the State Alquist-Priolo Special Studies Zone and the City Seismic Zone for the East Branch of the Calaveras fault (CDMG, 1982; Barrett, 1976).

The data gathered and analyzed (including the trench data and the MRT dates) indicate that there is no evidence for an active fault trace to cross the building site studied. Therefore, the potential for ground rupture resulting from fault movement at the building site is considered to be low.

Secondary Earthquake Effects

Ground Shaking – Hollister experienced severe shaking during the 1989 earthquake, according to local accounts (McCann, 1990). Ground shaking from a seismic event is the primary seismic hazard that will have the greatest impact on the proposed development within its design life span. Ground shaking can trigger other secondary seismic hazards that are discussed in following sections.

Strong ground shaking is documented for the following earthquakes: 1906 M 8.3 San Francisco (Lawson, 1908), 1983 M 6.7 Coalinga (Stover, 1983), and the 1984 M 6.2 Morgan Hill (Stover, 1984) and can reasonably be expected in the future. The estimated shaking intensity in the Hollister area during the 1989 Loma Prieta event was VII on the Modified Mercalli scale (Plafker and Galloway, 1989). Wood and Neumann (1931) define Modified Mercalli VII intensity as, "*Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.*"

The Loma Prieta earthquake provided data on ground response in the Hollister area. Three strong-motion seismograph station are located in the Hollister area. These stations record peak ground accelerations (PGA), and the data is summarized below in Table B.

TABLE B
PEAK GROUND ACCELERATIONS RECORDED DURING THE OCTOBER 17, 1989 EARTHQUAKE IN THE HOLLISTER REGION

	Hollister City Hall	South and Pine Streets	Hollister Airport
Approximate distance and direction from site (feet)	500 NW	1,200 SE	11,000 N
Peak horizontal ground acceleration	0.25g	0.38g	0.29g
Peak vertical ground acceleration	0.22g	0.20g	0.16g
Site geology	Alluvium	Alluvium	Alluvium
Source of data	1	2	1

[1] Maley and others (1989)
[2] Shakal and others (1989)

The PGA is one of the factors involved in designing a structure to resist seismic forces. Using the method of Idriss (1987) with the EQFAULT program (Blake, 1989), a maximum probable earthquake of M 6.5 occurring on the nearest point of the Calaveras fault could produce a PGA of 0.47 g at the site. The PGA generated by EQFAULT is an approximate value and does not take into account other factors such as depth to bedrock, ground saturation, and topographic amplification. For wood-frame structures, the PGA tends to be conservative, and the repeatable high ground acceleration (RHGA) is appropriate (Ploessel and Slosson, 1974). For a maximum probable earthquake of M 6.5 occurring on the Calaveras fault, the RHGA is 0.31 g.

Liquefaction – Soil liquefaction is the loss of soil strength during a significant seismic event. It occurs primarily in saturated loose- to medium-dense, fine to medium-grained sands and sandy silts. Liquefaction results in rearrangement of the soil particles into a denser condition, resulting in localized areas of ground failure. Common types of liquefaction-related ground failure include differential settlement and lateral spreading. Secondary ground cracks frequently occur as a result of liquefaction-related ground failure and should not be confused with ground deformation resulting from fault rupture.

No signs of liquefaction such as sand boils were observed in trenches of in the immediate vicinity of the site after the Loma Prieta earthquake (Plafker and Galloway, 1989; McCann, 1990). The native site soils are relatively fine-grained and may be susceptible to liquefaction, if saturated. Groundwater was not encountered in the exploratory trenches, and the soils were damp to very moist. If the groundwater table were to rise, or if perched groundwater conditions develop, or if the near-surface granular material becomes saturated, then the risk of liquefaction is moderate. From a geologic viewpoint, the risk of liquefaction in the present environment is considered to be low. A geotechnical study is needed to definitively assess the risk of liquefaction.

Lurching cracks are a variety of ground cracking that could be related to earthquakes. There was no evidence seen in the trenches that lurch cracking occurred at this site as a consequence of an earthquake. Therefore, the potential for lurch cracking to occur at this site is considered to be minimal.

CONCLUSIONS

The conclusions are based on the data gathered and analyzed for this study.

1. Based on trench observations, we conclude that an active fault does not cross the "600-block" properties nor is there a fault trace within 50 feet of the project.

2. In the trenches excavated as part of this study, nearly flat-lying sediments maintain an almost constant thickness in the trenches. Laterally continuous stratigraphic units could be correlated in the trenches and from trench to trench. No evidence of offset was apparent along these marker units.

3. Two near-vertical clay-filled seams crossed laterally continuous clay and sand beds in Trench ET-3. These features are probably due to one of the following geologic processes: infilling as a result of ground cracking from subsidence; depositional features such as load casting, flame structures, and intrusive clay dikes.

4. The subject sites can be developed from a geologic point of view.

RECOMMENDATIONS

The subject site is suitable from an engineering geologic viewpoint for the planned building reconstruction, provided that the recommendations in this report are followed.

1. A soil engineering study should be performed for the proposed new structures. The study should address liquefaction potential and associated effects such as differential settlement of buildings. The study should also address the possibility of buried features such as old foundations, basements, tanks, and trash pits.

2. The proposed structures should be designed to withstand strong ground shaking. The project structural engineer should determine the appropriate method used for seismic design of the new buildings. If the structural engineer elects to use the design criteria of the Uniform Building Code (1988 edition), we suggest that a seismic zone factor of 0.40 and a site coefficient of 1.0 (Tables 23-I and 23-J, respectively) be used. The selection of the appropriate seismic zone factor and site coefficient are the purview of the structural engineer.

3. The trenches for this study have been backfilled using lean grout up to within 3 feet of the ground surface with the top 3' filled with clean compacted imported fill. Their position and condition should be taken into consideration in the design of the improvements planned for this study area.

REFERENCES CITED

Allen, J.E., 1946, Geology of the San Juan Bautista quadrangle, California: California Division of Mines Bulletin 133, 75 p., 3 plates, scale 1:62,500.

Applied Soil Mechanics, Inc., 1991a, Geologic evaluation, proposed three-lot subdivision, 49, 53, and 57 Hawkins Street, Hollister, California: unpublished report prepared for Dean Rodrigues. File No. A0-2303-S1.

_____, 1991b, Fault study, Showcase Theatre, 705 San Benito Street, San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2282-S1.

_____, 1991c, Fault study, "600-block" properties, SE Corner of Sixth and San Benito Streets, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2323-S1.

_____, 1991d, Fault study, Bruhn and Peterson properties, 515, 525 and 530 San Benito Street, San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2281-S1.

_____, 1991e, Fault study, Building Sites 1, 3, 4, 5, 6, and 10: Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2280-S1.

_____, 1991f, Fault study, Poletti property, 335 San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2279-S1.

Barrett, Nestor, 1976, Seismic Safety Element of the General Plan: City of Hollister Planning Department open-file report, 37 p.

Bay Soils, Inc., 1981, Soil and geologic investigation, Hollister shopping center, SWC Nash Road and Southside Road, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-1337, 20 p., 3 appendices.

Blake, T.F., 1989, EQFAULT, a computer program for the deterministic prediction of peak ground acceleration from digitized California faults.

Boggs, Sam, Jr., 1987, Principles of sedimentology and stratigraphy: Merrill Publishing Company, Columbus, Ohio, 784 p.

Bryant, W.A., 1979, Fault evaluation report, Calaveras (Hollister segment) and "Buena Vista Road" faults: California Division of Mines and Geology Fault Evaluation Report FER-94, 14 p., 4 plates, scale 1:24,000.

_____, 1980, Fault evaluation report, SE segments of Sargent and Castro faults: California Division of Mines and Geology Fault Evaluation Report FER-96, 21 p., 11 plates, scale 1:24,000.

Bull, W.B., 1972, Prehistoric near-surface subsidence cracks in western Fresno County, California: U.S Geological Survey Professional Paper 437-C, 85 p.

California Division of Mines and Geology, 1974, Special studies zones map, Hollister 7.5 minute quadrangle: California Department of Conservation, 1 sheet, scale 1:24,000.

_____, 1975, Recommended guidelines for determining the maximum credible and the maximum probable earthquakes: California Division of Mines and Geology Note 43, 1 p.

_____, 1982, Special studies zones map, Hollister 7.5 minute quadrangle: California Department of Conservation, 1 sheet, scale 1:24,000.

Compton, R.R., 1966, Granitic and metamorphic rocks of the Salinian block, California Coast Ranges *in* Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 277–287.

Dibblee, T.W., Jr., 1975, Geologic map of the Hollister quadrangle: U.S. Geological Survey Open-File Report 75-394, 1 map, scale 1:62,500.

Earth Systems Consultants, 1985, Seismic hazard evaluation, Kelly Ranch, Parcel 2, Southside Road, Hollister, California: unpublished report prepared for San Benito Engineering and Surveying, Inc., 22 p.

Ellis, W.C., 1952, Elevations on top of the blue clay zone, Hollister area: U.S. Bureau of Reclamation unpublished map.

Geoconsultants, Inc., 1978, Geologic hazard investigation for proposed commercial development, Park Hill and San Benito Streets, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-742, 12 p.

Hart, E.W., 1988, Fault-rupture hazard zones in California: California Division of Mines and Geology Special Publication 42, 24 p.

Hoose, S.N., 1986, Was there a great Pleistocene Lake San Benito? (M.S. thesis): San Jose State University, 87 p.

Idriss, I.M., 1987, Lecture notes, presentation at the EERI course on strong ground motion, April 10-11, 1987, Pasadena, California, *in* Singh, J.P., Course Organizer, Strong ground motion, seismic analysis, design and code issues: Earthquake Engineering Research Institute, 14 p.

International Conference of Building Officials, 1988, Uniform Building Code: Whittier, California, 926 p.

Jenkins, O.P., 1973, Pleistocene Lake San Benito: California Geology, v. 26, no. 7, p. 151–163.

Kilburn, Chabot, 1972, Ground-water hydrology of the Hollister and San Juan Valleys, San Benito County, California: U.S. Geological Survey Open-File Report 73-144, 5 maps, various scales.

Lawson, A.C., chairman, 1908, The California earthquake of April 18, 1906: Report of the California State Earthquake Investigation Commission: Washington D.C., Carnegie Institution of Washington, Publication 87, v. 1, 2 parts, 451 p.

Leighton and Associates, 1974, Fault hazard study of eastern and western portions of Ridgemark Estates development, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-56, 11 p., 1 appendix.

Lowney, J.V., & Associates, 1990a, Fault location investigation for Kelly Ranch residential development, Southside Road, Hollister, California: City of Hollister Open-File report, 20 p., 2 appendices.

_____, 1990b, Supplemental fault location investigation for Kelly Ranch residential development, Southside Road, Hollister, California: City of Hollister Open-File report, 13 p., 2 appendices.

Maley, R., Acosta, A., Ellis, F., Etheredge, E., Foote, L., Johnson, D., Porcella, R., Salsman, M., and Switzer, J., 1989, U.S. Geologic Survey strong-motion records from the northern California (Loma Prieta) earthquake of October 17, 1989: U.S Geological Survey Open-File Report 89-568, 84 p.

McCann, J.Z., 1990, Aftershock: the Loma Prieta earthquake and its impact on San Benito County: Hollister, California, Seismic Publications, 80 p.

McClellan, P.H., and Hay, E.A., Geologic evidence for triggered slip on the Calaveras fault during the magnitude 7.1 Loma Prieta earthquake of October 17, 1989: U.S Geological Survey Open-File Report 89-641, 37 p.

McMasters, C.R., Herd, D.G., Throckmorton, C.K., and Heusser, L.E., 1987, Subsurface stratigraphy of the eastern Hollister Valley, California: U.S Geological Survey Miscellaneous Field Studies Map MF-1461, 3 sheets, various scales.

Oppenheimer, D.H., Bakun, W.H., and Lindh, A.G., 1990, Slip partitioning of the Calaveras fault, California, and prospects for future earthquakes: Journal of Geophysical Research, v. 95, no. B6, p. 8483–8498.

Page, B.M., 1966, Geology of the Coast Ranges of California *in* Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 255–276.

Plafker, George, and Galloway, J.P., eds., 1989, Lessons learned from the Loma Prieta, California earthquake of October 17, 1989: U.S. Geological Survey Circular 1045, 42 p.

Ploessel M.R., and Slosson, J.E., 1974, Repeatable high ground accelerations from earthquakes: California Geology, v. 27, no.9, p. 195–199.

Rogers, T.H, 1967, Active extensional faulting north of Hollister near the Calaveras fault zone: Bulletin of the Seismological Society of America, v. 57, no. 4, p. 813–816.

_____, 1973, Preliminary geologic map, NE 1/4 Hollister quadrangle: California Division of Mines and Geology unpublished open-file report, 1 sheet, scale 1:12,000

Rogers, T.H., and Nason, R.D., 1971, Active displacement on the Calaveras fault zone at Hollister, California: Bulletin of the Seismological Society of America, v. 61, no. 2, p. 399–416.

Rogers, T.H., Nason, R.D., and Cooper, A.K., 1968, Preliminary map showing traces of the Calaveras fault zone in the City of Hollister, California: California Division of Mines and Geology Open-File Report 68-3, 1 sheet, scale 1 in. = 500 ft.

Shakal, A., Huang, M., Reichle, M., Ventura, C., Cao, R., Sherburne, R., Savage, M., Darragh, R., and Petersen C., 1989, CSMIP strong motion records from the Santa Cruz Mountains (Loma Prieta), California: California Division of Mines and Geology, Office of Strong Motion Studies Report No. OSMS 89-06, 196 p.

Stover, C.W., 1983, Intensity distribution and isoseismal map *in* Bennett, J.H., and Sherburne, R.W., eds., The 1983 Coalinga, California earthquake: California Division of Mines and Geology Special Publication 66, p. 1–4.

_____, 1984, Intensity distribution and isoseismal map for the Morgan Hill, California, earthquake of April 24, 1984 *in* Bennett, J.H., and Sherburne, R.W., eds., The 1984 Morgan Hill, California earthquake: California Division of Mines and Geology Special Publication 68, p. 1–4.

Taliaferro, N.L., 1948, Geologic map of the Hollister quadrangle: California Division of Mines Bulletin 143, 1 sheet, scale 1:62,500.

Terratech, Inc., 1974, Geologic evaluation, proposed commercial building, Alpha Beta shopping center, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-107, 4 p.

_____, 1976, Geotechnical investigation, K & S Market, Southside Road and Nash Road, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-329, 11 p.

_____, 1977, Geotechnical investigation, Royal Court Estates, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-642, 9 p.

_____, 1978, Geologic/geotechnical investigation, First Street commercial property, Hollister, California: City of Hollister Open-File report, 9 p., 2 appendices.

_____, 1981, Geologic investigation, proposed Nob Hill shopping complex, Hollister, California: California Division of Mines and Geology Alquist-Priolo Special Studies Zone Open-File Report AP-1336, 5 p.

_____, 1985, Fault investigation, J.C. Penney building, Hollister, California: City of Hollister Open-File report, 10 p.

_____, 1987, Investigation of the east branch of the Calaveras fault, Prune Street school site (Rancho San Justo Tandem school site), Hollister, California: City of Hollister Open-File report, 5 p.

U.S. Bureau of Reclamation, 1989, Engineering geology field manual: U.S. Department of the Interior, 599 p.

Wood, H.O., and Neumann, Frank, 1931, Modified Mercalli intensity scale of 1931: Bulletin of the Seismological Society of America, v. 21, no. 4, p. 277–283.

Woodward-Clyde Consultants, 1978, Geologic evaluation, Prospect Avenue property, Hollister, California: City of Hollister Open-File report, 5 p.

Woodward-Clyde & Associates and McClure & Messinger, 1968, Earthquake fault and earthquake engineering studies, proposed upper school site, Hollister, California: unpublished report submitted to Hollister School District, Hollister, California.

Working Group on California Earthquake Probabilities, 1990, Probabilities of large earthquakes in the San Francisco Bay region, California: U.S. Geological Survey Circular 1053, 51 p.

AERIAL PHOTOGRAPH REFERENCES

Pacific Aerial Surveys, July 3, 1987, V-SBN-C1-11 to 12, black and white, vertical, approximate scale 1:33,600.

_____, August 29, 1990, SBN-3845 47-54 to 55, black and white, vertical, approximate scale 1:12,000.

U.S. Department of Agriculture, May 15, 1967, BUX–1HH–91 to 93, black and white, vertical, approximate scale 1:20,000.

_____, May 7, 1980, 379–75 to 78, black and white, vertical, approximate scale 1:40,000.

WAC Corporation, April 2, 1985, WAC–85CA 7–45 to 48, black and white, vertical, approximate scale 1:31,680.

_____, June 14, 1989, WAC–90CA, 32–139 to 142, black and white, vertical, approximate scale 1:31,680.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report are based upon the assumption that the subsurface conditions do not deviate substantially from those disclosed in the trenches and borings. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that planned at the present time, Applied Soil Mechanics, Inc. should be notified so that supplemental recommendations can be given.

2. This report is issued with the understanding that it is the responsibility of the owner or of his representative to ensure that the information and recommendations presented herein are called to the attention of the project architect and engineers for the project and incorporated into the project plans and specifications, and that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the present date. Changes in the conditions of a property can occur with the passage of time, however, whether they be due to natural processes or the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or partially, by changes outside of our control. Therefore, this report should not be relied upon after a period of three (3) years without being reviewed by an engineering geologist.

4. This report was prepared upon your request for our services, and in accordance with currently accepted standards of professional engineering geology practice. No warranty as to the contents of this report is intended, and none shall be inferred from the statements or opinions expressed.

5. The scope of our services did not include any environmental assessment or study for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater or air, on or below or around this site. Any statements in this report regarding odors noted or unusual or suspicious items or conditions observed are strictly for the information of our client.

APPENDIX A

Exploratory Trench Logs

Exploratory Boring Log

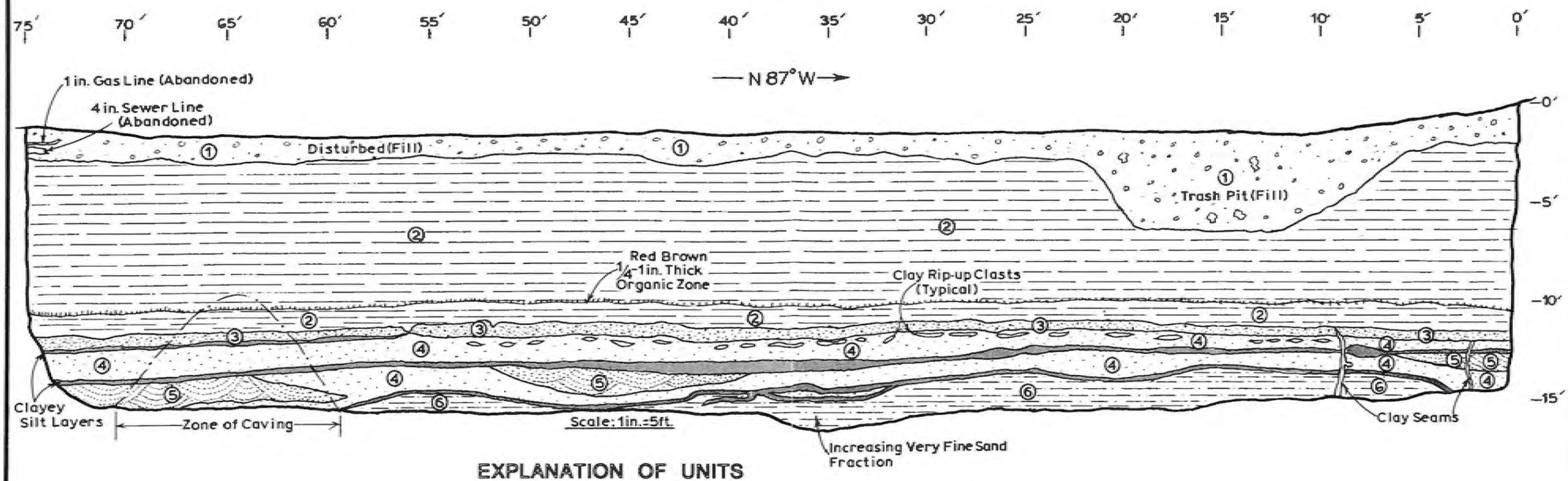
Exploratory Trench No. 1

Trench not logged due to caving

Exploratory Trench No. 2

Trench not logged due to caving

Exploratory Trench No. 3



EXPLANATION OF UNITS

Fill:

Unit 1: Dark grayish-brown (10YR 4/2) silty clay with construction debris; moist, loose.

Lacustrine deposits:

Unit 2: Olive brown (2.5Y 4/3) silty clay, with thin (1/4-1 inch thick) continuous dark reddish-brown (2.5YR 3/4) clay layer; moist to very moist, stiff, bioturbated. Sharp upper and lower contacts.

Fluvial deposits:

Unit 3: Light olive brown (2.5Y 5/4) well-graded medium to coarse-grained clayey sand; moist, medium dense, sharp upper and gradational lower contacts.

Unit 4: Light brownish-gray (2.5Y 6/2) fine to very fine-grained silty sand; moist, loose, thin subparallel laminations and faint cross-bedding, gradational upper and sharp lower contacts. Includes continuous layers of clayey silt to silty clay.

Unit 5: Very pale brown (10YR 8/3) very fine to medium-grained sand; slightly moist, very loose, trough cross-bedding, sharp upper and lower contacts.

Unit 6: Olive brown (2.5Y 4/3) silt; moist, stiff, indistinct bedding, sharp upper contacts. Grades locally to very fine-grained sandy silt.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A1 - Log of Exploratory Trench 3

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION Drilling supervised by BEP on 4/26/91	IN-PLACE DRY DENSITY p.c.f.	IN-PLACE MOISTURE CONTENT % dry wt
0						
1				Silty CLAY (CL), dark yellowish brown (10YR4/2) medium stiff, moist		
2						
3						
4						
5				Very soft, very moist, plastic, trace very fine sand		
6						
7						
8				Becomes moist at 8.0 feet		
9	1-1		13			
10	1-2		16	Silty SAND (SM), pale yellowish brown (10YR6/2), loose to medium dense, slightly moist, very fine to fine grained		
11				SAND (SP), pale yellowish brown (10YR6/2) loose to med. dense, slightly moist, very fine to fine grained, increase silt fraction from 11'-12'		
12	1-3		14			
13	1-4		15	SILT (ML), dark yellowish brown (10YR4/2) soft to med. stiff, slightly moist to moist, trace of very fine sand, occasional ½" interbeds of moist silty Clay		
14	1-5					

Figure A2 - Log of Test Boring 1 (0-14 feet)

DEPTH IN FEET	SAMPLE NO.	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f.	IN-PLACE MOISTURE CONTENT % dry wt
14				Boring 1 continued		
15	1-5		10	SILT (ML), dark yellow. brown (10YR4/2) soft to med. stiff, slightly moist to moist, trace very fine sand, occas. ½" interbeds of moist silty Clay		
16	1-6		24	Silty SAND (SM), pale yellowish brown (10YR6/2), dense, slightly moist, very fine to fine grained		
17				SAND (SP), pale yellowish brown (10YR6/2) dense, slightly moist, very fine to fine grained		
18	1-7		42			
19				Silty CLAY (CL), dark yellowish brown (10YR4/2) very soft, very plastic, saturated to wet		
20	1-8		12			
				Boring terminated at 20.0 feet *NOTE: ground surface is 2.5'-3.0' below street elevation = Modified California Sampler		

Figure A3 - Log of Test Boring 1--continued (14-20 feet)

DRAFT

KINGSLEY ASSOCIATES

Geologists & Geohydrologists
1595 Josselyn Canyon Road
Monterey, CA 93940
408 373 0909

July 30, 1991

Hugh Riley
City Manager
City of Hollister
375 Fifth St
Hollister, Ca. 95023

Dear Mr. Riley,

This letter with the attached map is the suggested proposal for additional geologic work in the city of Hollister. The objective of the investigation is to redefine the Alquist-Priolo Zone along the east branch of the Calaveras fault in the downtown area.

SCOPE OF WORK:

1. Research and evaluate past literature and consultant reports.

2. Obtain, analyze, and plot water well data from local drillers, Department of Water Resources, and U.S. Bureau of Reclamation files to identify the water table and "blue clay" depths on either side of the west and east branches of the Calaveras fault zone.

3. Drill 14 core holes along the proposed profile lines (attached map) with continuous cores to a minimum of 30 feet in order to produce a stratigraphic subsurface structure cross-section. The core holes should be measured using electric resistivity and/or gamma geophysical logs for comparison with the cores and correlation across the fault zone. Each hole should be cased with slotted P.V.C., gravel packed and completed with a locked Christy box. The core holes are then available for future monitoring activities. The cores should be preserved and stored by the city for future study. Laboratory testing of the core samples is not required to meet the objective of this investigation.

DRAFT

4. One initial trench is required to evaluate the California Department of Mines and Geology mapped trace of the east branch on the South Street east of the intersection of South and Sally streets (See attached map). This trench is critical because it will cross a break in slope which is interpreted as a fault scarp along the east branch. Additional trenches can be located from the results of the core hole program.

Hugh, this investigation should stand on its own two feet and not rely on previous, unverifiable consultant reports or projected fault locations (trendology). Also, the trenches should be covered and left available for inspection by other geologists studying the extended Hollister area for about a week after the contracted consultant's trench-logging and interpretation is completed.

If you have any questions or comments about this please contact me.

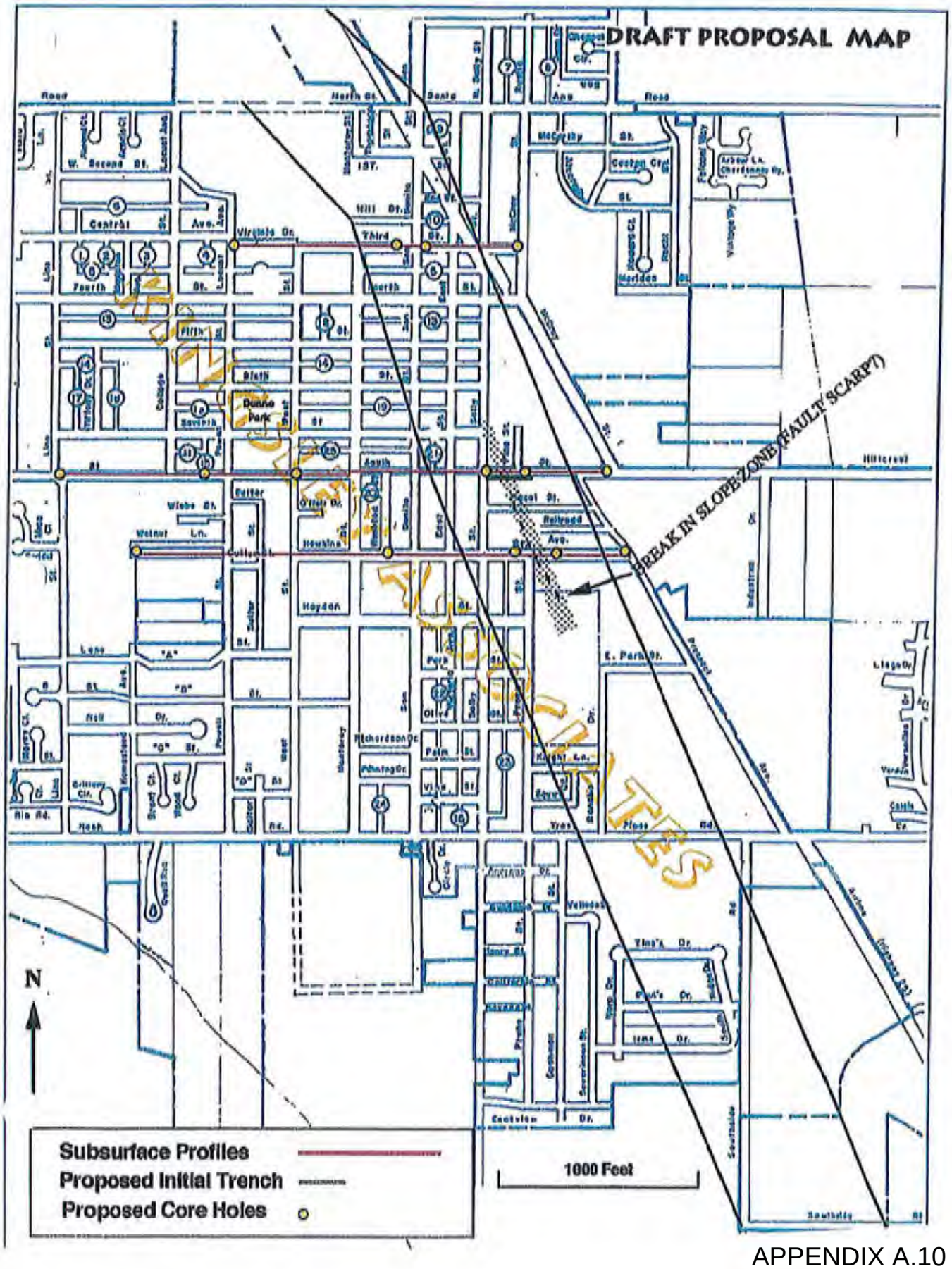
Sincerely,

ccccc jk ccccc

John Kingsley

Registered Geologist

Cert. No. 2987


DRAFT PROPOSAL MAP
BREAK IN SLOPE ZONE (FAULT SCARP)
Subsurface Profiles
Proposed Initial Trench
Proposed Core Holes
1000 Feet
N

JOHN KINGSLEY
Geologist and Geohydrologist
1595 Josselyn Canyon Road
Monterey, California 93940
(408)373-0909

RECEIVED
MAR - 8
CITY MANAGER'S OFFICE

March 5, 1993

Mr. Hugh Riley, City Manager
City of Hollister
375 Fifth Street
Hollister, California 95023

Re: Geologic Study of the Machado Property

Dear Mr. Riley,

This letter details my recommendation concerning the Machado property on 3rd Street that we discussed in our phone conversation on February 25, 1993. I recommend a geologic fault study for the Machado property be initiated and it be independent of those studies done by Applied Soils Mechanics in the downtown area during 1990-91. The purpose of a site-specific study on the Machado property is to provide verifiable observations concerning faulting as defined by the Alquist-Priolo Special Studies Zone Act of 1972 (APSSZ).

The Machado property is in line with the inferred, northwest "no fault trend" to the IOOF site (see Exhibit 1). The IOOF property (Site #1), was to be trenched as shown in the Applied Soil Mechanics, Inc. (ASMI) proposal dated November 1990 (See Exhibit 2). However, because data obtained from trenches observed by ASMI at sites 3,6 and 10 in the downtown fault study, trenches on the IOOF property were deferred by projecting the inferred data from those nearby sites where no fault evidence was observed to the IOOF site (see attached ASMI Addendum Letter dated July 12, 1991).

The Machado site is on the slope of a fault-block hill and therefore differs from the IOOF site which is on the flat area away from the possible faulting associated with the Park Hill uplift. As the Machado property is in the East Branch of the Calaveras Fault APSSZ, the regulations of the California Division of Mines and Geology clearly dictate

that a geologic fault study is required.

In addition, below is a quote from my letter to you (July 30, 1991) outlining a proposal for additional geological work in the city (see my attached letter of July 12, 1991):

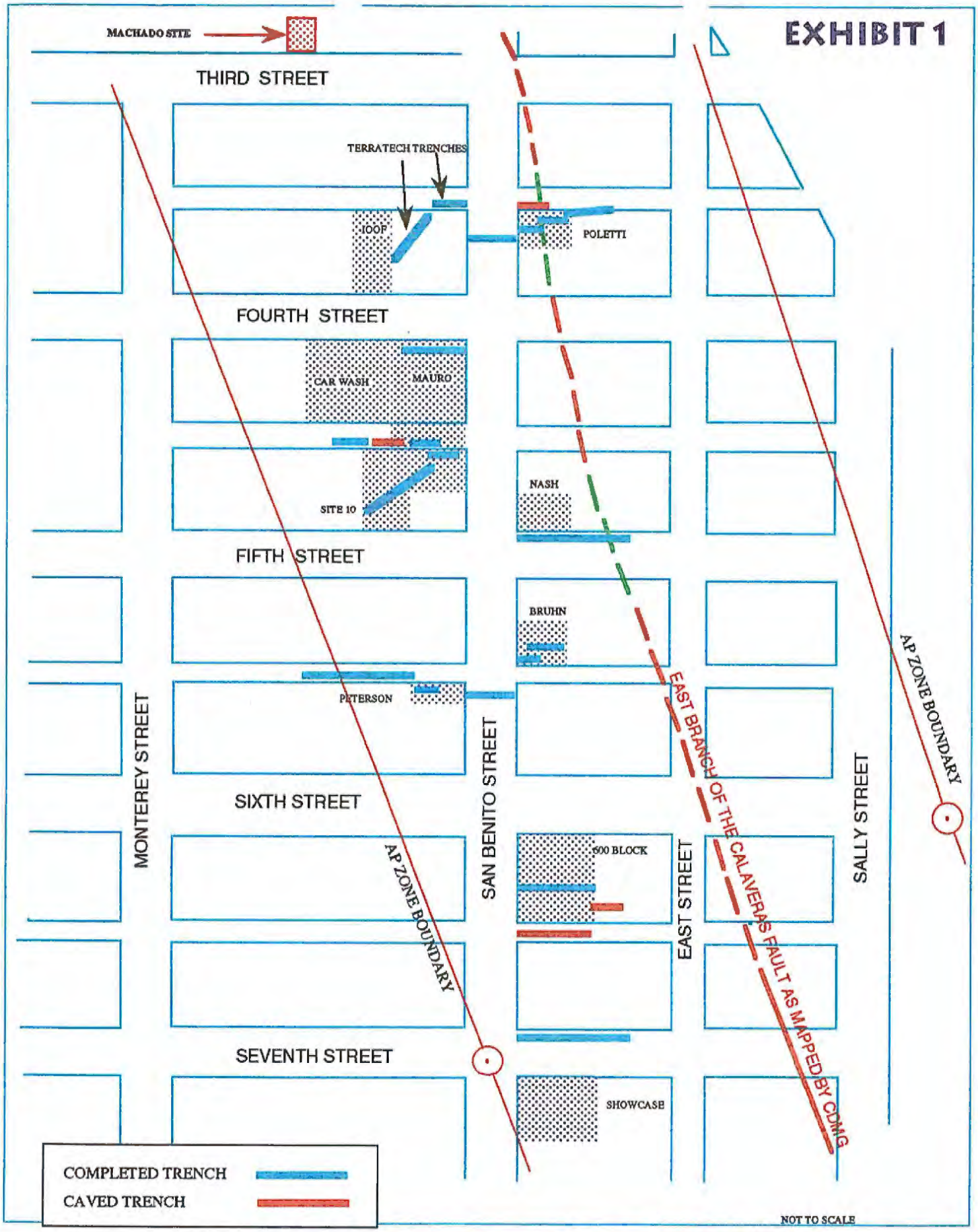
"If the city seeks to eliminate and/or modify the Alquist-Priolo Special Studies Zone up to Park Hill, I suggest a trench long enough to satisfy the State. This additional trench, sited on Third street, should supply adequate geological data to detail both site 1 and extend the fault data to the northernmost edge of the buildable area in town."

If another geologic study showed no indication of faulting on the north side of the Machado property along the inferred "no fault trend", then the site would be bracketed and support the "no fault trend" concept. At present, this is not the case.

Respectfully submitted,

John Kingsley
Certification number 2987

Attachments



HOLLISTER FAULT STUDY

TRENCH MAP

Geology by: KINGSLEY & ASSOCIATES

APPENDIX A.11

/30/91/2/4/93

EXHIBIT 2

File No. AP-1179

November 13, 1990

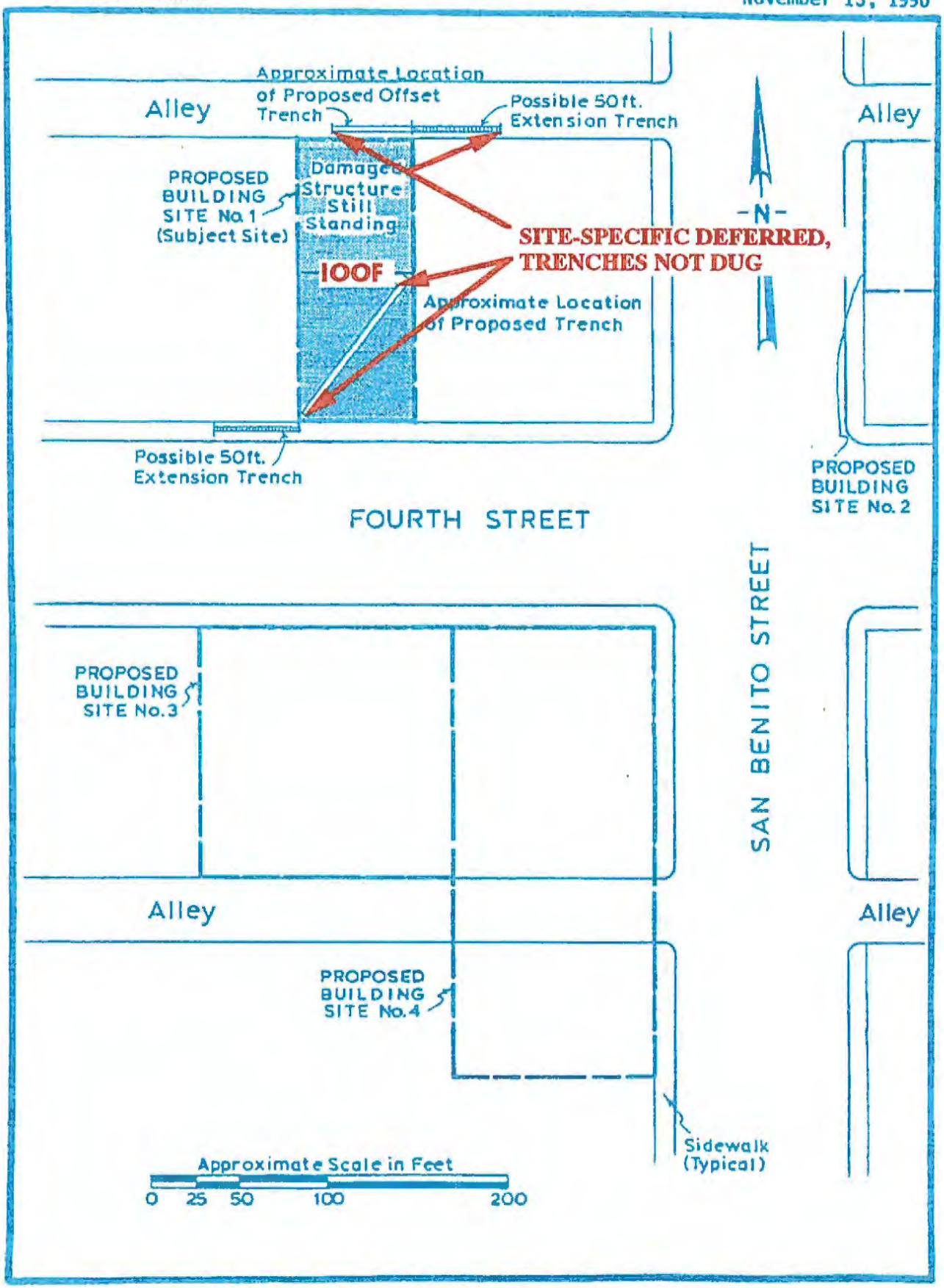
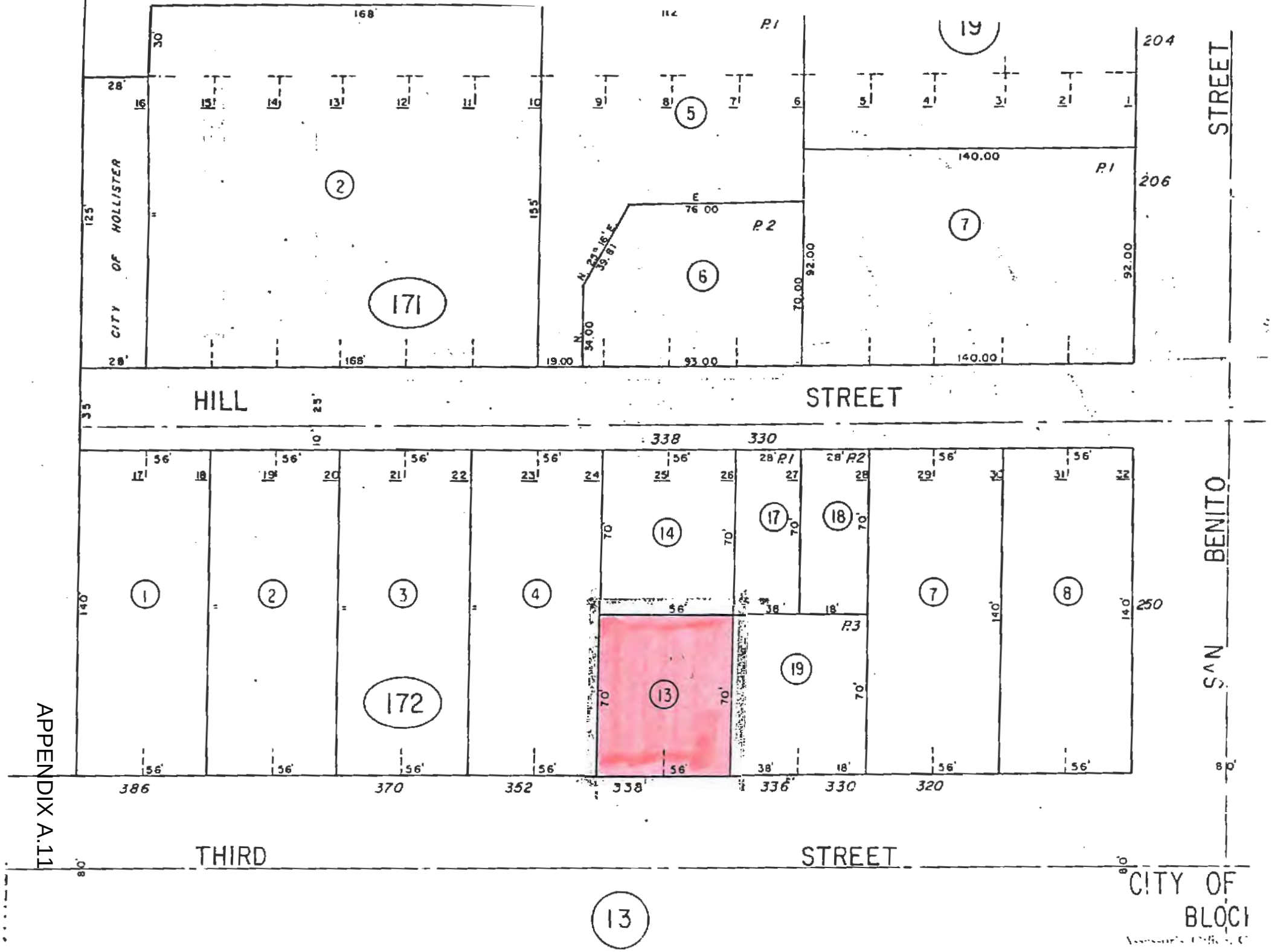


Figure 1 - Location Map, IOOF / Caputo Printing Site

SOURCE: PROPOSAL MAP, APPLIED SOIL MECHANICS



APPENDIX A.11

KINGSLEY ASSOCIATES
Geologists & Geohydrologists
1595 Josselyn Canyon Road
Monterey, CA 93940
408 373 0909

July 12, 1991

Hugh Riley
City Manager
City of Hollister
375 Fifth St
Hollister, Ca. 95023

Dear Mr. Riley,

I recently reviewed the *Fault Study (sites 1,3-6 and 10)* submitted to the City of Hollister by Applied Soil Mechanics and suggested some revisions for the final report. I judge the final report is complete and meets the objectives of the Alquist-Priolo requirements for properties the investigated with the exception of site 1. I discussed this omission with the Applied geologists, Lew Rosenberg and Rick Gorman. They agreed the write an addendum presenting the rationale for not trenching this site.

The interpretation by Rick Gorman is satisfactory if the trend of the Calaveras Fault is consistent with the now known fault information secured from the trench studies completed to date. The trace of the east branch of the Calaveras Fault, as mapped by the California Division of Mines and Geology in the city, lies about one block east of site 1.

If the city seeks to eliminate and/or modify the Alquist-Priolo Special Studies Zone up to Park Hill, I suggest a trench long enough to satisfy the State. This additional trench, sited on Third street, should supply adequate geological data to detail both site 1 and extend the fault data to the northernmost edge of the buildable area in town.

As you are aware, I reviewed the geology in each trench with the Applied geologists while the trenches were open. I state with certainty that no evidence for faulting was observed in any of the trenches included in this report.

Respectfully submitted,

John Kingsley
Certification number 2987

cc: Chris Reyes
Lew Rosenberg
Rick Gorman

APPLIED SOIL MECHANICS ADDENDUM LETTER

File No. A0-2280-S1 July 10, 1991

City of Hollister Redevelopment Agency
375 Fifth Street
Hollister, CA 95023

Attention: Mr. Hugh Riley, City Manager

Subject: Sites 1, 3-6, and 10:
City of Hollister, California
ADDENDUM LETTER TO FAULT STUDY DATED JUNE 12, 1991

Gentlemen:

At the request of the Reviewing Geologist, Mr. John Kingsley, we have written this addendum letter to the Fault Study for the subject properties. Mr. Kingsley asked that we explain our rationale for not trenching Site 1 (I.O.O.F and Caputo Printing Building) of the downtown fault study. The following comments explain our basis for this decision.

In our proposal, we originally planned on trenching Site 1. An exploratory trench was not excavated on or adjacent to Site 1 as part of this study. However, additional trenches were excavated during the downtown fault study (ET-5 on Site 2, ET-5 on Site 10, and ET-5 and ET-6 on Site 8). The additional exposures provided by these trenches revealed no indication of faulting. In addition, Terratech excavated two exploratory trenches in 1985 on the J.C. Penney property which borders the east side of Site 1. Terratech reported no indication of faulting in these trenches.

Considering the north-northwest strike of the East Branch of the Calaveras fault, evidence of faulting extended across Site 1 would have been observed in the above mentioned trenches excavated as part of this study and Terratech's 1985 study. Based on the data gathered in this study and the known structure in the area, it is unlikely that an active fault trace crosses Site 1.

Sincerely,

APPLIED SOIL MECHANICS, INC.

Written by:

Lewis Rosenberg
Project Geologist

Reviewed by:

Richard T. Gorman, C.E.G. 1325
Consulting Geologist

Copies: 1 to Addressee
1 to City of Hollister Redevelopment Agency

City of Hollister

TELEPHONE (408) 636-4300

FAX (408) 636-4310

375 FIFTH STREET
HOLLISTER, CALIFORNIA
95023

April 29, 1994

Memorandum

To: Barry Johnson, Hollister Redevelopment Agency

From: Tom Barry, Building Director

Subject: Earthquake Fault Studies: Hollister Downtown Area

Details:

In late 1990, or early 1991, the Hollister Redevelopment Agency contracted with Applied Soil Mechanics, Inc. to perform a fault study of the Hollister Downtown Business District area. City Administrators recognized the need to properly evaluate the entire downtown area so as to provide a clearance for post-Loma Prieta reconstruction with respect to properties located within the Special Studies Zone as delineated by the State Geologist.

In June and July of 1991, fault study reports were provided by Applied Soil Mechanics, Inc. to the City for individual sites scattered throughout the downtown area.

Approximately four months ago, I reiterated my concern to both Chris Reyes and Hugh Riley that, to the best of my knowledge, the reports had not been "consolidated" to cover a single large downtown area as was the original intent. Without such an amendment, the property owners of parcels in the downtown that were not a part of the specific test sites would likely be required to pay for the costs of an independent costly fault study as a prerequisite to new development. This situation is likely sometime in the near future for some areas that are vacant due to fire.

I was made to assume that the process of consolidating the study area was being accomplished. However, as of this writing, I have not seen any evidence supporting a single study area, such as a map or written documentation.

Please pursue this matter at your earliest convenience. If the revision has occurred, this department needs to have copies of all documentation in order to process building permits on the affected sites.

cc: Stanley Hall

INTEROFFICE MEMORANDUM

DATE: May 12, 1994

TO: Stanley H. Hall, Interim City Manager

FROM: Barry Johnson, Redevelopment Program Manager

SUBJ: EARTHQUAKE FAULT STUDIES

In reference to the attached letter, I contacted the consulting firm Applied Soil Mechanics, Inc. a.k.a. Earth Systems and found that a consolidated report had never been ordered.

I will be meeting with their local engineer next week to discuss pursing this issue. I'll inform Tom Barry of the meeting for his attendance if necessary.

BJ/asl

cc: Tom Barry

K NGSLEY ASSOCIA ES
Consulting Geologists and Hydrogeologists
1595 Josselyn Canyon Road
Monterey, California 93940
(408) 373-0909

May 27, 1994

Barry Johnson
City of Hollister
375 Fifth St.
Hollister, Ca. 95023

Dear Mr. Johnson,

In response to our meeting last week, I'm submitting a not to exceed, proposal for the review of the geologic fault investigation outlined by Rick Gorman of Earth Systems Consultants. The calculations are derived from those incurred in the spring of 1991.

My consulting fee is $75.00\hour.

I estimate 120 hours for the entire review process distributed as follows:

1. Five trench inspection visits.	80 hours
2. Review and study of the Earth Systems Consultants report.	15 hours
3. Preparation of the reviewed report	10 hours
4. Meetings and consultations with the City of Hollister and/or Earth Systems Consultants	15 hours
Total estimated	120 hours

Not to exceed proposal is $9,000.00

I understand that I am to bill the city monthly beginning June 1, 1994.

Respectfully submitted,

John Kingsley

John Kingsley
License # 2987

Please complete this agreement and return a copy to Kingsley Associates.

I have read and understand the attached letter of agreement and agree to the terms and conditions set forth within.

Name:_____

Signature:_____

Date:_____

PROPOSAL FOR
ENGINEERING GEOLOGY SERVICES
and
GEOLOGIC FAULT TRENCHING

for

THE CITY OF HOLLISTER
HOLLISTER REDEVELOPMENT AGENCY
HOLLISTER, CALIFORNIA

submitted by

EARTH SYSTEMS CONSULTANTS
NORTHERN CALIFORNIA

JULY 15, 1994

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APPENDIX A.14

Earth Systems Consultants Northern California
A Member of The Earth Systems Group
400 Park Center Drive Ste. 7 • Hollister, CA 95023 • (408) 637-2133 • FAX (408) 637-0510

July 15, 1994

Hollister Redevelopment Agency
Attn: Mr. Barry Johnson, Program Manager
375 Fifth Street
Hollister, CA 95023

SUBJECT: **Proposal for a Geologic Fault Summary Report and Additional Fault Trenching**

Dear Mr. Johnson:

Earth Systems Consultants Northern California is pleased to submit this proposal to provide engineering geology services for the City of Hollister. We understand that the City of Hollister wishes to further define the trace of the East Branch of the Calaveras Fault with respect to the areas slated for future redevelopment. We are proposing a two-fold approach for this project. The first phase will be to consolidate the existing reports prepared by this firm for the properties extending from Fremont Way to South Street. This will aid in achieving the City's objective of having one reference document that addresses existing information regarding the fault's impact upon the redevelopment area. The second phase will be to perform additional investigative work to determine if the fault is present within distances that would affect the remaining redevelopment areas.

The proposed project team will be the same as that assigned to the earlier phases of the work. As they are already familiar with the area, the geologic features, and the background of the project, we feel that we can provide efficient and cost-effective services for these phases of the project.

Thank you for your consideration of our firm for this project. We trust that this proposal adequately presents our capabilities, proposed approach, and our interest in the project. Please feel free to contact the undersigned if you have any questions or if we can be of service in any way.

Sincerely,

EARTH SYSTEMS CONSULTANTS
NORTHERN CALIFORNIA

Craig S. Hill, V.P.

Craig S. Hill, Vice President

Doc. No.: 9406-007.PRP

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SECTION 2 PROPOSED SCOPE OF WORK

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APPENDIX A RESUMES OF THE PROJECT TEAM

APPENDIX B CLIENT REFERENCES

SECTION 1

BACKGROUND AND PROJECT APPROACH

Phase I will consist of a geologic fault summary report, Phase II will consist of performing a fault investigation.

The Calaveras Fault is an active fault that extends through the City of Hollister, California. As part of the State fault evaluation program, the California Division of Mines and Geology (CDMG) defined the East Branch of the Calaveras Fault as sufficiently active and well-defined to be included within an Earthquake Fault Zone (formerly known as an Alquist-Priolo Special Studies Zone). State law prohibits construction of habitable buildings within 50 feet of an active fault. To determine if the fault crosses within 50 feet of a proposed building site, exploratory trenches are generally excavated within the proposed building site (and extending 50 feet beyond the building footprint) under the supervision of an engineering geologist experienced in fault investigation. Our firm, Earth Systems Consultants (formerly Applied Soil Mechanics), has conducted several such investigations for the Hollister Redevelopment Agency. These included properties extending from Fremont Way to South Street. In the areas investigated for the City, no traces of the fault were found.

Based upon our meeting with the City of May 20, 1994, we understand that the City wishes to further define the trace of the fault with respect to the areas slated for redevelopment. As separate reports were issued for each of the properties previously investigated by this firm, the first phase of our work would involve compiling the information into a single report that specifically addresses the impact of the fault's presence (or absence) on the proposed redevelopment areas. This compilation of existing information will be augmented by probablistic analysis of significant faults located within a 100-mile radius of the City of Hollister. The second phase would be to conduct further physical exploration of the remaining redevelopment areas to determine if the presence of the fault will affect redevelopment plans.

The same project team that performed the earlier investigations will be assigned to this project. The team will be led by Richard Gorman, chief geologist, and Craig Hill, project engineer. Field support will be provided by staff geologists Brian Papurello and Craig Harwood.

SECTION 2

PROPOSED SCOPE OF WORK

Phase 1: Geologic Fault Summary Report

The previous fault study reports will be reviewed and the information will be summarized into a single report. The report will include discussions of regional geology, local geology, and seismicity. The significant faults located within a 100-mile radius of the City of Hollister will be listed, included with their activity levels and their significant structural characteristics. The faults will be analyzed using a computer program to estimate their maximum probable ground accelerations. A probabilistic earthquake analysis will also be performed. Based upon the results of the analysis and the information contained in the earlier reports, conclusions will be developed with respect to the impact of seismic activity upon the City of Hollister's redevelopment area. If possible, zones within the redevelopment that should be considered as excluded from the Earthquake Fault Hazard Zone will be established. Figure 1 presents the areas where the presence of faulting has been cleared. These areas are based on the previous fault investigations.

Phase II: Geologic Fault Investigation

As only a portion of the City's redevelopment area located within the Earthquake Hazard Zone has been investigated, additional subsurface exploration will be necessary to assess the fault's impact upon the remaining areas. We estimate that four fault trenches totaling approximately 1,000 lineal feet will be required. The depths of the trenches will be about 15 feet below street elevation. The proposed trench locations are shown on Figure 1.

The trenching will be conducted under the supervision of a registered engineering geologist, who will log the materials and structural elements encountered in the trench and evaluate the trench for evidence of the faulting. It will be the resposibility of the City of Hollister to provide a dump truck and driver to haul away and dispose of the trench spoils during trench excavation operations. This proposal also assumes that the City of Hollister will also provided an additional laboror/trench spotter to aid in the trenching operations and general site safety. Following completion of the evaluation, the trenches will be backfilled with slurry (a two-sack grout mix), or a controlled density backfill, to finish subgrade elevation. Placement of aggregate base and repaving of the street will be the responsibility of the City of Hollister. Backfill material will be supplied by San Benito Supply, and this proposal assumes that the backfill supplier will invoice the City of Hollister directly for backfill material costs.

PROPOSED
SCOPE OF WORK
(Continued)

A report will be prepared that discusses the findings of the fault investigation. Based upon the results of the investigation, conclusions will be developed with respect to the presence or absence of the fault in the redevelopment area. If possible, zones within this portion of the redevelopment that should be considered as excluded from the Earthquake Fault Hazard Zone will be established.

SECTION 3

FIRM HISTORY AND QUALIFICATIONS

Earth Systems Consultants has a geographic distribution that spans the State of California.

The State of California selected us as their geotechnical consultant.

Our laboratories have been certified by the Army Corps of Engineers, OSA and CCRL.

Earth Systems Consultants has been operating since 1969 and has a geographic distribution that spans the State of California. This structure allows us to integrate the advantages of local knowledge of geotechnical and geologic conditions, with the broad base of professional and technical personnel available through a large consulting organization. As Earth Systems Consultants includes affiliated divisions of similar structure and expertise, the needs of a particular project can be fully addressed from project inception through completion of construction, regardless of its location. Each investigation is conducted under the direct supervision of a registered engineer or geologist. This degree of involvement allows us to thoroughly address the aspects of a project at the early critical stages. Assessment of the potential for hazardous substances can be combined with evaluations of geotechnical and geologic aspects, thus providing a complete evaluation of the site.

We were selected by the State of California Department of Transportation as their District 5 (San Luis Obispo, San Benito, Santa Barbara, Monterey, and Kern Counties) geotechnical and materials testing consultant. The California Office of Project Development and Management also selected us as their geotechnical consultant for the Central Coast region. Both of these contracts were recently renewed due to these agencies' high level of satisfaction with our services. We were also selected by the State of California to perform geologic studies and preliminary environmental site assessments for the State Water Project. Both GTE Mobilnet and MCI Communications selected us to perform geotechnical engineering investigations for sites across the State of California.

Our laboratories have the capacity to perform hundreds of tests upon soils, concrete, asphalt, steel, masonry, and other building materials. Tests are conducted by trained technicians in strict accordance with ASTM, Caltrans, and other appropriate laboratory standards. We have mobile laboratory equipment for fill control services and for concrete sampling, curing (tank and fog room), compression testing, and asphalt concrete testing. Our laboratories have been certified by the Army Corps of Engineers (Sacramento District), Office of the State Architect (OSA) and Concrete and Cement Reference Laboratory (CCRL). Our laboratories are inspected annually, and the calibrations are traceable to the National Bureau of Standards.

FIRM HISTORY AND QUALIFICATIONS *(Continued)*

Earth Systems Consultants has consistently provided quality geotechnical, geological and environmental services for projects such as dams, highways, bridges, airports, military installations, hospitals, educational facilities, and single and multi-family residential developments throughout California.

SECTION 4

THE PROJECT TEAM

Mr. Richard T. Gorman, chief geologist

Richard T. Gorman is the chief geologist with the firm and is a registered geologist and a certified engineering geologist. He is experienced in all phases of engineering geology from project inception, field investigation, data analysis, to final compilation and issuance of the completed report, as well as post-study consultation. He has conducted numerous large scale geologic investigations both with Earth Systems and in his previous position with Irvine/Highland Soil Engineering of Riverside and Irvine, California. These investigations have involved major site specific studies of seismicity, geologic hazard, landslides, faults, and coastal bluff retreat. Mr. Gorman is responsible for developing and conducting field investigations, document research, and report preparation. His education consists of a Bachelor of Science degree in Geology obtained from California Polytechnic State University, Pomona, California and he is presently a member of the Association of Engineering Geologists and the Geologic Society of America. He also was the senior geologist for the previous fault investigation for the City of Hollister.

Mr. Craig S. Hill, project engineer

Craig S. Hill Craig Hill is a registered civil engineer and manager of Earth Systems Consultants Hollister office. Mr. Hill specializes in pre-construction geotechnical investigations and site assessments. He obtained his B.S. degree in Civil Engineering from California Polytechnic State University in San Luis Obispo, California. His project experience in the Hollister area includes a geotechnical engineering study for the Downtown Parking Structure, a four-story parking garage located within an Earthquake Studies Zone; a geotechnical engineering study for the Hollister Areawide Sewer Project; and a geotechnical engineering study for the Cienega Road Realignment. This last project involved evaluation of slope stability, pavement design, and drainage facilities. Mr. Hill is a member of the American Society of Civil Engineers and the Post Tensioning Institute.

THE PROJECT TEAM
(Continued)

Mr. Brian Papurello, staff geologist

Brian Papurello Mr. Papurello's assignment for this project will be staff geologist. Mr. Papurello has been a staff geologist with Earth Systems Consultants since 1990. His work includes assisting in geologic and geotechnical engineering investigations, including logging of soils during trenching and drilling operations; fault investigations; evaluation of slope stability; field inspection during construction operations; observation and testing during grading projects; and inspection of rip-rap placement for creek realignment and seawall projects. He obtained a Bachelor of Science degree in geology from San Diego State University. He also assisted in the previous fault investigations for the City of Hollister as a staff geologist and project coordinator.

Mr. Craig S. Harwood, staff geologist

Craig S. Harwood will also be a staff geologist for this project. Mr. Harwood has served as a staff geologist on a number of projects since joining Earth Systems Consultants in 1989. His projects have involved geologic hazard assessment, landslide and fault evaluation, and distressed residence evaluation. Most recently, he worked on several earthquake distressed sites in Santa Cruz County. Mr. Harwood obtained his Bachelor of Science degree in geological sciences from the University of California, Santa Cruz. He participated in geologic field mapping in Oregon and Nevada for the U.S. Geological Survey, and has co-authored several geologic maps as a result. He also assisted in the previous fault investigations for the City of Hollister as a staff geologist.

SECTION 5

FEES AND INSURANCE

FEES

Phase I - Geologic Fault Summary Report	**$5,100.00**
Phase II - Fault (Trenching) Investigation	**$143,000.00**

INSURANCE

Earth Systems Consultants maintains general liability insurance and professional liability insurance in the amount of $1,000,000. The City of Hollister will be named as an additional insured on our general liability policy.

APPENDIX A

RESUMES OF THE PROJECT TEAM

Please see attached.

Resumes of Hollister Redevelopment Agency Project Team

Mr. Richard T. Gorman
Mr. Craig S. Hill
Mr. Brian Papurello
Mr. Craig S. Harwood

RICHARD T. GORMAN, Vice President

EXPERIENCE

March 1989 to Present
Vice President, Geology Department
Earth Systems Consultants, Pacific Geoscience Division, San Luis Obispo, California
Responsibilities: Manages the geology department and conducts studies involving engineering geology, seismicity, and hydrology. Areas of expertise include groundwater, fault hazard investigations, landslide analysis (including computer-generated slope stability analysis), seismic refraction analysis, and mass grading geologic inspection.

August 1987 to March 1989
Senior Engineering Geologist
Buena Engineers, Inc., San Luis Obispo, California
Responsibilities: Managed geology department and conducted studies involving engineering geology, seismicity, and hydrology.

September 1978 to August 1987
Project Geologist
Irvine Soils Engineering, Irvine, California
Responsibilities: Seismic refraction analysis, percolation testing, managed geology department and coordinated geologic projects. Worked on projects regarding groundwater, fault hazard investigations, landslide investigations, geotechnical preliminary investigations and mass grading geologic inspections.

July 1976 to September 1978
Soils Technician
Le Roy Crandall and Associates, Los Angeles, California
Responsibilities: In charge of grading control and inspection.

EDUCATION

B.S., Geology, California Polytechnic State University, Pomona, California, 1974

Graduate courses in Geology, California State University, Los Angeles, California

REGISTRATION AND CERTIFICATION

Certified Engineering Geologist, State of California, 1986 (No. 1325)
Registered Geologist, State of California, 1985 (No. 4065)

PROFESSIONAL AFFILIATIONS

Member, Inland Geologic Society
Member, Association of Engineering Geologists
Member, Geologic Society of America

PROJECT EXPERIENCE
(as head geologist)

- City of Hollister, fault investigation
- City of Pismo Beach, bluff erosion study
- Atascadero State Hospital, fault investigation
- Valley Community Hospital, Phase 1 expansion, Santa Maria
- General Hospital Replacement Facility, San Luis Obispo
- Cuesta College Student Center, San Luis Obispo
- Paso Robles Public School District, various schools
- San Luis Coastal Unified School District, various schools
- California Highway Patrol, Arroyo Grande
- Unocal Pipeline, Cuesta Ridge, slope stability and monitoring

CRAIG HILL, Vice President

EXPERIENCE

September 1991 to Present
Manager and Chief Engineer
Earth Systems Consultants Northern California, Hollister, California
Responsibilities: Manages the Hollister office. As such, supervises laboratory testing of construction materials and supervises field inspectors and technicians. Authors soils engineering reports, develops foundation design criteria and performs foundation evaluations. Inspects foundation excavations and reinforced concrete. Prepares estimates, proposals, and contracts.

1987 to 1991
Testing and Inspection Engineer
Earth Systems Consultants Northern California, San Luis Obispo, California
Responsibilities: Coordinated and supervised field and laboratory operations, supervised materials and soils technicians and inspectors. Prepared cost estimates and tracked project budgets. Ensured timely completion of construction reports.

1983 to 1987
Project Engineer
Buena Engineers, Inc. (prior to their merger with Earth Systems Northern California)
Responsibilities: Provided geotechnical engineering services for a wide range of residential and commercial developments. Authored soils engineering reports which included foundation design criteria, retaining wall design criteria, liquefaction analysis, slope stability analysis, and pile capacity analysis. Designed effluent disposal systems.

1981 to 1983
Staff Engineer
Buena Engineers, Inc. (prior to their merger with Earth Systems Northern California)
Responsibilities: Authored soils engineering reports and project plan reviews under the supervision of the project engineer. Produced cost estimates for soils engineering investigations and testing and inspection services. Performed drilling operations and logged soil profiles.

1979 to 1981
Field Technician
Buena Engineers, Inc. (prior to their merger with Earth Systems Northern California)
Responsibilities: Field construction inspection testing of construction materials, preparation of construction reports.

EDUCATION

B.S. Civil Engineering, California Polytechnic State University,
San Luis Obispo, California, 1981

REGISTRATIONS AND CERTIFICATIONS

Registered Professional Engineer (Civil), State of California, 1983, (No. 38234)

ICBO Certified Special Inspector: Reinforced Concrete, 1985 (No. 58644)

PROFESSIONAL AFFILIATIONS

American Society of Civil Engineers
Post Tensioning Institute
Society of American Military Engineers

SELECTED MAJOR PROJECT EXPERIENCE
(as lead professional engineer)

- Hollister Sewer Main Project
- Hollister Parking Garage
- Atascadero State Hospital Warehouse Additions
- River Road Widening, Salinas
- Cienaga Road Realignment, Hollister
- Carmel Valley Ranch, Carmel Valley
- Chappell Road Subdivision, Hollister
- American Cooling, Inc., Castroville, California
- Pismo Beach Post Office, Pismo Beach
- San Luis County Operational Center, Main Jail Expansion, San Luis Obispo
- San Luis Obispo Wastewater Treatment Plant, San Luis Obispo
- San Benito School, Atascadero
- Smart SMR of California, Inc., Basalt Hill, Stevinson, Kettleman Hills, and Joaquin Ridge cell sites

BRIAN PAPURELLO, Staff Geologist

EXPERIENCE

1988 to Present
Staff Geologist and Field Technician
Earth Systems Consultants Northern California, Hollister, California
Responsibilities: Authors geologic studies involving landslides, slope stability, distressed foundations, and mass grading projects. Drills borings and logs soil profiles. Performs field and laboratory testing and inspection of construction materials. Performs special inspection of reinforced concrete.

EDUCATION

B.S. Geological Sciences, California Polytechnic State University, San Diego, Ca., 1987

REGISTRATIONS AND CERTIFICATIONS

ICBO Certified Special Inspector, Reinforced Concrete, 1989 (No. 62573)
NICET Level II, Associate Engineering Technician (No. 081495)
Licensed Nuclear Gauge Operator (No. 1266)

SELECTED MAJOR PROJECT EXPERIENCE
(as geologist and/or technician)

- Hollister Sewer Main Project, Hollister, CA
- Cienaga Road Realignment, Hollister, CA
- Sally Street Renovation, Hollister, CA
- Hollister Earthquake Fault Study, Hollister, CA
- Sunnyslope Villages, Hollister, CA
- American Cooling, Inc., Castroville, CA
- Christopher Estates, Hollister, CA
- Smart SMR of California, Inc., Basalt Hill, Stevinson, Kettleman Hills, and Joaquin Ridge cell sites

CRAIG HARWOOD, Staff Geologist

EXPERIENCE

1989 to Present
Staff Geologist and Field Technician
Earth Systems Consultants Northern California, Hollister, California
Responsibilities: Authors geologic and soil engineering studies involving landslides, slope stability, distressed foundations, and mass grading projects. Drills borings and logs soil profiles. Performs field and laboratory testing and inspection of construction materials.

EDUCATION

B.S. Geological Sciences, University of California, Santa Cruz, California, 1987.
A.A. Physical/Natural Sciences, Cabrillo Community College, Aptos, California, 1983.

REGISTRATIONS AND CERTIFICATIONS

Licensed Nuclear Gauge Operator, (No. 12535)
OSHA 40 Hour Haz/Mat Training (in progress)

SELECTED MAJOR PROJECT EXPERIENCE
(as geologist and/or technician)

- Hollister Earthquake Fault Study, Hollister, CA
- Hollister Sewer Main Projects, Hollister, CA
- Hayward Fault Study, Hayward, CA
- Paramounts Great America Theme Park, Santa Clara, CA
- Sony Western Regonal Headquarters, Santa Clara, CA
- Milpitas Underground Sewer Utility Project, Milpitas, CA
- Cabrillo College Geologic Evaluation, Aptos, CA
- Sky Valley Development, Vallejo, CA

APPENDIX B

CLIENT REFERENCES

Please see attached.

CLIENT REFERENCES

- City of Hollister, Engineering Department, Jim Perrine/Clint Quilter375 5th Street, Hollister, California, 95023, (408) 636-4340.

- County of San Benito, Public Works Department, Max Bridges, 3220 Southside Road, Hollister, California, 95023, (408) 637-3725.

- MH Engineering Company, Brian Curtis, 225 6th Street, Suite B, Hollister, California, 95023, (408) 637-2133.

- San Benito Engineering and Surveying, Inc., Dan Weatherly, 502 Monterey Street, Hollister, California, 95023, (408) 637-2763.

  City of Hayward, Building Inspection Division, Robert Bauman, 25151 Calwilter Road, Hayward, California, 94545-2731, (510) 293-8675.

- County of San Mateo, Planning and Building Division, William R. Rozar, 590 Hamilton Street, County Government Center, Redwood City, CA 94063, (415) 363-4016.

- City of San Bruno, Mary Jo Dutra, 567 El Camino Real, San Bruno, CA 94066, (415) 877-8874.

- Daily City, Carlos DeMelo, 333 - 90th Street, Daily City, CA 94015, (415) 991-8033.

- City of Loas Gatos, Ronald S. Gruenwald, P.E., One North San Antonio Road, Los Altos, CA 94022; (415) 948-1491.

- City of Fremont, Public Works Department, Richard Asimus, City Engineer, 39550 Liberty Street, Fremont, CA 94537-5006, (510) 494-4670.

- County of Santa Clara Housing Authority, Kathy Elright Robinson, 505 W. Julian Street, San Jose, CA 95110, (408) 275-8770.

- South County Housing, Cynthia Bokura, 7477 Carmel Street, Gilroy, CA 95020, (408) 842-9181.

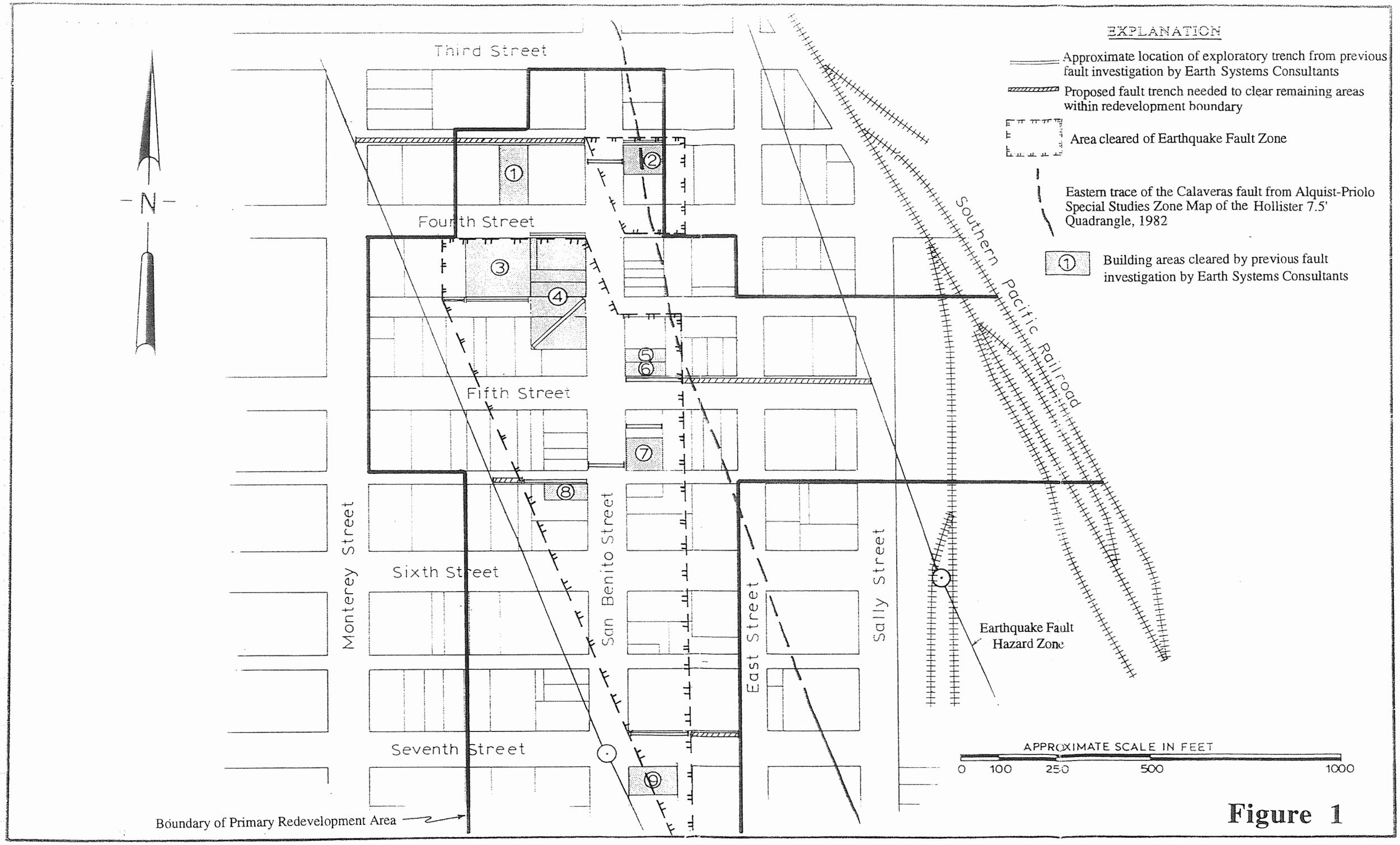
EXPLANATION
Approximate location of exploratory trench from previous fault investigation by Earth Systems Consultants
Proposed fault trench needed to clear remaining areas within redevelopment boundary
Area cleared of Earthquake Fault Zone
Eastern trace of the Calaveras fault from Alquist-Priolo Special Studies Zone Map of the Hollister 7.5' Quadrangle, 1982
Building areas cleared by previous fault investigation by Earth Systems Consultants
N
Third Street
Fourth Street
Fifth Street
Sixth Street
Seventh Street
Monterey Street
San Benito Street
East Street
Sally Street
Southern Pacific Railroad
Earthquake Fault Hazard Zone
Boundary of Primary Redevelopment Area
APPROXIMATE SCALE IN FEET
0 100 250 500 1000
1
2
3
4
5
6
7
8
9

Figure 1

K NGSLEY ASSOCIA ES
Consulting Geologists and Hydrogeologists
1595 Josselyn Canyon Road
Monterey, California 93940
(408) 373-0909

May 27, 1994

Barry Johnson
City of Hollister
375 Fifth St.
Hollister, Ca. 95023

Dear Mr. Johnson,

In response to our meeting last week, I'm submitting a not to exceed, proposal for the review of the geologic fault investigation outlined by Rick Gorman of Earth Systems Consultants. The calculations are derived from those incurred in the spring of 1991.

My consulting fee is $75.00\hour.

I estimate 120 hours for the entire review process distributed as follows:

1.	Five trench inspection visits.	80 hours
2.	Review and study of the Earth Systems Consultants report.	15 hours
3.	Preparation of the reviewed report	10 hours
4.	Meetings and consultations with the City of Hollister and/or Earth Systems Consultants	15 hours
	Total estimated	120 hours

Not to exceed proposal is $9,000.00

I understand that I am to bill the city monthly beginning June 1, 1994.

Respectfully submitted,

John Kingsley

John Kingsley
License # 2987

Please complete this agreement and return a copy to Kingsley Associates.

I have read and understand the attached letter of agreement and agree to the terms and conditions set forth within.

Name:_____

Signature:_____

Date:_____

GEOLOGIC FAULT STUDY
SAN BENITO FOODS
STORAGE BUILDING
HOLLISTER, CALIFORNIA

July 16, 1998

Prepared for

San Benito Foods

Prepared by

Earth Systems Consultants Northern California
400 Park Center Drive, Suite 1
Hollister, CA 95023

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Earth Systems Consultants
Northern California

400 Park Center Drive, Suite1
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FAX (408) 637-0510

File No. NHW-7197-01

July 16, 1998

Mr. Mike Mullen
San Benito Foods
P.O. Box 100
Hollister, CA 95024

Project: **San Benito Foods 60,000 Square Foot Building**
Northwest Corner of Sally and South Streets
Hollister, California

Subject: **GEOLOGIC FAULT STUDY**

Dear Mr. Mullen:

This report presents the findings of our geologic fault study for the subject site located at the northwest corner of Sally and South Streets in Hollister, California. The scope of work for the geologic fault study was as stated in our contract effective April 8, 1998. The focus of the study was to investigate the possible presence of a trace of the active Calaveras Fault crossing the site. In addition, this report presents our findings relevant to the local and regional geologic setting of the site. A soils engineering report for the site, conducted concurrently, was issued under separate cover.

We appreciate the opportunity to have provided geologic services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact either of the undersigned.

EARTH SYSTEMS CONSULTANTS
Northern California

Craig S. Harwood
Staff Geologist

Richard T. Gorman
C.E.G. #1325

REGISTERED GEOLOGIST
RICHARD T. GORMAN
No. CEG 1325
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

Distribution: - San Benito Foods (8)

Document No. 9807-542.RPT

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1.0 INTRODUCTION

Planned Development

Based upon our discussions with Mr. Mike Mullen and our review of the Tentative Map by Roger Grimsley & Associates (dated March, 1998), we understand that the approximately 72,000 square foot site will receive a 60,000 square foot, 30 foot high, metal frame building for storage of canned agricultural products. The proposed building will essentially encompass the entire site and will have a concrete slab on grade floor. The building will have a maximum occupancy rate of about 900 person-hours per year. According to the policies and criteria set forth by the State Mining and Geology Board in the Fault-Rupture Hazard Zones, Appendix B (Hart, revised 1997), the intended use of the proposed structure is less than the 2000 person-hours per year, and therefore, is exempt from the provisions of the Alquist-Priolo Earthquake Fault Zoning Act (Hart, revised 1997). However, the City of Hollister's General Plan policies require that the development incorporate mitigation measures to reduce potential geologic and seismic hazards. To provide recommendations for reducing potential geologic and seismic hazards, a geologic fault investigation was performed at the site.

Location and Description of Site

The site is located in downtown Hollister and is bounded on the north by Seventh Street, on the east by Sally Street, on the south by South Street and on the west by East Street. It is accessed directly from Sally Street at the northeast property corner and at a location about 200 feet south of the northeast property corner. The site is bordered by developed commercial property on the north, west, south and east. There is a natural, gently inclined west facing slope in the vicinity of the site which is apparent on Seventh Street and South Street just to the east of the southeast property corner. This slope has about 3 to 4.5 feet of topographic relief.

The site previously contained a food processing plant for San Benito Foods which was built sometime in the 1940's and was demolished earlier this year. Existing structures remaining from the previous building include; concrete slab-on-grade floors, a water well in the north central portion of the site and a 400 square foot electrical vault building at the east property line. Refer to the Vicinity Map and the Site Geologic Map for the general layout of the site and relative locations of the described features.

Drainage at the site is controlled and collected in a system of concrete lined trenches constructed in the concrete slab floors. Runoff is delivered at drainage facilities at the adjacent streets. There is no vegetation of any type at the site, and there are no exposures of the soil.

Purpose and Scope of Work

The purpose of this geologic fault study was to identify and evaluate the site specific geologic conditions and constraints that could potentially affect the proposed development. The entire site is located within a State of California Alquist Priolo Earthquake Fault Zone due to the presence of the "Eastern Branch" of the active Calaveras fault mapped on site. The following work was performed during the study:

1. Geologic reports and maps pertaining to the site and its vicinity were reviewed and evaluated. Most of the published geologic information is preliminary in nature and is based on reconnaissance techniques and extrapolation of data.

2. Air stereo photograph pairs of the site and its vicinity taken in 1959 and 1967 were examined to identify terrain features characteristic of active fault zones, particularly lineaments.

3. A geologic site reconnaissance was performed. The reconnaissance included mapping of the subject site and accessible adjacent areas.

4. An exploratory trench was excavated to depths ranging from 13 to 18 feet. The trench extended from the eastern boundary of the AP-Zone, through the entire site and terminated at the north edge of South Street, just beyond the southwest property corner. A short secondary trench was attempted near the east property line but was abandoned due to instability of the trench walls. The purpose of the trenching was to identify possible evidence of a trace of the East Branch of the Calaveras fault crossing the site.

5. The field and research data were analyzed to characterize the geologic site conditions and to develop conclusions.

6. Soil samples obtained from the site were tested using radiocarbon age dating techniques.

7. This report and associated graphics were prepared to summarize the findings and conclusions of our study.

2.0 FIELD INVESTIGATION

Geologic Reconnaissance

Geologic reconnaissance and mapping of the site and its immediate vicinity were conducted on May 4, 1998, by Staff Geologist, Mr. Craig Harwood. The purpose of the reconnaissance was to observe features at or near the site indicative of the possible presence of a fault, or other potential geological hazards. The results of the reconnaissance are shown on the Site Geologic Map in Appendix A and are discussed below.

The site exists in an area of downtown Hollister which has been extensively developed for years, therefore, no subsurface materials are exposed on or near the site. A subtle, southwest facing slope is apparent on the north and the southeast sides of the site. The feature presumably traversed the site in a northwest direction prior to the initial grading at the site, conducted sometime in the 1940's (see Aerial Photo Interpretation). The slope trends northwest from the intersection of South and Sally Streets and extends into the PG & E property just north of the site. The crest of this slope extends through the northeast property corner and the base of this slope trends through the northeast half of the site with an approximate trend of N30°W. Our survey of the streets surrounding the site revealed that there is approximately 3 to 3.5 feet of topographic relief across the slope. The level building pad on site appears to have been created by creating a raised fill pad in the southwest two-thirds of the site. The fill was retained by a wall constructed along the south, west and north property lines. During our surface reconnaissance, no evidence was noted of recent tectonic fault creep affecting cultural features (i.e., disturbed or offset sidewalks, street pavements, concrete slabs, etc.).

Subsurface Exploration and Conditions

A exploratory trench was excavated on site between the dates of May 4 and June 1, 1998. A second trench was excavated on May 29, 1998, but was abandoned due to extensive caving of the subsurface materials. The trenches were excavated utilizing an excavator equipped with a 24-inch wide bucket. Trench 1 was approximately 425 feet long, a maximum of 18 feet deep, and extended continuously from about 50 feet east of the northeast property corner (within Sally Street) to about 17 feet beyond the southwest property corner within the sidewalk for South Street. The trench did not extend into the pavement on South Street due to the presence of several deep utility

trenches in the street. The portion within Sally Street trended N87°W, and the portion which traversed the site trended N38°E. The log of Trench 1 is included in Appendix A. The stratigraphy exposed within Trench 2 was briefly observed but was not logged due to unstable conditions which developed during the trench wall cleaning operations. The approximate locations of the exploratory trenches are indicated on the Site Geologic Map in Appendix B.

The following descriptions of subsurface materials encountered in Trench 1 is generalized. Refer to the trench log in Appendix A for more detailed descriptions of the materials encountered. In general, the trench exposed thin near surface layers of artificial fill overlying a sequence of unconsolidated, stratified sands and clays with minor textural variations representing flood plain deposits of the ancestral San Benito River.

The artificial fill materials consisted of imported baserock and disturbed native soil within the street right-of-ways (Units 1, 1a, 2) and imported granular fill and disturbed native soils on the site (Units 1a, 2, 2a). Below the fills are a sequence of fluvial materials which consist of a buried topsoil layer (Unit 6) and three main geologic units (Units 3, 4, and 5) with minor textural variations designated; 3a, 3b and 4a. Unit 6 is interpreted to be the youngest unit due to its stratigraphic position and occurrence on the southwest side of the fault scarp. Unit 6 consists of a very dark grayish brown lean clay with fine grained sand which is massive in structure and has a medium stiff consistency. Unit 3 is the stratigraphically highest fluvial unit and consists of light olive brown sandy lean clay which has a medium stiff consistency. Unit 3 contains some continuous and discontinuous lenses and thin beds of poorly graded sand (Units 3a and 3b) which are massive in structure. Unit 3 contains several distinctive, very thin dark reddish brown stained horizons which are semi-continuous and were used to verify continuity of structure across caved sections of the trench. These horizons typically contain trace organic remains (rootlets and charcoalized wood fragments). Unit 4 consists of a thick, light olive brown lean clay which has a very stiff consistency. Unit 4 contains a thin, distinctive reddish brown clay bed (Unit 4a) at its upper contact with Unit 3 which is continuous up to the location of the fault at Station 1+43. Unit 4 also contains a thin bed of poorly graded sand. Unit 5 is a light olive brown lean clay which has a very stiff consistency. Units 3, 4 and 5 have a relict structure consisting of horizontal laminations which have been extensively bioturbated. Bedding attitudes were not discernible in these clay units due to the extensive disturbance of the bedding laminations due to bioturbation. The fluvial deposits encountered in the trench are unconsolidated, slightly weathered and exhibit structures (fine laminations) and contact relationships which suggests that they were deposited in

generally low energy currents as fluvial "overbank" flood plain deposits of the ancestral San Benito River.

A fault was exposed near the base of the trench at Station 1 + 43. The basis for identifying the fault at this location includes the following; 1) a thin, continuous sand bed and an underlying thin clay bed (Units 3a and 4a, respectively) are truncated abruptly at Station 1 + 43 and, 2) a thick buried topsoil unit extends to the southwest of the fault location whereas, it is not present to the northeast of the fault. The sand bed appears to have been dragged downward at the fault on the exposure at the south wall of the trench. The opposing (northwest wall) exposure was more complicated where the fault can be characterized as a series of anastomotic (interconnected) traces which indicate both downward dragging of the sand bed and upward warping of the clay marker bed. The fault trace trends about N4°W across the trench. The fault could not be identified higher than about 1.5 feet above the top of the sand bed (Unit 3a) and no discolorations, shearing structure or other evidence was observed within this massive clay bed (Unit 3) which would suggest that the fault extended or disrupted Unit 3 above the truncated sand bed. However, the presence of a buried topsoil layer (Unit 6) which thickens to the traversing southwest of the fault, and the previously identified (i.e. Rogers & Nason, 1971; Bryant, 1969) as a fault scarp suggests that unit 3 may have been affected by faulting without any physical evidence of fault off set.

A string line was established and used to maintain vertical control for logging purposes. Extensive caving of the trench walls occurred within the fill soils between; Stations 0 + 45 to 0 + 67, 0 + 87 to 1 + 05, 1 + 45 to 1 + 53, 2 + 18 to 2 + 37, 2 + 57 to 2 + 68, 2 + 88 to 2+ 97 and between 3 + 82 to 4 + 10. Correlation of units was maintained beyond the caved areas. Relatively continuous marker horizons consisting of very thin, distinctive reddish-brown clay beds were used to help establish continuity of geologic structure along throughout the trench.

A second trench (Trench 2) was excavated near the east-central property line in order to expose the fault at a second location (see Site Geologic Map). Trench 2 was located in alignment with the trend of the fault and the alignment of the fault scarp. This trench had to be abandoned due to unstable trench wall conditions, but enough time had been spent cleaning the clay smear from the trench wall to confirm that the stratigraphy and structure of geologic units is very similar to that exposed within Trench 1 on the northeast side of the fault. Furthermore, the geologic structure exposed in the second trench is very similar to the structure encountered adjacent to the fault within Trench 1, which aided in mapping the fault through the location of this second trench.

Two exploratory borings were drilled on site by our firm during the field investigation for the soils engineering investigation. The borings were drilled on May 26, 1998, to a maximum depth of 28 feet below the top of slab elevation. Both borings were located to the west of the fault. Boring 1, located in the southeast corner of the site revealed about 6.5 feet of artificial fill overlying native soils. Between the depths of 6.5 and 24.0 feet is a olive brown, moist lean clay. Below the depth of 24.0 feet was a medium brown, moist, poorly graded sand. Boring 2, located at the northwest property corner revealed 4.5 feet of fill overlying native soils. Between the depths of 4.5 and 24 feet was olive brown, moist lean clay. Between the depths of 14 and 22 feet was a light brown, damp poorly, graded sand. Below the depth of 22 feet was a medium brown, damp silty sand.

Groundwater Conditions

Free subsurface water or zones of saturation were not encountered in the exploratory trench for this study nor in the exploratory borings for the soils engineering investigation. The maximum depth achieved in our exploratory trench was 18 feet, whereas the maximum depth achieved for the exploratory soil borings was 28 feet below the top of slab elevation. No groundwater level information was available from the abandoned water well located on site. However, water levels from wells located within the main processing plant located one city block (500 feet) directly south of the site fluctuate between 50 and 150 feet (Mike Mullen, verbal comm.). In general fluctuations in the level of subsurface water are possible due to variations in rainfall, temperature, irrigation, and other factors.

3.0 GEOLOGY

Regional Geology

The San Benito Foods site is situated within the southern part of the Hollister Valley, which is bounded by the Pajaro River to the north, the Gabilan Range to the west, the Diablo Range to the east, and the juncture of the Gabilan and Diablo Ranges to the south. The Gabilan Range consists of late Cretaceous age granitic rocks and metamorphic rocks which are overlain by a series of Oligocene to middle Miocene age sandstones and shales (Compton, 1966; Allen, 1946). The Diablo Range consists of Jurassic-Cretaceous age sandstones, limestones, volcanic rocks, and metamorphic rocks of the Franciscan Assemblage, which are blanketed by a series of upper Cretaceous age sandstones, shales and conglomerates (Page, 1966).

The geologic structure of the Hollister area and the Gabilan and Diablo Ranges is strongly influenced by the active San Andreas and Calaveras fault systems. These fault systems strike northwest and are characterized by a combination of strike-slip and reverse displacement. The San Andreas fault, which is a steeply southwest-dipping shear zone separating Jurassic-Cretaceous Franciscan basement rocks from Cretaceous granitic basement rocks, is located approximately 5 miles southwest of the site. The other major fault, the Calaveras, branches off the San Andreas fault approximately 8 miles south of Hollister (see Regional Fault Map, Appendix B). Several periods of movement on the San Andreas and Calaveras faults have occurred in the Hollister area, causing uplift of the mountains bordering the valley and resulting in folding and faulting of the geologic formations.

During Pliocene and Pleistocene time, extensive flood plain deposits known as the San Benito Formation were deposited in the Hollister Valley and were later overlain by alluvium and stream terrace deposits consisting of sands, silts, gravels, and clays (McMasters and others, 1987). These deposits are interpreted as Pleistocene and Holocene age lake deposits (Jenkins, 1973) or as sediments deposited in a group of shallow, short-lived lakes in a fluvial environment (Hoose, 1986; McMasters and others, 1987). Holocene activity consists mostly of down-cutting by the San Benito River and mass wasting of upland areas by landslides and erosion. The regional geology is depicted on the Regional Geologic Map in Appendix B.

Local Geology

Locally, the site is located in an area within the Hollister Valley that is underlain by Holocene and Pleistocene age fluvial sediments or fluvial "overbank" deposits. The site is located on what is designated by Hoose as the "Hollister Surface"; an alluvial plain which is underlain by stratified sands, silts and clays deposited in a series of flood events within the ancestral San Benito River flood plain. Our field investigation revealed that the fluvial deposits underlying the site consist of a sequence of unconsolidated clays and thin beds of well sorted, fine grained sands.

Faulting

The Calaveras Fault divides into two branches approximately 3 miles south of the site. The main branch of the Calaveras fault in the Hollister area is referred to as the "West Branch" by Bryant

(1979). The creeping "West Branch" of the Calaveras fault zone is the closest known, historically active fault (active within the last 200 years) to the site. The near point of the fault is located approximately 1,500 feet west of the southwest property corner (see Alquist-Priolo Earthquake Fault Map in Appendix B). (Rogers (1967) mapped the Calaveras fault within Hollister as a right-lateral strike-slip fault. The West Branch has documented creep activity, producing 0.4in./yr of displacement between the years of 1967 to 1971 and at least 13 inches of right-lateral slip during the period of 1909 to 1971 (Rogers and Nason, 1971). In addition, there was at least 1/5-inch (5 mm) of observed slip along the West Branch as a result of sympathetic movement during the Loma Prieta earthquake (McClellan and Hay, 1989).

The eastern branch of the Calaveras fault is the closest active Holocene fault (active within the last 11,000 years) to the site. The eastern branch was mapped in Hollister based upon geomorphic evidence at Park Hill at the north end of Hollister and on a hill south of town. The location of the fault was inferred between these locations based upon a groundwater offset, a 50 foot offset of a blue clay layer (Ellis, 1952; Kilburn, 1972) and a subtle west facing scarp extending through town (Bryant, 1979). This branch of the fault was mapped by Rogers and others (1993) within downtown Hollister as a high-angle fault with the west side up thrown. Rogers and Nason (1971) concluded that the main branch of the Calaveras fault exhibited active creeping movement; however, the subsidiary (east) branch of the Calaveras fault was considered presently dormant because they do not show consistent evidence of curb or sidewalk offset.

Site specific studies performed along the east branch of the Calaveras fault include those performed by; Terratech (1978, 1987), Bay Soils (1981), J.V. Lowney & Associates (1990a, 1990b) and Applied Soil Mechanics (1991a). The fault studies by Terratech (1987) and Applied Soil Mechanics (1991a) were performed at a site located about 1,000 feet southeast of the southeast property corner of the San Benito Foods site. Terratech characterized the fault exposed in several of their trenches as "units offset vertically by about 1.5 to 3 feet along near-vertical discontinuous clay seams with the east side up". The strike of the fault traces vary from N - S to N40°E with steep dips to the east and west". At the same location, Applied Soil Mechanics (1991a) characterized the Calaveras east branch fault as "steeply dipping to near vertical, NNE to NNW-striking fractures infilled with loose, fine grained sand. Thin continuous clay layers and entire stratigraphic units were observed to be disrupted and offset in this zone with the maximum offset of 21 inches." Trenching performed by Applied Soil Mechanics, Inc. (1991b) along the mapped trace of the Calaveras fault north of the San Benito Foods site did not encounter evidence of

faulting. Presumably, the fault is discontinuous between the San Benito Foods site and Park Hill or, the fault plunges deeper into the subsurface than could be exposed by the trenches excavated by Applied Soil Mechanics, Inc. At a site located 1 mile south of the subject site, J.V. Lowney & Associates (1990a,1990b) encountered "abrupt offset of laterally continuous beds, abrupt monoclonal folding of sediments and convoluted bedding" which they interpreted as evidence of faulting.

Aerial photographs taken in 1959 and 1967 were scrutinized for terrain features characteristic of active fault zones, particularly lineaments. A lineament is seen on a stereo aerial photo pair as a feature having tonal differences on either side. These tonal differences may be due to changes in soil or rock type, vegetation, groundwater levels or sedimentary bedding characteristics. Lineaments are often indicative of the presence of geologic structures such as folds and faults. These photographs were marginally useful due to the fact that the area in the vicinity of the site has been extensively developed for many years. The fault scarp of the west branch of the Calaveras fault is visible in the photos as a break in slope which extends through the town in a northwest direction. The break in slope associated with the east branch of the Calaveras fault isn't apparent in the vicinity of the site due to the small scale of the photos (1:20,000).

During our site reconnaissance we observed a gently inclined, west facing scarp which is evident within the streets beyond the north property line and beyond the southeast property corner. This scarp is thought to be a result of fault offset along the east branch of the Calaveras fault and is the basis for mapping the fault in the immediate area of the site (Bryant, 1979). Our trench exposure of the fault is located approximately where the trench intersects the projected base of the scarp. There is a buried topsoil layer which thickens dramatically on the southwest side of the fault trace encountered in our trench, which is also approximately where the scarp intersects the trench.

No specific information regarding the magnitude of offset of beds could be ascertained at the single fault exposure in our trench. However, a fault investigation on the same trace of the Calaveras Fault conducted approximately 1/4 mile southeast of the San Benito Foods site revealed 1 to 4 foot of fault offset within Holocene Age beds which was dated at 7,600 +/- 110 years old (Applied Soil Mechanics, 1991a). Trenching on the above mentioned site by both Terratech and Applied Soil Mechanics revealed that there was typically a normal component of fault offset with the soil layers down-dropped to the west of the fault. The sand bed at the San Benito Foods site which was observed truncated by the fault (Unit 3a) appears to have been dragged primarily down against the

primarily down against the northeast side of the fault. Although the east branch of the Calaveras Fault is considered a right lateral fault, there appears to be some normal component that offsets the geologic units that have been down-dropped to the west of the fault.

Standard AMS radiocarbon age dating of charcoalized wood fragments collected within a massive clay bed (Unit 3) as part of this study produced ages of 2,570 +/- 50 and 2,650 +/- ybp (years before present) at depths of 8.0 feet and 15.5 feet, respectively. The Radiocarbon date of Sample "B", collected adjacent to the fault trace within a massive clay bed ("Unit 3"), suggests that sediments as young as at least 2,570 +/- 50 years old have been disrupted by faulting. This confirms that the sequence of unconsolidated fluvial materials underlying the site are Holocene in age and that the eastern branch of the Calaveras fault is therefore active. No evidence of fault offset could be discerned within sediments younger than approximately 2,570 years old (the upper 9.5 feet of geologic materials exposed in the trench) due to lack of expression of fault offset or disruption of soil layers above the highest point of the fault trace. The presence of an inset topsoil layer that thickens dramatically just to the southwest of the fault trace suggests that there was likely a break in slope present when this soil layer formed and therefore, presumably a fault scarp present.

Landsliding

The site is located in an area of Hollister which is essentially flat and located far from any slopes. Therefore, landsliding is not a threat to the site.

4.0 SEISMICITY

Earthquake History

In assessing the seismic hazards for a given area, it is useful to examine historic records of local earthquakes. This information is useful for predicting the recurrence of various magnitude earthquakes in an area. Within historic time, significant earthquakes have severely damaged man-made structures over a large part of San Benito County. These include the 1906 M 8.3 San Francisco (Lawson, 1908), the 1984 M 6.2 Morgan Hill (Stover, 1984), and the 1989 M 7.1 Loma Prieta earthquakes. According to local accounts (McCann, 1990), Hollister experienced severe ground shaking during the 1989 Loma Prieta earthquake. A strong-motion seismograph

station located within the city of Hollister recorded peak ground accelerations (PGA) of 0.25 gravity (g) horizontal acceleration and 0.22 g vertical acceleration (Maley and others, 1989) during the 1989 Loma Prieta event. Other local seismograph records show accelerations of 0.38g in the horizontal direction and 0.20 g in the vertical direction at South and Pine Streets (Shakal and others, 1989), and 0.29 g horizontal acceleration and 0.16 g vertical at Hollister Airport (Maley and others, 1989).

Seismic Design Considerations

The site is located in a region of generally high seismicity. According to the 1997 edition of the Uniform Building Code, Chapter 16, Figure 16-2, the site also lies within Seismic Zone 4, the most active seismic zone rated. The site has the potential of experiencing strong ground shaking from earthquakes on regional and/or local causative faults. Due to the presence of an active fault crossing the northeastern corner of the building area, there also is a potential for ground rupture to occur along the trace of this fault. To characterize the seismicity at the site and to provide seismic design parameters for the structural engineer, a seismic analysis was performed for the site.

Table 1 lists the active faults within a 100-kilometer radius of the site, their proximity to the site, and their estimated seismic parameters. The distances from the nearest point of a fault to the site were estimated using the EQFAULT computer program (Blake, revised 1997). The east and west branches of the Caleveras fault system (located 0.7 km west and at the site, respectively) are treated as a simple near source fault in estimating the seismic perimeters. The mean peak horizontal ground acceleration that may occur at the site from the maximum moment magnitude on each fault was calculated from the Boore and others (1993) ground attenuation (larger) curve for C type soil sites, with a soil profile type of S_D. The soil profile type was derived from the subsurface soil conditions encountered from a nearby boring that was drilled to a depth of 30 meters (Rosenberg, 1998) and from Table 16-J - Soil Profile Types (UBC, 1997 Edition). A S_D soil profile type is described in the above as being a stiff soil profile with a shear wave velocity ranging from 180 to 360 meters per second and Standard Penetration Test (blows/foot) of 15 to 50.

The results of the analysis indicate that a 7.9 moment magnitude earthquake on the 1906 segment of the San Andreas fault would produce the highest mean peak ground acceleration at the site (0.64g). The mean peak ground acceleration generated from the Boore and others (1993) larger, ground attenuation curve is an approximate value that does not take into account other factors such as depth to bedrock, ground saturation, and topographic amplification.

TABLE 1

Deterministic Estimates of Peak Ground Accelerations for Significant Known Faults in the Site Region

Fault Name (Age of most Recent movement)	Closest Distance From Site (mi/km)	Maximum Magnitude (Mw) (1)	Est. Peak Ground Acceleration (g) Mean (2)	Mean + 1s	Recurrence Interval (3)	Fault Type (4)
Calaveras (historical)	0/1	6.2	0.48	0.77	33	B
Calaveras (historical) (No. of Calaveras Reserv.)	47/75	6.8	0.09	0.14	146	A
Sargent (Holocene)	3/5	6.8	0.51	0.83	1200	B
San Andreas (historical) (creeping segment)	5/8	6.5	0.36	0.58	n/a	A
Monterey Bay (Holocene)	32/50	7.1	0.14	0.27	2841	B
San Andreas (historical) (Santa Cruz segment)	18/29	7.0	0.20	0.31	400	A
San Andreas (historical) (1906 segment)	6/10	7.0	0.64	1.03	210	A
San Gregorio (Holocene)	41/65	7.3	0.12	0.19	400	B
Hayward (historic)	47/75	6.9	0.09	0.14	167	A
Ortigalita (Holocene)	33/21	6.9	0.17	0.27	1153	B
Hosgri (Holocene)	52/83	7.3	0.09	0.16	646	B
Quien Sabe (Holocene)	12/19	6.4	0.35	0.57	647	B

(1) Moment magnitude taken from Appendix A, CDMG Open File Report 96-08.
(2) Ground accelerations estimated from Boore and others, 1993, random, for B-type soil conditions.
(3) Recurrence intervals taken from Appendix A, CDMG Open File Report 96-08.
(4) Table 16-U - Seismic Source Type , 1997 Uniform Building Code

The fundamental period (T_s) of the site was calculated to provide the engineer with an estimated value of the soil period vibration (generally expressed in seconds or fraction of seconds). Studies of ground-motion characteristics and building damage from past earthquakes have shown that the characteristic period at which maximum damaging effects occur is approximately equal to the fundamental period of the soil deposit overlying rock like formations. Values of T_s will vary from

a minimum value of 0.5 seconds for shallow, stiff soils deposits to a maximum value of 2.5 seconds for deep, soft soil deposits (Hays, 1980). The T_S value calculated for the site is 0.86 seconds. This value was based on an average shear wave velocity of 209 meters/second, derived from subsurface soil conditions encountered off site from a nearby boring (Rosenberg, 1998).

A response spectra was developed using the ground motions attenuation relationship equation by Boore, Joyner and Fumal (1993). The equation gives ground motion in terms of moment magnitude, distance, and site conditions for strike slip, reverse or unspecified faulting mechanism. The site conditions are represented by the shear wave velocity averaged over the upper 30 meters of the ground surface. A response spectra curve was generated for the San Andreas fault (1906), the Calaveras fault (south of the Calaveras Reservoir) and the Sargent Fault. Based on the seismic analysis results presented in the above Table 1, these faults are likely to generate the largest ground motions at the site. The results of the site response spectra ground motions are presented in Appendix D, Figures 1 and 2.

A Design Response Spectrum curve was also prepared using UBCSEIS, a computer program for estimation of Uniform Building Code Coefficients (Blake, 1998). This response spectrum was prepared to compare the above Boore, Joyner and Fumal response spectra ground motion values to the UBC Design Response Spectrum. The UBC Design Response Spectrum ground motions is based on seismic acceleration and velocity coefficients presented in UBC (1997) Tables 16-Q and 16-R and on near-source acceleration and velocity factors in Tables 16-S and 16-T, also presented in the UBC (1997). The selected UBC seismic coefficients based on a site soil type S_D and a near source type B fault for the Calaveras system (South of Calaveras Reservoir segment) are as follows:

Na: 1.3
Nv: 1.6
Ca: 0.57
Cv: 1.02
Ts: 0.716
To: 0.143

The Design Response Spectrum curve is presented in Appendix D. The nearest Type A fault to the site is the San Andreas fault (1906 segment) located 10 km west.; and the nearest Type C fault to

the site is the Quien Sabe fault located 7.5 km to the southwest. The portion of the Caleveras fault system located south of Calaveras Reservoir is considered a Type B fault, which includes both the east and west branch faults in the City of Hollister.

Primary Earthquake Effects

Fault-Related Ground Rupture

The nearest active fault to the site is the east branch of the Calaveras fault which traverses the northeast part of the proposed building site with a trend of about N20°W to N25°W. Therefore, there is potential for fault-related ground rupture in the northeast part of the building along the trace of the fault. Using the Tables 2A through 2C and Figures 9 through 11 derived by Wells and Coppersmith in the Bulletin of the Seismological Society of America (1994) the maximum horizontal displacement and maximum vertical displacement were estimated for the east branch of the Calaveras fault. It was estimated that an earthquake event on the east branch of the Calaveras fault could cause a maximum horizontal displacement of 17 inches and 5 inches of vertical displacement.

Secondary Earthquake Effects

Liquefaction

Soil liquefaction is the loss of soil strength during a significant seismic event. It occurs primarily in saturated, loose to medium-dense, fine to medium grained sands and sandy silts. Common types of liquefaction-related ground failure include differential settlement and lateral spreading. Previous occurrences of liquefaction have been documented in and near Hollister during the 1906 and 1989 earthquakes, the nearest of which is reported to have occurred about 1/4 miles northwest of the site (Rosenberg, 1998). Groundwater levels have been reported as being 50 to 150 feet below the ground surface in the vicinity of the site (Mullen, verbal comm, 1998). The site is located in a part of town with a low potential for liquefaction even in a major earthquake (Rosenberg, 1998). Therefore, we conclude that there is a low potential for the occurrence of liquefaction at the site.

Seismically Induced Landsliding

Slope instability is not an issue at the site as the site is nearly level with a very gently inclined, southwest facing slope adjacent to the southeast and north property lines.

~~Seismically Induced Settlement~~

Seismically induced settlement of sufficient magnitude to cause structural damage is normally associated with poorly consolidated, predominantly sandy soils, or variable consolidation characteristics within the building areas. Blow counts taken at selected intervals during our field drilling program for the soil engineering study of the site indicate that the soils have generally stiff and medium dense consistencies to 28 feet, the maximum depth explored. Therefore, the potential for seismically induced settlement is considered to be low at the site.

CONCLUSIONS AND RECOMMENDATIONS

It is our opinion that the existing local and regional geologic conditions would not preclude development of the subject site for the construction of a food storage facility and associated improvements if the following recommendations are implemented during design and construction. The following conclusions are based on the data acquired and analyzed during the course of this geologic study.

1. Our field investigation revealed the site is underlain by a continuous sequence of Holocene age fluvial deposits which have been affected by fault offset on the eastern branch of the identified within the northeast portion of the site trending N25°W to N30°W and was determined to be active based on disruption of sediments that were determined to be 2,570 +/- 50 years old. Therefore, the fault should be considered capable of producing surface ground rupture in the northeastern part of the building during an earthquake event on the fault. To reduce the potential for the building to be damaged by surface ground rupture, we recommend that the proposed building foundation be set-back a minimum of 25 feet (50 foot wide corridor) from the mapped trace of the fault. As an alternative to the 25 foot set-back, the building foundation may be set-back 15 feet (30 foot wide corridor) if the building and foundation are structurally reinforced to accommodate an estimated maximum horizontal displacement of 17 inches and 5 inches of vertical displacement.

2. Our review of available literature and maps, aerial photos, a soil engineering investigation (Earth Systems Consultants, 1998) and our fault investigation suggest that there is a low potential for secondary effects of seismic shaking to affect the site (such as liquefaction, lurching, settlement). Slope instability under static or seismic conditions is not a threat to the site due to the lack of significant slopes on or near the site. Erosion is not a factor at the

site due to the lack of exposed soils.

3. The site is located within the seismically active Central California area, and severe ground shaking can be expected during the life of the proposed structure. The largest historical horizontal peak ground acceleration to have occurred in the vicinity of the site was 0.38g, recorded by CDMG during the Loma Prieta earthquake. The deterministic seismic analysis indicated that the site could experience a 0.64g mean horizontal peak ground acceleration from a 7.9 maximum moment magnitude earthquake event on the San Andreas fault (1906 segment). Using the calculated site period of 0.86 seconds, the estimated spectral accelerations for an earthquake event on the San Andreas fault (1906 segment) for the site are listed below. The near source type B Calaveras fault (South of Calaveras Reservoir segment) acceleration from UBC Design Response Spectrum is also listed for comparison.

Median Spectral Acceleration	Median + 1 Standard Deviation Spectral Acceleration	UBC Design Response Spectrum Acceleration
1.32g	2.38g	1.44g

6.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The conclusions of this report are based on data acquired and evaluated from this study and are intended to apply only to the San Benito Foods site at Seventh and Sally Streets, Hollister, California. The conclusions of this report are based upon the assumption that the site geologic conditions do not deviate substantially from those disclosed in our research or field exploration. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that planned at the present time, Earth Systems Consultants Northern California should be notified so that supplemental recommendations can be given.

2. This report is issued with the understanding that it is the responsibility of the owner or of the owner's representative to ensure that the information presented herein is called to the attention of the project architect and engineer.

3. The findings of this report are valid as of the present date. Changes in the conditions of a

property can occur with the passage of time. In addition, changes in applicable or appropriate standards occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or partially, by changes outside of our control. Therefore, this report should not be relied upon after a period of one (1) year without being reviewed by a qualified geologist.

4. This report was prepared in accordance with currently accepted standards of professional geologic practice. No warranty is intended, and none shall be inferred from the statements or opinions expressed.

REFERENCES

J.E. Allen, Geology of the San Juan Bautista quadrangle, California: California Division of Mines Bulletin 133, 75 p., 3 plates, scale 1:62,500, 1946.

Applied Soil Mechanics, Inc., 1991a, Geologic evaluation, proposed three lot subdivision, 49, 53 and 57 Hawkins Street, Hollister, California: unpublished report prepared for Dean Rodrigues, File No. A0-2303-S1.

_____, 1991b, Fault Study, Sites 1, 3 - 6 and 10, Hollister, California, prepared for the City of Hollister Redevelopment Agency, File No. A0-2280-S1.

Bay Soils, Inc., 1981, Soil and geologic investigation, Hollister shopping center, SWC Nash Road and Southside Road, Hollister, California: Division of Mines and Geology Alquist Priolo Special Studies Zone Open File Report AP-1337, 20p., 3 a.

T.F. Blake, UBCSEIS, A Computer Program for the Estimation of Uniform Building Code Coefficients Using 3-D Fault Sources, Newbury Park, California, January, 1998.

D.M. Boore, and others, Estimation of Response Spectra and Peak Accelerations from Western North American Earthquakes: an interim report, USGS Open File Report, 93-509, 1993.

W.A. Bryant, Fault evaluation report, Calaveras (Hollister segment) and "Buena Vista Road" faults: California Division of Mines and Geology Fault Evaluation Report FER-94, 14 p., 4 plates, scale 1:24,000, 1979.

_____, 1980, Fault Evaluation Report, SE segments of Sargent and Castro faults: California Division of Mines and Geology Fault Evaluation Report FER-94, 14p., 4 plates, scale 1:24,000.

California Division of Mines and Geology, 1982, Special studies zone map, Hollister 7.5

minute quadrangle: California Department of Conservation, 1 sheet, scale 1:24,000.

R.R. Compton, Granitic and metamorphic rocks of the Salinian block, California Coast Ranges in Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 277–287, 1966.

Thomas W. Dibblee, Jr., Geologic Map of the Hollister 15' Quadrangle, California, U.S.G.S. Open File Report Map 75-394, 1:62, 500, 1975.

Earth Systems Consultants Northern California, 1998, Soils Engineering Report for San Benito Foods Storage Building, South and East streets, Hollister, California, File No.-NHW-7197-01, 7p, 2 Appendices.

W.C. Ellis, Elevations on top of the blue clay zone, Hollister area: U.S. Bureau of Reclamation unpublished map, 1952.

E.W. Hart, and Bryant, W.A., 1997 Fault-rupture hazard zones in California: California Division of Mines and Geology Special Publication 42, 38 p.

Hays, W.W., 1980, Procedures for estimating earthquake ground motion, U.S. Geological Survey Prof. pages 1114, P. 63-37.

Hoose, S.N., 1986, Was there a great Pleistocene Lake San Benito? (M.S. thesis): San Jose State University, 87p.

International Conference of Building Officials, 1994, Uniform Building Code: Whittier, CA, International Conference of Building Officials, 3 volumes, variously paginated.

Jenkins, O.P., 1973, Pleistocene Lake San Benito: California Geology, v.26, no. 7p.

Kilburn, C., 1972 Groundwater Hydrology of the Hollister and San Juan Valleys, San Benito County, California, U.S. Geological Survey Open-File Report 73-144, 44p.

A.C. Lawson, The California Earthquake of April 18, 1906 - Report of the State Earthquake Commission, two volumes, Carnegie Institute of Washington, 1908.

_____, Geology of the Hollister and San Felipe Quadrangles, San Benito, Santa Clara and Monterey Counties, California, California Division of Mines and Geology Open File Report 93-01, 26 p., 2 plates, 1:24,000, 1993.

T.H. Rogers and R.D. Nason, Active displacement on the Calaveras fault zone at Hollister, California: Bulletin of the Seismological Society of America, v. 61, no. 2, p. 399–416, 1971.

L. I. Rosenberg, 1998, Liquefaction susceptibility of the Hollister area, San Benito County, California, National Earthquake Hazards Reduction Program, 69p., 6 appendices.

C.W. Shakal and others, CSMIP strong motion records from the Santa Cruz Mountains (Loma Prieta), California: California Division of Mines and Geology, Office of Strong Motion Studies Report No. OSMS 89-06, 196 p, 1989.

Carl W. Stover, Intensity Distribution and Isoseismal Map for the Morgan Hill, California, Earthquake of April 24, 1984, in "The 1984 Morgan Hill, California Earthquake", California Division of Mines and Geology, 1984, Special Publication 68, 1984.

Terratech, Inc., 1978, Geologic/geotechnical investigation, First Street commercial property, Hollister, California: City of Hollister Open File Report, 9p., 2 appendices.

_____, 1987, Investigation of the east branch of the Calaveras Fault, Prune Street school site (Rancho San Justo Tandem School site), Hollister, California: City of Hollister Open File Report, 5p.

Wells, D.L., and Coppersmith, K.J., 1994, New Relationships Among Magnitude, Rupture Length, Rupture Width and Surface Displacement: Bulletin of the Seismological Society of America, v84, p. 974-1002.

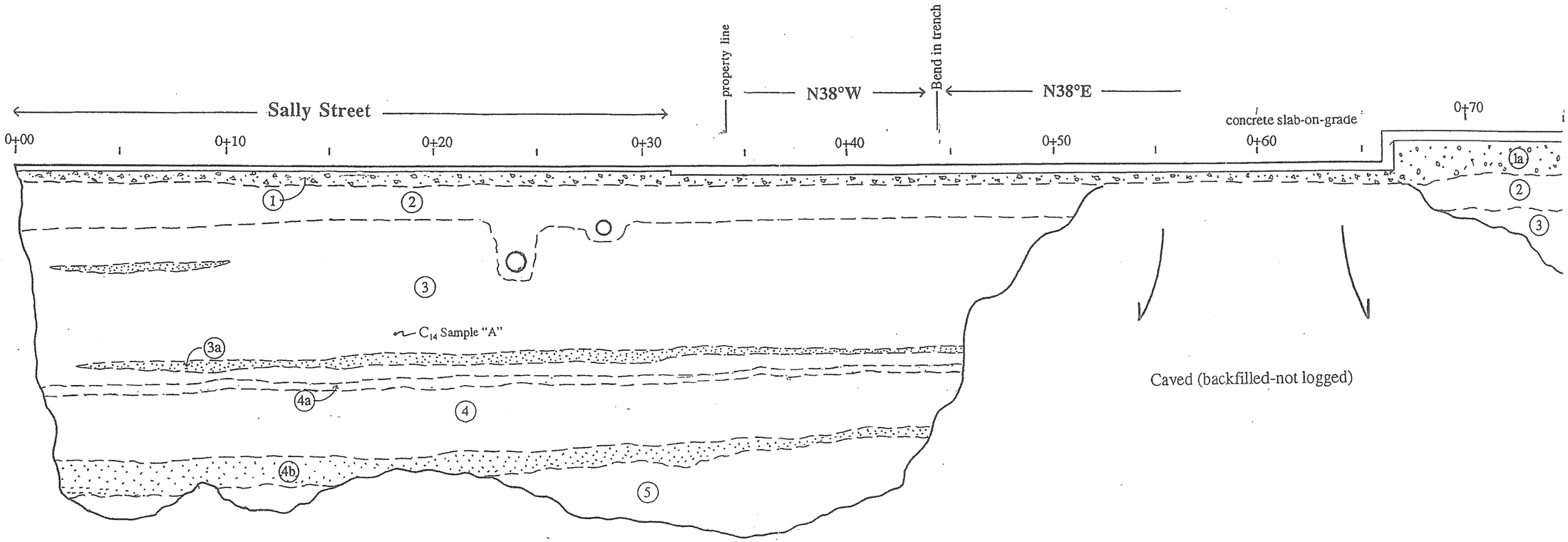
AERIAL PHOTOGRAPHS

May 15, 1967, frames Bux-1HH-109 & 110, flown by US Department of Agriculture, Vertical black & white, 1:20, 000 scale.

June 13, 1959, frames Bux-7v-12 & 13, flown by US Department of Agriculture, vertical black & white, 1:20,000 scale.

APPENDIX A

Exploratory Trench Logs and Boring Logs



Artificial Fill

(1) Blue gray aggregate baserock, damp, very dense

(1a) Light brown GRAVEL with abundant sand, slightly moist, medium dense

(2) Light olive brown (2.5Y4/6) sandy lean CLAY, slightly moist, stiff

(2a) Heterogeneous mixture of Unit 2 and Unit 6 (see below): very moist, medium stiff, contains sparse man-made materials including glass, nails and other metal fragments, milled lumber pieces

Quaternary Age Fluvial Deposits

(3) Light olive brown (2.5Y4/6) sandy lean CLAY, slightly moist, stiff, relict laminations present locally but extensively bioturbated, charcoalized wood fragments common near base of unit, mottled w/ reddish brown. Textural variations include: (3a) a light olive brown (2.5YR4/6) well sorted SAND, slightly moist, medium dense, massive, and (3b) a light brown (10YR7/2) well sorted SAND, slightly moist, medium dense

(4) Light olive brown (2.5Y4/4) lean CLAY, slightly moist, stiff, relict laminations present locally but extensively bioturbated, rootlets common. Textural variations including; (4a) a distinct, reddish brown, thin, laterally continuous bed of lean CLAY, and (4b) a olive brown (2.5Y4/4) well sorted SAND, slightly moist, medium dense

(5) Light olive brown (2.5Y4/4) lean CLAY, slightly moist, stiff, mottled w/ reddish brown, relict laminations present locally but extensively bioturbated

(6) Buried topsoil: Very dark brown (10YR2/2) lean CLAY with fine grained sand, very moist, massive mottled w/ reddish brown

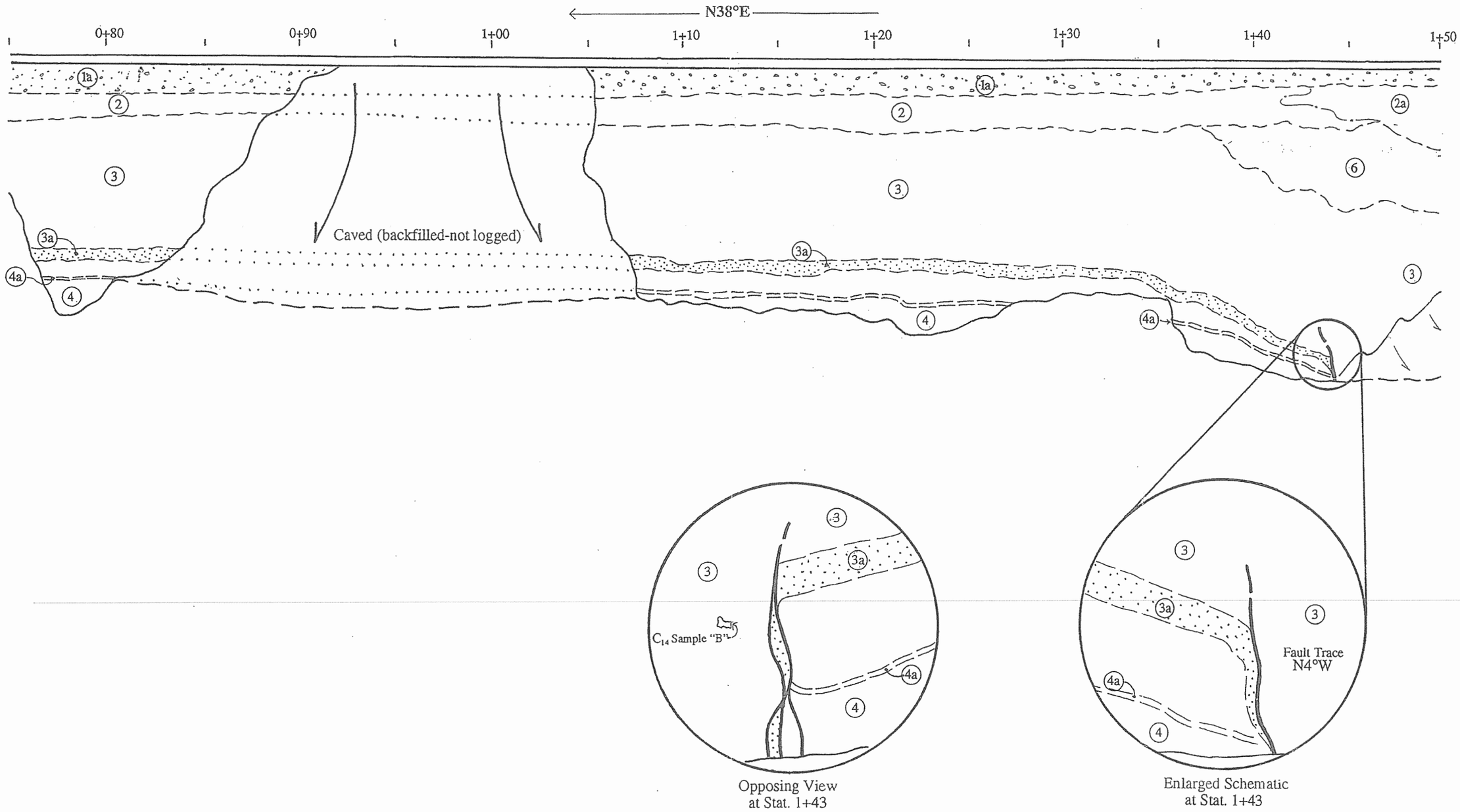
All geologic units are unconsolidated

Approximate Scale: 1" = 5'
(Horizontal = Vertical)

Log of Exploratory Trench T-1
Station 0+00 to 0+75
San Benito Foods
Hollister, California

Earth Systems Consultants Northern California
400 Park Center Drive, Suite 1 Hollister, CA 95023

NHW-7197-01 July, 1998



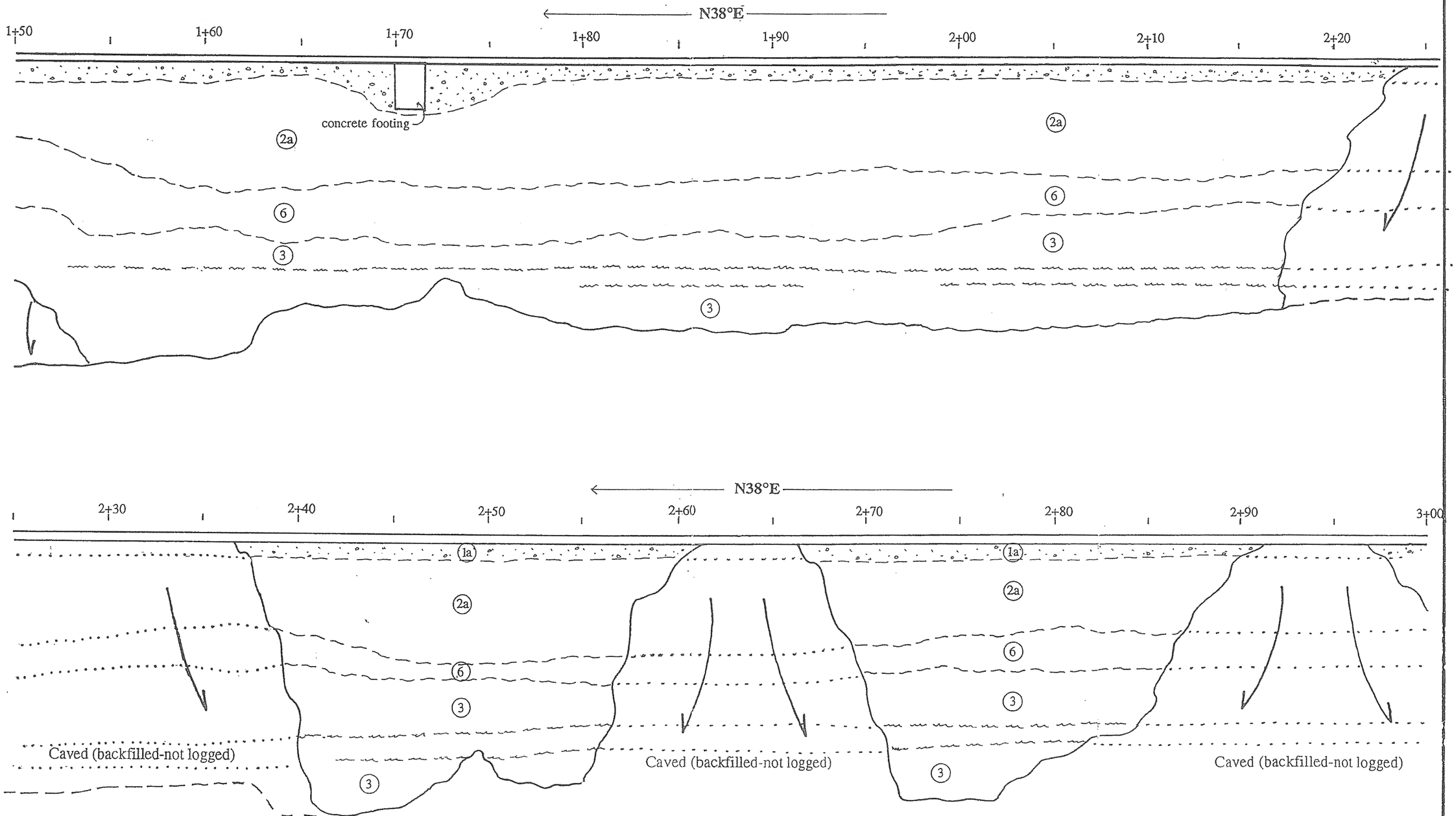
Opposing View
at Stat. 1+43

Enlarged Schematic
at Stat. 1+43

Log of Exploratory Trench T-1
Station 0+75 to 1+50
San Benito Foods
Hollister, California

Approximate Scale: 1" = 5'
(Horizontal = Vertical)

Earth Systems Consultants Northern California
400 Park Center Drive, Suite 1 Hollister, CA 95023
NHW-7197-01 July, 1998



Log of Exploratory Trench T-1
Station 1+50 to 3+00
San Benito Foods
Hollister, California

Approximate Scale: 1" = 5'
(Horizontal = Vertical)

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400 Park Center Drive, Suite 1 Hollister, CA 95023
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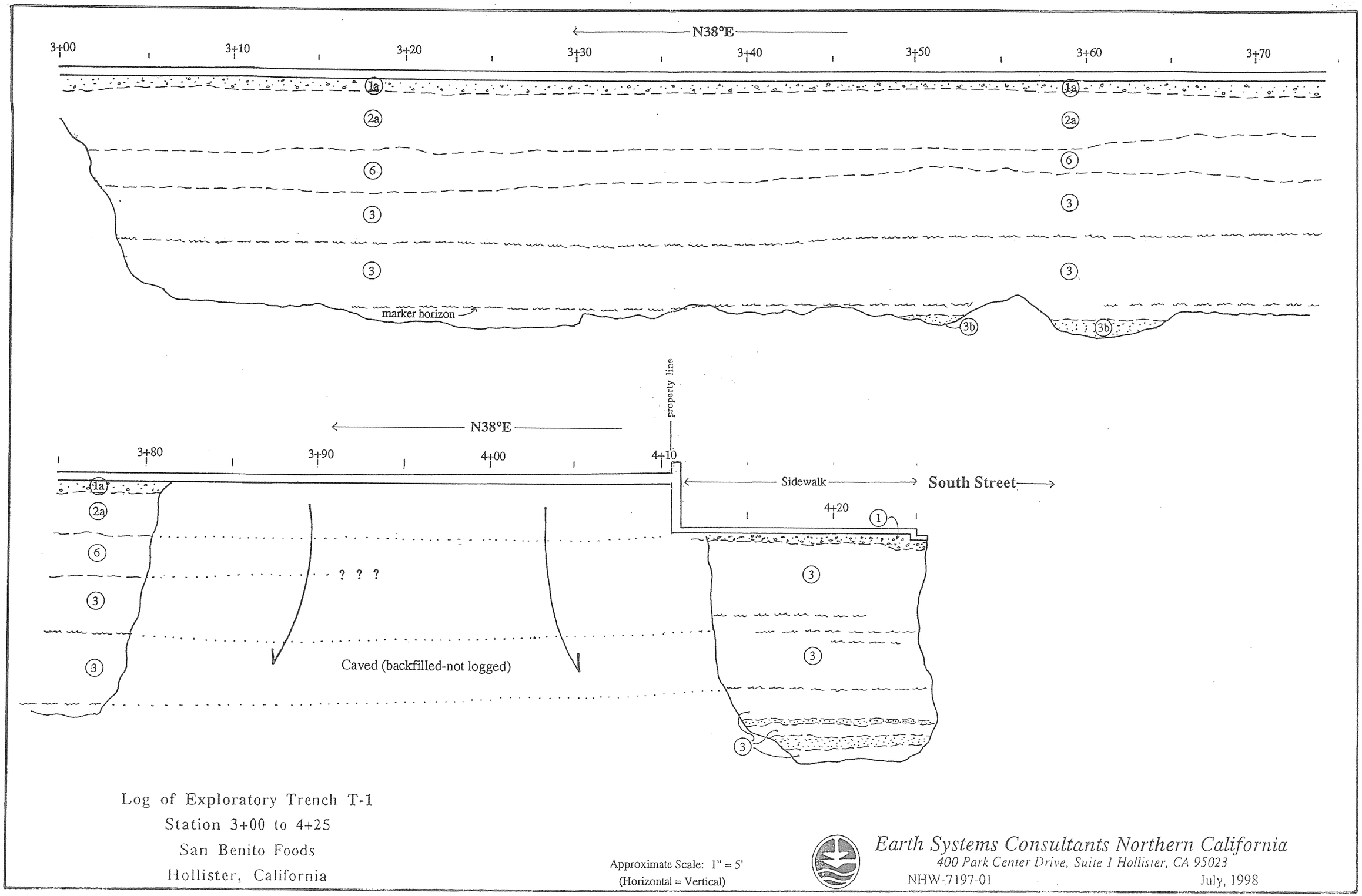

Log of Exploratory Trench T-1
Station 3+00 to 4+25
San Benito Foods
Hollister, California

Approximate Scale: 1" = 5'
(Horizontal = Vertical)

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NHW-7197-01 July, 1998

SOIL CLASSIFICATION SYSTEM

(Modified from U.S.C.S)

MAJOR DIVISIONS			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	More than 50% of coarse fraction retained on No. 4 sieve	GRAVELS WITH FINES		GM	Silty gravels, gravel-sand-silt mixtures
				GC	Clayey gravels, gravel-sand-clay mixtures
More than 50% of material is larger than No. 200 sieve size	SAND AND SANDY SOILS	CLEAN SAND (little or no fines)		SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
	More than 50% of coarse fraction passing No. 4 sieve	SAND WITH FINES (Appreciable amount of fines)		SM	Silty sands, sand-silt mixtures
				SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts and organic silty clays of low plasticity
More than 50% of material is smaller than No. 200 sieve size		LIQUID LIMIT GREATER THAN 50		MH	Inorganic silts, micaceous, or diatomaceous fine sand or silty soils
				CH	Inorganic clays of high plasticity, fat clays
				OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS				PT	Peat, humus, swamp soils with high organic contents

Earth Systems Consultants Northern California

File Name: San Benito Foods, Hollister, California

File No.:NHW-7197-01

DATE DRILLED:

TYPE OF RIG:

BORING DIAMETER:

LOGGED BY:

BORING NO.:

DRIVE WEIGHT:

DROP:

Depth (ft)	Sample Type: Drive	Sample Type: Bulk	Blows Per 6 inch	Graphic Log	Explanation of Exploratory Boring	U.S.C.S Soil Group	In-Place Moisture (% dry weight)	In-Place Dry Density (pcf)
0								
1								
2					Modified Cal sample			
3					No Sample Recovered		NSR	
4								
5					Bulk sample			
6								
7					Ground water			
8					Standard Penetration test			
9					Seepage			
10								
11					Solid line denotes lithologic change			
12								
13								
14					Dashed line denotes gradational lithologic change			
15								
16								
17								
18					Termination of boring			
19								
20								

Earth Systems Consultants Northern California

File Name: San Benito Foods, Hollister, California

File No.:NHW-7197-01

DATE DRILLED: 5/26/98

TYPE OF RIG: Mobile B-53

BORING DIAMETER: 8" Hollow Stem

LOGGED BY: R. Helali

DRIVE WEIGHT: 140 lbs

DROP: 30 inches

DEPTH TO GROUNDWATER: N/A

Log of Exploratory Boring No. 1

Depth (ft)	Sample No.	Sample Type: Drive	Sample Type: Bulk	Graphic Log	Blows Per 6 Inch	Description	U.S.C.S. Soil Group	In-Place Moisture (% dry weight)	In-Place Dry Density (pcf)
0						6" Concrete Slab			
			A			Dark brown lean CLAY, moist, medium stiff	CL		
2					2 5 13	Olive brown sandy lean CLAY, moist, stiff	CL		
6					50 2"	6" Concrete Slab			
8						Olive brown lean CLAY, moist, stiff			
10					8 10 10				
14						very stiff	CL		
16					7 8 11				
18					5 8 9				
					8 11 12				
24						Medium brown poorly graded SAND, moist, medium dense	SP		
26					8 10 10				
					7 10 11	Olive brown lean CLAY, moist, stiff	CL		
28						The stratification lines represent the approximate boundry between soil types and the transitions may be gradual. Terminated at a depth of 28.0' below existing grade. No groundwater encountered.			
30									
32									
34									
36									
38									
40									

Earth Systems Consultants Northern California

File Name: San Benito Foods, Hollister, California

File No.:NHW-7197-01

DATE DRILLED: 5/26/98

TYPE OF RIG: Mobile B-53

BORING DIAMETER: 8" Hollow Stem

LOGGED BY: R. Helali

DRIVE WEIGHT: 140 lbs

DROP: 30 inches

DEPTH TO GROUNDWATER: N/A

Log of Exploratory Boring No. 2

Depth (ft)	Sample No.	Sample Type: Drive	Sample Type: Bulk	Graphic Log	Blows Per 6 Inch	Description	U.S.C.S Soil Group	In-Place Moisture (% dry weight)	In-Place Dry Density (pcf)
0						6" Concrete Slab			
2–4		■			10 16 14	Light brown well graded SAND with gravel, moist, medium dense	SW		
6		■			5 9 14	Dark brown lean CLAY, moist, very stiff	CL		
8–12									
10–12		■			9 12 14	Olive brown lean CLAY, moist, very stiff	CL		
12–14			B						
16					4 6 7	Brown poorly graded SAND, moist, medium dense	SP		
18–20									
20–22					7 7 8				
24						Brown silty SAND, moist, medium dense	SM		
26					5 7 8				

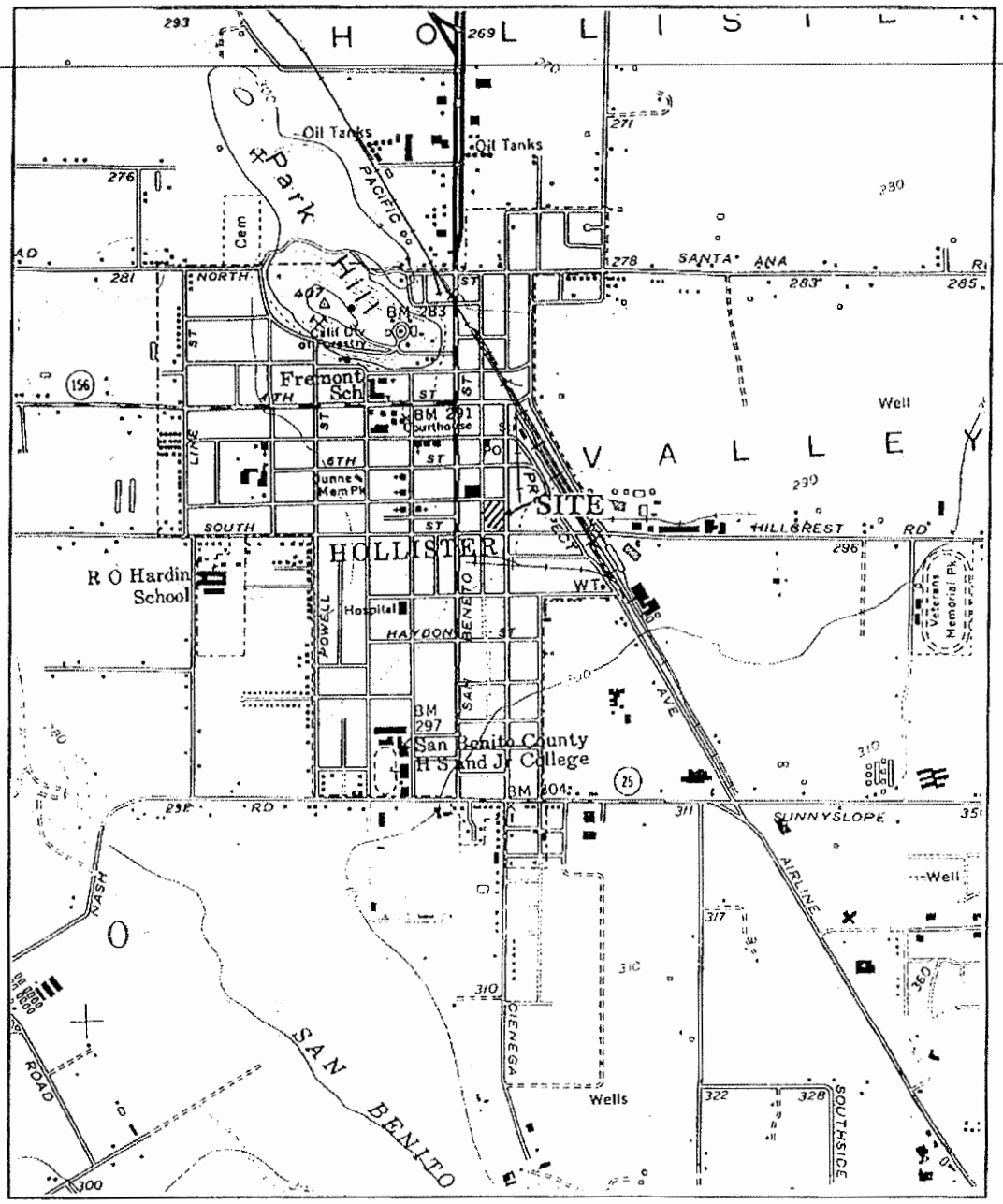
The stratification lines represent the approximate boundry between soil types and the transitions may be gradual. Terminated at a depth of 26.5' below existing grade. No groundwater encountered.

Earth Systems Consultants Northern California

APPENDIX B

Vicinity Map
Site Geologic Map
Regional Geologic Map
Regional Geologic Map
Alquist-Priolo Earthquake Fault Zone Map
Regional Fault Map
Historical Earthquakes Map

Vicinity Map



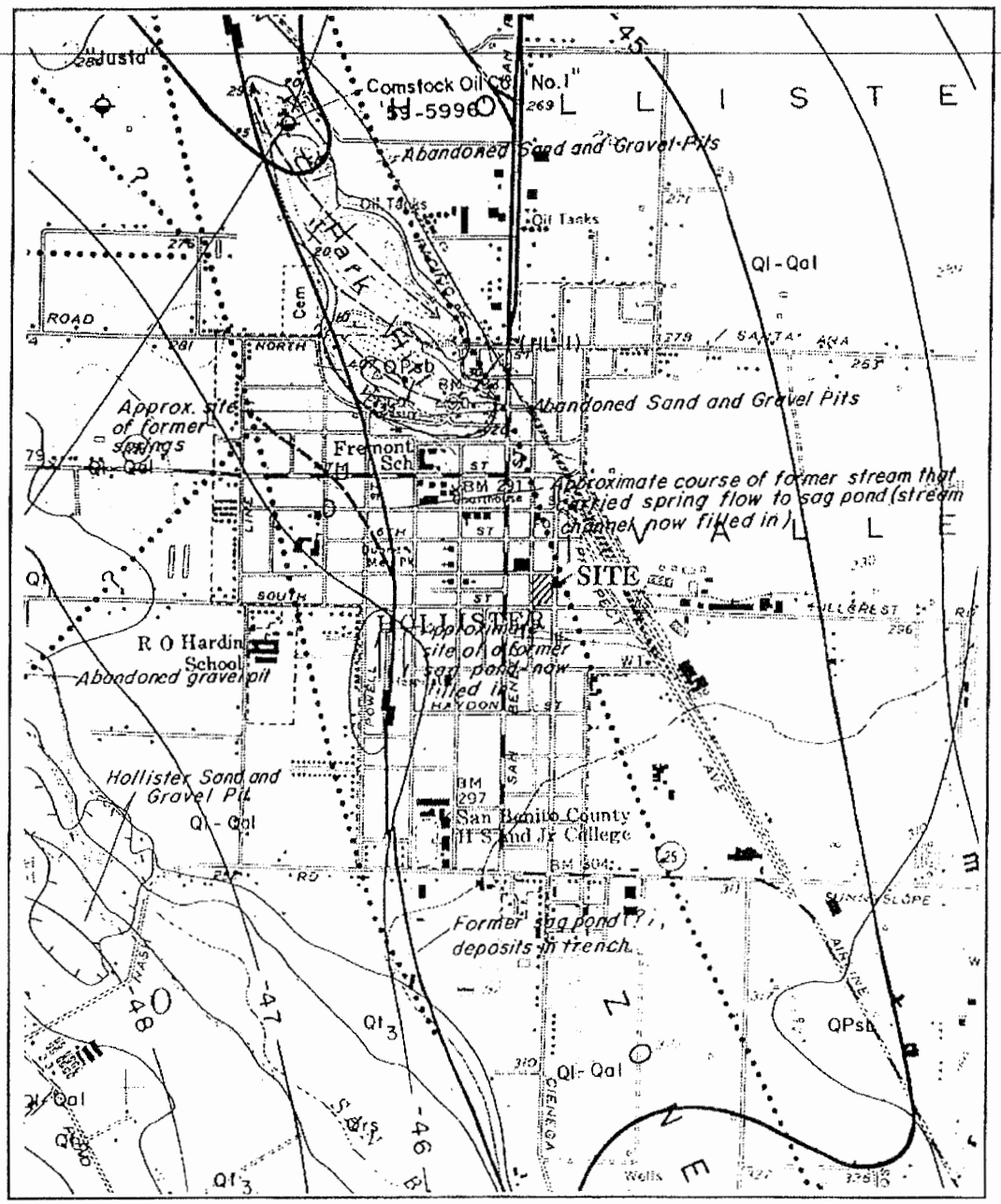
Base: USGS Hollister 7.5' topographic map 1955, Photorevised 1971

0 2000 ft

N

Earth Systems Consultants Northern California

Regional Geologic Map



Base: From T. Rogers, 1993

0 2000 ft

N

Earth Systems Consultants Northern California

Regional Geologic Map Explanation

GEOLOGIC UNITS

QUATERNARY

Qrs	River sand
Qt1 / Qt2 / Qt3	River trace deposits
Ql - Qal	Fine grained lacustine and alluvial deposits
QPs / QPsb	QPs-Unconsolidated sand, silt, and gravel QPsb- San Benito Formation: gravel, sand and silt

TERTIARY

Psu	Purisima Formation: non-marine sandstone member

48

Bouguer gravity contour
(contour interval = 1 milligal)

GEOLOGIC SYMBOLS

Contact
Dashed where approximately located, dotted where concealed

Fault
Dashed where approximately located, dotted where concealed

Syncline
Dashed where approximately located, dotted where concealed

Anticline
Dashed where approximately located, dotted where concealed

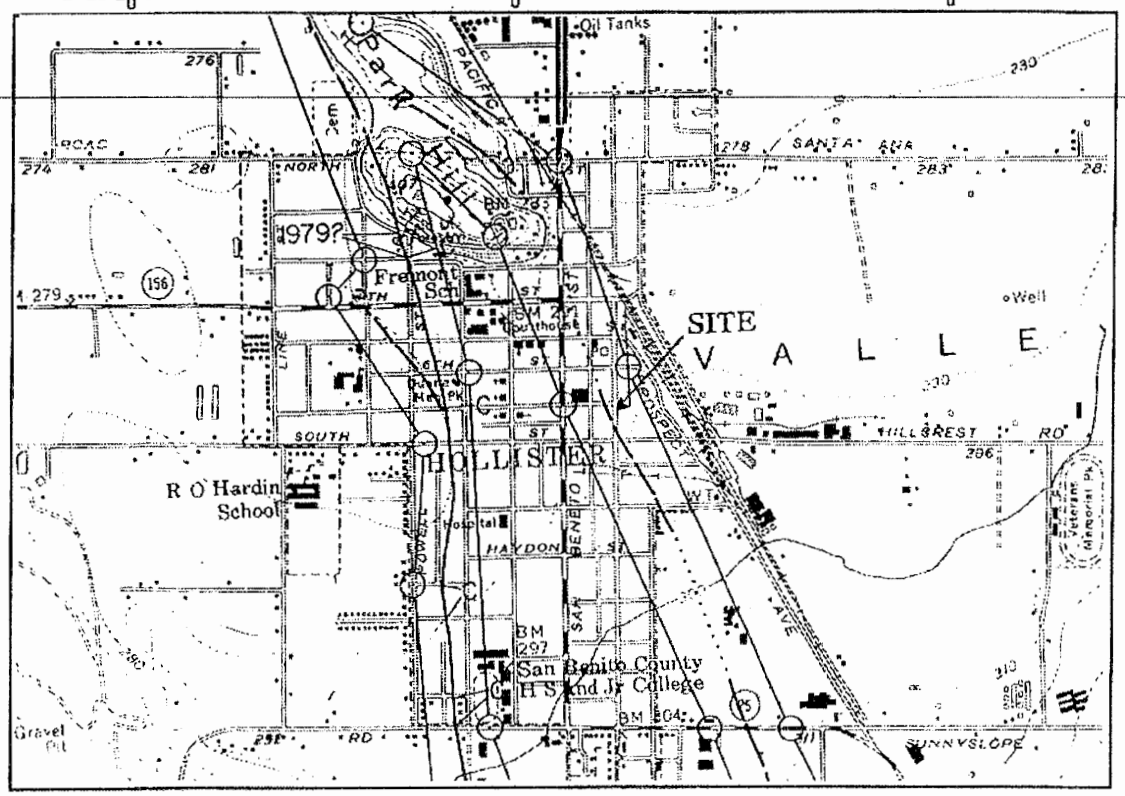
Strike and Dip of Bedding

Horizontal — Inclined (30) — Vertical

Nomenclature and Descriptions from T. Rogers, 1997

Earth Systems Consultants Northern California

Alquist-Priolo Earthquake Fault Zone Map



Active Faults

1906 C

Faults considered to have been active during Holocene time and to have a relatively high potential for surface rupture; soild line where accurately located, long dash where approximately located, short dash where inferred, dotted where concealed; query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacment caused by creep or possible creep.

Earthquake Fault Zone Boundaries

These are delineated as straight-line segments that connect encircled turning points so as to define earthquake fault zone segments.

Seaward projection of zone boundary

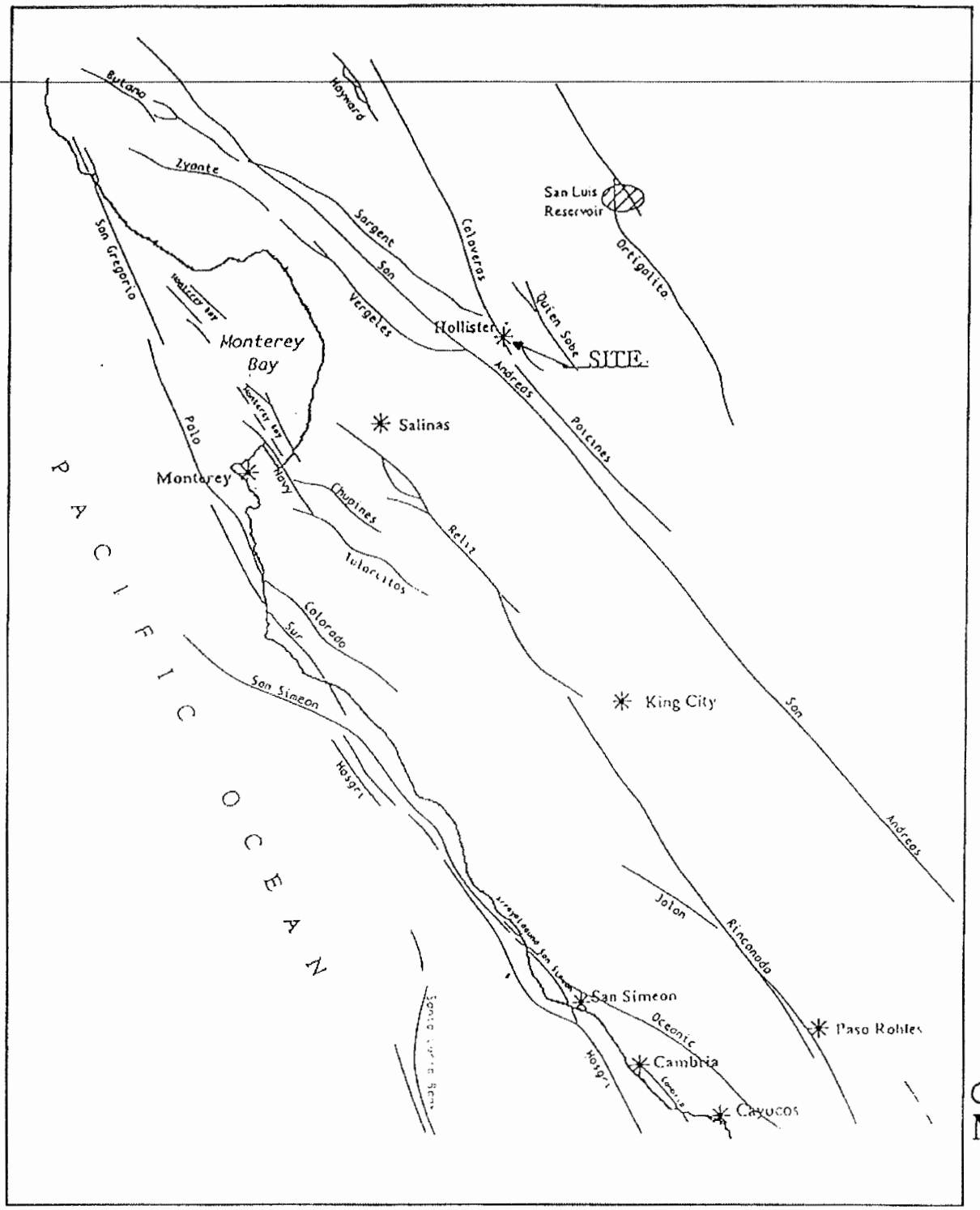
N

Base from: T. Rogers, 1993

0 2000 ft

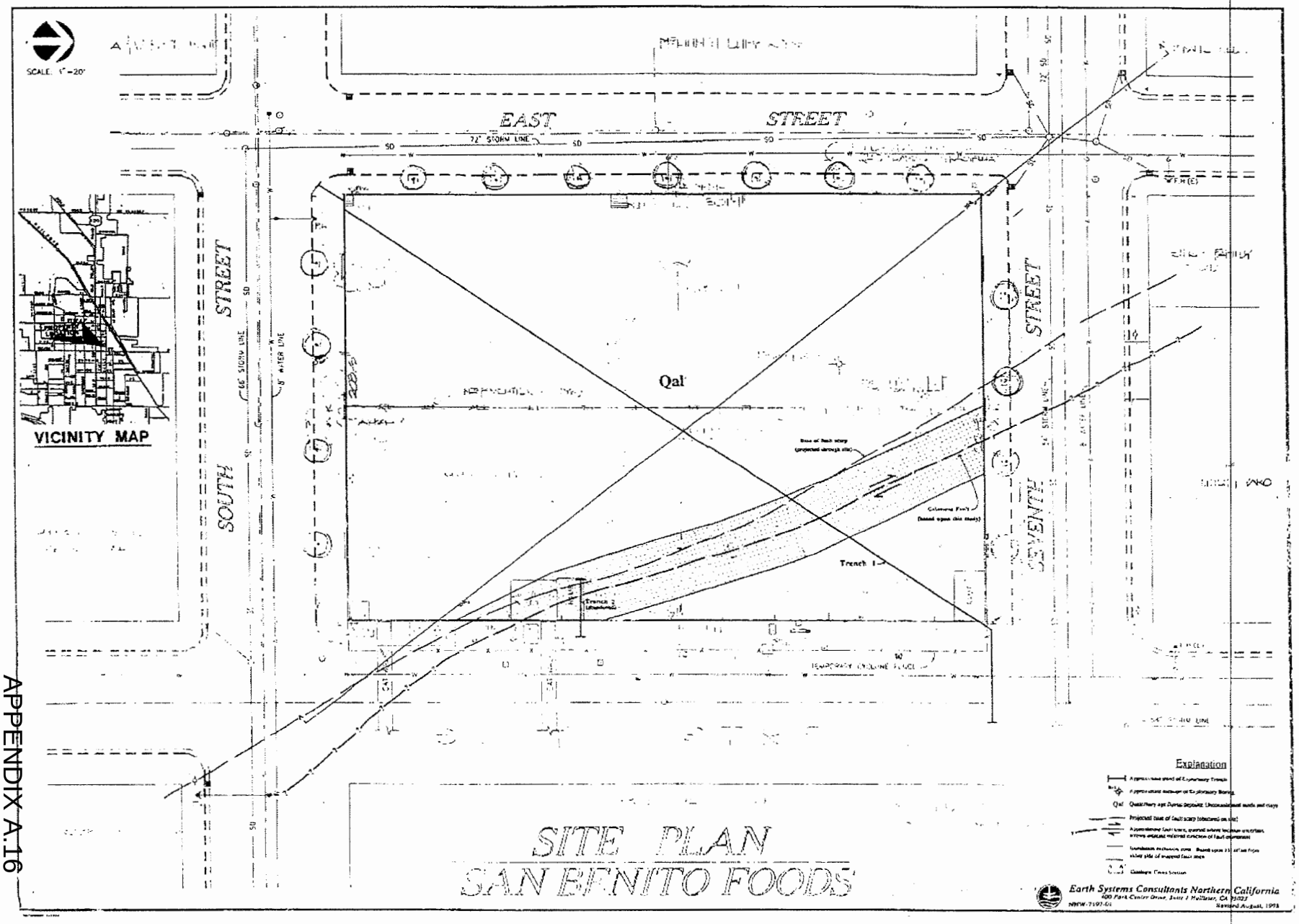
Earth Systems Consultants Northern California

Regional Fault Map



Adapted from Map of Digitized Faults, EQFAULT, T. Blake, 1989; Fault Activity Map of Califorina, Jennings, and from the Map of Faults and Folds, PG&E, 1988.

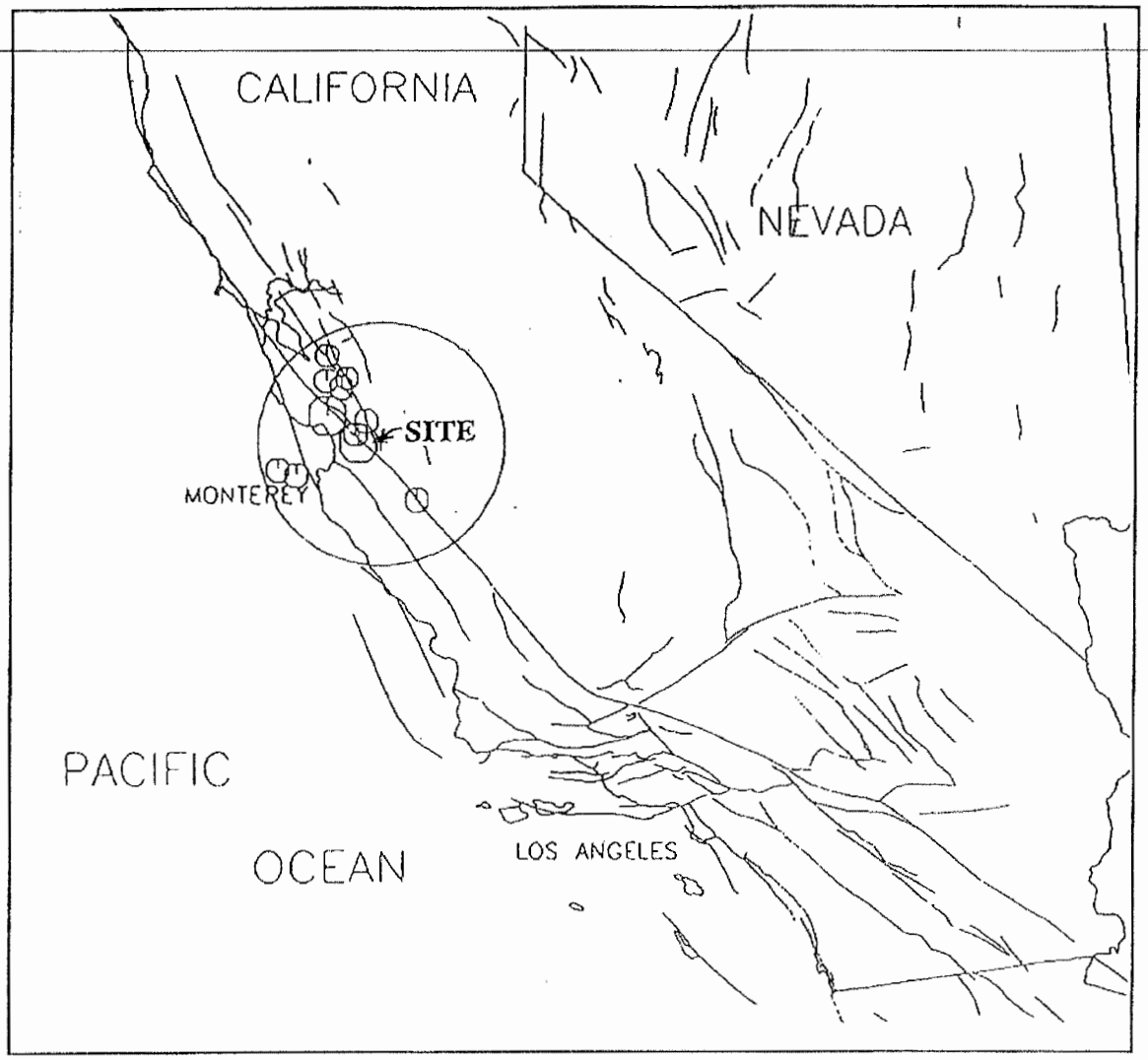
Earth Systems Consultants Northern California



APPENDIX A.16

Historical Earthquake Map

1800 to 1995



M = 8.0 +

M = 7.0 - 7.9

M = 6.0 - 6.9

M = 5.0 -5.9

M = 4.0 -4.9

SITE LOCATION (+)

Latitude - 36.8492 N
Longitude - 121.3994 W

N

0 100 mi

Earth Systems Consultants Northern California

APPENDIX C

Radiocarbon Age Date Results (Samples A,B)

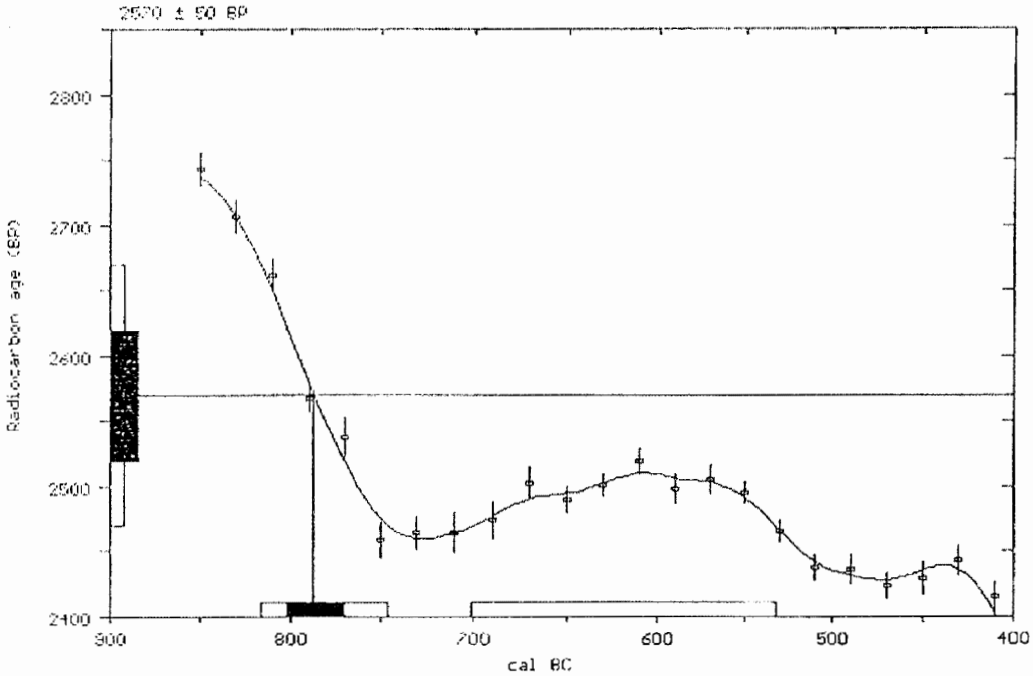
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables:C13/C12=-25:lab mult.=1)

Laboratory Number:	Beta-118289, Earth Systems Sample "A"
Conventional radiocarbon age:	**2570 ± 50 BP**
Calibrated results: (2 sigma, 95% probability)	**cal BC 815 to 745 and cal BC 700 to 530**

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal BC 790
1 sigma calibrated results: (68% probability)	cal BC 800 to 770



References:

Pretoria Calibration Curve for Short Lived Samples
Vogel, J. C., Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86
A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C. 1993, Radiocarbon 35(2), p317-322
Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 ■ Tel (305)667-5167 ■ Fax: (305)663-0964 ■ E-mail: beta@radiocarbon.com

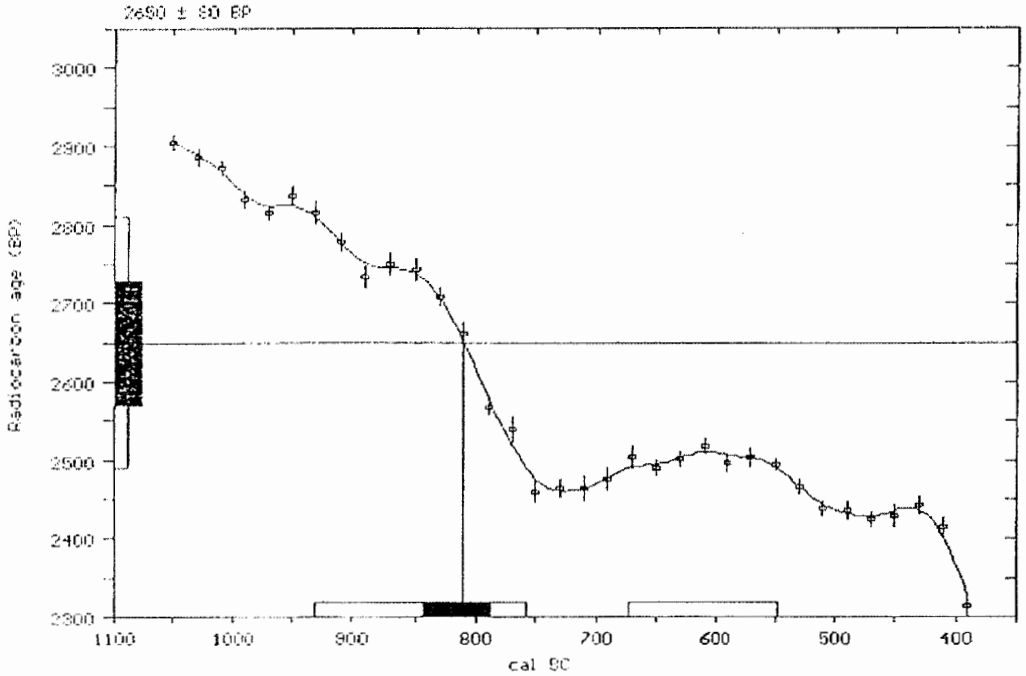
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables:C13/C12=-25.8:lab mult.=1)

Laboratory Number:	Beta-118290, Earth System Sample "B"
Conventional radiocarbon age:	**2650 ± 80 BP**
Calibrated results: (2 sigma, 95% probability)	**cal BC 930 to 760 and cal BC 670 to 550**

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal BC 810
1 sigma calibrated results: (68% probability)	cal BC 845 to 790



References:

Pretoria Calibration Curve for Short Lived Samples
Vogel, J. C., Tuis, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86
A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322
Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

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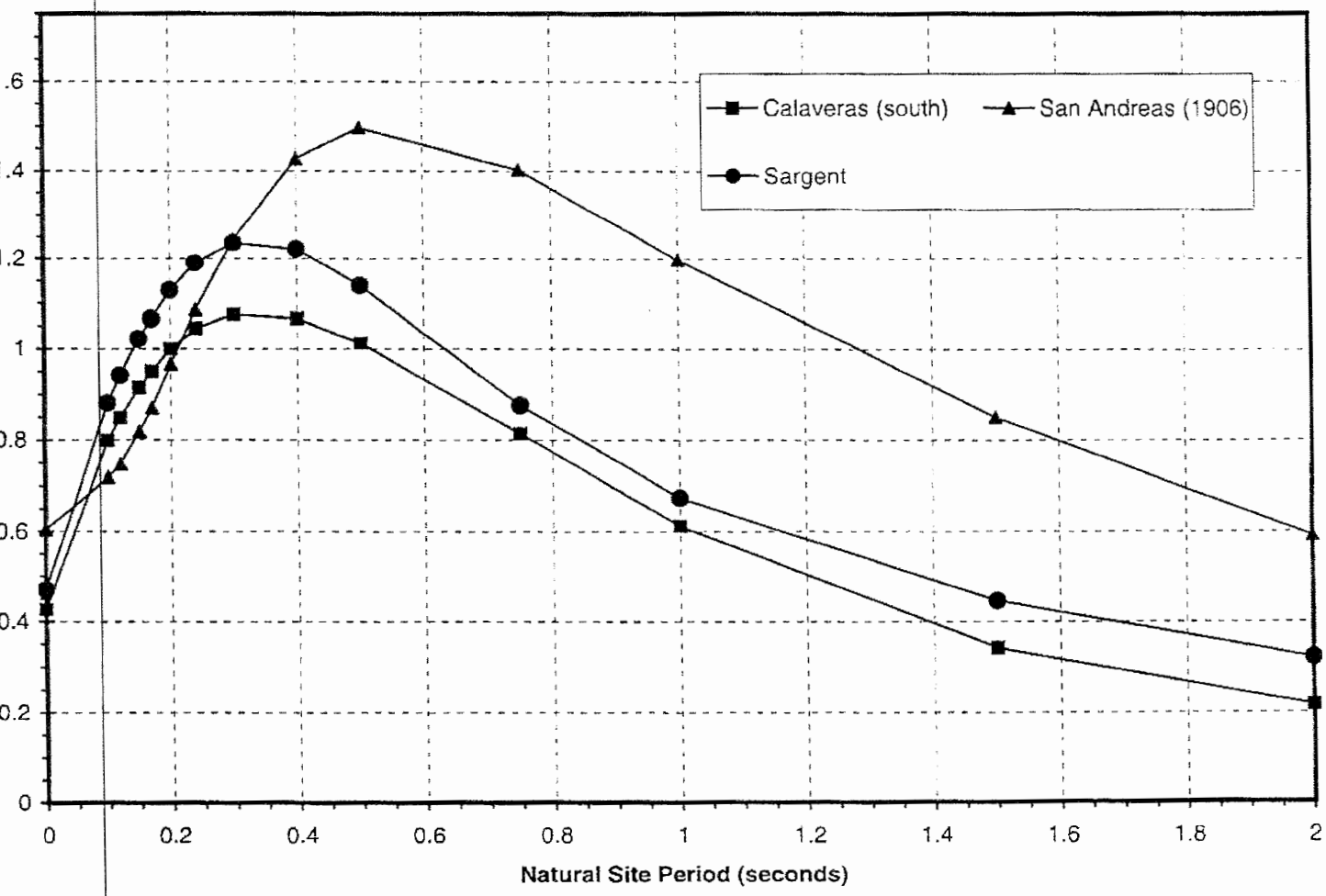
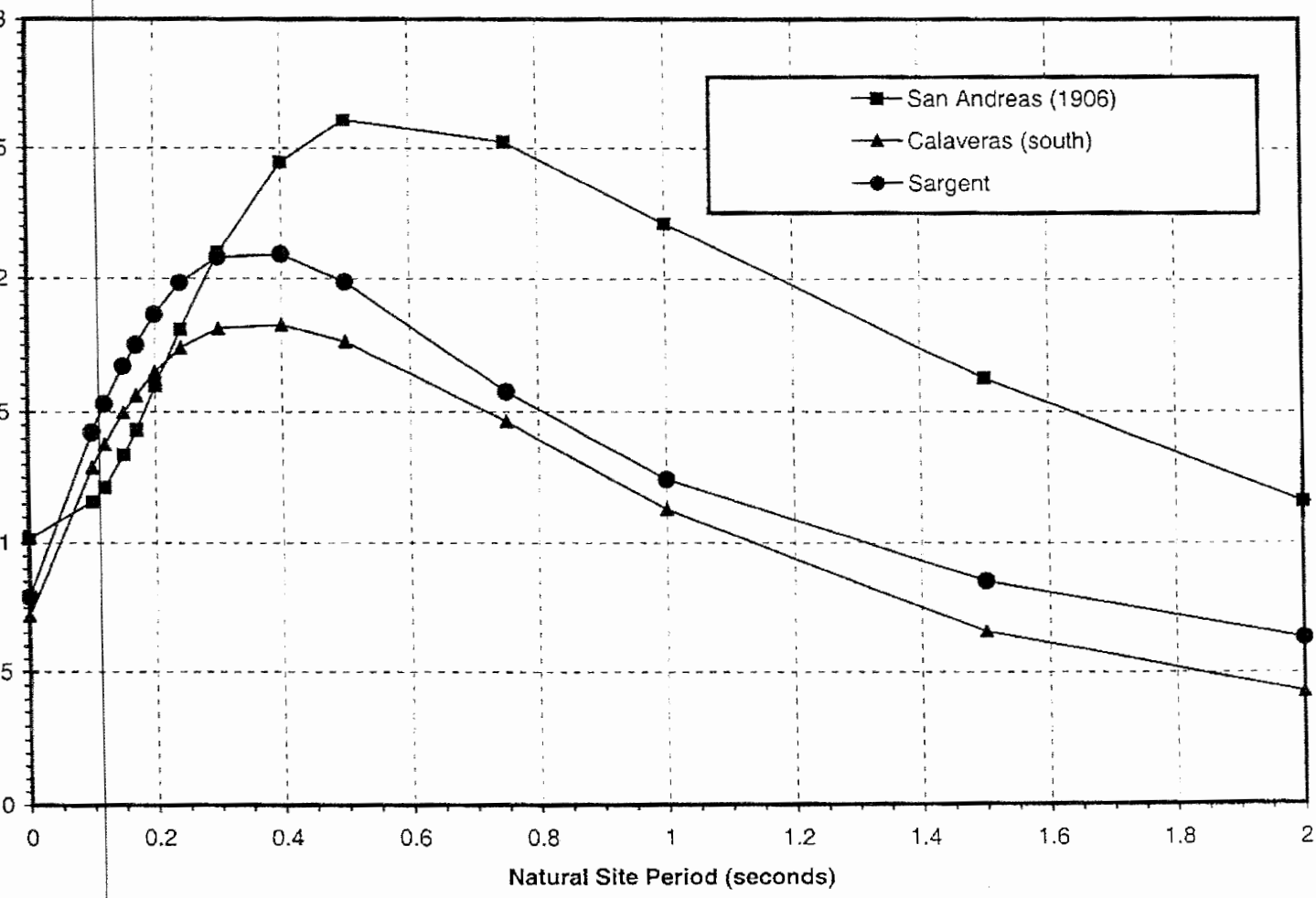
APPENDIX D

Site Response Design Spectra Ground Motions

5% damped, Median Spectral Acceleration
Figure 1

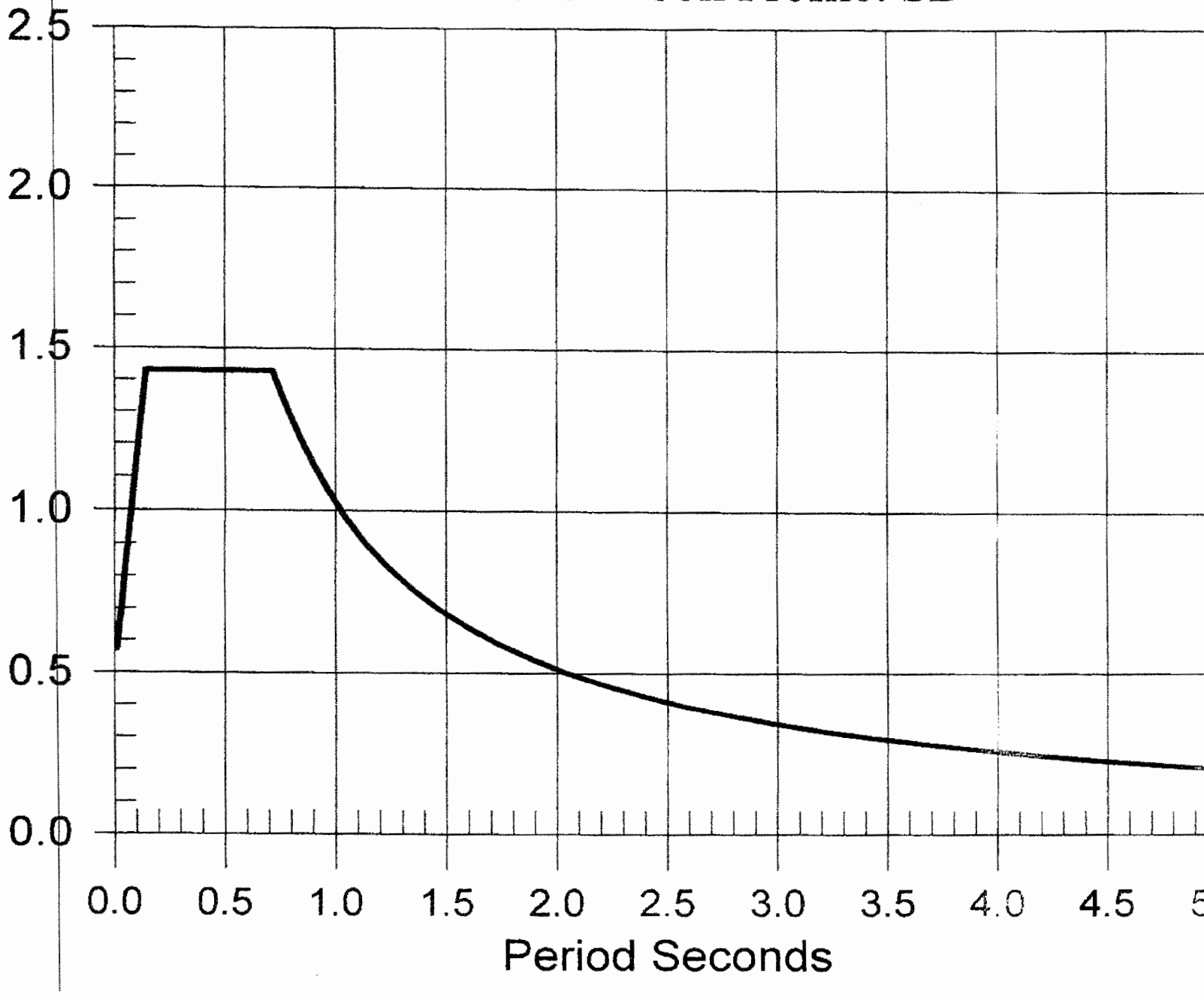


5% damped, Median + 1 Standard Deviation Spectral Acceleration
Figure 2



DESIGN RESPONSE SPECTRUM

Seismic Zone: 0.4 Soil Profile: SD FIGURE 3



PACIFIC RIM GEOLOGIC

ENGINEERING GEOLOGIC CONSULTANTS

GRACE & ASSOCIATES
CERTIFIED PUBLIC ACCOUNTANTS
341 FIRST STREET
HOLLISTER, CALIFORNIA 95023

FAULT LOCATION AND ENGINEERING GEOLOGIC INVESTIGATION
GRACE PROPERTY-PARCEL 1, APN 54-19-09
341 FIRST STREET
HOLLISTER, CALIFORNIA

Project 1093

for

Mr. Michael Grace
Grace & Associates
341 First Street
Hollister, California 95023

By

Pacific Rim Geologic
171 Fairview Court
Hollister, California 95023

March 2002

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Fault Location and Engineering
Geologic Investigation
Grace Property-Parcel 1, APN 54-19-09
341 First Street
Hollister, California

INTRODUCTION

This report summarizes the findings and conclusions from our fault location and engineering geologic investigation of the Grace property located at 341 First Street, situated approximately 250 feet west of the intersection of San Benito and First Streets, in Hollister, California (see Figure 1). Our investigation focused on the relatively level northeastern portion of the property planned for future development, hereafter designated as the "project site." It is our understanding that development plans have not been finalized and could consist of a commercial storage facility or multiple-family residential structures.

The property is located within a State of California Alquist-Priolo Earthquake Fault Zone (formerly Special Studies Zone) established for the East Branch of the Calaveras fault. The purpose of the Alquist-Priolo Earthquake Fault Zoning Act is "to prohibit the location of most structures for human occupancy across the traces of active faults and to mitigate thereby the hazard of fault rupture" (Hart, 1997). The State of California defines structures for human occupancy as ones with an occupancy rate that equals or exceeds 2000 person hours per year. This is equivalent to one person present 40 hours per week for 52 weeks, or approximate total hours worked by one person during one year, excluding vacations and holidays.

BACKGROUND INFORMATION

The following background information is pertinent to our fault location investigation.

1978 Terratech Investigation

In 1978 Terratech, Inc. performed a geologic/geotechnical investigation on the property for a previous owner. Based on the results of their investigation, Terratech mapped a northwest-trending fault trace passing diagonally through the rectangular property (see Figure 2). The primary evidence for locating the fault trace was the presence of the following: 1) "*a minor fault*" at station I+30 in Trench T-2(78), 2) steepening of bedding and a "*fault scarp developed on siltstone and overlain by loose sand and gravel*" at Station 1+10, and 3) "*at about Station 0+48 in Trench T-3, the bedding steepened and slickensided siltstone, indicative of previous shearing was evident*" (Terratech, 1978). In addition, Terratech reported that "*unstable, caving trench*

walls precluded a thorough examination of this zone in place, but on the basis of our surface observations, we believe a fault was in evidence at Station 0+48 in Trench T-3, and this fault is continuous with that shear zone encountered in Station 1+10 in Trench T-2." On their trench log of TR-3(78) from Station 0+30 (beginning of trench) to Station 0+60 Terratech states *"caved area – area of suspected faulting (slickensided planes on blocks of siltstone brought up in a bucket, not observed in place)."* This last sentence corresponds to item 3), above, which appeared in the text of Terratech's 1978 report.

November-December 1999, Proposed Low-Cost Housing Development

In November-December 1999, the current owner Mr. Michael Grace contacted us to determine the feasibility of performing a new fault study for his proposed low-cost housing development on the subject property. Based on our review of the 1978 report by Terratech, it was our professional opinion that most of the fault-related features observed by Terratech, taken as a whole, did not represent unequivocal evidence for faulting. What made judging the presence of a fault on the property difficult was that Terratech made interpretations based on inferences that 1) slickensided surfaces unequivocally represent faulting, and 2) the fault trace passed through a trench that had not been thoroughly inspected because it had caved and was too dangerous to enter. More conclusive evidence for faulting observed for the East Branch of the Calaveras by other workers (Terratech, 1983, 1987a and 1987b; Pacific Geotechnical Engineering, Inc., 1988) has been observations on the sidewalls of backhoe trenches of in place native layered materials that had been "disturbed" by fault movement, such as obviously displaced sedimentary layering, several (three or more) near vertical clayey shear zones, and/or several (three or more) in place slickensided sheared surfaces aligned in zones and along trends that are fairly distinct and pervasive. This subject is discussed in more detail in the Evaluation of Evidence of Subsurface Rupture section on page 13.

Although we recommended excavating new trenches to confirm or deny the presence of faulting on the property, we did not perform a fault location study at that time. It was the opinion of Engineering Geologist Mr. Lew Rosenberg (consulting review geologist for the City of Hollister) that such a study would not likely be worthwhile because the findings of Terratech's 1978 report have already been accepted by the City of Hollister (personal communication, December 1999).

April 2001 Earth Systems Geotechnical Investigation

The presence of a fault and associated setbacks established by Terratech (1978) made it economically infeasible to develop the property for multiple residential structures. Consequently, Mr. Grace decided to develop the property with no-human occupancy structures, namely a self-storage facility.

On April 11, 2001 Earth Systems Consultants of Hollister, California, performed subsurface field exploration for a geotechnical investigation of the proposed personal storage facility. The field work involved excavating and logging six backhoe test pits at various locations on the property under the direction of California Registered geologist Craig Harwood (RG 6831). The results of their geotechnical investigation are summarized in a report titled "**Preliminary Soils Engineering Report, Grace Storage Lockers, First Street, Hollister, California,**" dated June 27, 2001.

Current Fault Location Investigation-Fall 2001

The following paragraphs summarize the generally accepted guidelines for a fault investigation of the proposed development based on our understanding of verbal agreements made between Mr. Grace and Mr. Ray Proffitt City of Hollister Building Official (personal communication with Mr. Grace, November 2001).

As stated above, the newly proposed development would consist of structures with essentially zero human occupancy and consequently would not be required to conform to State requirements for establishing surface faulting hazards (meaning the State would not require that a copy of our fault investigation report be submitted for State review). As a result, the City of Hollister 1) would only require that the location of the fault trace through the property as determined by Terratech in 1978 be reestablished for the proposed development, 2) the City would not require the same in-depth level of geologic review of such an investigation, 3) the City would require that their representative (Building Official Mr. Ray Proffitt) be allowed to observe the trenches, and 4) once the fault's location was reestablished, a minimal building setback from the fault trace be provided. The result of Item 4) was that the City of Hollister would use our fault investigation report for their files and would not have the report reviewed by their consulting engineering geologist. It was for this reason that we did not contact the City's review engineering geologist Lew Rosenberg prior to our trenching, as we normally would have for a regular fault investigation.

It should be noted that during our field exploration on December 6 and 7, 2001, Mr. Rosenberg was contacted by Mr. Proffitt. According to Mr. Proffitt (personal communication December 2001), Mr. Rosenberg indicated that if we encountered evidence of a fault arrangements would be made for Mr. Rosenberg to observe the fault exposure in our trenches. If, on the other hand, we did not encounter a fault, then a review or our report would be made with a likely result being the elimination of any surface fault hazard in the project site.

OBJECTIVES

Initially, under the agreed verbal guidelines established between Mr. Grace and the City of Hollister Building Official Mr. Ray Proffitt (as outlined above), the objective of our fault investigation was to reestablish the trace of the Calaveras fault across the property determined by Terratech in 1978 in accordance with City of Hollister requirements. The fault location needed to be reestablished because there was no known record that the fault had ever been accurately surveyed. Once the fault trace was located in our trenches it would be necessary to have a surveyor provide accurate location of the fault on a suitable site plan.

A contingency objective of the fault investigation was formulated if a fault trace was not located during our field investigation, which would consist of excavating and logging additional trenches to clear the project site of surface rupture hazard.

The objective of the engineering geologic portion of investigation was to address engineering geologic conditions in the vicinity of the project site in accordance with Hollister requirements. The anticipated primary geologic constraints for the proposed development on the project site include potential landsliding, erosion, and seismic shaking.

INFORMATION PROVIDED

For our evaluation we were provided with the following:

1) A copy of Terratech's 1978 report
2) A copy of Earth Systems Consultants' 2001 geotechnical report of the project site titled **"Preliminary Soils Engineering Report, Grace Storage Lockers, First Street, Hollister, California"**
3) A preliminary site map titled **"Grace Property, First Street – Trench Location Survey,"** prepared by Roger Grimsley & Associates, Inc., dated 1/11/01, scale 1"=40'

SCOPE OF WORK

The following work was performed for this fault location and engineering geologic investigation.

1. Reviewed available published and unpublished geologic literature pertaining to the project site and the East Branch of the Calaveras fault.

2. Examined several sets of stereoscopic aerial photographs of the project site and its surroundings to evaluate surface fault rupture, slope stability, erosion history, and geologic features that cannot be seen from the ground surface.

3. Performed reconnaissance level geologic field mapping of the project site and vicinity.

4. Reviewed subsurface data from other investigations of the East Branch of the Calaveras fault on nearby properties.

5. Performed a field reconnaissance of the parcel and surrounding area to look for possible geologic and topographic features and vegetation patterns that may indicate the presence of fault traces.

6. Excavated, inspected, and logged four exploratory backhoe trenches roughly perpendicular to a previously mapped fault trace, which was inferred to cross diagonally through the property, to look for evidence of subsurface faulting and to observe and classify subsurface soils.

7. Compiled and analyzed our office and field data and formulated conclusions regarding the presence of a fault trace through the project site. In addition we formulated conclusions regarding other engineering geologic constraints to the proposed development.

8. Prepared this report which summarizes our findings, conclusions, and recommendations regarding engineering geologic suitability of the proposed development. Our report includes a geologic site map, geologic cross section, trench logs, a fault location map, selected stereo pair aerial photographs, and a design response spectrum plot.

FINDINGS

Field Logging of Exploratory Trenches

Prior to performing our field investigation, we scheduled viewing of our trenches with City of Hollister Building Official Mr. Ray Proffitt. On December 6 and 7, 2001, we spent about 34 combined hours (20 hours of Senior Engineering Geologist James Nelson and 14 hours of Associate Engineering Geologist Amy Hosokawa) logging exploratory backhoe trenches TR-1(01), TR-2(01), TR-3(01), and TR-4(01) excavated at strategic locations. City of Hollister Building Official Mr. Ray Proffitt visited the site and viewed all our trenches on December 6 and 7, 2001. After reviewing our trenches it is our understanding that Ray Proffitt informed Mr. Lew

Rosenberg that we did not observe any evidence of faulting in our trenches (personal communication with Mr. Proffitt, December 2001). Appendix A (Figure A1) shows photographs of trenches TR-2(01) and TR-3(01).

The locations of our trenches are shown on Figure 2. To differentiate between trenches and test pits excavated on the property at various times by different consultants we have added the year the excavation was performed in parenthesis following the exploration designation. For example trench T-3 excavated in 1978 by Terratech is designated as T-3(78). For this investigation, trenches were oriented and located to intercept the fault trace previously identified by Terratech (1978). Specifically, Trench TR-1(01) was located about 60 feet west-northwest of Terratech's trench T-2(78) (Figure 2) and TR-2(01) was located about 125 feet northwest of T-3(78) to attempt to intercept the fault features observed by Terratech's geologist. As mentioned above, previous evidence consisted of "*a minor fault*" at Station 1+30 near the southwestern end of Trench T-2(78) and at Station 1+10 bedding steepened considerably, and evidence of a fault scarp developed on siltstone overlain by loose sand and gravel (Terratech, 1978). When the previously identified trace was not encountered in Trenches TR-1(01) and TR-2(01), additional trenches TR-3(01) and TR-4(01) were performed to clear buildable portions of the property of surface faulting hazards. To intercept any fault traces passing through the project site trench locations were selected in the field in such a manner that each trench provided sufficient overlap with an adjacent trench. As seen in cross section (Figure 3), minimum overlap was about 10 feet. Because the zone of faulting evident at other locations in the Hollister area (Terratech, 1978, 1983, 1987a and 1987b; Pacific Geotechnical Engineering, Inc., 1988) was usually at least 15 feet wide, the 10-foot-wide overlap appears to be sufficient.

Locating trenches for our investigation was constrained in the eastern portion of the project site by the presence of the existing development and in the northwestern and central portions by garbage and construction debris. Trench TR-1(01) was situated between relatively steep slopes to the south and the Grace & Associates office building to the north. This trench was not excavated longer than about 27 feet to the north because we did not want to undermine the office building foundation. During the previous investigation on the property by Terratech in 1978, the presence of relatively thick loose garbage fill (up to about 15 feet thick) caused trench walls to be unstable and collapse. The presence of thick and potentially unstable fill meant that new trenches would need to be excavated to greater depths so that native materials could be observed to properly assess the presence and age of faulting, if encountered.

During two initial attempts to excavate Trench TR-2(01) on December 6, 2001, in the northwestern portion of the property the backhoe encountered relatively large blocks of concrete debris. Because the backhoe could not excavate through the large concrete blocks these two initial locations were abandoned and a favorable location for TR-2(01) was found in the northwestern corner of the project site (Figure 2). Both TR-1(01) and TR-2(01) were suitably excavated 5 to 10 feet into native San Benito Gravels. This is significant because San Benito

Gravels are sufficiently old (Plio-Pleistocene age) that the absence of fault evidence would indicate that no active fault traces (defined as having not moved during the last 11,000 years) are present at greater depths.

During excavation of trenches TR-2(01) and TR-3(01), sloughing and caving of the sandy and gravelly soils made it impossible to stabilize the trench with hydraulic shoring. Consequently, we directed the backhoe to lay back the trench sidewalls on both sides with a series of benches. In this manner, the trench wall remained stable and allowed safe entry.

Based on the findings of Terratech's 1978 investigation the identified fault trace should have been encountered somewhere between about Station 0+00 and 0+10 (0 to 10 feet from the southern end) of TR-1(01) and between about stations 0+15 and 0+20 of TR-2(01) (corresponding to 15 feet and 20 feet from the southwestern end of TR-2(01)). Trench TR-2(01) was extended an additional 30 feet northeastward to clear the project site of surface fault hazards.

The subsurface conditions encountered in the exploratory trenches were logged in the field by Certified Engineering Geologist James Nelson and California Registered Geologist Amy Hosokawa. Ms. Hosokawa was specially contracted from Redwood Geotechnical Engineering, Inc. of Morgan Hill, California for this investigation. Soils were described in accordance with the Unified Soil Classification System (ASTM D2487). Logs of the trenches denote the subsurface conditions encountered at the locations shown on Figure 2. It is not warranted that the logs are representative of subsurface conditions at other locations or times.

Field Mapping

On December 8, 2001, we spent about 2 hours locating our exploratory trenches from the previous two days and performing reconnaissance geologic mapping in the vicinity of the project site.

For this investigation we developed a suitable site plan to use as a base for our Geologic Site Plan (Figure 2) by combining scanned images of 1) a site map from Terratech (Figure 2, 1978), 2) a City of Hollister orthophotographic map, scale 1" = 200', prepared by Bissell & Karn, Inc. (1984, sheet 15 of 27) of the project site and vicinity, 3) a **Field Exploration Location Map** from the 2001 report of the property by Earth System Consultants, and 4) the provided site plan prepared by Roger Grimsley & Associates titled **Grace Property, First Street – Trench Location Survey**, dated 1/11/02, scale 1"=40'.

Mapped geologic features and our interpretation of the subsurface configuration of geologic units in the immediate vicinity of the project site are shown on the Geologic Site Map, Figure 2, and the Geologic Cross Section, Figure 3.

It should be noted that the surveyed location of trench TR-1(01) provided by Grimsley & Associates (dashed line, Figure 2), does not appear to be oriented correctly.

Surface Conditions

The physiographic setting of the project site is shown on the Vicinity Map, Figure 1. Predominantly northeast-facing moderate slopes (approximately 25 to 30 degrees), covered with grasses and weeds characterize the southwestern half of the subject property. The sloping ground is a portion of Park Hill. Relatively level ground at the base of the slope characterizes the project site in the northeastern half subject property (Figure 2).

According to the site plan based on the City of Hollister orthophotographic maps by Bissel & Karn (1984) elevations in the vicinity of the project site range from about 340 feet near the top of the slope in the southwestern corner to about 284 feet near the northeastern corner of the property (Figure 2).

Regional Geology

The geology of the project site and its surroundings is shown on published maps (Taliaferro, 1945; Kilburn, 1972; Dibblee and Rogers, 1975; Robbins, 1982; Rogers, 1993; Majmundar, 1994; and Rosenberg, 1998a).

Hollister and vicinity are located on a broad, flat alluvial plain near the southern end of Santa Clara Valley. Several hundred feet of unconsolidated sediments that unconformably overlie various bedrock units locally underlie the valley. The near surface sediments in the immediate vicinity of Hollister have been interpreted to be either ancient lake deposits (lacustrine) (Jenkins, 1973; Herd, 1978), or overbank flood deposits (alluvium) from San Benito River (Hoose, 1983). Carbon-14 dating suggests an age of approximately 4000 years for the uppermost beds of near-surface sediments in the Hollister area (Herd, 1978; Hoose, 1983; Rosenberg, 1998).

The alluvial/lacustrine deposits in the vicinity of Hollister are typically clay, silt, and fine to medium-grained sand (Terratech, 1983, 1987a, 1987b; PGEI, 1988). These sediments are generally well bedded, and individual layers continue laterally for hundreds of feet. These sediments overlie Plio-Pleistocene San Benito Gravels (QTsb) in the vicinity of the project site.

Calaveras Fault Zone

The Calaveras fault zone trends northwestward through the City of Hollister. Two subparallel branches (Main Branch and East Branch, see Figure 1) of the fault have been mapped crossing the city (Rogers, 1968; Dibblee and Rogers, 1975; Robbins, 1982; Rogers, 1993; Majmundar,

1994). The Main Branch is actively creeping. Although the East Branch has not been historically active, it is considered potentially active because the fault has deformed and displaced Holocene to Late Pleistocene sediments. Relative displacement is right lateral strike slip, with the west side moving northward relative to the east side.

East Branch of the Calaveras Fault

The mapped location and length of the East Branch of the Calaveras fault in the Hollister area are based on topographic, ground water, geophysical, and geodetic evidence. At several locations the East Branch is marked by a subtle, discontinuous, west-facing topographic scarp. Subsurface location of the fault appears to be marked by differences in ground water elevation on opposite sides of the scarp (Kilburn, 1972; Farrar, 1981). Robbins (1982) measured an anomalous gravitational pattern along the trend of the scarp and interpreted the pattern to represent vertical displacement of bedrock along the East Branch of the Calaveras fault.

Location of the East Branch of the Calaveras Fault on Nearby Property

We reviewed available unpublished consultant's reports of fault studies of the East Branch of the Calaveras fault in the Hollister area (Terratech, 1978, 1983, 1987a and 1987b; Pacific Geotechnical Engineering, Inc., 1988). It was anticipated that comparisons and possible correlations could be made between soils on the property and nearby soils that have been involved in faulting. Also, it was hoped that if the soils are correlative, possible fault related features observed beneath the property would be at similar depths to those observed by other workers.

A trace of the East Branch was located in the northeastern portion of Hollister, directly south of the property by Terratech in 1978. Portions of the East Branch were located in the southeastern part of Hollister by Terratech in 1983 and 1987 (Terratech, 1983, 1987a and 1987b) and by Pacific Geotechnical Engineering, Inc. in 1988 (PGEI, 1988).

The East Branch was observed in trenches on several large acre parcels in southeastern Hollister by Terratech at three locations (Terratech, 1983, 1987a, and 1987b) and by PGEI at one location (PGEI, 1988). Our principal geologist James Nelson observed and logged East Branch fault traces for two of the 1987 Terratech projects (1987a and 1987b). At each location evidence of faulting included the presence of (1) undulating, near vertical slickensided sheared surfaces, (2) truncation or abrupt termination of laterally continuous beds, (3) vertical displacement of laterally continuous beds (generally with west side down), (4) monoclinal folding of sediments (west side down), and (5) vertical clay seams. The width of the fault zone varied between 13 feet and 50 feet and was characterized by two to five distinct fault traces that displaced Holocene to late

Pleistocene interbedded clay, sand, and silt layers within about 4 feet to 10½ feet of the ground surface.

These investigations indicate that fault features produced by the East Branch of the Calaveras fault in deposits of Holocene to Late Pleistocene age in the vicinity of the property would be fairly obvious over a relatively wide zone (13 to 50 feet) and at relatively shallow depths (4 to 10½ feet).

Site Geology

Taliaferro (1945), Kilburn (1972), Dibblee and Rogers (1975), Robbins (1982), Rogers (1993), Majmundar (1994) and Rosenberg (1998a) mapped the project site as being underlain by Plio-Pleistocene San Benito Gravels or San Benito Formation. Mapped geologic features and our interpretation of the subsurface configuration of geologic units on the project site are shown on the Geologic Site Map, Figure 2, and Geologic Cross Section, Figure 3.

Earth material beneath the project site can be divided into two general categories, surficial geologic units consisting of artificial fill and younger alluvium, and a bedrock unit consisting of the relatively young San Benito Gravels.

Surficial Geologic Units

Artificial fill (Qf) appears to cover most of the project site. We encountered fill 1-1/2 feet thick in TR-2(01), at least 4 feet thick in TR-3(01), and about 4-1/2 feet thick in TR-4(01). Terratech (1978) encountered "trash fill" up to about 15 feet thick in TP-3(78) in the north-central portion of the property. Earth Systems Consultants (ESC, 2001) encountered garbage fill between about 3 feet to 14 feet thick in their test pits. The fill is predominantly garbage and construction debris. During trenching we observed rusty metal objects, porcelain fragments, burnt trash, bones, concrete debris, bottles, and brick fragments. ESC encountered similar items. The debris is surrounded by clayey sands that appear to be loose to medium dense and sandy clays that appear to be soft to stiff. Based on the old style of bottles encountered, we roughly estimate some of the garbage to be at least 75 to 100 years old (personal communication with geologist Craig Harwood, January 2002).

Younger alluvial deposits (Qa) on the project site consist of unconsolidated, fine-grained clayey, silty, sandy soil derived from the underlying San Benito Gravels. They form a thin mantle, generally less than about 4 feet thick, in the north-central portion of the project site. These deposits are only shown on the Geologic Site Map (Figure 2) where they are estimated to be thicker than about 3 feet.

It should be noted that we also logged colluvial soils in trenches TR-1(01) and TR-2(01) (Figure 4). Because these soils are relatively thin (less than about 2 feet thick) and localized we did not map their vertical or areal extent. Consequently, colluvium is not shown on Figures 2 and 3.

Bedrock Unit

San Benito Gravels (QTsb) of Plio-Pleistocene age is the only near surface bedrock unit underlying the project site. The San Benito Gravels were deposited by streams and possesses clay, silt, sand and gravel. The San Benito Gravels lie beneath a relatively thin veneer of surface colluvium on sloping ground in the southwestern half of the property as observed in TR-1(01), beneath garbage fill overlying most of the project site as observed in TR-2(01), TR-3(01), and TR-4(01), and beneath younger alluvial soils (Qa) in the vicinity of the existing paved parking area as observed in TR-4(01).

San Benito Gravels encountered in our trenches consist predominantly of alternating beds of poorly graded sands (SP) and gravels (GP), with minor silty sand (SM) and sandy clay (CL) layers. The encountered sands and gravel were generally dry to moist and medium dense to very dense. The encountered sandy clays were generally damp and very stiff to hard. Fairly well indurated claystone and siltstone beds were encountered in the southwestern ends of trenches TR-1(01) and TR-2(01) at the base of the slopes in the southwestern half of the property.

Geologic Structure

Bedding beneath the project site is not shown on published maps (Taliaferro, 1945; Kilburn, 1972; Dibblee and Rogers, 1975; Robbins, 1982; Rogers, 1993; Majmundar, 1994; and Rosenberg, 1998). We observed bedding in trenches TR-1(01), TR-2(01), and TR-3(01) as striking northwestward and dipping 20 to 42 degrees to the northeast. Terratech (1978) observed apparent dips of 42 degrees and 32 degrees in the same general direction in sedimentary beds in T-3(78) and they graphically depicted northeast dipping beds on the T-2(78) trench log.

Surface Water and Ground Water

Surface drainage off of sloping ground on the project site generally occurs as unchanneled sheet flow. Because relatively sandy soils and sandy bedrock are present beneath most of the project site, much of the precipitation probably infiltrates rapidly into the ground. Other than the erosional bluff face on the southwestern half of the property, we did not observe obvious erosional processes in the vicinity of the project site during field reconnaissance mapping or on aerial photographs.

In the vicinity of the project site we did not observe any indications of shallow ground water conditions such as springs, seeps, or water-loving plants.

Effects of the Loma Prieta Earthquake

The Loma Prieta earthquake of October 17, 1989, which occurred along the San Andreas or a branch fault, had a moment magnitude of 6.9, and its epicenter was located approximately 32 miles northwest of the project site. The project site is not shown on the Preliminary Map of Ground Rupture Resulting from the October 17, 1989, Earthquake (Santa Cruz County, 1989) or other maps of earthquake induced failures (Spittler and Harp, 1990; Spittler and Sydnor, 1990; Manson and others, 1991). During our reconnaissance site visit we did not observe any obvious ground fissures, evidence of landsliding, or any ground disturbance that may have been the result of the Loma Prieta earthquake.

During the Loma Prieta earthquake peak ground accelerations were measured at strong-motion stations maintained by the California Strong Motion Instrumentation Program (CSMIP). The closest instrument is located approximately 3 miles northwest of the project site in Hollister. Peak vertical ground acceleration at this station was 0.20 g and peak horizontal ground accelerations ranged from 0.18 g to 0.38 g (Shakal and others, 1989). The reported estimated Modified Mercalli Intensity of shaking in the Hollister area was VII (Stover and others, 1990; Sydnor and others, 1990).

POTENTIAL GEOLOGIC HAZARDS AND MITIGATION MEASURES

Faulting and Ground Rupture

The project site is located within an earthquake fault zone (formerly "special studies zones") established for areas of potential surface faulting in accordance with the Alquist-Priolo Earthquake Fault Zoning Act (formerly Special Studies Zones Act) of 1972 (Hart, 1994).

Seismic hazards can be divided into two general categories; hazards due to ground rupture and hazards due to ground shaking. Figure 1 shows potential ground rupture hazards and Figure 6 shows potential ground shaking hazards. The location of the inferred trace of the East Branch of the Calaveras fault governs the ground rupture hazard in the vicinity of the property.

Based on subsurface data obtained during this investigation summarized in the following Evaluation of Evidence of Subsurface Rupture section, it appears that the previously mapped fault trace identified by Terratech is not present. Therefore, ground rupture is not considered a potential hazard to the present development, and mitigation measures are unnecessary.

Evaluation of Evidence of Surface Rupture

To observe whether obvious fault related features are present on the ground surface of the property we performed reconnaissance geologic field mapping and reviewed seven sets of aerial photographs taken in 1949, 1959, 1967, 1980, 1985, 1987, and 1997. Figures 7 and 8 show stereo pairs of the 1949, 1959, 1967, and 1997 photographs. These four sets of photographs were chosen because they possess the best contrast. Obvious surface evidence for active fault movement such as displaced curbs, pavement, or other artificial features was not observed in the immediate vicinity of the property on aerial photographs or during our geologic reconnaissance mapping. In addition, we did not observe photolineaments in the vicinity of the property on aerial photographs.

Evaluation of Evidence of Subsurface Rupture

Evidence of faulting was not observed in our exploratory trenches in San Benito Gravels and alluvial deposits. The interbedded siltstone, claystone, sands, and gravels exposed in trenches TR-1(01) through TR-4(01) are not displaced (Figures 4, and 5).

The soils encountered at the trench bottoms were inspected for the presence of fault related features such as near-vertical clay seams, rotated or disturbed clasts, displaced bedding, monoclinal folding, or subtle textural differences (for example; finer-grained sands and gravels butted against coarser material). We did not observe disturbance or displacement of northeastward-dipping beds of San Benito gravels exposed in Trenches TR-1(01), TR-2(01), and TR-3(01), younger silty sand alluvium in TR-4(01), or any other features that would indicate faulting beneath the vicinity of the project site.

In the following two sections we discuss Terratech's interpretation of faulting on the property. In the first section, Fault Related Features Inferred by Terratech, we attempt to show that Terratech's logs and report do not provide enough corroborative subsurface data to assess whether the observed slickensides unequivocally represent faulting. In the second section, Possible Alternative Fault Interpretation, we attempt to show that truncated bedding shown on Terratech's trench log of T-2(78) at Station 1+30, may provide more convincing evidence of faulting. This feature was identified by Terratech (1978) as a fault plane, but it appears the feature was not used to locate the fault through the property.

Fault Related Features Inferred by Terratech

As mentioned previously, Terratech inferred that a fault trace passed through the project site based on inferences that 1) slickensided surfaces present in trenches T-2(78) and T-3(78) unequivocally represent faulting and 2) the fault trace passed through a portion of trench T-3(78) that had not been thoroughly inspected because the trench had caved and was too dangerous to

enter. As stated on the log, evidence for faulting in T-3(78) is solely based on the presence of "*slickensided planes on blocks of siltstone brought up in a bucket, not observed in place.*" Terratech did, however, observe in place slickensided surfaces on siltstone at Station 1+10 in trench T-2(78).

The term "slickensides" generally describes polished and striated surfaces usually produced in clayey soils by shearing. Based on our local experience, slickensides can be produced by processes other than faulting. Slickensides can be artificially produced by a backhoe bucket during excavation due to shearing action of the bucket as it dislodges the soil. Another process that can produce slickensides is self-shearing of near-surface earth materials that contain highly expansive clay minerals. As these materials experience alternating wetting and drying conditions during rainy and dry seasons, the clay minerals will shrink and swell, which results in a "self-shearing" action to produce slickensided surfaces. Landslide movement can also shear clayey soils to produce slickensides. Flexural slip folding is a process that involves localized shearing, typically along bedding surfaces, as beds are folded during simple shear. The process is analogous to the movement that occurs along individual sheets of paper when a stack of papers is bent. The presence of slickensides along bedding surfaces is commonly associated with flexural slip. Flexural slip could have occurred in the San Benito Gravels beneath the site and vicinity as a result of local monoclinal folding that produced Park Hill, directly to the south-southwest. This folding is evident by the northeast dipping San Benito Gravel layers observed in our trenches beneath the project site.

Because the slickensided features were not observed in place in the trench sidewall of T-3(78), one can not be certain whether they were produced artificially by the backhoe bucket during trench excavation, by faulting, self shearing, landsliding, or flexural slip folding. The orientation of "*slickensided striated on siltstone surfaces*" observed at Station 1+10 in T-2(78) were measured to be trending N65^{O}W and dipping 59° N (Terratech, 1978), as shown on Figure 2. This orientation is very similar to bedding attitudes in San Benito Gravels that we measured in trenches TR-1(01), TR-2(01), and TR-3(01). It seems fortuitous that the local orientation of the inferred fault trace closely matches bedding orientation. Consequently, a more likely explanation for the slickensides observed in T-2(78) would be local shearing due to flexural slip. During our trenching on December 6 and 7, 2001, we did not observe any slickensides or indications of obvious pervasive shearing.

It is acceptable geologic practice during trench logging to first 1) adequately describe features observed on sidewalls in as much detail as possible and then 2) present interpretations based on the observations made. To illustrate the potential difficulties that may arise if interpretations are not backed up by sufficiently detailed observations we provide the following simplified example: A geologist observes and logs a trench for a project that involved concerns with shallow groundwater. On the log the geologist only stated his interpretation that "soils to a depth of 15 feet were oxidized." As a result of this interpretation, the geologic report for the project states

that "because observed soils were oxidized the site has not experienced shallow ground water conditions in the recent geologic past." During subsequent review of the log and report, a regulatory geologist would have no way of knowing whether the geologist has truly observed oxidized soil at the project site without adequate descriptions of the soil by the field geologist. Such descriptions would show a reviewer what evidence had led to the field geologist's interpretation. A more convincing log would have descriptions that supported an interpretation that the site soils were oxidized had it stated that the soils were "dry, reddish brown, and contained live rootlets."

Similarly, the term "slickensides" is an interpretative word that implies an observed soil has experienced shearing. As indicated above, slickensides can be produced by processes other than faulting. As in the above example, instead of just stating that slickensides are present, it would be more convincing to describe the feature in detail in the form of both written descriptions and graphically on the trench log. Additional descriptions of slickensides that would further support a fault interpretation could include 1) the presence of shears that cuts across and displace bedding, 2) the degree of polish/and or striations on clay surfaces, 3) orientation of striations that are consistent with expected fault mechanism, etc. Also, the field geologist should look for additional corroborative evidence for faulting (such as clay seams, warped bedding, truncated or laterally displaced bedding). Such corroborative data helps the reviewer of the trench logs visualize what was observed in the field and allows the reviewer to agree (or disagree) that the data indicates the presence of a fault.

Possible Alternative Fault Interpretation

During trenching to located fault traces geologists should make every attempt to observe truncated or laterally displaced bedding because these features usually provide some of the better corroborative evidence for faulting. Trench log of T-2(78) at Station 1+30 shows an interbedded sequence of gravels, sand, and siltstone at the upslope (southwestern end) of the trench. These beds abruptly terminate downslope (to the northeast) against a relatively thick bed of siltstone. The contact between the sedimentary sequence and the siltstone is described as "*Fault Plane, N0°E, 87°N with white caliche along plane, gray shears to 1" either side*" (Terratech, 1978). The stated bearing of the fault plane appears to contain a transcription error because an inclined planar feature cannot trend in a north-south direction and at the same time dip to the north. Three possible orientations for this feature are 1) N90°E (trending east-west), 87°N; 2) N0°E (trending north-south), 87°E; or 3) N0°E (trending north south), 87°W It seems more likely that the actual bearing of the "*fault plane*" was N90°E (trending east-west) dipping 87°N because we did not encounter any evidence of faulting in the trenches logged for the Ranchers Feed property directly north of the project site (*Pacific Rim Geologic*, 1998). In our opinion, it could be argued that subsurface evidence for the presence of an east-west-trending, nearly vertical fault based on the observed "*fault plane*" is perhaps stronger than the evidence presented by Terratech based solely on the presence of slickensides. The East Branch of the Calaveras fault

has been observed by others as being nearly vertical. (Terratech, 1983, 1987a, and 1987b; PGEI, 1988).

On Figure 2 we have mapped a second inferred fault trace designated as the "inferred southern fault trace" passing through the steeper slopes in the southern portion of the property. The northernmost fault trace inferred by Terratech is designated as the "inferred northern fault trace." Although the observed "*fault plane*" in T-2(78) was not used by Terratech (1978) to locate faulting through the property, we believe the inferred southern fault trace could represent a suitable alternative interpretation for faulting. We did not encounter this fault trace in our trenches in the vicinity of the project site. Consequently, the inferred southern fault trace will not adversely affect the proposed development.

Ground Shaking

The project site is situated in the seismically active San Francisco and Monterey Bay Areas. Relatively strong, damaging earthquakes occur fairly frequently in the Hollister area. According to Rogers (1980), between 1800 and 1961 at least 19 earthquakes he defined as "major" caused damage in the City of Hollister. Since 1961, 2 additional earthquakes have caused significant damage in Hollister, namely the 1976 "Coyote Lake" earthquake and the 1984 "Morgan Hill" earthquake. These data suggest that earthquakes capable of causing damage in Hollister occur on the average of about once every decade. Therefore, it appears likely that periodically the project site will be shaken by earthquakes generated by movements along nearby active faults and, possibly, along nearby potentially active faults.

Faults that have the possibility of causing significant ground shaking at the project site are listed in Table 1 and shown in Figure 6, Regional Fault Location Map. The Working Group on Northern California Earthquake potential (1996) and the State of California (Petersen and others, 1996) have identified these faults as capable of producing earthquakes larger than moment magnitude 6 in the vicinity of the project site. For each fault we have listed fault length, distance from the project site, historic moment magnitude of the largest earthquake the fault is capable of generating, estimated mean (50th percentile) horizontal peak ground acceleration in San Benito Gravels at the project site from such an earthquake, activity level, and estimated effective recurrence time for such an earthquake. "50th percentile PGA" means there is an 50% probability that the peak ground acceleration will not exceed the stated value.

Table 1 - Pertinent Faults and Seismic Considerations – Grace Property

Fault & activity	Length km (miles)	Distance & direction from site km (miles)	Historic* Moment Magnitude (M_w)	Peak** Ground Accel. 50th %ile QTsb	Effective recurrence time, yr
Southern Calaveras (RL)	106 (66)	1 (0) to W	6.2	0.60	33
Sargent (R & RL)	53 (33)	4 (3) to NW	6.8	0.69	330
Quien Sabe (RL)	22 (14)	7 (5) to NE	6.4	0.42	600
Zayante-Vergeles (R & RL)	35 (5)	9 (5) to W	6.8	0.44	10,000
San Andreas 1906 rupture (RL)	470 (292)	10 (6) to W	7.9	0.47	210
San Andreas SC Mts (RL)	37 (23)	28 (17) to NW	7.0	0.14	400
Ortigalita (RL)	66 (41)	33 (20) to E	6.9	0.12	1,100
Rinconada (RL)	190 (118)	36 (22) to SW	7.3	0.13	1,700
Great Valley 8 (R)	41 (25)	45 (28) to NE	6.6	0.09	540
Great Valley 9 (R)	39 (24)	46 (28) to E-NE	6.6	0.09	520
Monterey Bay -	—	—	—	—	
Tularcitos (R & RL)	83 (52)	50 (31) to SW	7.1	0.10	2,600
Hayward, Southeast Ext.(R & RL)	26 (16)	54 (34) to N-NW	6.4	0.06	220
Monte Vista-Shannon (PA) (R)	41 (25)	55 (34) to NW	6.8	0.08	2,400
Great Valley 10 (R)	22 (14)	58 (36) to E-SE	6.4	0.06	400
San Gregorio –	—	— —	—	—	
Sur Region (R & RL)	79 (49)	63 (39) to SW	7.1	0.08	400
Greenville (RL)	73 (45)	63 (39) N-NW	6.9	0.06	550
San Andreas Peninsula (RL)	88 (54)	64 (40) to NW	7.1	0.06	400
San Gregorio (R & RL)	129 (80)	65 (40) to SW	7.3	0.08	400
Great Valley 7 (R)	45 (28)	70 (43) to NE	6.7	0.06	560
Great Valley 11 (R)	25 (16)	71 (44) to SE	6.4	0.05	425
Northern Calaveras (RL)	52 (32)	74 (46) to N-NW	6.8	0.05	146
Hayward South (A) (RL)	43 (27)	74 (46) to NW	6.9	0.05	210
Great Valley 12 (R)	17 (10)	95 (59) to SE	6.3	0.03	360
Great Valley 6 (R)	45 (28)	96 (60) to N-NE	6.7	0.04	560

Notes:
* The maximum earthquake (based on historic data) that appears capable of occurring under the presently known tectonic framework (Working Group on Northern California Earthquake Potential, 1996, Petersen and others, 1996).
** Peak ground acceleration values represent 50th percentile, calculated using relationships from Abrahamson and Silva, 1997. (RL) = right lateral strike slip fault, (R) = reverse fault.

The notes listed at the bottom of Table 1 provide sources for the data in the table. The list of "Historic Moment Magnitude" in the fourth column from the left is based on information from Petersen and others (1996) and the Working Group on Northern California Earthquake Potential (1996). These are the maximum earthquake (based on historic data) that each fault appears capable of occurring under the presently known tectonic framework. The attenuation relationships for calculating peak ground accelerations were based on Abrahamson and Silva (1997). Abrahamson and Silva (1997) utilizes a correction that provides more conservative values (higher accelerations) that are characteristic of reverse (R) or right lateral with reverse component (RL & R) types of faults.

Peak ground acceleration values do not completely characterize the hazard due to ground shaking at a given site. Frequency distributions, duration of shaking, and number of repeatable high ground accelerations are also important. So-called "site effects," another unknown, could

also affect actual ground accelerations at the project site. Site effects mainly include the effects that topography has on transmission and focusing of seismic energy.

The last characteristic earthquake on the North Coast segment of the San Andreas fault was the "San Francisco" earthquake of 1906. The North Coast segment of the San Andreas fault is approximately 292 miles long and includes the San Francisco Peninsula segment and the Southern Santa Cruz Mountains segment. Movement along the entire North Coast segment of the San Andreas fault caused the 1906 earthquake which in turn caused extensive damage throughout the San Francisco Bay Region.

Recent data from the U.S. Geological Survey (Working Group on California Earthquake Probabilities, 1999) indicates there is a 70 percent (formerly 67 percent, WGCEP, 1990) chance for at least one earthquake of magnitude 6.7 (formerly magnitude 7) or greater in the San Francisco Bay Area in the next 30 years. Earthquakes of this magnitude could occur on faults or fault segments in the region closest to the project site; the San Francisco Peninsula segment of the San Andreas fault (21% probability), the southern portion of the Calaveras fault (18% probability), the northern portion of the Hayward fault (32% probability), and the San Gregorio fault (10% probability) (Figure 6).

The project site is likely to be shaken by earthquakes of approximate moment magnitude 7.9 (similar to the "San Francisco" earthquake of 1906) with an effective recurrence time of 210 years (Working Group on Northern California Earthquake Potential, 1996).

The primary seismic hazard at the project site appears to be the potential for very strong ground shaking and associated high vertical and lateral bedrock acceleration due to a major earthquake close to the project site. Even under the influence of severe ground shaking, the presence of relatively dense clayey soils and shallow dense young San Benito Gravel bedrock, and absence of observed ground failures indicates a very low potential for seismically induced landsliding or ground failure in the vicinity of the proposed development. As discussed below in more detail (**Liquefaction, Lateral Spreading and Lurching** section, below), the liquefaction potential within the dense clayey soils and gravel bedrock is considered negligible. The levels of risk to property and life due to intense ground shaking are considered similar to nearby properties.

Field Based Geotechnical Parameters from Nearby Sites Underlain by QTsb

Table 2 summarizes pertinent field based geotechnical parameters of subsurface materials beneath 3 sites in the vicinity of the project site as compiled and summarized by Rosenberg in his 1998 report (Rosenberg, 1998a) "Liquefaction Susceptibility of the Hollister Area, San Benito County, California." The three investigation locations are: 1) Hollister Highway 156 bypass investigated by Caltrans in 1992 (situated about 2.5 miles west and northwest of the project site); 2) Park Hill water tank site investigated by Earth Systems consultants in 1996 (situated about 1000 feet west

of the project site); and 3) the Migrant Farmworker Center investigated by Earth Systems Consultants in 1996 (situated about 3 miles southeast of the project site). These investigation locations share similar geologic conditions because of their location on three tectonically elevated hills believed to have formed due to compressive forces along the adjacent Calaveras fault, and because the hills are underlain by San Benito Gravels. Consequently, we have inferred that geotechnical parameters beneath the project site are likely to be similar to the three investigation locations. It should be noted that we did not use subsurface geotechnical data from Terratech's (1978) logs for borings B-1 through B-4 on the subject property because we are not certain whether these borings encountered San Benito Gravels.

Table 2 summarizes data collected at approximate 5-foot intervals in each boring by Earth Systems Consultants, including boring number, depth of sampling interval, equivalent standard penetration test (SPT N1) values for the field blow counts using relationships by Seed and others (1985). The last column on the right is the estimated shear wave velocity in meters per second based on SPT values. These shear wave velocities are used to provide suitable seismic design parameters for the project site as specified by recent building codes (see **Seismic Design Parameters** section, below).

Table 2 - SPT N Values in QTsb Based on Borehole Data Compiled by Rosenberg, 1998a

Location: Hollister Highway 156 Bypass Investigated by Caltrans, undated

Boring No.	Surface Elev. (feet)	Depth (ft)	Date Drilled	Drilling Method	SPT N Values	USCS Soil Type	Lithology	SPT Range (average)	Est. Shear Wave Velocity m/s
B-12	283	0-5	9/16/92	3.5"	---	GW	QTsb	21-72	180-360
(2)*		5-10		rotary	53	ML	QTsb	(40)	
		10-15		wash	54	ML	QTsb		
		15-20			72	SW	QTsb		
		20-25			21	SP	QTsb		
		25-30			34	ML	QTsb		
		30-35			35	ML	QTsb		
		35-40			29	ML	QTsb		
		40-45			32	ML	QTsb		
		45-50			27	ML	QTsb		

Table 2 (cont.) - SPT N Values in QTsb Based on Borehole Data Compiled by Rosenberg, 1998a

Location: Park Hill Water Tank Investigated by Earth Systems Consultants, 1996

Boring No.	Surface Elev. (feet)	Depth (ft)	Date Drilled	Drilling Method	SPT N Values	USCS Soil Type	Lithology	SPT Range (average)	Est. Shear Wave Velocity m/s
2	392	0-5	3/26/96	8"	29	SP	QTsb	29-124	360-760
(100)*		5-10		hollow	33	SP	QTsb	(70)	
		10-15		stem	78	SM	QTsb		
		15-20			124	SM	QTsb		
		20-25			72	SM	QTsb		
		25-30			68	SM	QTsb		
		30-35			106	SP	QTsb		
		35-40			61	SP	QTsb		
		40-45			59	SP	QTsb		

Location: Migrant Farmworker Center Investigated by Earth Systems Consultants, 1996

Boring No.	Surface Elev. (feet)	Depth (ft)	Date Drilled	Drilling Method	SPT N Values	USCS Soil Type	Lithology	SPT Range (average)	Est. Shear Wave Velocity m/s
B-3	415	0-5	10/1/96	8"	56	SC	QTsb	56-132	360-760
(281)*		5-10		hollow	32	SW	QTsb	(80.5)	
		10-15		stem	102	SW	QTsb		
		15-20			132	SW	QTsb		
B-4	415	0-5	10/1/96	8"	96	SC	QTsb	42-161	360-760
(282)*		5-10		hollow	42	SW	QTsb	(100)	
		10-15		stem	161	SW	QTsb		
B-5	422	0-5	10/1/96	8"	46	SW	QTsb	46-180	360-760
(280)*		5-10		hollow	124	SW	QTsb	(109)	
		10-15		stem	86	Rk	QTsb		
		15-20			180	Rk	QTsb		
B-6	430	0-5	10/1/96	8"	57	SC	QTsb	31-180	360-760
(279)*		5-10		hollow	31	SW	QTsb	(80.5)	
		10-15		stem	180	SW	QTsb		
		15-20			54	Rk	QTsb		
B-7	450	0-5	10/1/96	8"	57	SC	QTsb	32-65	360-760
(278)*		5-10		hollow	32	SW	QTsb	(51)	
		10-15		stem	65	SW	QTsb		

Notes: Soil types: SW=well graded sand; SC = clayey sand; SP = poorly graded sand; CL = low plasticity clay; SM = silty sand; ML = high plasticity silt; Rk = rock; SPT N Values ="standardized" blow count (N1)60 using method outlined by Seed and others (1985); QTsb = San Benito Gravels
Data from "Appendix 1 - Borehole data for subsurface data location map (plate 1)" of Rosenberg (1998a)

Seismic Design Parameters

The project site is located at 36.855 Latitude and 121.403 Longitude as determined on the U.S. Geological Survey 7.5-minute Hollister, California quadrangle using Topo! Software. The site is located in 1998 California Building Code (CBC) seismic zone 4. Table 3 summarizes pertinent seismic design parameters for the proposed project in accordance with the 1997 Uniform Building Code (UBC) and the 1998 CBC. Based on Table 2, above, the inferred soil profile type for San Benito Gravels beneath the project site is SC, very dense soil/soft rock, with an estimated shear wave velocity ranging from 360-760 meters/second.

To attempt to adjust the 1997 UBC and 1998 CBC seismic design parameters to conform to conditions in the Hollister area, we reviewed design response spectrum curves for six critical sites in Hollister, prepared by CDMG Senior Engineering Geologist Robert Sydnor (1999). These curves were provided to us by Mr. Lew Rosenberg so that appropriate design basis ground motion parameters could be formulated for the project site. The six sites include the Hollister Airport, Fairhaven School, Freemont School, Ladd Lane School, San Benito Health Care, and San Benito High School.

Based on our review, it appears that the design response spectrum calculated for San Benito High School would be appropriate for the project site. The San Benito High School site and the project site are similar because they are both situated within several hundred feet of the main trace of the Calaveras fault. Consequently, both sites would likely experience intense near field seismic shaking during a significant earthquake on the southern segment of the Calaveras fault.

The underlying geology, however, and thus the UBC 1997 soil profile types for the two sites are slightly different. For San Benito High School, Sydnor (1999) characterized the valley floor sediments as soil class SD, stiff soil. However, because the project site is underlain by San Benito Gravels, with inferred SPT N blow counts generally greater than 50 (see Table 2), we have characterized the soil profile as being soil class SC, very dense soil to soft rock. Consequently, to apply the design response spectrum for San Benito High School to the project would appear to be sufficiently conservative.

Figure 9 shows the design response spectrum for San Benito High School as determined by Sydnor (1999) and provided to us by Rosenberg. The three curves on Figure 9 include (1) a bold lower line, which is the response spectrum based on 1997 UBC, (2) a dashed middle line, showing the design response spectrum for residential and commercial development based on 10% exceedence in 50 years, and (3) a solid upper line, showing design response spectrum for public schools and hospitals based on 10% exceedence in 100 years. The calculated probabilistic estimate for peak ground acceleration (Design Basis Ground Motion defined in the 1997 UBC) for residential and commercial development (dashed curve, Figure 9) is approximately 0.77g at

Tn = 0.4 seconds (Sydnor, 1999). This is similar to the probabilistically derived peak ground acceleration of 0.73g value for the Ranchers Feed commercial site provided by Rosenberg in his geologic review letter (1998b) of our report of that site (*Pacific Rim Geologic*, 1998), and for the Hollister Airport (0.73g, Table 1, Rosenberg, 1998a).

Specifically, seismic response coefficients Ca and Cv were determined to be 0.77 and 0.90, respectively, for an earthquake within 1 km of the project site on the Calaveras fault (nearest type "B" fault).

Table 3 – Parameters for Seismic Design 1997 Uniform Building Code and 1998 California Building Code, Grace Property

Active Seismic Source	Seismic Zone	Closest Distance To Seismic Source	Soil Profile Type (QTsb)	Seismic Coeff. Ca*	Seismic Coeff. Cv**	Na	Nv	Design Basis Ground Motion #
Calaveras fault	"B" Type	< 1 km	SC-very dense soil/soft rock Shear Wave Velocity = 360 – 760 meters/second	0.77	0.90	1.3	1.6	0.77g

Notes: * site specific value for San Benito High School prepared by Senior Engineering Geologist Robert H. Sydnor, California Division of Mines
** from Tables 16-R & 16-T of the 1997 Uniform Building Code
# based on 10% exceedance in 50 years, used for residential and commercial development

Liquefaction, Lateral Spreading, and Lurching

Because the predominantly sand and gravels of the San Benito Gravels beneath the project site are generally dense to very dense and the younger alluvium clays are stiff to very stiff, the potential is low that liquefaction will effect the project site. Therefore, liquefaction appears to be highly unlikely in the vicinity of the proposed development. Liquefaction potential for areas underlain by San Benito Gravels is considered very low according to Rosenberg (1998a).

Because we did not observe any evidence of lateral spreading or lurching due to the Loma Prieta earthquake in the vicinity of the proposed developments during field mapping our on aerial photographs, we believe that it is unlikely that lateral spreading or lurching could significantly affect the project site. Therefore, liquefaction, lateral spreading, and lurching are not considered a potential hazard to the project site, and mitigation measures are unnecessary.

Landsliding

Majmundar (1994) shows landslides in the vicinity of the project site on a published California Division of Mines and Geology map. Majmundar (1994) mapped the entire project site as being in a "relative landslide susceptibility area 2," which are areas marginally susceptible to landsliding. Majmundar did not map any landslide features within the vicinity of the project site (Majmundar, 1994).

We reviewed seven sets of aerial photographs taken in 1949, 1959, 1967, 1980, 1985, 1987, and 1997 to attempt to observe historic instability on slopes in the vicinity of the project site (see Figures 7 and 8). We did not observe any obvious landslide related features in the vicinity of the project site or immediate vicinity on the seven sets aerial photographs we reviewed taken during the last 50 years. We did not observe any obvious landslide features such as disturbed ground or fresh landslide scarps.

Earth System Consultants (2001) evaluated slope stability for the project site and concluded the following:

> "*The results of the slope stability analysis indicated that the existing slope is marginally sable under static conditions, i.e. the factor of safety against gross instability is between 1.3 and 1.5. However, under seismic conditions the factor of safety would be less than 1.0. Therefore, instability would be expected. The instability would probably be in the form of a wedge type failure, with the slide plane originating an estimated 15 to 20 feet back from the slope crest and extending to near the midpoint of the slope.*"

ESC used a design horizontal seismic acceleration of 0.31g to perform a pseudostatic factor of safety due to expected high accelerations from the nearby East Branch of the Calaveras.

Debris Flow Activity

Areas were debris flows have occurred in the past, or where they may occur in the future, are potentially hazardous areas for development. Saturated soil and colluvium on steep slopes can fail and flow downhill as fast as 30 to 40 miles per hour, and structures situated in the torrent track or in the depositional area of the debris flow can be damaged or destroyed by the impact of the rapidly-moving material. In addition, ground failure at the source of the debris flow could undermine structures built on or close to the source area.

We did not observe evidence of recent debris flow activity such as fresh scars, torrent tracks, or deposits in the vicinity of the project site on aerial photographs or during field mapping. The

southwestern half of the property is situated on relatively steep (~25 to 30 degrees) slopes covered with thin colluvial soils derived from San Benito Gravel. Consequently, it appears that this portion of the property has the potential to be a source for debris flows. The relatively flat northeastern half, designated as the project site, will not likely be a source of debris flows, but could be adversely effected by debris flows emanating from the adjacent slopes. Therefore, debris flow activity is considered a potential hazard to the project site. Mitigation of debris flow hazard on the project site may be provided by suitably designed and constructed stabilizing or retaining structures under the direction and supervision of a geotechnical engineer.

Earth System Consultants (2001) indicated that slopes on the property are subject to shallow failures. In their report they stated:

> "*Although the analysis indicated that the slope is marginally stable (with respect to a large, deep failure) in the static condition, it is also subject to shallower failures. These types of failures could occur, particularly in the locally very steep portions of the slope, as the near-surface soils lose strength when they become saturated or more weathered. Vegetation growth and erosion can also cause or contribute to shallow slope stability. Shallow instability could also occur during an earthquake producing accelerations less than the design event.*"

Erosion

Sandy material of the surface residual/colluvial deposits and underlying San Benito Gravels are erodible where exposed on unvegetated slopes throughout San Benito County. On unvegetated slopes or when disturbed by grading, these material are susceptible to erosion by significant quantities of flowing water. Except for long term mass wasting of the slope along the southwestern half of the property, we did not observe any significant erosional features in the vicinity of the project site on aerial photographs or during our field mapping. Due to the relatively steep slopes that border the southern parameter of the project site, it appears that surface runoff has the potential to significantly affect the proposed development.

Measures to improve site drainage of the proposed improvements are discussed in the **Recommendations** section of our report. Properly designed and constructed erosion features can mitigate the potential hazard of erosion of surficial soils.

Expansion of Surface Soil

Because the San Benito Gravels and younger alluvium underlying the project site consist predominantly sands, gravels, and clays with low plasticity, the expansion potential of the on-site

surface soil is low. Highly expansive soil therefore is not considered a potential hazard to the proposed development, and mitigation measures are unnecessary.

Settlement of Thick Fill

Relatively thick fill (up to about 15 feet) consisting of garbage and construction debris underlies most of the project site. Consequently, the potential exists that long term settlement of the fill could adversely affect the development. The project geotechnical engineer should provide recommendations for mitigating settlement due to consolidation of the fill beneath the project site.

Rapid Sedimentation and Flooding

We did not observe any evidence of rapid sedimentation such as fresh unvegetated sedimentary deposits, or flooding in the vicinity of the project site on aerial photographs or during field mapping. Because the sandy earth materials beneath the project site appear to be fairly permeable, runoff from large storms probably infiltrates rapidly into the ground. Also, the watershed upslope of the project site and vicinity is relatively small. Therefore, the watershed will not likely produce significantly large runoff with the potential to adversely affect the proposed development.

Although sedimentation and flooding do not appear to be a significant constraint to the proposed development, it would be prudent to construct surface drainage structures upslope of proposed buildings. These structures would collect and divert runoff away from the proposed development. Prudent surface drainage of the proposed improvements is discussed in the **Recommendations** section of our report.

CONCLUSIONS AND RECOMMENDATIONS

From a geologic standpoint, the project site and vicinity appear to be suitable for the proposed development of either a commercial storage facility (no human occupancy) or multiple-family residential structures (human occupancy) if the recommendations presented in this report and those provided by the project geotechnical engineer are incorporated into planning, design, and construction. The most significant constraints to the project site and development are severe ground shaking due to an earthquake on a nearby active or potentially active fault, and settlement of thick garbage fill.

No evidence of faulting was observed in Plio-Pleistocene age San Benito Gravels, or in younger alluvial deposits, in four exploratory trenches. Consequently, it appears that the previously mapped fault trace identified by Terratech (1978) is not present. We conclude that the possibility

of future fault rupture across the project site is low and no further investigation of faulting in the project site is warranted.

The fault trace identified by Terratech (1978) was mapped solely on the presence of slickensides observed on siltstone. In our opinion, a more likely explanation for the slickensides observed in trench T-2(78) by Terratech (1978) would be local shearing due to flexural slip during monoclinal folding of the San Benito Gravels during uplift of Park Hill. Because the slickensides in T-3(78) were not observed in place it possible they could have been produced by the backhoe bucket during digging operations. The observed slickensides in T-2(78) appear to be very local features. During our trenching on December 6 and 7, 2001, we did not observe any slickensides or indications of obvious pervasive shearing. Consequently, it appears that the potential is low for future flexural slip shearing beneath the project site. Because we did not observe any specific features indicative of pervasive shearing due to flexural slip, it is our opinion building sites could be situated anywhere in the project site (i.e. no building setback distances are needed) . It may be prudent however, to mitigate the potential hazard of minor ground movement due to flexural slip by suitable design and construction of foundations to withstand anticipated ground movements.

Properly designed and constructed rigid mat foundation or a pier and grade beam with suitable pier depth into competent firm earth material would likely provide a low risk for injury and loss of life due to ground accelerations, fill settlement, or flexural slip. The project geotechnical engineer should be consulted for site specific recommendations and design of foundations for the proposed development.

On Figure 2 we mapped a second inferred fault trace designated as the "inferred southern fault trace" passing through the steeper slopes in the southern portion of the property. It appears that an observed "fault plane" in T-2(78), which possessed a probable east-west trend and near vertical dip (87°N), was not used by Terratech (1978) to locate their generally northwest-trending and moderately northeast dipping (59°NE) fault through the property. The fault plane is depicted on trench log of T-2(78) at Station 1+30 as an interbedded sequence of gravels, sand, and siltstone at the upslope (southwestern end) of the trench that abruptly terminate downslope against a relatively thick bed of siltstone. In our opinion, it could be argued that subsurface evidence for the presence of an east-west-trending, nearly vertical fault based on the observed termination of several beds is perhaps stronger than the evidence presented by Terratech based solely on the presence of slickensides. Previous fault investigations that encountered the East Branch of the Calaveras fault where it passes through the southeastern Hollister (Terratech, 1983, 1987a, and 1987b; PGEI, 1988), indicate that the presence of terminating beds along near vertical shear surfaces provided unequivocal evidence of faulting. In addition, the orientation of Terratech's "inferred northern fault trace" is very similar to bedding attitudes in San Benito Gravels that we measured in trenches TR-1(01), TR-2(01), and TR-3(01). It seems fortuitous that the local orientation of the inferred fault trace closely matches bedding orientation.

Because we did not encounter the southern inferred fault trace in our trenches in the vicinity of the project site, the inferred southern fault trace, if present, will not adversely affect the development. Therefore, ground rupture due to the inferred southern fault trace is not considered a potential hazard to the present development, and mitigation measures are unnecessary.

The levels of risk of property and life posed by earthquake-induced ground accelerations and erosion at the project site are comparable to the levels of risk for other sites in the region. The potential for property damage due to ground accelerations is low to moderate if suitable 1997 UBC and 1998 CBC seismic design parameters are incorporated into structural design of the residence. It should be noted that UBC and CBC parameters represent minimum requirements for seismic design. Building codes are intended to prevent collapse of structures for safety of life, but not to prevent structural damage.

For the project site, sufficiently conservative seismic response coefficients of 0.77 (Ca) and 0.90 (Cv) for an earthquake within 1 km of the project site on the Calaveras fault (nearest type "B" fault). These values were determined by CDMG Senior Engineering Geologist Robert Sydnor (1999) for a similar site in Hollister (San Benito High School).

Because we did not observe any evidence of lateral spreading or lurching due to the Loma Prieta earthquake in the vicinity of the proposed development during field mapping, we believe that it is unlikely that lateral spreading or lurching could significantly affect the project site. Liquefaction potential for areas underlain by San Benito Gravels is considered very low according Rosenberg (1998a). Therefore, liquefaction, lateral spreading, and lurching are not considered a potential hazard to the project site.

We did not observe any obvious landslide features on the project site such as fresh landslide scarps on aerial photographs taken during the last 50 years or during mapping. Based on their slope stability analysis for the project site Earth Systems Consultants (2001) concluded the following:

> "*The results of the slope stability analysis indicated that the existing slope is marginally sable under static conditions, i.e. the factor of safety against gross instability is between 1.3 and 1.5. However, under seismic conditions the factor of safety would be less than 1.0. Therefore, instability would be expected. The instability would probably be in the form of a wedge type failure, with the slide plane originating an estimated 15 to 20 feet back from the slope crest and extending to near the midpoint of the slope.*"

We did not observe evidence of recent debris flow activity such as fresh scars, torrent tracks, or deposits in the vicinity of the project site on aerial photographs taken during the last 50 years or during field mapping. The southwestern half of the property is situated on relatively steep (~25

to 30 degrees) slopes covered with thin colluvial soils derived from San Benito Gravel. Consequently, it appears that this portion of the property has the potential to be a source for debris flows. The relatively flat northeastern half, designated as the project site, will not likely be a source of debris flows, but could be adversely effected by debris flows emanating from the adjacent slopes. Therefore, debris flow activity is considered a potential hazard to the project site. To mitigate general mass wasting/debris flow hazards on the project site we recommend that engineered structures be suitably designed and constructed upslope of proposed structures that directly stabilize the slope (such as soil nailing) or retain soil debris such as retaining walls. The project geotechnical engineer should be consulted for site specific recommendations and design of stabilizing structures for the proposed development.

We did not observe any significant erosional features in the vicinity of the project site on aerial photographs or during our field mapping. Due to the relatively steep slopes that border the southern parameter of the project site, it appears that surface runoff has the potential to significantly affect the proposed development. To mitigate the potential for erosion, thorough control of all site drainage must be established and diligently maintained by the property owner. It appears likely that the native sandy soils are highly erodible where exposed to concentrated runoff. Collected runoff should be conveyed away from buildings, and discharged in a controlled fashion into existing or properly constructed drainage courses. The site drainage improvements should be easily accessible to promote frequent routine maintenance by the property owner. Surface runoff be collected upslope of each residential development and diverted to suitable downslope locations. Design of suitable drainage structures for the anticipated runoff should be provided by a licensed Civil Engineer.

Because the San Benito Gravels and younger alluvium underlying the project site consist predominantly sands, gravels, and clays with low plasticity, the expansion potential of the on-site surface soil is low. Highly expansive soil therefore is not considered a potential hazard to the proposed development, and mitigation measures are unnecessary.

Relatively thick fill (up to about 15 feet) consisting of garbage and construction debris underlies most of the project site. Consequently, the potential exists that long term settlement of the fill could adversely affect the development. The project geotechnical engineer should provide recommendations for mitigating settlement due to consolidation of the fill beneath the project site.

We did not observe any evidence of rapid sedimentation such as fresh unvegetated sedimentary deposits, or flooding in the vicinity of the project site on aerial photographs or during field mapping. Because the sandy earth materials beneath the project site appear to be fairly permeable, runoff from large storms probably infiltrates rapidly into the ground. Also, the watershed upslope of the project site is relatively small. Therefore, the watershed will not likely

produce significantly large runoff with the potential to adversely affect the proposed development.

LIMITATIONS

Our work has been performed in accordance with the practices and standard of care generally employed by the local engineering geologic profession. They have been based upon data obtained from the study of geologic literature, interpretation of aerial photographs, logging of exploratory backhoe trenches, reconnaissance geologic field mapping, and review of design seismic response spectrum of six locations in Hollister performed by CDMG Senior Engineering Geologist Mr. Robert Sydnor. No other warranty, express or implied, is provided. Our geologic evaluation has been conducted in a manner consistent with the standard of practice.

Sincerely,

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REFERENCES

Bissell & Karn, Inc, 1984, Sheet 15 of 27, City of Hollister orthophotographic-topographic maps, scale 1"=200'.

Boore, D.M., Joyner, W.B., and Fumal, T.E., 1997, Equations for estimating horizontal response spectra and peak acceleration from Western North American earthquakes: a summary of recent work: in Seismological Society of America, Seismological Research Letters, Vol. 68, No. 1, January/February 1997, pp. 128-153.

Coppersmith, K.J., 1979, Activity assessment of the Zayante-Vergeles fault, central San Andreas fault system, California: unpublished Ph.D. dissertation, University of California Santa Cruz, 216 p., scales 1:48,000 and 1:250,000.

California Building Standards Commission, 1998, 1998 California Building Code, Chapters 16 and 18.

California Division of Mines and Geology, 1982, Earthquake fault zone map of the Hollister, California Quadrangle, San Benito County, California, 1:24,000.

California Department of Conservation, Division of Mines and Geology, 1986a, Guidelines for geologic/seismic reports: CDMG Note 42, 2 p.

California Department of Conservation, Division of Mines and Geology, 1986b, Guidelines for preparing engineering geologic reports: CDMG Note 44, 2 p.

California Department of Conservation, Division of Mines and Geology, 1997, Guidelines for evaluating and mitigating seismic hazards in California: CDMG Special Publication 117, 74 p.

California Department of Conservation, Division of Mines and Geology, 1998, Guidelines for evaluating the hazard of surface fault rupture: CDMG Note 49, 2 p.

Campbell, K.W., 1981, Near-source attenuation of peak horizontal acceleration: Bulletin of the Seismological Society of America, v. 71, no. 6, p. 2039-2070.

Clark, J.C., 1973, Geologic and gravity maps of the Santa Cruz-San Juan Bautista area, Santa Cruz, Santa Clara, Monterey, and San Benito Counties, California: U.S. Geological Survey Professional Paper 783, plate 1, scale 1:125,000.

Clark, J.C., 1981, Stratigraphy, paleontology, and geology of the Central Santa Cruz Mountains, California Coast Ranges: U.S. Geological Survey Professional Paper 1168, 51 p., 2 sheets, scale 1:62,500.

Dibblee, T.W., Jr., and Rogers, T.H., 1975, Geologic map of the Hollister Quadrangle, San Benito County: U.S. Geological Survey Open File Map 79-394, 1:62,500.

Earth Systems Consultants, 1992, Fault study, Hart properties, APN 053-37-0-002-0 and 091-13-0-024-0, North Street, Hollister, California: unpublished consultant's report, 36 p.

Earth Systems Consultants, 1996a, Geology report, proposed Park Hill water tank & delivery line, Park Hill, Hollister, California: unpublished consultant's report on-file at City of Hollister Planning Department, 22p.

Earth Systems Consultants, 1996b, Soils engineering report, San Benito County Migrant Farmworker Center, Labor Camp Road, Hollister, California: unpublished consultant's report, 8p., 2 appendices.

Earth Systems Consultants Northern California, 2001, Preliminary soils engineering report, Grace storage lockers, First Street, Hollister, California: unpublished consultant's report, 15 p.

Farrar, C.D., 1981, Ground water level monitoring network, Hollister and San Juan Valleys, San Benito County, California: U.S. Geological Survey Water Resources Investigation, Open-File Report 81-86, 9 p.

Hart, E.W., 1997, Fault-rupture hazard zones in California: California Division of Mines and Geology Special Publication 42, revised edition, 25 p.

Herd, D.G., 1978, Neotectonics of the San Francisco Bay Region, California, in Summaries of technical reports, volume V, prepared by participants in the National Earthquake Hazards Reduction Program: U.S. Geological Survey, p. 22-24.

Hoose, S.N., 1983, Holocene fluvial and lacustrine (?) deposits in the vicinity of Hollister and the San Juan Valley, California: Program and Abstracts, Annual Meeting of Pacific Sections of AAPG, SEG, SEPM, Sacramento, California, p. 93.

Hoose, S.N., 1986, Was there a great Pleistocene Lake San Benito?: San Jose, California, San Jose State University, M.S. thesis, 87 p. 6 plates.

International Conference of Building Officials, 1997, Uniform building code.

International Conference of Building Officials, 1998, Maps of known active fault near-source zones in California and adjacent portions of Nevada, scale 1:150,000

Jenkins, O.P., 1973, Pleistocene Lake San Benito: California Geology, vol. 26, no. 7, p. 151-163.

Jennings, C.W., (compiler), 1975, Fault map of California: Geologic Data Map No. 1, scale 1:750,000.

Kilburn, Chabot, 1972, Ground-water Hydrology of the Hollister and San Juan Valleys, San Benito County, California: U.S. Geological Survey Water Resources Division, Open-File Report, 44 p.

Majmundar, H.H., 1994, Landslide Hazards in the Hollister Area, San Benito County, California, Landslide Hazard Identification Map No. 30: Department of Conservation, Division of Mines and Geology, DMG Open-File Report 94-02, scale 1:24,000.

Manson, M.W., Keefer, D.K., and McKittrick, M.A. (compilers), 1991, Landslides and other geologic features in the Santa Cruz Mountains, California, resulting from the Loma Prieta earthquake of October 17, 1989: California Division of Mines and Geology Open-File Report 91-05, 1:48,000, 45 p.

McCrory, P.A., Greene, H.G., and Lajoie, K.R., 1977, Map showing earthquake intensity zonation and distribution of Quaternary deposits, San Mateo, Santa Cruz, and Monterey Counties, California: U.S. Geological Survey Miscellaneous field Studies Map MF-903, scale 1:250,000

McNutt, S.R. and Sydnor, R.H. (eds), 1990, The Loma Prieta (Santa Cruz Mountains), California earthquake of 17 October 1989: California Department of Conservation, Division of Mines and Geology Special Publication 104, 142 p.

McNutt, S.R. and Toppozada, T.R., 1990, Seismological aspects of the 17 October 1989 earthquake: in S.R. McNutt and R.H. Sydnor (eds), 1990, The Loma Prieta (Santa Cruz Mountains), California earthquake of 17 October 1989: California Department of Conservation, Division of Mines and Geology Special Publication 104, p. 67-82.

Pacific Rim Geologic, 1998, Fault investigation of the east branch of the Calaveras fault, Ranchers Feed, 354 First Street, Hollister, California: unpublished consultant's report, 17p.

Pacific Rim Geologic, 2000, Preliminary engineering geologic evaluation, Sada property, 410 North Street, Hollister, California: unpublished consultant's report, 28p.

Petersen, M.D., Bryant, W.A., Cramer, C.H., Cao, T., and Reichle, M.S., 1996, Probabilistic seismic hazard assessment for the State of California: Department of Conservation Division of Mines and Geology Open File Report 96-08.

Ploessel, M.R. and Slosson, J.E., 1974, Repeatable high ground accelerations from earthquakes-important design criteria: California Geology, California Division of Mines and Geology, v. 27, no. 9, p. 195-199.

Robbins, S.L., 1982, Complete Bouguer gravity, aeromagnetic, and generalized geologic map of the Hollister 15-minute quadrangle, California: U.S. Geological Survey, Geophysical Investigations Map, GP-945, 1:62,500.

Rogers, T.H., 1993, Geology of the Hollister and San Felipe quadrangles, San Benito, Santa Clara, and Monterey Counties, California: California Division of Mines and Geology Open File Report 93-01, 26 p., 3 plates, scale 1:24,000.

Rosenberg, L.I., 1998a, Liquefaction susceptibility of the Hollister area, San Benito County, California: U.S. Geological Survey Final Technical Report 1434-97-HQ-GR-03125, 69 p., 4 sheets, scale 1:24,000.

Rosenberg, L., 1998b, Geologic report review: site and architectural application No. 98-17, fault investigation of the east branch of the Calaveras fault, Rancher's Feed, 345 First Street, Hollister, California, Pacific Rim Geologic, dated September 17, 1998: review letter from consulting geologist for the City of Hollister (Mr. Lew Rosenberg) to Mr. William J. Card, Senior Planner, City of Hollister, 4p.

Rosenberg, L., 2000, Geologic report requirements, proposed replacement of existing home, 410 North Street, Hollister, California: memorandum from consulting geologist for the City of Hollister (Mr. Lew Rosenberg) to Mr.. William J. Card, Senior Planner, City of Hollister, 4 p.

Sarna-Wojcicki, A.M., Pampeyan, E.H., Hall, N.T., 1975, Map showing recently active breaks along the San Andreas fault between the Central Santa Cruz Mountains and the Northern Gabilan Range, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-650, 2 sheets, scale 1:24,000.

Seed, H.B., Tokimatsu, K., Harder, L.F., and Chung, R.M., 1985, Influence of SPT procedures in soil liquefaction resistance evaluations: Journal of Geotechnical Engineering, American Society of Civil Engineers, v. 111, no. GT12, p. 1425-1445.

Schwartz, D.P., and Ponti, E.J. (eds), 1990, Field guide to neotectonics of the San Andreas fault system, Santa Cruz Mountains, in light of the 1989 Loma Prieta Earthquake: U.S. Geological Survey Open-File Report 90-274, 38 p.

Shakal, A., Huang, M., Reichle, M., Ventura, C., Cao, T., Sherburne, R., Savage, M., Darragh, R., and Petersen, C., 1989, CSMIP strong-motion records from the Santa Cruz Mountains (Loma Prieta), California earthquake of 17 October 1989: California Division of Mines and Geology, Office of Strong Motion Studies Report OSMS 89-06, 196, p.

Spittler, T.E., and Harp, E.L., 1990, Preliminary map of landslide features and coseismic fissures in the Summit Road area of the Santa Cruz Mountains triggered by the Loma Prieta earthquake of October 17, 1989: California Division of Mines and Geology, Open-File Report 990-6, scale 1:4,800, 35 p.

Spittler, T.E., and Sydnor, R.H., 1990, Landslides and ridge-top failures associated with the epicentral area of the Loma Prieta Earthquake of October 17, 1989, Santa Cruz County, California: California Geology, California Division of Mines and Geology, v. 43, no. 2, p. 35.

Sydnor, R.H., Griggs, G.B., Weber, G.E., McCarthy, R.J., and Plant N., 1990, Coastal bluff landslides in Santa Cruz County resulting from the Loma Prieta earthquake of 17 October 1989: in S.R. McNutt and R.H. Sydnor (eds), The Loma Prieta (Santa Cruz Mountains), California earthquake of 17 October 1989, California Department of Conservation, Division of Mines and Geology Special Publication 104, p. 67-82.

Sydnor, R.H., 1999, Design response spectrum parameters for 6 sites in Hollister, California - Hollister Airport SMA, Fairhaven School, Fremont School, Ladd Lane School, San Benito Health Care SNF, and San Benito High School; unpublished ground motion data provided by Mr. Sydnor to the City of Hollister.

Taliaferro, N.L., 1948, Geologic map of the Hollister quadrangle: California Division of Mines and Geology Bulletin 143, Plate 1, 1:62,500.

Taylor, C.L., and Cluff, L.S., 1973, Fault activity and its significance assessed by exploratory excavation in Proceedings of the Conference on Tectonic Problems of the San Andreas Fault System: Stanford University Publication, Geological Sciences, v. XIII, September 1973, p. 239-247.

Terratech, Inc., 1978, Geologic/geotechnical investigation, First Street commercial property, Hollister, California: unpublished consultant's report, 8 p.

Terratech, Inc., 1983, Geologic investigation, East Branch of the Calaveras fault, Tiffany Ranch, Hollister, California: unpublished consultant's report, 9 p.

Terratech, Inc., 1987a, Investigation of the East Branch of the Calaveras fault, Prune Street School site (Rancho San Justo Tandem School Site), Hollister, California: unpublished consultant's report, 10 p.

Terratech, Inc., 1987b, Investigation of the East Branch of the Calaveras fault, Boege property, Hollister, California: unpublished consultant's report, 11 p.

Tsai, Y.B., 1992, Site-dependent response spectral shapes of East Bay strong-motion records from the Loma Prieta earthquake, *in* Borchardt, Glenn and others, eds., Proceedings of the Second Conference on Earthquake Hazards in the Eastern San Francisco Bay Area: California Department of Conservation, Division of Mines and Geology Special Publication 113, p. 475-480.

U.S. Department of Agriculture, Soil Conservation Service, 1969, Soil survey of San Benito County, California, 111 p.

Varnes, D.J., 1978, Slope movement types and processes, in Landslides: Analysis and Control: Transportation Research Board, National Academy of Sciences Special Report 176 (Schuster, R.L. and Krizek, R.J., eds.), Washington, D.C., p. 11-33.

Working Group on California Earthquake Probabilities, 1990, Probabilities of large earthquakes in the San Francisco Bay region, California: U.S. Geological Survey Circular 1053, 51 p.

Working Group on Northern California Earthquake Probabilities, 1996, Database of potential sources for earthquakes larger than magnitude 6 in Northern California: U.S. Geological Survey Open-File Report 96-705, 40 p.

Working Group on California Earthquake Probabilities, 1999, Earthquake probabilities in the San Francisco Bay region: 2000 to 2030 – a summary of findings: California: U.S. Geological Survey Open File Report 99-517, Internet online version 1.0, 36 p.

Youd, T.L., 1973, Liquefaction, flow, and associated ground failure: U.S. Geological Survey Circular 688, 12 p.

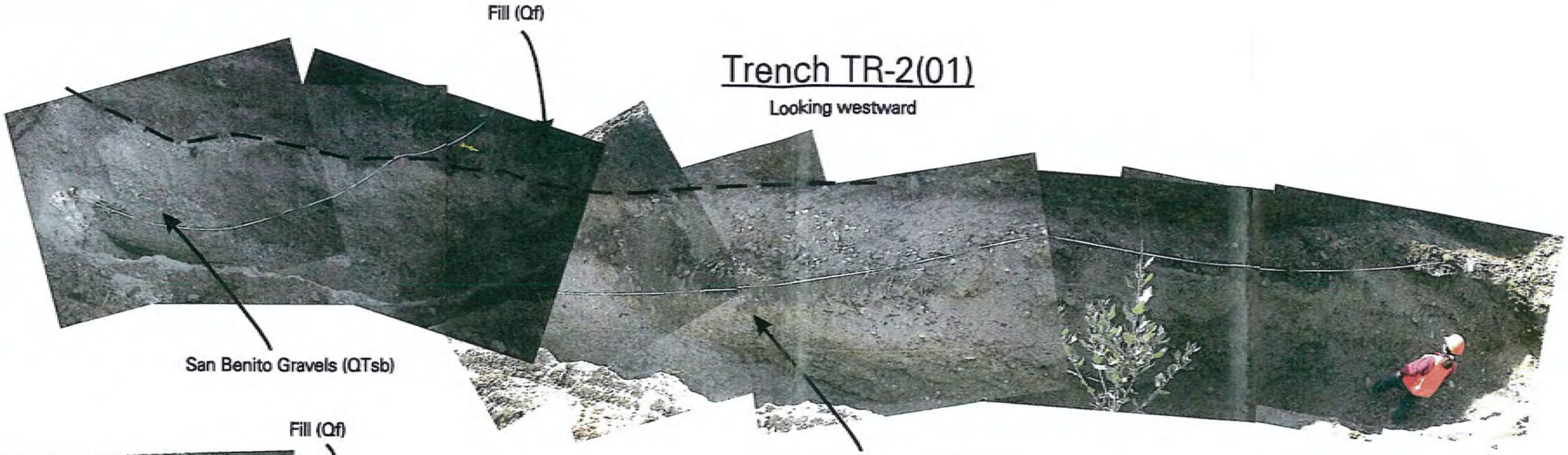
Youd, T.L. and Hoose, S.N., 1978, Historic ground failures in northern California triggered by earthquakes: U.S. Geological Survey Professional Paper 993, 117 p.

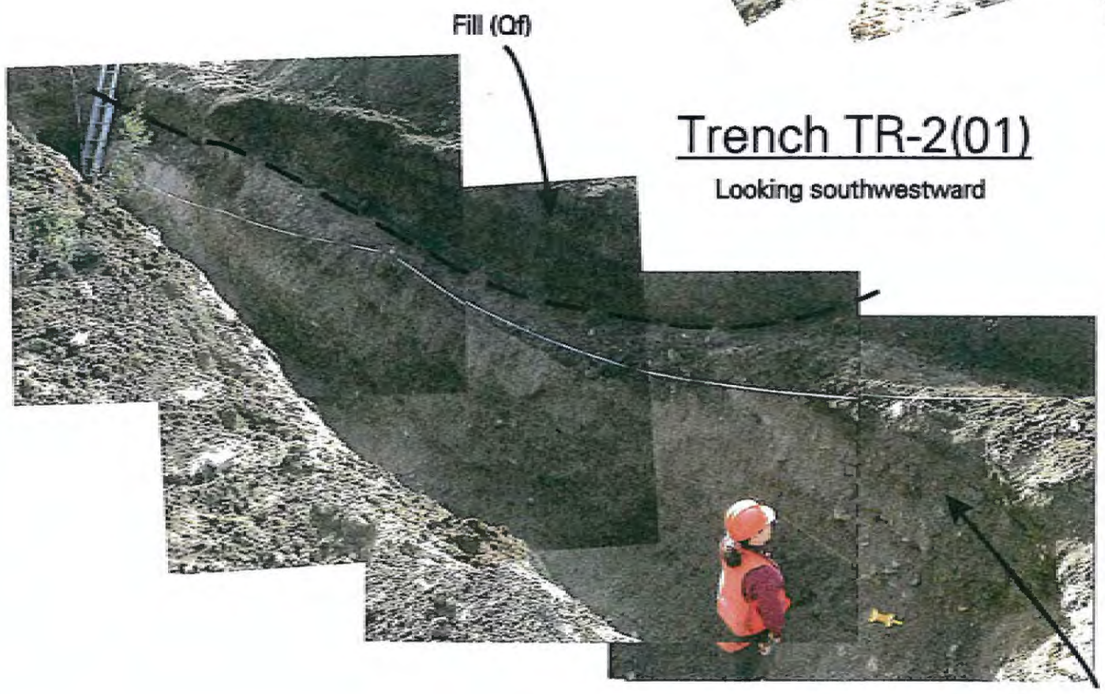
AERIAL PHOTOGRAPHS

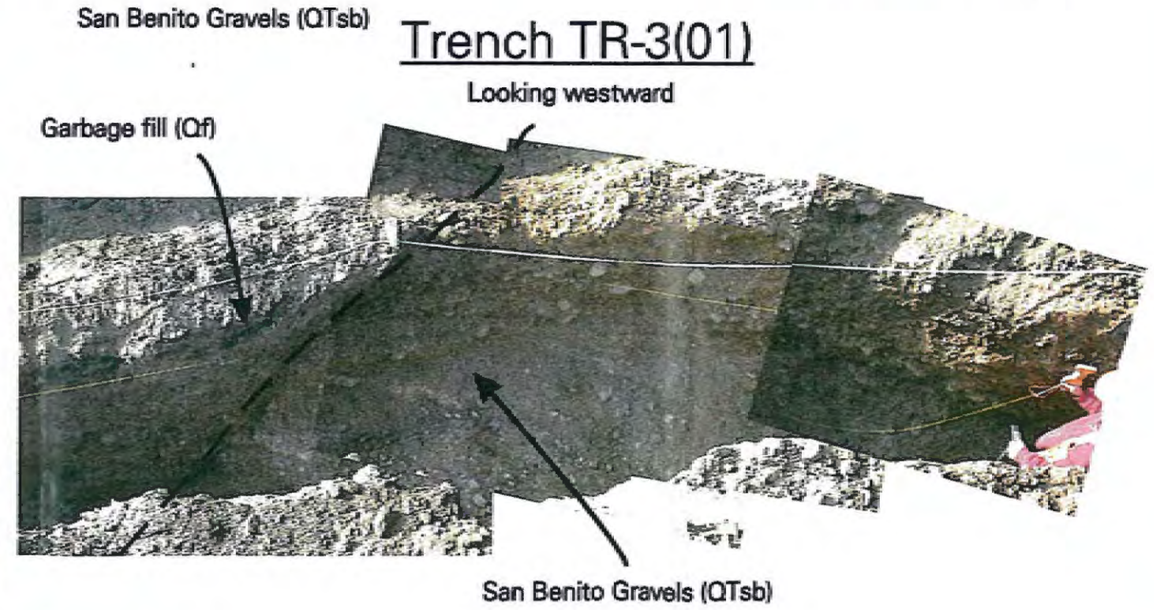
Date	Agency	Type	Roll & Frame	Scale
08/01/49	U.S.D.A.	black & white	BUX 12F-97 & 98	1:20,000
06/13/59	U.S.D.A.	black & white	BUX 7V-12 & 13	1:20,000
05/15/67	U.S.D.A.	black & white	BUX-1HH-91 & 92	1:20,000
05/07/80	U.S.D.A.	black & white	06069 379-76, 77, & 78	1:40,000
04/03/85	W.A.C. Corp.	black & white	WAC-85CA 7-248, 249, & 250	1:31,680
06/20/87	U.S.G.S.	black & white	NAPP 509-99 & 101	1:40,000
9/21/97	W.A.C. Corp.	black &	WAC-97CA 16-182 & 183, 16-199 & 200	1:31,680

APPENDICES

Appendix A – Figure A-1, Field Photographs – TR-2(01) & TR-3(01)







Pacific Rim Geologic

Notes:
1) photographs taken on December 6& 7, 2001
2) no scale
3) see Figures 4 and 5 for logs of trenches

March 2002

Field Photographs-TR-2(01) & TR-3(01)
Grace Property-Parcel 1, APN 54-19-09
341 First Street
Hollister, California

FIGURE
A1
PROJECT
1093

LIST OF FIGURES

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Figure 2 - Geologic Site Plan
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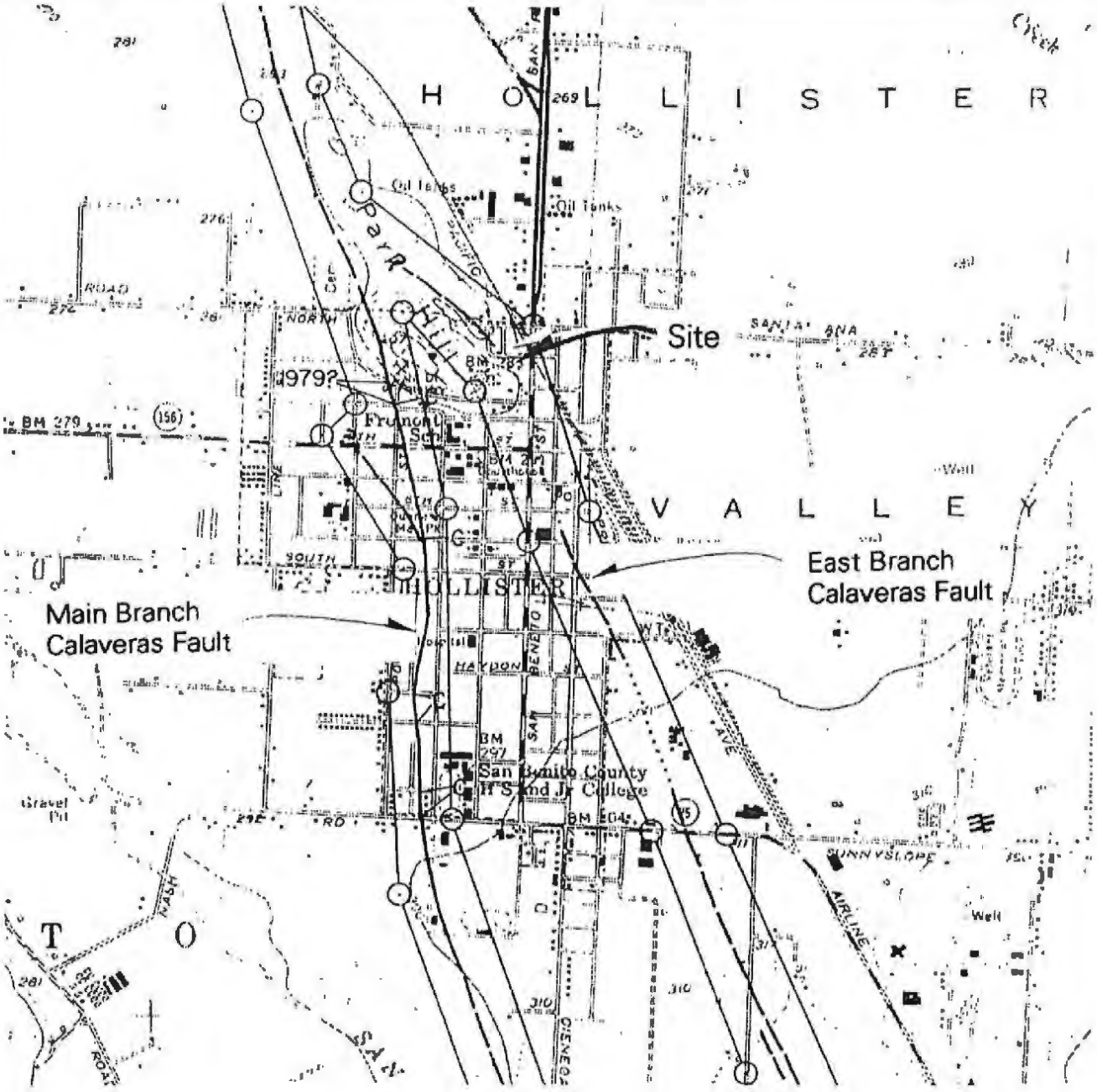
Figure 5 – Trench Logs of Trenches TR-3 and TR-4
Figure 6 – Regional Fault Location Map
Figure 7 – 1949 & 1959 Aerial Photographs
Figure 8 – 1967 & 1997 Aerial Photographs
Figure 9 – Design Response Spectrum of San Benito High School



Explanation

Boundary of Alquist-Priolo Earthquake Fault Zones

Active or potentially active fault, dashed where inferred, dotted where concealed; creep location indicated by 'C'

Base Maps: CDMG Earthquake Fault Zone Map, Hollister, California quadrangle, 1982

0 2000 4000

Scale in Feet

March 2002

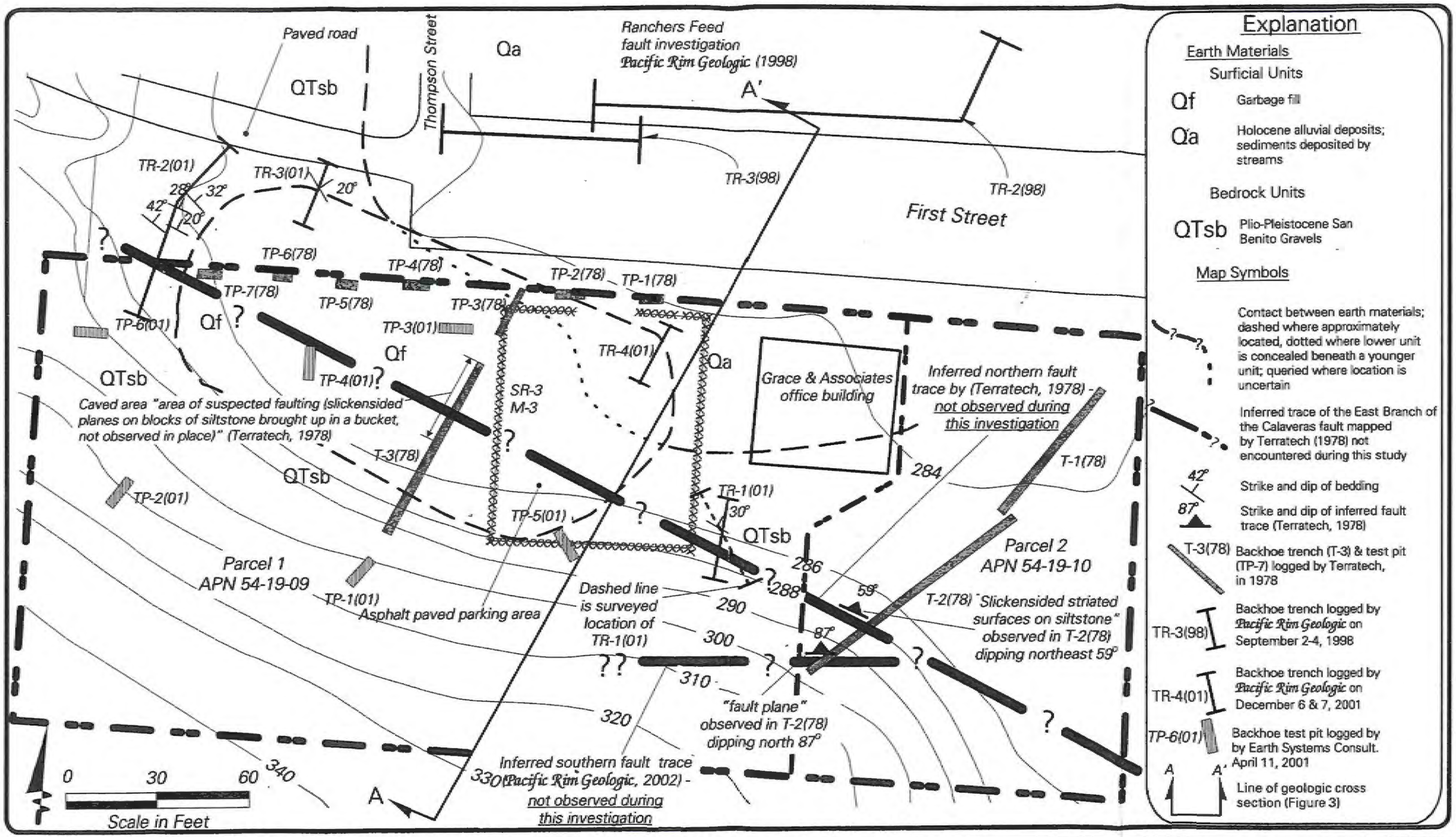
Pacific Rim Geologic

Vicinity Map

Grace Property-Parcel 1, APN 54-19-09
341 First Street
Hollister, California

FIGURE 1

PROJECT 1093



Pacific Rim Geologic

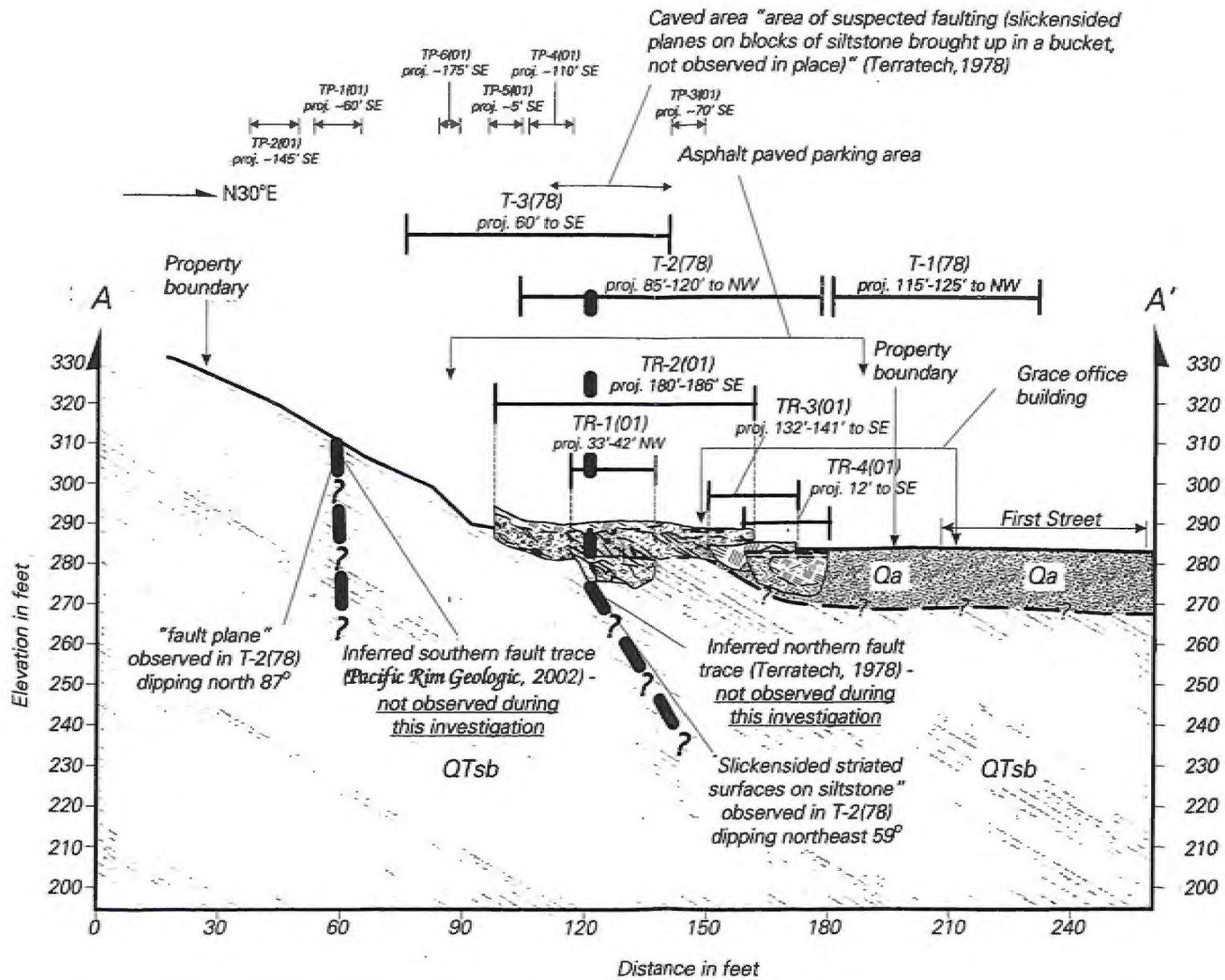
Base Maps: compilation of 1) Figure 2, Site Geologic Map from 1978 Terratech report; 2) Bissil & Kam, Inc., 1984, sheet 15 of 27 Department of Public Works, City of Hollister orthophoto map, scale 1"=200', based on 3/19/84 photography; 3) Field Exploration Location Map from 2001 Earth System Consultants report, scale 1"=200'; 4) Grace Property, First Street - Trench Location Survey," Roger Grimsley & Associates, dated 1/11/02, scale 1"= 40"

March 2002

Geologic Site Plan

Grace Property-Parcel 1, APN 54-19-09
341 First Street
Hollister, California

FIGURE 2
PROJECT 1093



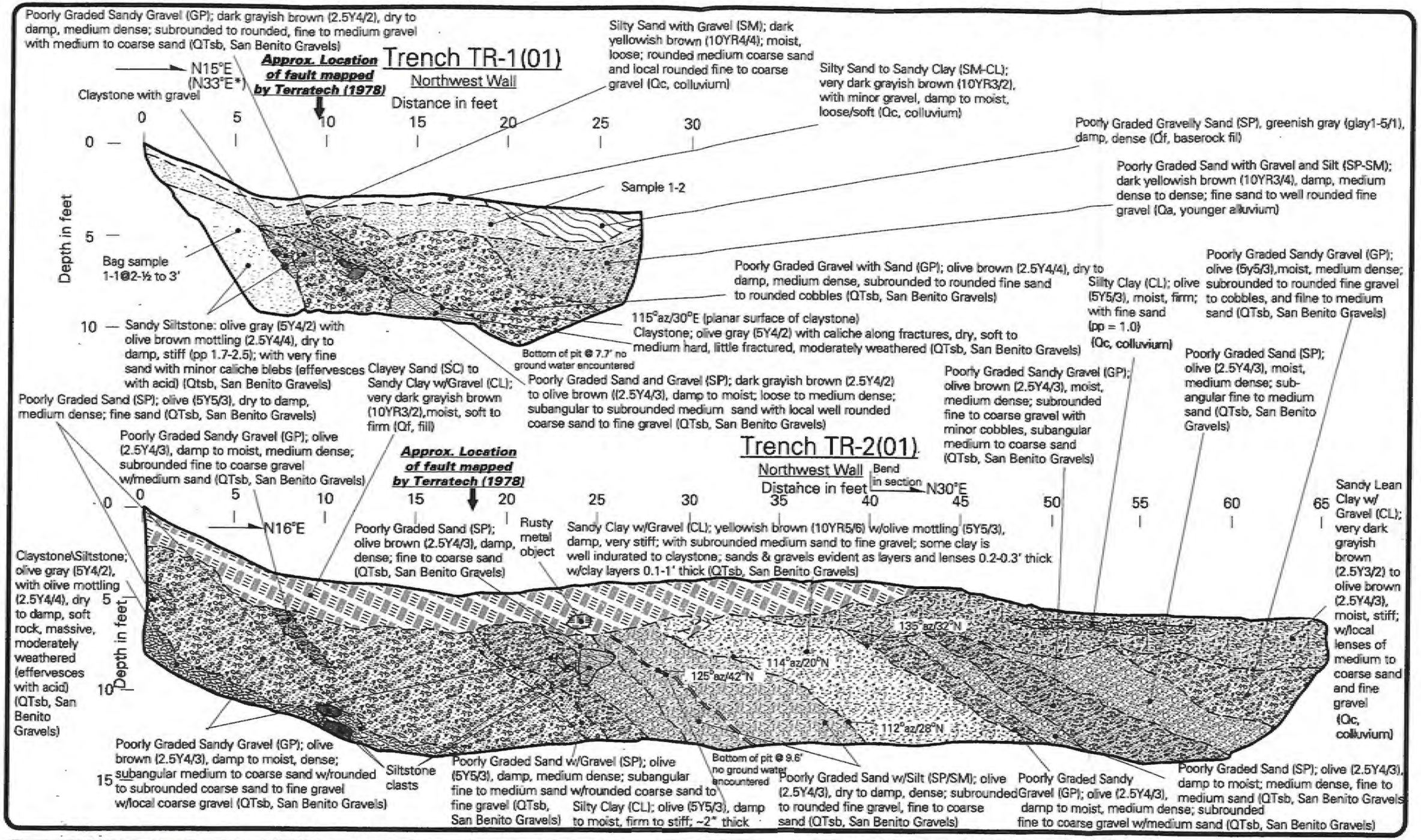
Pacific Rim Geologic

Notes: 1) See Figure 2 for explanation and location of section

March 2002

Geologic Cross Section
Grace Property-Parcel 1, APN 54-19-09
341 First Street
Hollister, California

FIGURE 3
PROJECT 1093



Pacific Rim Geologic

Notes:
1) Logged by J.L. Nelson & A.M. Hosokawa on December 6 & 7, 2001
2) 135°az/32°N = orientation of bedding: strike in degree azimuth/dip amount in degrees and dip direction
3) pp = pocket penetrometer
4)(N33°E*) = bearing of trench from Roger Grimsley & Assoc. Survey, 1/11/02

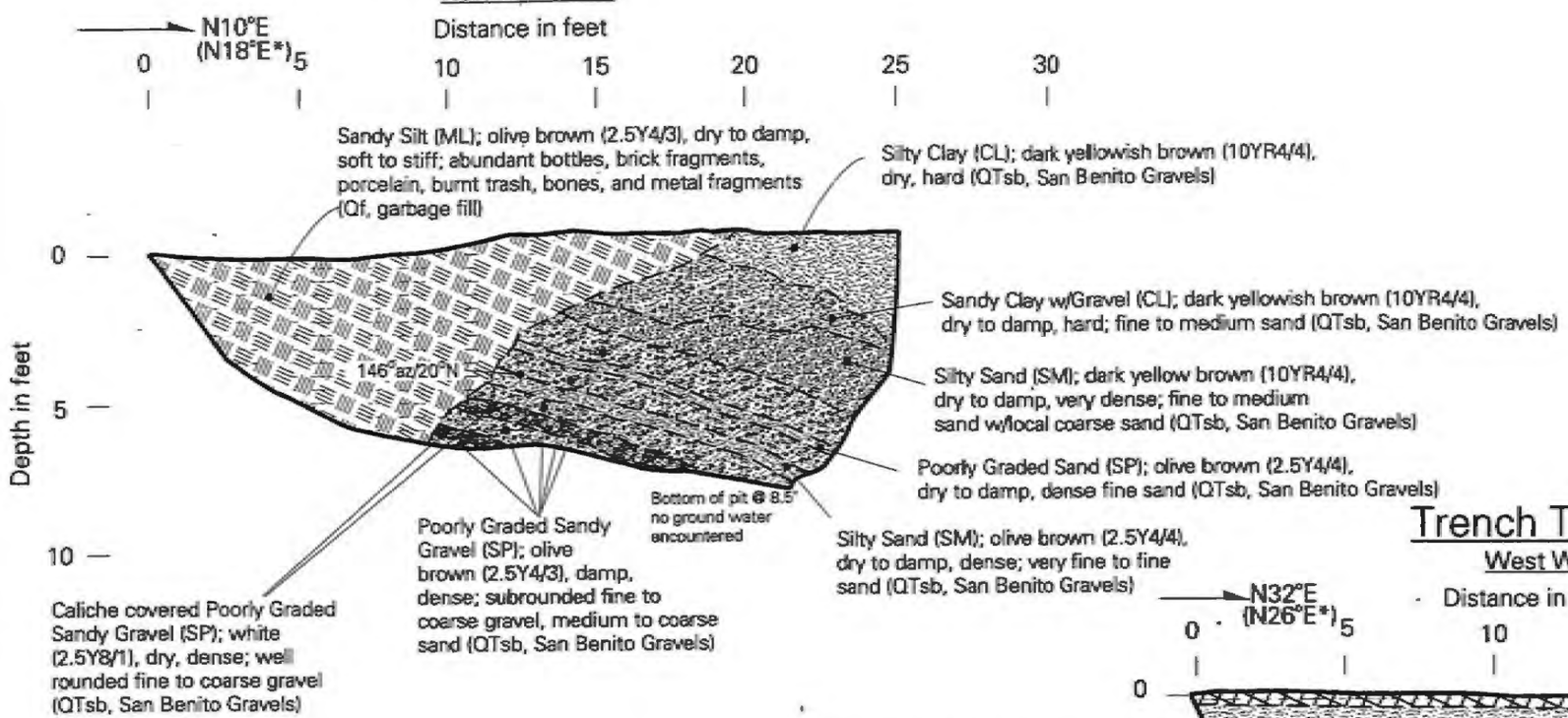
March 2002

Trench Logs of Trenches TR-1 and TR-2
Grace Property-Parcel 1, APN 54-19-09
341 First Street
Hollister, California

FIGURE 4
PROJECT 1093

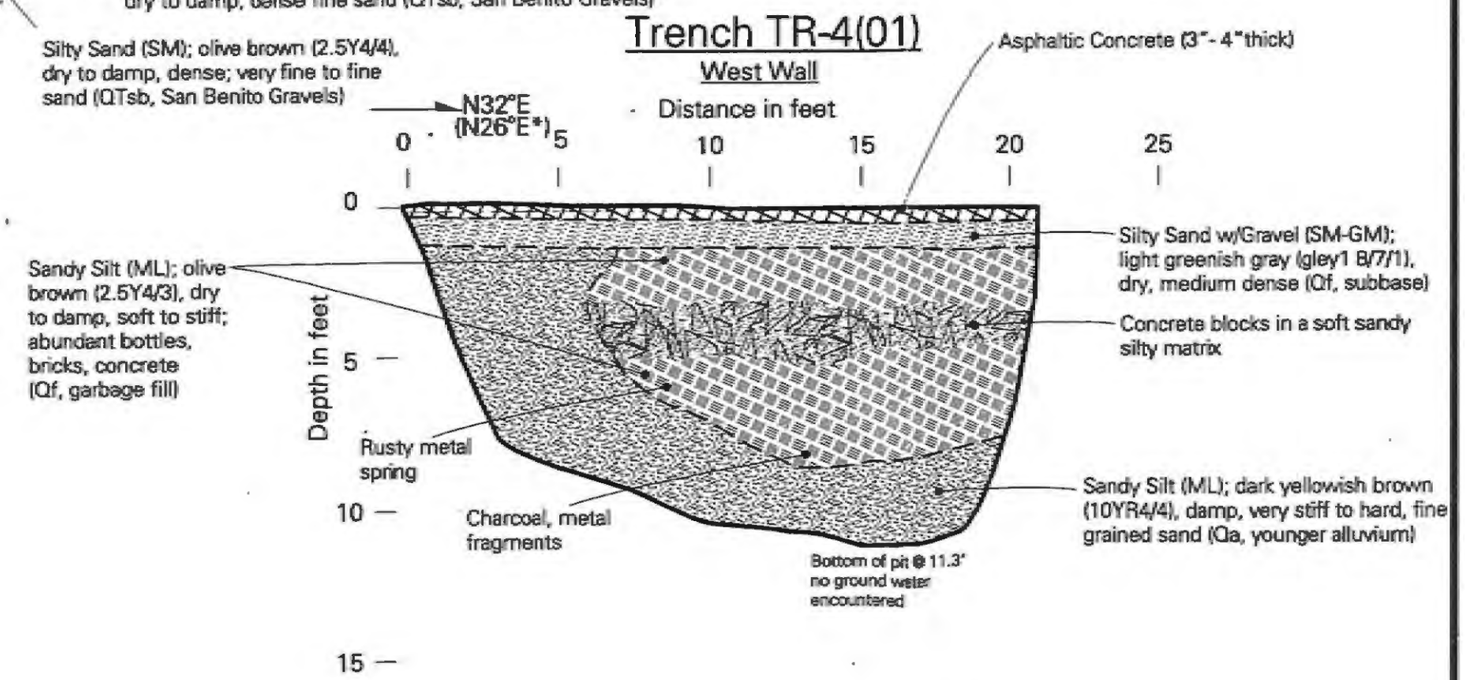
Trench TR-3(01)

Northwest Wall



Trench TR-4(01)

West Wall



Pacific Rim Geologic

Notes:
1) Logged by J.L. Nelson & A.M. Hosokawa on December 7, 2001
2) 146°az/20°N = orientation of bedding: strike in degree azimuth/dip amount in degrees and dip direction
3) (N26°E*) = bearing of trench from Roger Grimsley & Assoc. Survey, 1/11/02

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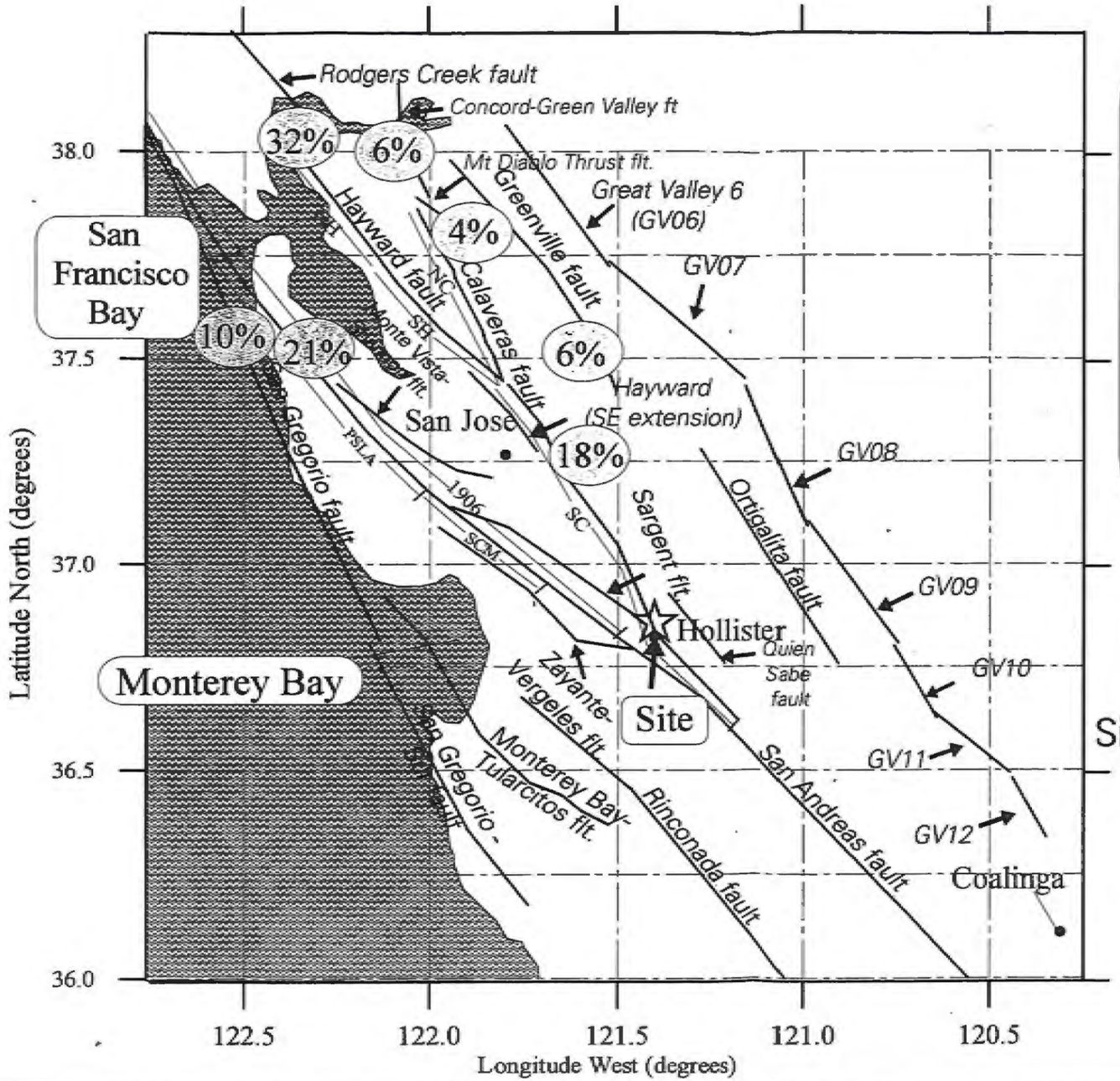
Trench Logs of Trenches TR-3 and TR-4
Grace Property-Parcel 1, APN 54-19-09
341 First Street
Hollister, California

FIGURE 5
PROJECT 1093



Explanation

32% Odds of mag. 6.7 or greater from 2000 to 2030 (see text)

Fault segment abbrivations

NC = Northern Calaveras
SC = Southern Calaveras
PSLA = Peninsula segment of SA
SCM = Santa Cruz Mts.segment of SA
1906 = 1906 EQ segment of SA
NH = Northern Hayward
SC = Southern Hayward
GV = Great Valley

N

0 20

Scale in Miles

Site Coordinates: Latitude: 36.855 N
Longitude: 121.403 W

March 2002

Pacific Rim Geologic

Regional Fault Location Map
Grace Property-Parcel 1, APN 54-19-09
341 First Street
Hollister, California

FIGURE
6
PROJECT
1049

Site

1949 photos

Z

Site

1959 photos

Notes:
1) each photo set is a stereo pair
2) see Aerial Photographs section of report for pertinent information on photographs
3) arrow shows general north direction
4) photos resized to unknown scale

March 2002

Pacific Rim Geologic

1949 & 1959 Aerial Photographs
Grace Property-Parcel 1, APN 54-19-09
341 First Street
Hollister, California

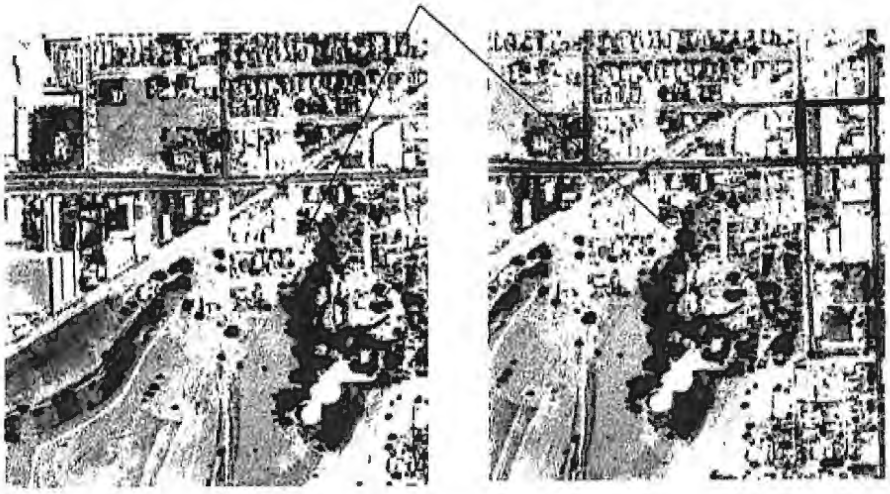
FIGURE 7
PROJECT 1093

Site

1967 photos

N

Site



1997 photos

Notes:
1) each photo set is a stereo pair
2) see Aerial Photographs section of report for pertinent information on photographs
3) arrow shows general north direction
4) photos resized to unknown scale

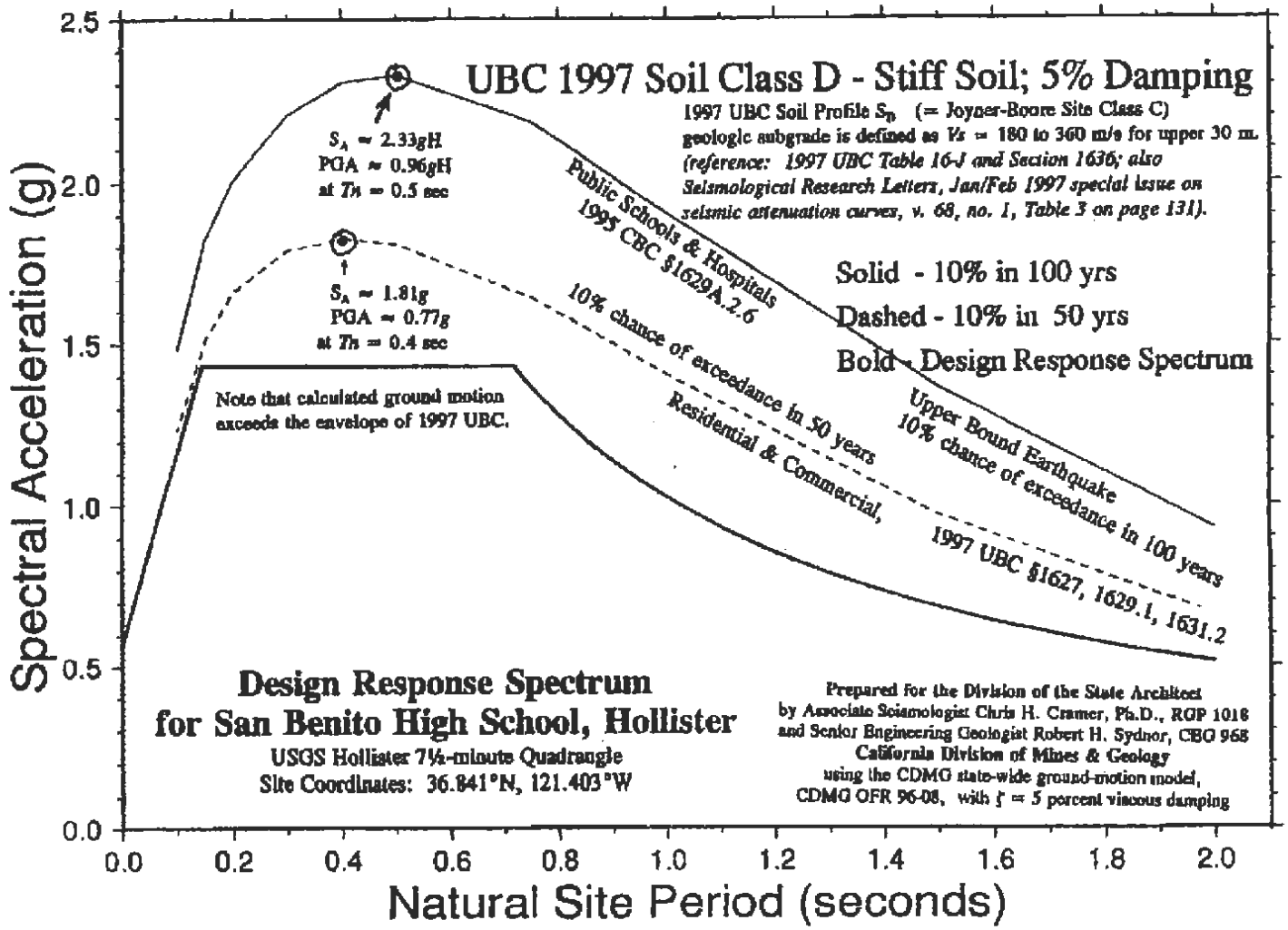
March 2002

Pacific Rim Geologic

1967 & 1997 Aerial Photographs
Grace Property-Parcel 1, APN 54-19-09
341 First Street
Hollister, California

FIGURE 8
PROJECT 1093

San Benito High School - Hollister



Pacific Rim Geologic

Design Response Spectrum
of San Benito High School
Grace Property-Parcel 1, APN 54-19-09
341 First Street
Hollister, California

FIGURE 9
PROJECT 1093

March 2002

Lew Rosenberg
C.E.G., C.P.G.

Consulting Geologist
Calif. License EG-1777

September 27, 2002

Mr. Ray Proffitt, C.B.O.
Building Official
City of Hollister
375 Fifth Street
Hollister, California 95023

GEOLOGIC REPORT REVIEW
Fault Location and Engineering Geologic Investigation
Pacific Rim Geologic, Project 1093, dated March 1, 2002
Grace Property, Parcel 1, APN 054-19-009
341 First Street, Hollister, California

Dear Mr. Proffitt:

At your request, I reviewed the geologic report prepared by Pacific Rim Geologic (project geologic consultant) for the proposed development at the Grace property. The purpose of this review was to evaluate whether the subject geologic report satisfies the City of Hollister requirement for mitigating potential geologic and seismic hazards to an acceptable level. The scope of services for this review included the following tasks:

- Reviewing the project geologic report prepared by Pacific Rim Geologic (PRG, 2002). The California Geological Survey (CGS) Notes 42, 44, and 49; and Chapter 16 of the 1997 Uniform Building Code (UBC) were used as the applicable review standards.
- I also read, but did not formally review the project soils engineering report (Earth Systems, 2001), as well as geologic reports prepared for the subject property and two adjacent sites (Terratech, 1978, 1990; Pacific Rim Geologic, 1998a, 1998b).
- Field review of the fault trenching was not included, because I was notified of the trenching while it was in progress and was unable to arrive in time to examine the trenches. However, the Hollister City Building Official, Ray Proffitt, inspected the trench conditions.
- Preparing this letter report discussing my findings, conclusions, and recommendations.

Project Description

Currently, the proposed project is undefined. According to PRG (2002), the site "could consist of a commercial storage facility or multiple-family residential structures." On the other hand, an earlier report by Earth Systems (ESC, 2001) stated that the project will consist of four single-story storage locker buildings with a concrete retaining wall at the base of the hill.

The Grace property is a 150- by 365-foot lot at the base of southeastern side of Park Hill. An existing office building is on the eastern side of the property and storage trailers and fill piles occupy the western side. The northern half of the property is nearly level, in contrast to the southern half of the property, which is a northeast-facing hillside that slopes down toward the site at an inclination of approximately 2H:1V (50 percent slope steepness). Surficial geologic materials at the site consist mainly of dense Pleistocene sand and gravel mapped as the San Benito Formation by Rogers (1993), with minor amounts of alluvium and colluvium on the more level part. The northwestern part of the site is locally underlain by buried garbage, which is typically several feet thick and as much as 14 feet thick. The proposed project will be on the level part of the site, to the west of the existing office building.

P.O. Box 183, Templeton, California 93465 • Phone & Fax: 805/434-1750 • E-Mail: Lrosenberg@thegrid.net

The entire property is within the State Earthquake Fault Zone established for east branch of Calaveras fault and a concealed trace extends northwest across the site (CDMG, 1982). If the project consists of storage lockers, it is exempt from the Alquist-Priolo Earthquake Fault Zoning Act because, according to PRG, the proposed storage lockers will have a human occupancy rate of less than 2,000 person-hours per year. However, if the project consists of multiple-family residential structures, then it is considered a "project" under the Alquist-Priolo Earthquake Fault Zoning Act. Additionally, Policies III.E.19 and 20 of the 1995 Hollister General Plan require that, "... all faults (as indicated by Alquist-Priolo Earthquake Fault-Rupture Hazard Zones) in the vicinity of the proposed development site have been investigated and that the proposed development incorporates mitigation measures which reduce all potential geologic and seismic hazards associated with the site to an acceptable level of risk."

Consultant's Conclusions and Recommendations

The PRG investigation consisted of a review of pertinent geologic data, photointerpretation of site, geologic mapping, subsurface exploration (logging of four trenches), and evaluation of geologic and seismic hazards. Based on their work, PRG reached the following main conclusions (p. 25–28):

1. Site Suitability. The site is suitable for either a commercial storage facility (no human occupancy) or multiple-family residential structures (human occupancy).

2. Fault-Related Ground Rupture. No evidence of faulting was exposed in the trenches and the slickensides that Terratech (1978) interpreted as related to active faulting are "... local shearing due to flexural slip..."; therefore, the fault previously mapped by Terratech (1978) is not present. Based on this negative evidence, PRG concluded that the risk of surface fault rupture is low and no building setbacks are needed.

3. Ground Shaking. Using probabilistic design response spectra prepared for San Benito High School (R.H. Sydnor, California Geological Survey, 1999, unpublished data), PRG recommended a peak ground acceleration of 0.77*g* for the Design Basis Earthquake (p. 21). The potential for damage from ground shaking is low to moderate if 1997 Uniform Building Code and 1998 California Building Code seismic design parameters are incorporated into the building design.

4. Liquefaction. The potential for liquefaction, lateral spreading, and lurching is low.

5. Landsliding. Although PRG cited Earth System's conclusion which states that the slope is marginally stable under static conditions and unstable under seismic conditions, PRG did not comment as to whether they concurred with Earth System's assessment. Debris flow activity is a potential hazard, and the level part of the site could be adversely affected by debris flows. The recommended mitigation is a combination of engineering structures (retaining walls) and slope stabilization measures (soil nailing).

6. Erosion. There is a potential for erosion from surface runoff off the slope to affect the site. The recommended mitigations are: collecting and discharging runoff in a controlled manner, design of the drainage structures by the project civil engineer, and maintenance of the structures by the property owner.

7. Flooding. The likelihood of flooding is low.

8. Expansive soil. Expansive soil is not considered a potential hazard and no mitigation is proposed.

9. Settlement. There is a potential for the garbage fill to settle and adversely affect the development. PRG recommended that the project geotechnical engineer provide mitigation recommendations for settlement.

Reviewer's Comments

The PRG report identifies the major constraints for developing the site. However, before the report can be accepted as fulfilling the City's requirement that the proposed development incorporates mitigation measures which reduce all potential geologic and seismic hazards associated with the site to an acceptable level of risk, several issues need clarification as discussed below:

1 Site Suitability. Development of this site poses major challenges from landsliding, active tectonic structures, and fill settlement. Providing a safe project will involve a combination of conservative design, skillful construction, and regular maintenance.

2. Fault-Related Ground Rupture. In the earlier report for this site by Terratech (1978), several features exposed in the trenches were interpreted by Terratech as evidence of "potentially active" (Quaternary) faulting. At least two of these same stratigraphic features exposed in the PRG trenches also align with the features in the Terratech trenches and are listed below:

Table 1. Aligned features in PRG (2002) and Terratech (1978) trenches

PRG (2002)		Terratech (1978)	
Feature	Location	Feature	Location
Sand and gravel beds truncated by siltstone bed	Trench TR–1, station 0+05	Sand and gravel beds truncated by sandstone bed	Trench 2, station 1+10
Planar surface of claystone (N. 65°W., 30°NE)	Trench TR–1, station 0+15	Slickensided surface on siltstone, fault plane? (N. 65°W., 59°NE)	Trench 2, station 1+10

The similar features and alignment suggest that the features found in the PRG trenches may be evidence of Quaternary faulting, especially the sand and gravel beds truncated by siltstone at 0+05 feet in PRG trench TR–1 and at 1+10 in Terratech trench 2. Identifying the age of the most recent faulting at this site is not possible due to the lack of Holocene marker beds, which have been removed by the excavation and subsequently replaced with artificial fill.

However, PRG does not believe that these features are indicative of Quaternary faulting. Instead, PRG (p. 26) contends that the slickensides found in Terratech's trenches 2 and 3 represent "local shearing due to flexural slip during monoclinal folding of the San Benito Gravels during the uplift of Park Hill." Because Park Hill was uplifted as the result of earthquakes, the implication is that the shearing is an "earthquake-generated flexural-slip fault" rather than an "earthquake-generating reverse fault" (Lensen, 1976; cited in Carver and McCalpin, 1996).

There are two problems with the proposed explanation. First, the folding at Park Hill is not monoclinal—Rogers (1993) shows a paired anticline and syncline. Second, the are no known examples of flexural slip folds formed by aseismic creep, such as present on the southern part of the Calaveras fault zone (Yeats, 1986). Even if the flexural slip explanation is correct, coseismic movement on flexural-slip faults is documented for the 1980 El Asnam, Algeria, earthquake and the 1968 Inangahua, New Zealand, earthquake (Yeats, 1986; Carver and McCalpin, 1996).

Therefore, regardless of whether the shear features exposed in the trenches can cause earthquakes or were caused by earthquakes, there is a potential for surface ground rupture at the site.

3. Ground Shaking. The Design Basis Earthquake ground motion of 0.77*g* was calculated using acceptable methodology and is appropriate for the commercial storage facility.

4. Liquefaction. The conclusions are satisfactory.

5. Landsliding. The project soils engineering report states that the gross factor of safety (FS) for the hillside is between 1.3 and 1.5 under static (nonseismic) conditions and "less than 1.0" under seismic conditions (ESC, 2001, p. 5). Presently, a FS of at least1.5 is for static conditions and at least 1.15 for seismic conditions are used by most jurisdictions in southern California (Blake and others, 2002, p. 56, 76). Using these criteria, the implication is that the hillside is unstable under the present conditions. For this reason, PRG needs to elaborate on whether the potential for landsliding is a geologic constraint that can or cannot be mitigated. The recommendation on p. 28 of the PRG report that; "... engineered structures be suitably designed and constructed upslope of proposed structures (such as soil nailing) or retain soils debris such as retaining walls" is unclear whether this refers to the gross stability of the entire slope or to surficial soil failures. There is also no mention of the possibility that the beds dipping out of slope (shown on figure 2 of the PRG report) are a possible contribution to slope instability.

In addition, there is no discussion of the potential for rockfall from the steep slope. In a geologic report for the adjacent property to the south, Terratech (1990, p. 4) noted that gravel- to boulder-size blocks had fallen from the slope during the 1989 Loma Prieta earthquake. Given the similar site conditions, there needs to be an evaluation of the rockfall potential at the site.

6. Erosion. The conclusions are satisfactory.

7. Flooding. The conclusions are satisfactory.

8. Expansive soil. The conclusions are satisfactory.

9. Settlement. The conclusions are satisfactory.

Reviewer's Recommendations

1. Fault-Related Ground Rupture. Because of the potential for ground rupture on either tectonic faults or flexural-slip faults, structures for human occupancy should not be constructed over the fault traces. Typically, the preferred mitigation for fault rupture is avoidance, with the structure typically set back 50 feet from the fault. PRG should provide estimates of vertical and horizontal ground movement along the fault that could be expected during earthquakes. Geotechnical and structural engineering techniques such as those outlined by Lazarte and others (1994) may be appropriate for mitigating secondary fracturing.

At the San Benito Foods warehouse (a site with less than 2,000 hours per year occupancy), the City of Hollister accepted this higher amount of risk and allowed building on the fault by adding several permit conditions:

- Commercial General Liability Insurance in an amount not less than $1,000,000 for each occurrence, combined single limit, in a form to be approved by the City.
- A release, indemnity and hold harmless agreement with the City.
- Appropriate signage on the premises warning occupants of potential seismic hazard.
- A limit on the number of persons that may occupy the building at any one time.
- Recording a deed restriction indicating the limits of occupied hours per year.

The City should consider implementing similar permit conditions if buildings (including less than 2,000 hours per year occupancy) are planned to be constructed with no fault setback.

2. Landsliding. PRG should state whether the potential for landsliding is a geologic constraint that can or cannot be mitigated. If it can be mitigated, provide specific recommendations on what type of measures are necessary from an engineering geologic viewpoint. Possible measures could include grading, retaining walls, or soil nailing. Design criteria from the engineering geologist are not necessary—they should be prepared by the project geotechnical and structural engineers. Discuss the potential for dip slope failures, including cuts for retaining walls. Also, comment on the potential for rockfall.

3. Design Review. PRG should review the project plans and to ensure that their engineering geology recommendations have been satisfied.

References Cited

Blake, T.F., Hollingsworth, R.A. and Stewart, J.P., eds., 2002, Recommended procedures for implementation of DMG Special Publication 117—Guidelines for analyzing and mitigating landslide hazards in California: Southern California Earthquake Center Report, 108 p., one appendix.

California Division of Mines and Geology, 1982, Revised Official Special Studies Zone Map of the Hollister quadrangle: State of California Alquist-Priolo Earthquake Fault Zoning Act map, scale 1:24,000.

_____1986a, Guidelines for preparing engineering geologic reports: DMG Note 44, 2 p.

_____1986b, Guidelines to geologic/seismic reports: DMG Note 42, 2 p.

_____1998b, Guidelines for evaluating the hazard of surface fault rupture: DMG Note 49, 2 p.

Carver, G.A., and McCalpin, J.P., 1996, Paleoseismology of compressional tectonic environments, *in* McCalpin, J.P., ed., Paleoseismology: San Diego, Calif., Academic Press, International Geophysics Series, v. 62, p. 183–270.

City of Hollister, 1995, Hollister General Plan, 1995–2010: City of Hollister Planning Department open-file report, 162 p.

Earth Systems Consultants, 2001, Preliminary soils engineering report, Grace Storage Lockers, First Street, Hollister, California: unpublished report, file no. HO-07641-01 dated June 27, 2001, 15 p., 2 appendices.

International Conference of Building Officials, 1997, Uniform Building Code: Whittier, Calif., International Conference of Building Officials, 3 volumes, variously paginated.

Lazarte, C.A., Bray, J.D., Johnson, A.M., and Lemmer, R.E., 1994, Surface breakage of the 1992 Landers earthquake and its effects on structures: Bulletin of the Seismological Society of America, v. 84, p. 547–561.

Lensen, G.J., 1976, Earth deformation in relation to town planning in New Zealand: Bulletin of the International Association of Engineering Geology, v. 14, p. 241–247.

Pacific Rim Geologic, 1998a, Fault investigation of the east branch of the Calaveras fault, Ranchers Feed, 345 First Street, Hollister, California: unpublished report, 17 p.

_____1998b, Addendum to fault investigation of the east branch of the Calaveras fault, Ranchers Feed, 345 First Street, Hollister, California: unpublished report, 3 p.

_____2002, Fault location and engineering geologic investigation, Grace Property, Parcel 1, APN 054-19-009, 341 First Street, Hollister, California: unpublished report, project 1093, dated March 1, 2002, 36 p., 1 appendix.

Rogers, T.H., 1993, Geology of the Hollister and San Felipe quadrangles, San Benito, Santa Clara, and Monterey Counties, California: California Division of Mines and Geology Open-File Report 93–01, 21 p., 3 appendices, 3 sheets, scale 1:24,000.

Terratech, 1978, Geologic/geotechnical investigation, First Street commercial property, Hollister, California: City of Hollister Planning Department open-file report, 9 p., 2 appendices.

_____1990, Limited geologic evaluation, Lands of Reardon and Wittrock, southeast corner of Park Hill, Hollister, California: unpublished report, project 8286, dated January 23, 1990, 9 p.

Yeats, R.S., 1986, Active faults related to folding, *in* Wallace, R.E., chairman, Active Tectonics: Washington, D.C., National Academy Press, p. 63–79.

Closure

This concludes my review comments. I will be happy to review the revised version of the project geologic report when it is available. Please contact me by phone at (805) 434–1750 or e-mail at Lrosenberg@thegrid.net if you have any questions regarding this review letter.

Sincerely,

Lewis I. Rosenberg
Calif. Certified Engineering Geologist EG-1777
Reviewing Geologist, City of Hollister

REGISTERED GEOLOGIST
EXP. 10/31/03
LEWIS ROSENBERG
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Copy: Bill Card, City of Hollister Community Development Dept.

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February 24, 2003

Mr. Ray Proffitt, C.B.O.
Building Official
City of Hollister
375 Fifth Street
Hollister, California 95023

COMMENTS ON PACIFIC RIM GEOLOGIC LETTER DATED DECEMBER 16, 2002

Response to 9/27/02 Review by City of Hollister Consulting Geologist, Lew Rosenberg
March 1, 2002 Pacific Rim Geologic Report
Fault Location and Engineering Geologic Investigation
Grace Property, Parcel 1, APN 054-19-009
341 First Street, Hollister, California

Dear Mr. Proffitt:

As you know, I reviewed the engineering geologic report prepared by Pacific Rim Geologic (project geologic consultant) for the proposed development at the Grace property. My review comments were issued in a letter dated September 27, 2002. In reply to this review letter, Pacific Rim Geologic (PRG) prepared a letter dated December 16, 2002, detailing their responses to my review. Therefore, my comments in this letter address the responses in the PRG December 2002 letter.

Consultant's Comments

1. Fault-Related Ground Rupture. In their March 2002 report, PRG interpreted disrupted bedding and slickenside features to have resulted from "local shearing due to flexural slip during monoclinal folding of the San Benito Gravels during the uplift of Park Hill." In response to comments in my review letter, PRG discarded the flexural slip model. Instead, PRG now postulates that the disrupted bedding and slickensides can be interpreted as features formed within a point-bar meandering stream environment. As shown on figure 3 of PRG (2002b), the paleochannel was near the base of the eastern side of Park Hill. The implication is that the disrupted bedding and slickensides are fluvial, not tectonic features; therefore, the risk of fault rupture hazard is low and no mitigating measures are necessary.

2. Landsliding. Potential landside hazards at the site include rockfall and adversely dipping beds. Comparison of a nearby site which experienced rockfall during the 1989 Loma Prieta earthquake with the subject site shows that the subject site lacks the vertical slope of the site that experienced rockfall and consequently, "rockfalls do not appear to pose a significant threat to the proposed development" (PRG, 2002b). Although adverse (dip-slope) bedding conditions exist at the site, "the slope has remained stable for at least the last 50 years and has experienced significant seismic and rainfall events" (PRG, 2002b). Additionally, because the bedding contacts consist of sandy cemented material rather than clayey material, PRG (2002b) believes that the coarse granular beds had "significant frictional strength" and the risk of landsliding is low to moderate.

Reviewer's Comments

1. Fault-Related Ground Rupture. An important part of science is considering multiple working hypotheses to explain observations. In this tradition, PRG goes to considerable length to

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explain why features previously mapped by others (Terratech, 1978; Bryant, 1979) as having a tectonic origin can be interpreted as having a fluvial origin. Distinguishing the origin of these features is a difficult task considering that the San Benito Gravels were laid down in a braided river environment (Griffin, 1967, p. 61) and that much of the drainage in the Hollister area is structurally controlled by faulting. Both the depositional environment and the tectonic setting obviously affect the character of the sediments exposed in the trench—separating these influences is a difficult task. Further complicating the interpretation is the fact that the southern part of the Calaveras fault zone is actively creeping, rather than moving in discrete episodes as most other faults, which results in a different style of deformation than other strike-slip faults. Although I agree that the sediments exposed in the trenches are fluvial, I disagree with the interpretation that the sediments are unfaulted.

In the classic meandering river model, sediments become increasing finer upward, with point bar lateral accretions consisting of lag conglomerate overlain by trough-bedded to parallel–laminated sandstone and ripple cross-laminated sandstone overlain by floodplain vertical accretions consisting of alternating sandstones and mudstones (Boggs, 1995, p. 317). The trench stratigraphy does not reflect this model because the fluvial sediments alternate between poorly graded sand and poorly graded gravel, with minor claystone and siltstone beds also present. Nor do the trench logs document the cross-bedding or ripple bedding that would be expected in a high-energy fluvial environment. Another interpretation is that the alternating sand and gravel beds represent stacked channel fills. Stacked channel fills are associated with intermittent streams that cross strike-slip faults (Weldon and others, 1996, p. 298–301). This interpretation would reconcile the postulated paleochannel and the mapped trace of the Calaveras fault.

PRG also discussed the non-pervasive nature of the fault-related features and how the trench conditions at the Grace site differ from other sites in Hollister where the east branch of the Calaveras fault was identified. The lack of persistence does not necessarily imply that a fault is not present. The persistence of faults exposed in trenches is problematic because under certain conditions faults are not always visible in trenches. Specifically, the non-visibility of fault strands is most common on strike-slip faults as compared with reverse or normal faults. Additionally, the non-visibility of faults is most common in sand-size materials (Bonilla and Lienkaemper, 1991). PRG's observation that the east branch of the Calaveras fault at the Boege, Tang, and Prune Street sites was characterized by near-vertical clay shears and vertical displacement of laterally continuous beds is correct. However, these other trench sites are near the center of the Hollister Valley and the upper 10 feet of material is mainly silt and clay (Holocene flood-plain deposits), whereas the Grace site is on the western edge of the valley and the upper 10 feet of material is mainly sand and gravel (San Benito Gravels). Therefore, the fault visibility and persistence would differ between these two groups of trenches because of their different stratigraphic units.

In summary, the evidence presented for a fluvial origin of the disrupted bedding and slickensides is equivocal. Three lines of evidence favor faulting over a fluvial origin. First, geomorphic features, specifically the saddle across Park Hill and a depression on the southeastern end of the saddle may be fault related (Bryant, 1979 p. 6). Second, the bedding in PRG trench TR-2(01) steepens toward the inferred fault mapped by Terratech (1978), suggesting a tectonic influence, if not origin. The third line of evidence is the truncation of gravel beds against steeply dipping claystone in PRG trench TR-1 (01).

With regard to my recommendation to provide estimates of vertical and horizontal ground movement along the fault, PRG (2002b) stated that the "current state of practice ... does not allow for adequately predicting or estimating the vertical or horizontal movements from such events." Actually, it is possible to estimate expected ground displacement during earthquakes

explain why features previously mapped by others (Terratech, 1978; Bryant, 1979) as having a tectonic origin can be interpreted as having a fluvial origin. Distinguishing the origin of these features is a difficult task considering that the San Benito Gravels were laid down in a braided river environment (Griffin, 1967, p. 61) and that much of the drainage in the Hollister area is structurally controlled by faulting. Both the depositional environment and the tectonic setting obviously affect the character of the sediments exposed in the trench—separating these influences is a difficult task. Further complicating the interpretation is the fact that the southern part of the Calaveras fault zone is actively creeping, rather than moving in discrete episodes as most other faults, which results in a different style of deformation than other strike-slip faults. Although I agree that the sediments exposed in the trenches are fluvial, I disagree with the interpretation that the sediments are unfaulted.

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With regard to my recommendation to provide estimates of vertical and horizontal ground movement along the fault, PRG (2002b) stated that the "current state of practice ... does not allow for adequately predicting or estimating the vertical or horizontal movements from such events." Actually, it is possible to estimate expected ground displacement during earthquakes

using parameters such as earthquake magnitude and fault rupture length. Wells and Coppersmith (1994) explain this methodology in a paper published by the Seismological Society of America.

2. Landsliding. The original report and review response document the landslide hazards at the site and provide general mitigation guidelines (PRG; 2002a, 2002b). However, I disagree with the assertion that the risk of adversely dipping bedding failures is low to moderate. The presence of "sandy cemented material" along bedding contacts is not conclusive evidence to assert that "sufficient frictional strength is present along the bedding." No laboratory testing has been done to support this statement. In addition, seepage along the contact could dissolve the cement, leaving sand, which typically has a cohesion value of near zero.

The project geotechnical engineering report also states that the hillside is "marginally stable in its current configuration" and that "removal of material near the base of the slope to construct the planned retaining wall could de-stabilize the slope" (ESC. 2001, p. 6). Therefore, the slope stabilization measures, whether grading or structural, will need to be carefully designed and implemented. Although these mitigations are typically developed during the design phase of a project, the City may wish to evaluate these before the project is approved because of the potential problems designing and constructing retaining walls to resist the possibility of deep-seated slope failure as suggested by ESC.

Reviewer's Recommendations

1. Fault-Related Ground Rupture. Because of the potential for ground rupture, structures for human occupancy should not be constructed over the fault traces. Typically, the preferred mitigation for fault rupture is avoidance, with the structure typically set back 50 feet from the fault. PRG should provide estimates of vertical and horizontal ground movement along the fault that could be expected during earthquakes. Geotechnical and structural engineering techniques such as those outlined by Lazarte and others (1994) may be appropriate for mitigating secondary fracturing.

At the San Benito Foods warehouse (a site with less than 2,000 hours per year occupancy), the City of Hollister accepted this higher amount of risk and allowed building on the fault by adding several permit conditions:

- Commercial General Liability Insurance in an amount not less than $1,000,000 for each occurrence, combined single limit, in a form to be approved by the City.
- A release, indemnity and hold harmless agreement with the City.
- Appropriate signage on the premises warning occupants of potential seismic hazard.
- A limit on the number of persons that may occupy the building at any one time.
- Recording a deed restriction indicating the limits of occupied hours per year.

The City should consider implementing similar permit conditions if buildings (including less than 2,000 hours per year occupancy) are planned to be constructed with no fault setback.

2. Landsliding. The City should require that plans be submitted and reviewed for stabilizing the slope before the project is approved because of the marginal slope stability at the site.

3. Difference of Opinion Among Experts. PRG and I have substantially different opinions on the presence of faulting at the Grace site. If the applicant still wishes to contest the City's geologic review, one solution would be to convene an independent review panel of other engineering geologists that have reviewed for other cities or counties and are familiar with the geology of the Hollister area. This review panel could review the engineering geology reports

and render an opinion on the more likely explanation for the features at the Grace site. I would be happy to provide several possible candidates if the City is interested in setting up a review panel.

References Cited

Boggs, Sam, Jr., 1995, Principles of sedimentology and stratigraphy (2d ed.): Englewood Cliffs, NJ, Prentice-Hall, 774 p.

Bonilla, M.G., and Lienkaemper, J.J., 1991, Factors affecting the recognition of faults exposed in exploratory trenches: U.S. Geological Survey Bulleting 1947, 54 p.

Bryant, W.A., 1979, Fault evaluation report, Calaveras (Hollister segment) and "Buena Vista Road" faults: California Division of Mines and Geology Fault Evaluation Report FER–94, 14 p., 4 plates, scale 1:24,000.

Griffin, W.L., 1967, Provenance, deposition, and deformation of the San Benito Gravels, *in* Marks, J.G., chairman, Guidebook, Gabilan Range and adjacent San Andreas fault: Pacific Section American Association of Petroleum Geologists and Pacific Section Society of Economic Paleontologists and Mineralogists Joint annual field trip, October 20–21, 1967, King City, Calif., p. 61–73.

Earth Systems Consultants, 2001, Preliminary soils engineering report, Grace Storage Lockers, First Street, Hollister, California: unpublished report, file no. HO-07641-01 dated June 27, 2001, 15 p., 2 appendices.

Lazarte, C.A., Bray, J.D., Johnson, A.M., and Lemmer, R.E., 1994, Surface breakage of the 1992 Landers earthquake and its effects on structures: Bulletin of the Seismological Society of America, v. 84, p. 547–561.

Pacific Rim Geologic, 2002a, Fault location and engineering geologic investigation, Grace Property, Parcel 1, APN 054-19-009, 341 First Street, Hollister, California: unpublished report, project 1093, dated March 1, 2002, 36 p., 1 appendix.

_____2002b, Response to 9/27/02 review by City of Hollister Consulting Geologist Lew Rosenberg unpublished letter, project 1093, dated December 16, 2002, 18 p.

Rosenberg, L.I., 2002, Geologic report review, fault location and engineering geologic investigation, Pacific Rim Geologic, Project 1093, dated March 1, 2002, Grace property, parcel 1, APN 054-19-009, 341 First Street, Hollister, California: unpublished report to City of Hollister, dated September 27, 2002, 6 p.

Terratech, 1978, Geologic/geotechnical investigation, First Street commercial property, Hollister, California: City of Hollister Planning Department open-file report, 9 p., 2 appendices.

Weldon, R.J., II, McCalpin, J.P., and Rockwell, T.K., 1996, Paleoseismology in strike-slip tectonic environments, *in* McCalpin, J.P., ed., Paleoseismology: San Diego, Calif., Academic Press, International Geophysics Series, v. 62, p. 271–329.

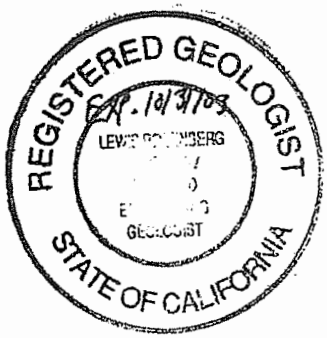
Wells, D.L., and Coppersmith, K.J., 1994, New empirical relationships among magnitude, rupture length, rupture width, and surface displacement: Bulletin of the Seismological Society of America, v. 84, no. 4, p. 974–1002.

Closure

This concludes my review comments. Please contact me by phone at (805) 434–1750 or e-mail at Lrosenberg@thegrid.net if you have any questions regarding this review letter.

Sincerely,

Lewis I. Rosenberg
Calif. Certified Engineering Geologist EG-1777
Reviewing Geologist, City of Hollister



Copy: Bill Card, City of Hollister Community Development Dept.

APPENDIX A.17.b

GEOLOGICAL FAULT INVESTIGATION
VISTA MEADOWS SENIOR APARTMENTS
EAST PARK STREET AND RANCHO DRIVE
APN 056-290-001
HOLLISTER, CALIFORNIA

August 12, 2008

Prepared for

South County Housing Corporation

Prepared by

Earth Systems Pacific
400 Park Center Drive, Suite 1
Hollister, California

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CITY OF HOLLISTER
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APPENDIX A.18.a

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August 12, 2008

File No.: SH-10941-GA

Cynthia Iwanaga, Project Manager
South County Housing Corporation
9015 Murray Avenue, Ste. 100
Gilroy, CA 95020

PROJECT: VISTA MEADOWS SENIOR APARMENTS
EAST PARK STREET AND RANCHO DRIVE, APN 20-28-46
HOLLISTER, CALIFORNIA

SUBJECT: **Geologic Fault Investigation**

REF: Proposal to perform a Geologic Fault Study, Vista Meadows Fault Study, East Park Street and Rancho Drive, Hollister, California, by Earth Systems Pacific, dated April 30, 2008.

Dear Ms Iwanaga:

In accordance with your authorization of the above-referenced proposal, we are submitting herewith the results of our Geological Fault Investigation that was performed on the above project site in Hollister, San Benito County, California. This report is based upon the results of our review of geologic maps and literature, radiocarbon testing, and field exploration. In the report we describe the general geologic characteristics of the site, identify potential geologic hazards, and provide guidance for site development. Six copies of this report have been furnished for your use.

We appreciate the opportunity to have provided geologic services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific

Brett Faust
Engineering Geologist
EG 2386

PROFESSIONAL GEOLOGIST
BRETT D. FAUST
No. 2386
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

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1.0 INTRODUCTION

Planned Development

This report presents the results of our geologic fault investigation for the proposed Vista Meadows Senior Apartments at the northwest corner East Park Street and Rancho Drive in Hollister, California (APN 056-290-001). The site location is shown on the Vicinity Map in Appendix A. The proposed development will consist of two 2-story apartment buildings with a total of 72 units and a common building along the eastern portion of the site. The western portion, where evidence of active faulting was found, will consist of paved parking and landscaping. The site will be accessed from East Park Street. The site is currently not developed and was formerly an orchard.

Scope of Services

The entire site is located within a State of California Earthquake Fault Zone. The Alquist-Priolo Earthquake Fault Zoning Act is intended to provide policies and criteria to assist cities, counties, and state agencies in the exercise of their responsibility to prohibit the location of developments and structures for human occupancy across the trace of an active fault. A northwest trending state mapped trace of the East Branch Calaveras fault is depicted through the site, see Alquist-Priolo Earthquake Fault Zone Map in Appendix A. Therefore, the primary purpose of this fault study was to identify any fault features within the site area within the Earthquake Fault Zone.

The scope of work for this geologic fault study included a general site reconnaissance, review of available geologic reports and maps, review of a pair of stereo aerial photos covering the site and its immediate vicinity, interpretation of the subsurface information derived from detailed logging of exploratory fault trenches, evaluation of the data collected, radiocarbon testing of soil samples, and preparation of this report. The scope of our work is intended to comply with the requirements of California Geological Survey Note 49, Guidelines for Evaluating the Hazard of Surface Fault Rupture.

The scope of our services did not include determination of percolation rates, soils engineering properties, soil corrosion potential, nor environmental assessment or investigation for the

presence or absence of hazardous or toxic materials in the soil, surface water, groundwater or air, on, below, or around the site.

Site Setting

The site is located on the Hollister, California, 7½-minute topographic quadrangle (U.S. Geological Survey, 1995); refer to Vicinity Map in Appendix A. The site is a rectangular parcel located at the northwest corner of East Park Street and Rancho Drive. Single family residences are present on the west, townhomes are present on the north and an apartment complex is on the east. Rancho San Justo Middle School is present at the southeast corner of East Park Street and Rancho Drive. The site is essentially level and lies at an elevation of about 300 feet. Ground surface in the site vicinity slopes very gently toward the northwest. At the time of our field investigation the site was disked and occupied by a few orchard trees related to previous site use.

2.0 FIELD EXPLORATION

On June 3, 2008 through June 12, 2008, exploratory Trenches T-1 thru T-4 were excavated and logged. Trench T-5 was excavated and logged between July 3 and 7, 2008. Trench T-1 was excavated across the middle of the site from the southwest to the northeast. Trenches T-2, T-4 and T-5 were excavated on the western section of the site north of T-1, and T-3 was excavated on the southern part of the site. Trenches T-1 thru T-4 were excavated to nominal depths of 15 feet with the west end of Trench T-1 deepened to 17 feet. Trench T-5 was excavated to a depth of 20 feet. The trenches were excavated utilizing a backhoe with a 30-inch wide bucket. The trench locations are shown on the Trench Location/Engineering Geologic Site Map in Appendix A. The materials encountered in the trenches were logged by a Certified Engineering Geologist. Copies of the trench logs are presented in Appendix B.

3.0 GEOLOGY

Geologic Site Conditions

The site is located in the seismically active central California Coast Ranges geomorphic province and is situated on the floor of the Hollister Valley. Structurally, the valley is divided into two structural blocks with the San Justo block west of the Calaveras fault and the Diablo Block east

of the fault (Rogers, 1993). The Diablo block underlies the subject site. Based on Rogers (1993), the overlying geologic unit consists of alternating lake and alluvial deposits of Quaternary age (Ql-Qal) and were described as unconsolidated, well sorted, gray to blue silt, clay and sand. Rosenberg (1998) further divided the surficial deposits in the region and mapped younger flood-plain deposits (Qyfm) on and in the site vicinity. Rosenberg (1998) describes these sediments as medium-textured flood-plain deposits consisting of mainly stiff sandy silt and silty clay with lenses of clean sand. Radiocarbon dates of the surficial units were 3,720± 90 yr B.P at 3.6 m (11.8 ft) depth and 18,110± 190 yr B.P at 5.2 m (17.1 ft) depth (Rosenberg, 1998). A Regional Geologic Map is presented in Appendix A.

Faulting

The site is located within the seismically active central California Coast Ranges geomorphic province. The major active faults (Type A Faults: faults that are capable of producing large magnitude events and that have a high seismic activity rate) recognized in this region of California are the San Andreas and San Gregorio faults. In addition to the East Branch Calaveras fault, other active faults (other than Type A) in the site region include the main trace of the Calaveras (southern segment), Quien Sabe, Sargent, Zayante-Vergeles, Ortigalita and Rinconada faults (see Regional Fault Map in Appendix A for the location of these faults relative to the site). Active faults are defined by the State of California as exhibiting well-defined evidence of displacement within Holocene time, or the last 11,000 years (Hart, 1997).

The Calaveras fault, a major branch of the San Andreas Fault system, branches off of the San Andreas Fault approximately 6 miles south of the site. The Calaveras fault in the Hollister area, is comprised of two, northwest trending fault traces: the Main branch which is located about 0.5 miles west of the site, and the East branch, which is mapped by the state through the subject site. The Main branch is historically active, having evidence of fault offset within the last 200 years (and up to the present) whereas the East branch is defined by the state as "recently active" having evidence of fault offset within the last 11,000 years. According to Templeton et al (2001), the juncture of the San Andreas and Calaveras faults is a complex area where subsurface seismicity does not always follow surface fault traces and secondary faults such as the Quien Sabe fault zone may play an active role accommodating deformation. Specifically, Templeton et al (2001) found that seismicity on the San Andreas and southern Calaveras faults is offset to the west of their surface traces indicating that these

faults are slipping at depth even though there may be little surface expression of slip. Templeton et al (2001) estimated a slip rate on the Calaveras fault in the Hollister region of 4-13 mm/year. The California Geological Survey (1998) has assigned a slip rate of 15 mm/year to the Calaveras fault.

McClellan and Hay (1989) indicated that the Calaveras fault at San Felipe Lake, northeast of the site, and in Hollister experienced slip of up to 5 mm at the ground surface near the time of the M7.1 Loma Prieta earthquake on October 17, 1989. It was calculated that the slip was triggered by dynamic strain (ground shaking) resulting from the Loma Prieta earthquake on the nearby San Andreas fault.

Previous Fault Studies

Terratech, Inc. (1987) performed an investigation of the East Branch Calaveras fault for a formerly proposed Rancho San Justo tandem school site on 20-acres adjacent to the existing school. Their study included the area of the subject site of this fault study. An easterly curving trace of the East Branch Calaveras fault was identified west of the subject site and its alignment generally coincided with a west-facing scarp. The width of the zone of faulting ranged from 13 to 35 feet and was characterized as consisting of three to five distinct fault traces within a section of warped beds. The measured individual attitudes of the fault traces diverged from the through-going trend of the East Branch and varied from N-S to N30°E. Terratech postulated that this was because the East Branch on the site consisted of closely spaced en echelon fault traces rather than a continuous plane of rupture. None of the eight trenches logged by Terratech extended onto the subject site or crossed the State-mapped trace. The location of the fault trace identified by Terratech is shown on the Alquist-Priolo Earthquake Fault Zone Map and the Trench Location and Engineering Geologic Map in Appendix A.

4.0 ANALYSIS AND CONCLUSIONS

Site Reconnaissance

A geologic reconnaissance of the project site was performed in June 2008. The purpose of the reconnaissance was to observe exposures of surface materials at or near the site location, and to identify geologic and geomorphic features indicative of the possible presence of faults, landslides, or other existing or potential geological hazards. During the reconnaissance, no geomorphic features suggesting the presence of faulting or landsliding were observed at the site.

Aerial Photographs

Stereoscopic aerial photographs reviewed for this study were taken in 1959. The photographs were reviewed for relief and tonal lineations that may indicate the presence of faulting on and near the study area. A lineation consisting of a subtle west-facing scarp is present immediately west of the site. No other lineations were present on or adjacent to the site.

Radiocarbon (Soil) Age Dating

During the field exploration, four samples of charcoal were taken from Trench 1 between depths of about 9.5 and 12 feet. Two samples were submitted to Beta Analytic, Inc., where Accelerator Mass Spectrometry (AMS) tests were performed to obtain their approximate ages. The sample collected at a depth of 9.5 feet (Sample A) from Unit 5 (poorly graded sand with silt) near Station 45 and the other at Station 55 at a depth of 12 feet (Sample E) in Unit 8 (clayey silt) were tested. The test results indicated that the charcoal sample found in Unit 5 had a calibrated age of 2,820 ± 40 years before present (BP) and the sample from Unit 8 had a calibrated age of 2960 ± 40 years BP. Beta Analytical's test report is presented in Appendix C.

Trench Interpretation

Well interbedded deposits of clay, silt and sand were exposed in all of the trenches and were generally lateral continuous in all of the trench exposures. The clay and silt deposits were typically massive, whereas the sand deposits were laminated with local cross-bedding suggesting a lacustrine to gentle fluvial environment of deposition. A thin distinct organic layer was present in all of the trenches at depths of about 10 feet. Semi-continuous, sub-vertical, sinuous clay-filled fissures or clay dikes that were generally 0.5 to 1 cm thick and trended N-S to N10E were also present in all of the trenches. Some of the clay dikes exhibited small voids on the order of 0.5 cm in width and had vertical laminations at their margins suggesting periodic dilation and clay injection. The clay dikes are interpreted to be evidence of ancient liquefaction. Except for warping and minor offsets of beds in trench T-1 between stations 55 and 60 where there was evidence of faulting at depth, there was no evidence, such as slickensides or offset of bedding, that would suggest the other clay dikes are fault rupture features.

Trench 1

Trench T-1 was about 220 feet in length and located on the central section of the site. Evidence of faulting was present between stations 55 and 60 in trench T-1. The bedding was warped and there were minor vertical bedding offsets across a slickensided clay gouge. This section of the trench was deepened and exposed and an apparent eastward step of the fault, moving upward in the trench, forming a half-graben feature. The slickensided clay gouge feature is near-vertical, strikes N-S and appears to have been incorporated in fault rupture propagation. At depth, the fault strikes N7E and dips 65 degrees to the southeast. Clay dikes were observed east of the fault, all of which could be traced from depths of about 3-5 feet to the trench bottom of approximately 15 feet. However, no evidence of offset beds or slickensided features was observed with these clay dikes.

Trench 2

Trench T-2 was about 23 feet in length and located on the northwest section of the site and intended to intersect the trend (N-S) of the clay dike fault present in trench T-1. There was no evidence of faulting in trench T-2.

Trench 3

Trench T-3 was about 122 feet in length and located on the southern section of the site. This trench was intended to intersect the slickensided clay gouge fault trend and the state-mapped trace of the East Branch Calaveras fault. Four clay dikes that were somewhat evenly spaced throughout the trench were present in T-3. These clay dikes were present at depths of about 2-3 feet and terminated downward within clay beds. No evidence of faulting was present in trench T-3.

Trench T-4

Because of uncertainty concerning the trend of faulting away from trench T-1, trench T-4 was excavated immediately to the north. A clay dike traceable to the bottom of the trench was exposed, but there was no evidence of faulting, such as offset of bedding or slickensides within

the clay dike. Based on the fault features exposed in Trench T-1 and T-5, we infer that evidence of faulting may be present at greater depths in T-4.

Trench T-5

Following deepening of trench T-1 that exposed additional fault features, trench T-5 was excavated on the northern section of the site. Trench T-5 was about 53 feet in length and intended to intersect the trend (N7E) of faulting identified in trench T-1. A vertical zone of brecciated soil was present between Stations 30 and 35 and interpreted to be evidence of faulting. Below a depth of about 10 feet in the trench the fault was a distinct zone about 2 cm in width that was filled with brecciated slickensided soil soil and trended N10W and dipped 81SW. Above the 10-foot level, the zone of faulting was up to 1 foot in width and contained warped bedding contacts and rotated soil blocks. The zone of faulting was traceable to within about 1/2 foot of the ground surface where it was characterized as a chimney of dark soil.

Earthquake History

In assessing the seismic hazards for a given area, it is useful to examine records of historic local earthquakes. This information can be extrapolated to estimate the recurrence of local earthquakes. A number of strong earthquakes that have damaged man-made structures have occurred on the active faults in the central California region within the last 200 years. Especially notable are the 1836 6.4M (estimated magnitude, M) San Juan Bautista earthquake; the 1838 7.4M San Francisco to San Juan Bautista earthquake; the 1865 6.6M Santa Cruz Mountains earthquake; the 1868 7.0M Hayward earthquake; the 1906 8.3M San Francisco earthquake; the 1911 6.6M Morgan Hill earthquake; the 1926 6.1M Monterey Bay doublet; the August 6, 1979 5.8M Coyote Lake earthquake; the April, 24 1984 6.2M Morgan Hill (Halls Valley) earthquake; and the October 18, 1989 7.1M Loma Prieta earthquake. According to the Working Group on California Earthquake Probabilities (2003), there is a 62 percent probability that a 6.7M or greater earthquake will occur between 2002 and 2031 in the region.

The historic seismicity in the site region was researched using EQSEARCH (Blake, 2005) and the Boore and Joyner (1997) method of analysis for stiff soil sites (D, California Building Code,

2007 Edition). EQSEARCH is a computer program that performs automated searches of a custom catalog of historical Central California earthquakes. As the program searches the catalog, it computes the epicentral distance from the selected site to each of the earthquakes within the specified search area. The epicentral distances should be considered estimates, particularly for earthquake data dating prior to 1932, when instruments were first used to record earthquake data. The parameters used for the search consisted of earthquake Richter magnitudes ranging from 5.0 to 9.0, occurring within a 65-mile radius from the site, from 1800 to June 2007.

Results of the search indicated that 79 earthquakes have occurred within the search parameters. The highest peak horizontal ground acceleration and largest magnitude estimated to have occurred at the site from those historical earthquakes is 0.27g from an earthquake that occurred in 1800 and had a 7.0 magnitude. This earthquake was approximately 10 miles west of the site and most likely occurred on the San Andreas fault. The closest earthquake was a 5.0 magnitude earthquake that occurred approximately 1.5 miles southwest in 1910. This earthquake produced a peak horizontal ground acceleration at the site of 0.20g.

Seismicity

Surface Ground Rupture

The project site is located in a State Earthquake Fault Zone, and the East Branch Calaveras fault is mapped crossing the site; see the Alquist-Priolo Earthquake Fault Site Map in Appendix A. Evidence of active faulting was identified in trenches excavated on the site and a building exclusion zone of 50 feet on either side of faulting is recommended. The building exclusion zone is shown on the Engineering Geologic Site Plan in Appendix A.

Ground Shaking

The project area is located in a region of generally high seismicity. The seismic design parameters for the site per Chapter 16 of the California Building Code (2007 Edition) are as follows. The values were determined utilizing the USGS Earthquake Hazards Program Earthquake Ground Motion Parameter Java Application and the NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures.

Site Class = D
Short Term Spectral Response Parameter, S_s = 1.810g
1 Second Spectral Response Parameter, S_1 = 0.749g
Site Coefficient, F_a = 1.0
Site Coefficient, F_v = 1.5

Additionally, a Probabilistic Seismic Hazard Analysis (PSHA) was performed. The PSHA was performed using the FRISKSP computer program (Blake, 2000) to estimate the parameters of the Design Basis Earthquake (DBE). This earthquake is defined as having a 10 percent chance of exceedance in 50 years with a return period of approximately 475 years. To develop the DBE, significant mapped faults within a radius of 65 miles from the site were selected from the program database. The peak horizontal ground acceleration and spectral accelerations at 5%, damped for a CBC soil type D, were estimated using the Boore and Joyner (1997) method for stiff soil sites. The soil profile types were interpreted from the soils encountered during the field investigation. The results of the analysis indicate that the DBE for the site is estimated to have a peak spectral acceleration of 2.50g at a 0.30 second period, and a peak horizontal ground acceleration of 1.05g.

Liquefaction

Soil liquefaction is the softening of soil during a significant seismic event. It occurs primarily in saturated, loose to medium-dense, fine to medium-grained sands and sandy silts. The majority of the site area is underlain by stiff and medium dense clay, silt and sand deposits that do not appear to be susceptible to liquefaction. According to Yates (2005), depth to ground water beneath the site is on the order of 70 feet and no groundwater was encountered to the maximum trench exploration depth of 20-feet and no potentially liquefiable soils were identified during the preliminary soils engineering investigation (Earth Systems Consultants Northern California, 2001). Furthermore, the site is located in an area designated as having a low liquefaction potential (Rosenberg 1998).

Lateral Spreading

Lateral spreading can occur as a consequence of liquefaction. This phenomenon is confined to areas where the terrain is sloping, or where the liquefied zone extends below sloping terrain, and

generally affects slopes along creeks, bays, or other water features bordered by slopes. Liquefaction of the soil induces instability of the soils on the slopes, resulting in the "spreading" of the soil into the inundated zone.

As no creeks, ponds or other water features are on or immediately adjacent to the proposed site area, the potential for lateral spreading to occur at the site is low.

Seismically Induced Settlement

Seismically induced settlement of sufficient magnitude to cause structural damage is normally associated with poorly consolidated, predominantly sandy soils, or variable consolidation characteristics within the building areas. Due to the consistency of the predominantly clayey and silty soils underlying the site, the site the potential for seismically induced settlement to occur on the site is low.

Summary of Conclusions

1. The site lies on the Hollister Valley floor and is underlain predominantly by clay deposits with lesser amounts of silt and sand. The site is relativity flat with no significant slope on or adjacent to the site. Thus, the potential for slope instability is non-existent.

2. Evidence of faulting, consisting of vertical bedding offsets and slickensided clay gouge surfaces, was present in trenches T-1 and T-5. The fault trends north-northeast through the central section of the site and curves to the northwest on the northern section. It is believed that this fault trace on the subject site is a secondary splay or a Riedel shear off the fault that Terratech (1987) identified to the west where fault attitudes of N-S to N30E were measured. Radiocarbon testing indicated that the deposits on the project site are about 3,000 years old at a depth of 12 feet. Because evidence of faulting is present at depths less than 12 feet, the fault on the site is considered to be active (<11,000 years BP). Thus, a building exclusion zone is recommended (see below).

3. Based on the consistency of the clay, silt and sand deposits, and depth to ground water, the soils should not be susceptible to liquefaction or seismically induced settlement.

5.0 RECOMMENDATIONS

Because evidence of active faulting was present on the site and there is a potential for ground surface rupture, a building exclusion zone is recommended. Structures that will be used for human occupancy should be setback a minimum of 50 feet either side of the fault trace. The recommended building exclusion zone is shown on the Trench Location/Engineering Geologic Site Map in Appendix A.

6.0 CLOSURE

The conclusions and recommendations of this report are based on data acquired and evaluated during this study and are intended to apply only to the proposed development of the project as described in the "Introduction" section of this report. This report is valid for conditions as they exist at this time for the type of project described herein. If changes with respect to project type or location become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report.

The conclusions presented in this report are based upon the assumption that the site geologic conditions do not deviate substantially from those disclosed during our research and field exploration. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that planned at the present time, Earth Systems Pacific should be notified so that supplemental recommendations can be prepared as applicable.

Our intent was to perform this study in a manner consistent with the level of care and skill commonly exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client for the subject project. Application beyond the stated intent is strictly at the user's risk.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. All other rights are retained by Earth Systems Pacific and any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific. End of Text

REFERENCES

Blake, T. F., EQSEARCH, "A Computer Program for the Estimation of Peak Horizontal Acceleration from California Historical Earthquake Catalogs," User's Manual, Newbury Park, California, 2005.

Blake, T. F., FRISKSP (ver. 4.0), A Computer Program for the Probabilistic Estimation of Peak Acceleration and Uniform Hazard Spectra Using 3-D Faults as Earthquake Sources," User's Manual, Newbury Park, California, 2000.

Boore, D. M. and others, "Estimating Response Spectra and Peak Accelerations from Western North American Earthquakes: a Summary of Recent Work," Seismology Research Letters, 68-1, January-February, 1997.

Bryant, W.A., California Division of Mines and Geology, Fault Evaluation Report – FER-94, October 19, 1979.

California Geological Survey, 1982, Sate of California Special Studies Zones Map of the 7½-minute Hollister Quadrangle.

Earth Systems Consultants Northern California, 2001, Preliminary Soils Engineering Report, Vista Meadows Senior Apartments, Park Street, Hollister, California, unpublished consultants report.

Hart, E.W., and Bryant W.A., 1997, Fault Rupture Hazard Zones in California, California Division of Mines and Geology Special Publication 42, 24 p.

McClellan, P.H. and Hay, E.A., Geologic Evidence for Triggered Slip on the Calaveras Fault During the Magnitude 7.1 Loma Prieta Earthquake of October 17, 1989, USGS Open-File Report 89-641.

Rogers, T.H., 1993, Geology of the Hollister and San Felipe quadrangles, San Benito, Santa Clara and Monterey Counties, California: California Division of Mines and Geology Open-File Report 93-01, 21 p., 3 appendices, 3 sheets, scale 1:24,000.

Terratech, Inc., June 1987, Investigation of the East Branch of The Calaveras Fault, Prune Street School Site (Rancho San Justo Tandem School Site), Hollister, California, unpublished consultants report

Templeton, D.C., Nadeau, R.M. and Burgmann, R., 2001, Structure and Kinematics at the Juncture Between the San Andreas and Southern Calaveras Faults, 2001 Fall AGU Abstract.

Rosenberg, L.I., (1998), Liquefaction Susceptibility of the Hollister Area, San Benito County, California, Final Technical Report", USGS Award No. 1434-HQ-97-GR-03125

Working Group on California Earthquake Probabilities, 2003, Probabilities of Large Earthquakes in the San Francisco Bay Region, California, U.S. Geological Survey Circular.

Yates, G., 2005, Annual Groundwater Report for the 2005 Water Year, San Benito County Water District, prepared for San Benito County Water District, Hollister, California, December.

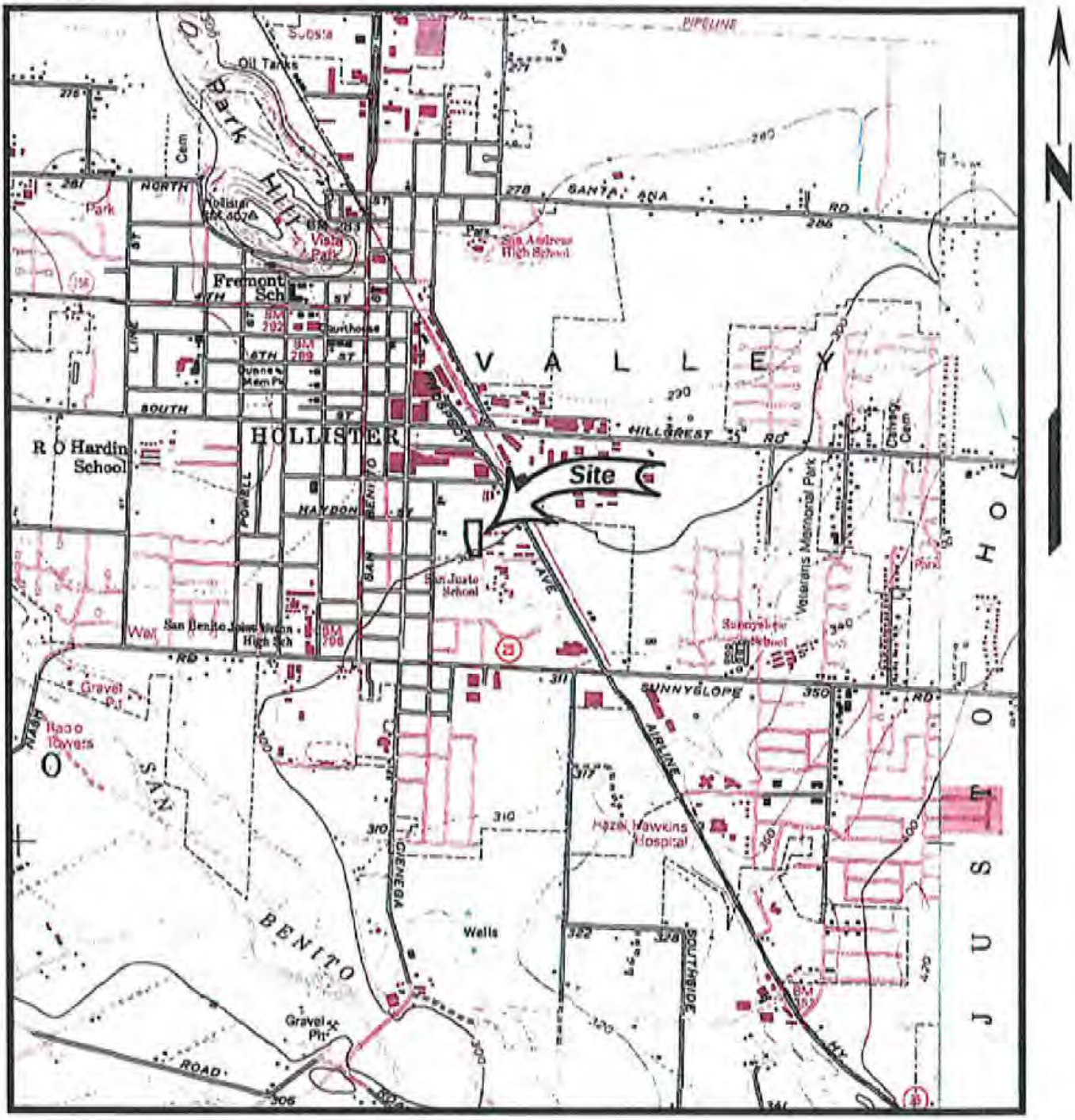
AERIAL PHOTOGRAPHS

Date	Agency	Type	Roll & Frame	Scale
6/13/59	USDA	B&W	BUX – 7V-47&48	±1:20,000

APPENDIX A

Vicinity Map
Alquist-Priolo Earthquake Fault Zone Map
Trench Location/Engineering Geologic Site Map
Regional Geologic Map
Regional Fault Map

Vicinity Map

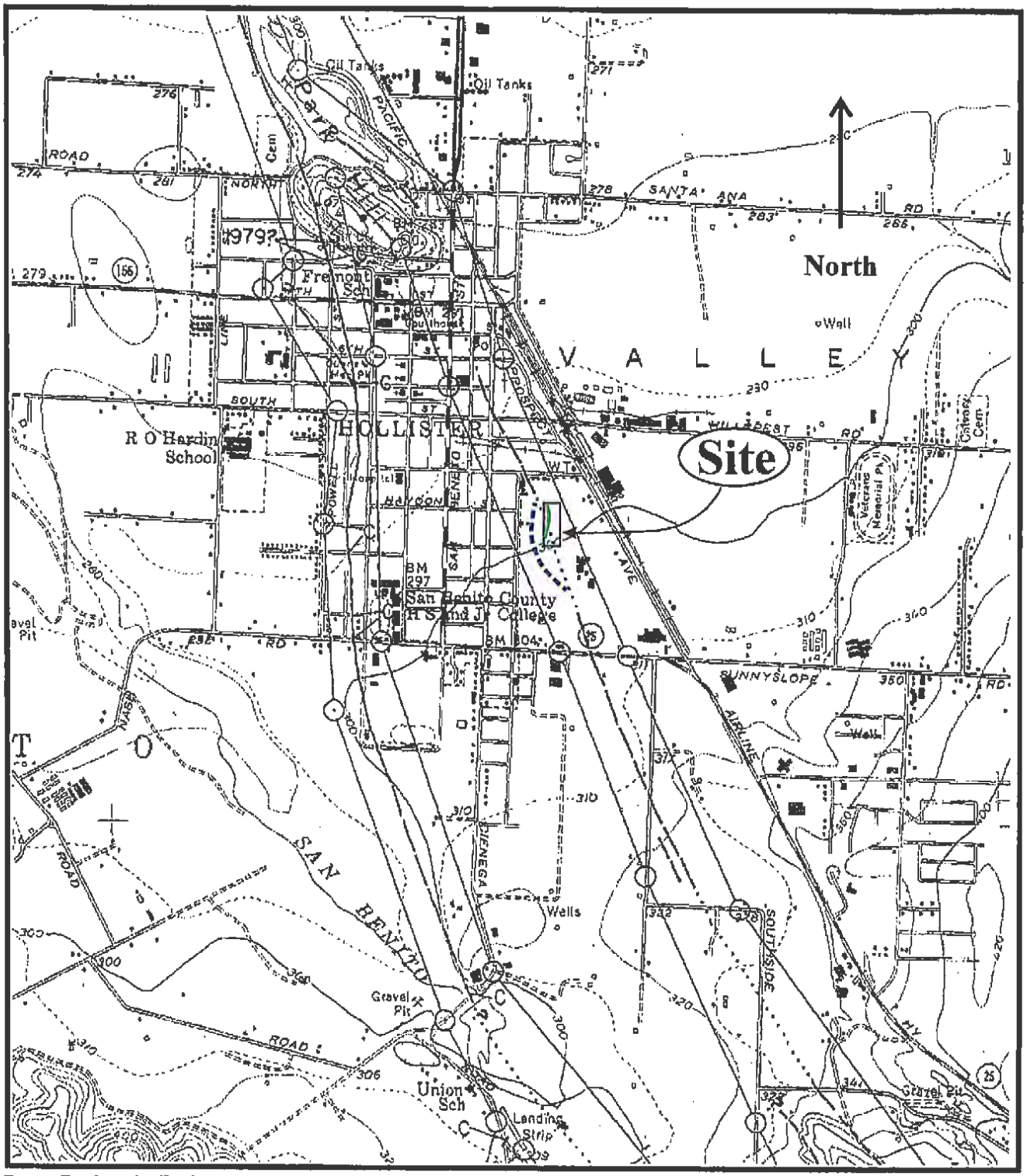


Base: USGS 7.5 minute Hollister (1993) & Tres Pinos (1971) Topographic Quadrangles

Earth Systems Pacific

SCH Vista Meadows Phase 1
Hollister, California

Alquist-Priolo Earthquake Fault Zone Map



Base: Earthquake Fault Zone Map, Hollister 7.5' quadrangle, 1982; Scale 1"=2000'

EXPLANATION

Fault Trace; Terratech 1987

Fault Trace; this study

Earth Systems Pacific

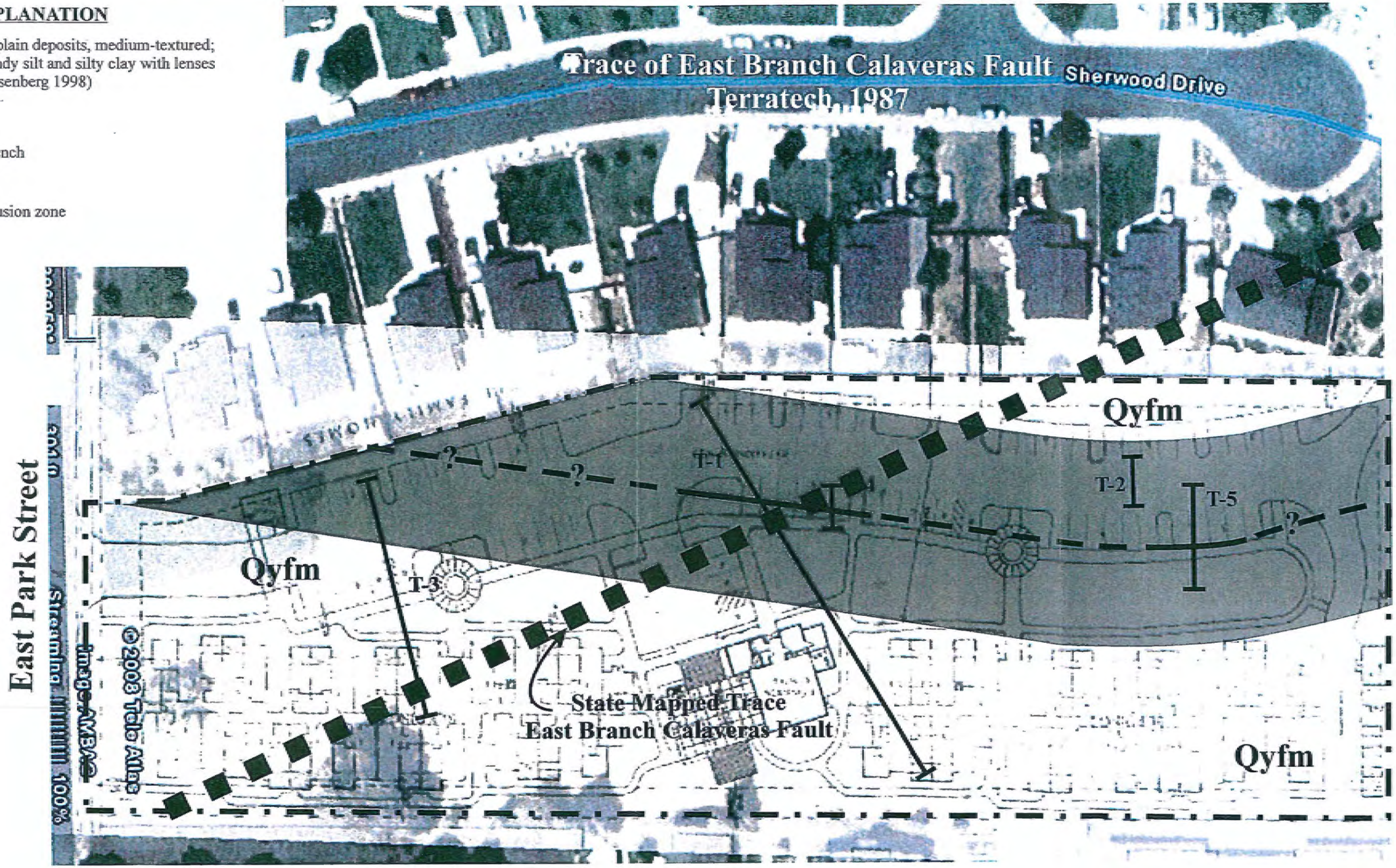
EXPLANATION

Qyfm Younger flood-plain deposits, medium-textured; mainly stiff sandy silt and silty clay with lenses clean sand (Rosenberg 1998)

Fault trace

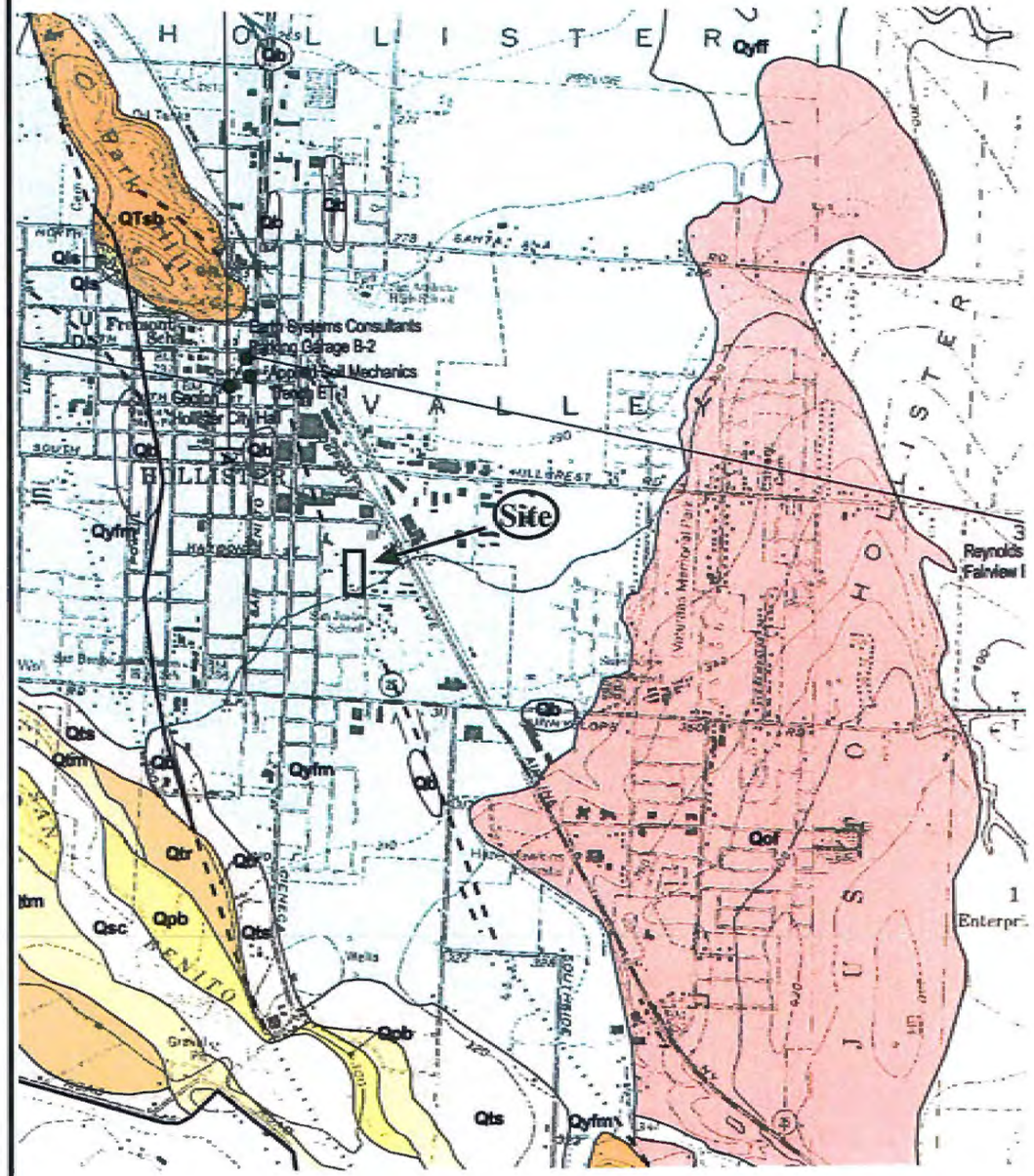
T-5 Exploratory trench

Building exclusion zone



Base: Google Earth image
Overlay: Conceptual Site Plan, Vista Meadows Senior Apartments, by TWM Architects, Sheet A1, dated July 30, 2008.

Earth Systems Pacific	Vista Meadows Senior Apartments East Park Street Hollister, California	**Trench Locations and Engineering Geologic Site Map**		
		August, 2008	Scale 1"=50'	SH-10941-GA



DESCRIPTION OF MAP UNITS

Qal	Alluvial deposits, undivided (Holocene) —Unconsolidated, heterogeneous, moderately sorted silt and sand with discontinuous lenses of clay and silty clay
Qsc	Stream channel deposits (Holocene) —Unconsolidated, well-sorted sand, gravel, and cobbles within in the beds of the larger streams
Qpb	Point bar deposits (Holocene) —Unconsolidated moderately sorted, fine-grained sand and silt underlain by coarse sand and gravel
Qb	Basin deposits (Holocene) —Unconsolidated, plastic clay and silty clay containing much organic material; locally contains interbedded thin layers of silt and silty sand
Qtm	Metz terrace (Holocene) —Unconsolidated silty sand underlain by layers of coarse sand and gravel. Capped by minimally developed soils
Qtr	Reiff terrace (Holocene)—Unconsolidated silty sand and silt with lenses of gravelly sand. Capped by minimally developed soils
Qts	Sorrento terrace (Holocene) —Unconsolidated sandy silt. Capped by undeveloped to minimally developed soils
Qyff	Younger flood-plain deposits, fine-textured (Holocene) —Unconsolidated silty clay and clayey silt with lenses of sandy silt and clean sand
Qyfm	Younger flood-plain deposits, medium-textured (Holocene) —Unconsolidated sandy silt and silty clay with lenses of well-sorted sand
Qls	Landslide deposits (Quaternary) —Rotational soil slides, earthflow, and debris flow deposits
Qof	Older flood-plain deposits (Pleistocene) —Poorly consolidated, moderately sorted gravel, sand and silt with Monterey Shale fragments. Capped by maximally developed soils
Qf	Alluvial fan deposits (Pleistocene) —Moderately consolidated, moderately to poorly sorted gravel, sand and silt. Capped by maximally developed soils
QTsb	San Benito Gravels (Pleistocene-Pliocene) —Poorly consolidated, moderately to well-sorted sand and gravel with silt; commonly crossbedded
Tr	e sedimentary rocks of Dibblee (1975) (Pliocene) —Greenish-gray to rarely reddish claystone, siltstone, and interbedded friable buff-gray sandstone

EXPLANATION OF MAP SYMBOLS

Contact, approximately located

Fault, well-defined—relative lateral displacement indicated by half arrows. On cross section, "A" denotes movement away from viewer, "T" denotes movement toward viewer

Fault, approximately located —relative vertical displacement indicated by U/D, queried where existence uncertain

Fault, concealed—relative vertical displacement indicated by U/D, queried where existence uncertain

A——A' Line of geologic cross section

Approximate boundary of study area

Borehole depicted in cross section —N denotes field blow counts (triangle), m/s denotes downhole shear wave velocity, small dot denotes radiocarbon date, TD denotes total depth of boring

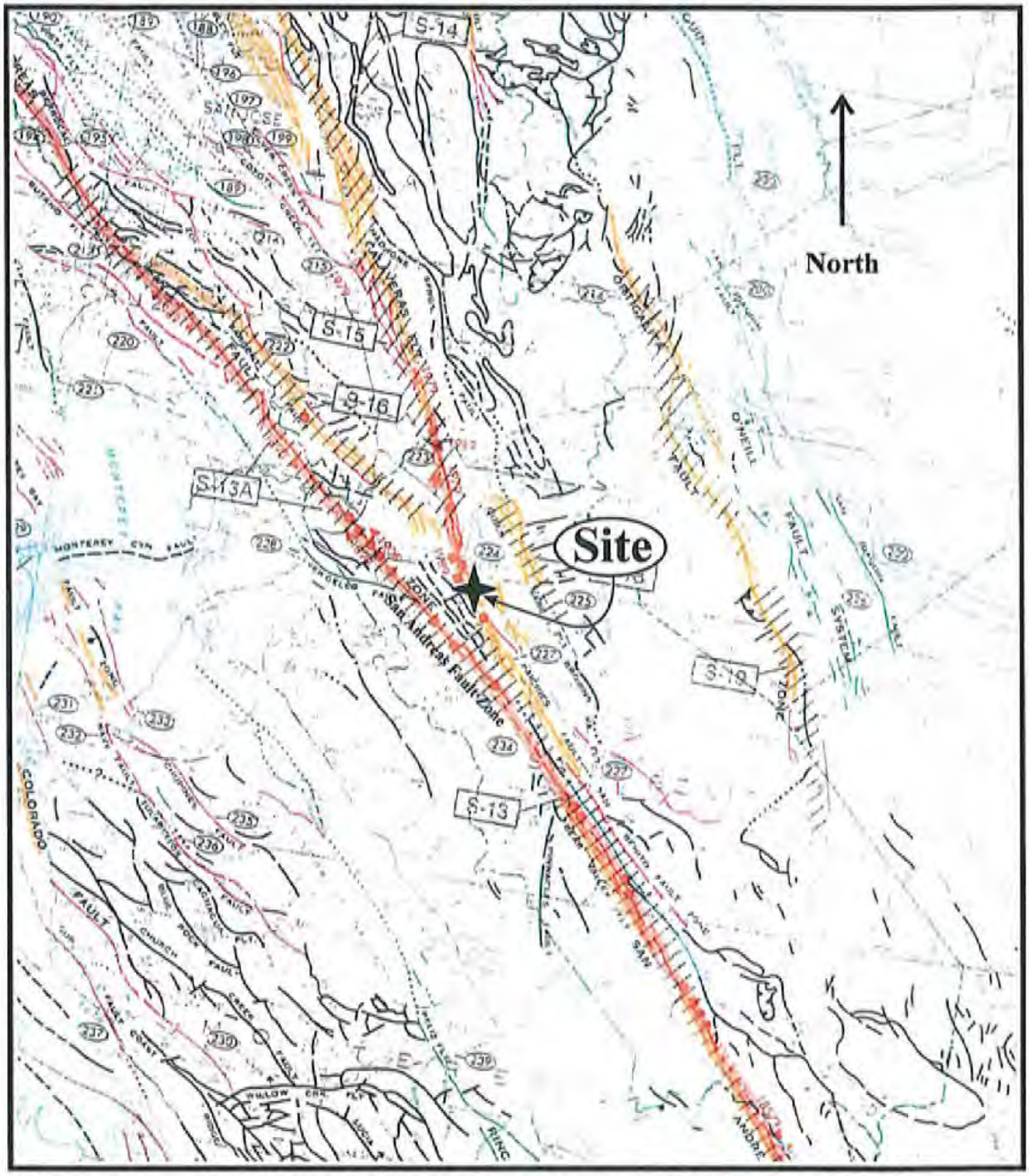
2-1/4" diameter cone penetration log depicted in cross section —driving rate in seconds per foot using a No. 2 McKiernan-Terry air hammer at 115 psi

North

Base: Rosenberg, L.I., 1998, Liquefaction Susceptibility of the Hollister Area, San Benito County, California

Earth Systems Pacific	Vista Meadows Senior Apartments East Park Street Hollister, California	Regional Geologic Map		
		August, 2008	Scale 1"=2,000'	SJL 10941 GA

Regional Fault Map



Base: Jennings, C.W., 1994, Fault Activity Map of California and Adjacent Areas; scale 1" =12 miles

Earth Systems Pacific

Vista Meadows Senior Apartments
Hollister, California

APPENDIX B

Trench Log T-1
Trench Logs T-2, T-3, T-4 and T-5

APPENDIX C

Radiocarbon Test Results

Beta Analytic Inc.
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Tel: 305 667 5167
Fax: 305 663 0964
beta@radiocarbon.com
www.radiocarbon.com

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MR. DARDEN HOOD
Director

Mr. Ronald Hatfield
Mr. Christopher Patrick
Deputy Directors

July 2, 2008

Mr. Rick Gorman
Earth Systems Pacific
4378 Santa Fe Road
San Luis Obispo, CA 93401
USA

RE: Radiocarbon Dating Results For Samples VISTA MEAD#A, VISTA MEAD#E

Dear Mr. Gorman:

Enclosed are the radiocarbon dating results for two samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable.

As always, no students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

If you have specific questions about the analyses, please contact us. We are always available to answer your questions.

Thank you for prepaying the analyses. A receipt is enclosed. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
UNIVERSITY BRANCH
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305/667-5167 FAX: 305/663-0964
E-MAIL: beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Mr. Rick Gorman

Report Date: 7/2/2008

Earth Systems Pacific

Material Received: 6/12/2008

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 245409 SAMPLE : VISTA MEAD#A ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal BC 1080 to 900 (Cal BP 3030 to 2850)	2750 +/- 40 BP	-20.8 o/oo	2820 +/- 40 BP
Beta - 245410 SAMPLE : VISTA MEAD#E ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal BC 1310 to 1040 (Cal BP 3260 to 2990)	2950 +/- 40 BP	-24.5 o/oo	2960 +/- 40 BP

Dates are reported as RCYBP (radulcarbon years before present, "present" = 1950A.D.). By International convention, the modern reference standard was 95% of the C14 content of the National Bureau of Standards' Oxalic Acid & calculated using the Libby C14 half life (5568 years). Quoted errors represent 1 standard deviation statistics (68% probability) & are based on combined measurements of the sample, background, and modern reference standards.

Measured C13/C12 ratios were calculated relative to the PDB-1 international standard and the RCYBP ages were normalized to -25 per mil. If the ratio and age are accompanied by an (*), then the C13/C12 value was estimated, based on values typical of the material type. The quoted results are NOT calibrated to calendar years. Calibration to calendar years should be calculated using the Conventional C14 age.

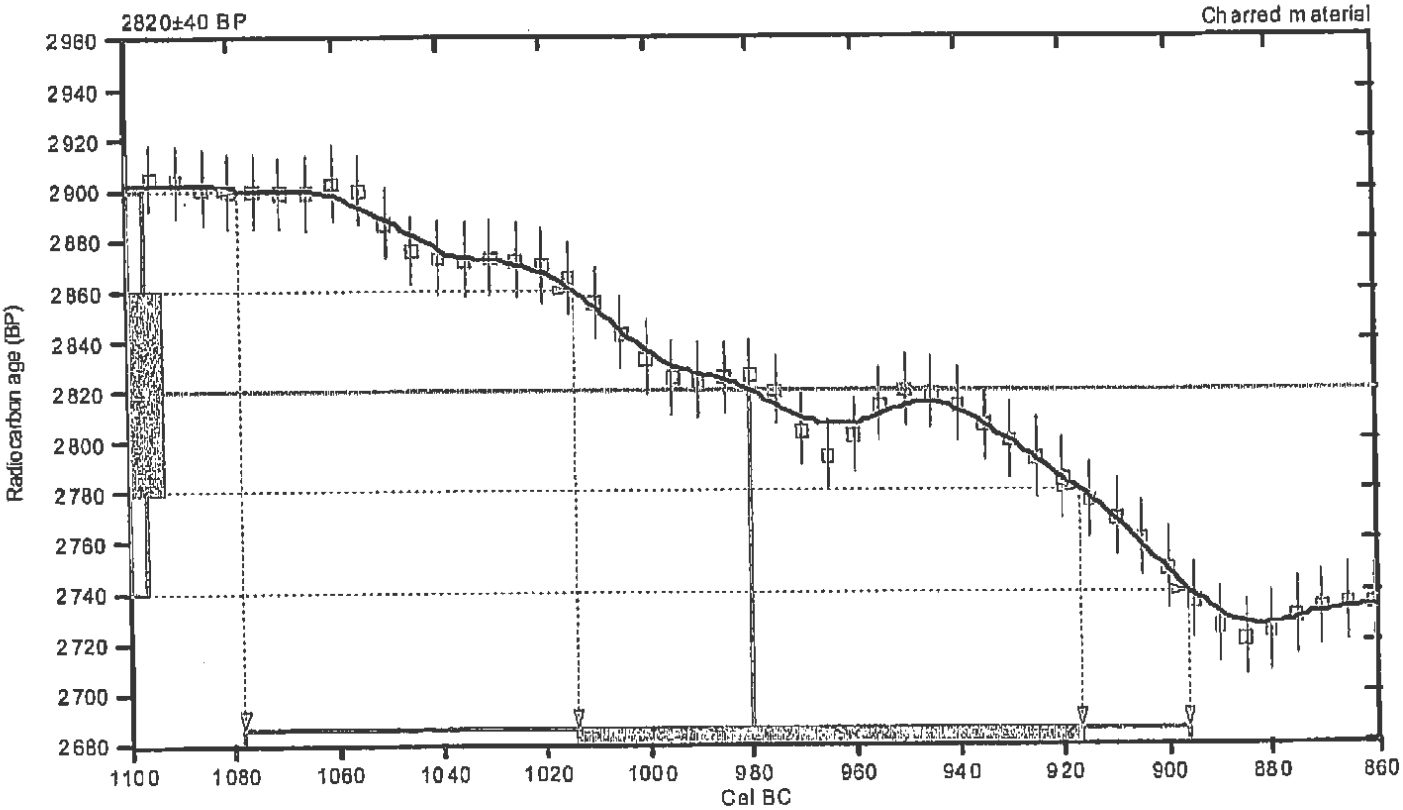
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-20.8:lab. mult=1)

Laboratory number:	**Beta-245409**
Conventional radiocarbon age:	**2820±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 1080 to 900 (Cal BP 3030 to 2850)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 980 (Cal BP 2930)
1 Sigma calibrated result: (68% probability)	Cal BC 1010 to 920 (Cal BP 2960 to 2870)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Radiocarbon Dating Laboratory

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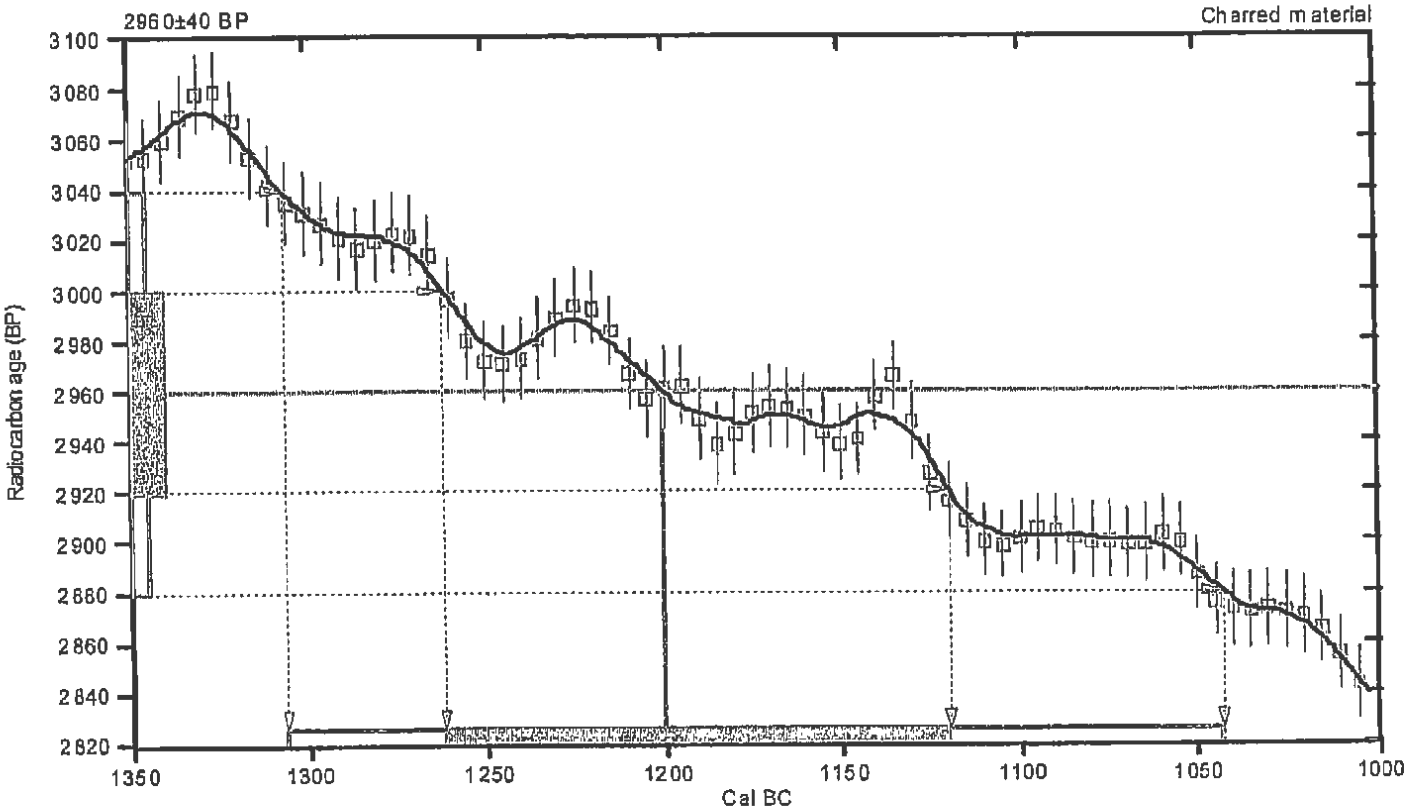
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.5:lab. mult=1)

Laboratory number:	**Beta-245410**
Conventional radiocarbon age:	**2960±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 1310 to 1040 (Cal BP 3260 to 2990)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 1200 (Cal BP 3150)
1 Sigma calibrated result: (68% probability)	Cal BC 1260 to 1120 (Cal BP 3210 to 3070)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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PRETREATMENT GLOSSARY
Standard Pretreatment Protocols at Beta Analytic

Unless otherwise requested by a submitter or discussed in a final date report, the following procedures apply to pretreatment of samples submitted for analysis. This glossary defines the pretreatment methods applied to each result listed on the date report form (e.g. you will see the designation "acid/alkali/acid" listed along with the result for a charcoal sample receiving such pretreatment).

Pretreatment of submitted materials is required to eliminate secondary carbon components. These components, if not eliminated, could result in a radiocarbon date, which is too young or too old. Pretreatment does not ensure that the radiocarbon date will represent the time event of interest. This is determined by the sample integrity. Effects such as the old wood effect, burned intrusive roots, bioturbation, secondary deposition, secondary biogenic activity incorporating recent carbon (bacteria) and the analysis of multiple components of differing age are just some examples of potential problems. The pretreatment philosophy is to reduce the sample to a single component, where possible, to minimize the added subjectivity associated with these types of problems. If you suspect your sample requires special pretreatment considerations be sure to tell the laboratory prior to analysis.

"acid/alkali/acid"

The sample was first gently crushed/dispersed in deionized water. It was then given hot HCl acid washes to eliminate carbonates and alkali washes (NaOH) to remove secondary organic acids. The alkali washes were followed by a final acid rinse to neutralize the solution prior to drying. Chemical concentrations, temperatures, exposure times, and number of repetitions, were applied accordingly with the uniqueness of the sample. Each chemical solution was neutralized prior to application of the next. During these serial rinses, mechanical contaminants such as associated sediments and rootlets were eliminated. This type of pretreatment is considered a "full pretreatment". On occasion the report will list the pretreatment as "acid/alkali/acid - insolubles" to specify which fraction of the sample was analyzed. This is done on occasion with sediments (See "acid/alkali/acid - solubles"

Typically applied to: charcoal, wood, some peats, some sediments, and textiles "acid/alkali/acid - solubles"

On occasion the alkali soluble fraction will be analyzed. This is a special case where soil conditions imply
That the soluble fraction will provide a more accurate date. It is also used on some occasions to verify the present/absence or degree of contamination present from secondary organic acids. The sample was first pretreated with acid to remove any carbonates and to weaken organic bonds. After the alkali washes (as discussed above) are used, the solution containing the alkali soluble fraction is isolated/filtered and combined with acid. The soluble fraction, which precipitates, is rinsed and dried prior to combustion.

"acid/alkali/acid/cellulose extraction"

Following full acid/alkali/acid pretreatments, the sample is bathed in (sodium chlorite) $NaClO_2$ under very controlled conditions (Ph = 3, temperature = 70 degrees C). This eliminates all components except wood cellulose. It is useful for woods that are either very old or highly contaminated.

Applied to: wood

"acid washes"

Surface area was increased as much a possible. Solid chunks were crushed, fibrous materials were shredded, and sediments were dispersed. Acid (HCl) was applied repeatedly to ensure the absence of carbonates. Chemical concentrations, temperatures, exposure times, and number of repetitions, were applied accordingly with the uniqueness of each sample. The sample was not be subjected to alkali washes to ensure the absence of secondary organic acids for intentional reasons. The most common reason is that the primary carbon is soluble in the alkali. Dating results reflect the total organic content of the analyzed material. Their accuracy depends on the researcher's ability to subjectively eliminate potential contaminants based on contextual facts.

Typically applied to: organic sediments, some peats, small wood or charcoal, special cases

Beta Analytic Inc.
4985 SW 74 Court
Miami, Florida 33155 USA
Tel: 305 667 5167
Fax: 305 663 0/97
Beta@radiocarbon.com
Www.radiocarbon.com

Consistent Accuracy ...
Delivered On Time.

Mr. Darden Hood
Director

Mr. Ronald Hatfield
Mr. Christopher Patrick
Deputy Directors

Final Report

The final report package includes the final date report, a statement outlining our analytical procedures, a glossary of pretreatment terms, calendar calibration information, billing documents (containing balance/credit information and the number of samples submitted within the yearly discount period), and peripheral items to use with future submittals. The final report includes the individual analysis method, the delivery basis, the material type and the individual pretreatments applied. The final report has been sent by mail and e-mail (where available).

Pretreatment

Pretreatment methods are reported along with each result. All necessary chemical and mechanical pretreatments of the submitted material were applied at the laboratory to isolate the carbon which may best represent the time event of interest. When interpreting the results, it is important to consider the pretreatments. Some samples cannot be fully pretreated, making their ^{14}C ages more subjective than samples which can be fully pretreated. Some materials receive no pretreatments. Please look at the pretreatment indicated for each sample and read the pretreatment glossary to understand the implications.

Analysis

Materials measured by the radiometric technique were analyzed by synthesizing sample carbon to benzene (92% C), measuring for ^{14}C content in one of 53 scintillation spectrometers, and then calculating for radiocarbon age. If the Extended Counting Service was used, the ^{14}C content was measured for a greatly extended period of time. AMS results were derived from reduction of sample carbon to graphite (100% C), along with standards and backgrounds. The graphite was then detected for ^{14}C content in one of 9 accelerator-mass-spectrometers (AMS) .

The Radiocarbon Age and Calendar Calibration

The "Conventional ^{14}C Age (*)" is the result after applying $^{13}C/^{12}C$ corrections to the measured age and is the most appropriate radiocarbon age. If an "*" is attached to this date, it means the $^{13}C/^{12}C$ was estimated rather than measured (The ratio is an option for radiometric analysis, but included on all AMS analyses.) Ages are reported with the units "BP" (Before Present). "Present" is defined as AD 1950 for the purposes of radiocarbon dating.

Results for samples containing more ^{14}C than the modern reference standard are reported as "percent modern carbon" (pMC). These results indicate the material was respiring carbon after the advent of thermo-nuclear weapons testing (and is less than ~ 50 years old).

Applicable calendar calibrations are included for materials between about 100 and 19,000 BP. If calibrations are not included with a report, those results were either too young, too old, or inappropriate for calibration. Please read the enclosed page discussing calibration.

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Director

Mr. Ronald Hatfield
Mr. Christopher Patrick
Deputy Directors

Calendar Calibration at Beta Analytic

Calibrations of radiocarbon age determinations are applied to convert BP results to calendar years. The short-term difference between the two is caused by fluctuations in the heliomagnetic modulation of the galactic cosmic radiation and, recently, large scale burning of fossil fuels and nuclear devices testing. Geomagnetic variations are the probable cause of longer-term differences.

The parameters used for the corrections have been obtained through precise analyses of hundreds of samples taken from known-age tree rings of oak, sequoia, and fir up to about 10,000 BP. Calibration using tree-rings to about 12,000 BP is still being researched and provides somewhat less precise correlation. Beyond that, up to about 20,000 BP, correlation using a modeled curve determined from U/Th measurements on corals is used. This data is still highly subjective. Calibrations are provided up to about 19,000 years BP using the most recent calibration data available.

The Pretoria Calibration Procedure (Radiocarbon, Vol 35, No.1, 1993, pg 317) program has been chosen for these calendar calibrations. It uses splines through the tree-ring data as calibration curves, which eliminates a large part of the statistical scatter of the actual data points. The spline calibration allows adjustment of the average curve by a quantified closeness-of-fit parameter to the measured data points. A single spline is used for the precise correlation data available back to 9900 BP for terrestrial samples and about 6900 BP for marine samples. Beyond that, splines are taken on the error limits of the correlation curve to account for the lack of precision in the data points.

In describing our calibration curves, the solid bars represent one sigma statistics (68% probability) and the hollow bars represent two sigma statistics (95% probability). Marine carbonate samples that have been corrected for $^{13}C/^{12}C$, have also been corrected for both global and local geographic reservoir effects (as published in Radiocarbon, Volume 35, Number 1, 1993) prior to the calibration. Marine carbonates that have not been corrected for $^{13}C/^{12}C$ are adjusted by an assumed value of 0 %0 in addition to the reservoir corrections. Reservoir corrections for fresh water carbonates are usually unknown and are generally not accounted for in those calibrations. In the absence of measured $^{13}C/^{12}C$ ratios, a typical value of -5 %0 is assumed for freshwater carbonates.

(Caveat: the correlation curve for organic materials assume that the material dated was living for exactly ten years (e.g. a collection of 10 individual tree rings taken from the outer portion of a tree that was cut down to produce the sample in the feature dated). For other materials, the maximum and minimum calibrated age ranges given by the computer program are uncertain. The possibility of an "old wood effect" must also be considered, as well as the potential inclusion of younger or older material in matrix samples. Since these factors are indeterminant error in most cases, these calendar calibration results should be used only for illustrative purposes. In the case of carbonates, reservoir correction is theoretical and the local variations are real, highly variable and dependent on provenience. Since imprecision in the correlation data beyond 10,000 years is high, calibrations in this range are likely to change in the future with refinement in the correlation curve. The age ranges and especially the intercept ages generated by the program must be considered as approximations.)

LANDSET
ENGINEERS, INC.
ENGINEERING - LAND PLANNING
SURVEYING - ENVIRONMENTAL CONSULTING

March 25, 2009

File No.: LSG-0631-02

City of Hollister. Case No. GPA2007-1

Ms. Mary Paxton
City of Hollister
375 Fifth Street
Hollister, California 95023

Subject **Review of Geologic Fault Investigations**
Earth Systems Pacific dated August 12 & October 28, 2008

Project: **Vista Meadows Senior Apartments (APN 056-290-001)**
East Park Street & Rancho Drive
Hollister, California

Dear Ms. Paxton:

Thank you for providing us a copies of the *"Geologic Fault Investigation"* reports prepared by Earth Systems Pacific (2008 & 2008b). The purpose of this letter is to summarize our findings and observations of site visits performed at the Vista Meadows site between the period of June 3 through October 21, 2008 and review of the above noted reports.

The site being considered for development is located within the official Earthquake Fault Zone (EFZ) of the East Branch of the Calaveras fault, designated by the State of California as defined by the Alquist-Priolo Act. Based on our research, site observations within the exploratory trenches and report review, it is our opinion that there is substantive geologic evidence to support the existence of active Holocene age faulting within the sediments underlying the site.

We reviewed the report for conformance with State of California, Public Resources Code, Division 2. Geology Mines and Mining, Chapter 7.5 Earthquake Fault Zones, Sections 2621, 2621.5, 2621.6, 2623, 2624, 3600, 3601 & 3603 and City of Hollister Municipal Code, Title 17, Chapter 17.14.040. It is our opinion that the site geologic conditions are accurately modeled as represented in the above referenced reports. In general, our findings are congruent with the conclusions and recommendations of the reports prepared by Earth Systems Pacific (ESP), dated August 12 and October 28, 2008.

520-B Crazy Horse Canyon Road, Salinas, CA 93907 • (831) 443-6970 • Fax (831) 443-3801

However, the geologic fault investigations prepared by ESP require additional information prior to final acceptance for site development. The studies conclusions and recommendations should be reviewed and updated in an addendum report in order to satisfy the requirements of Division 2., Chapter 7.5, Section 3603 of the California Code of Regulations.

As required by State Code and local municipal ordinance, the final approved surface fault investigation report along with supporting documentation and peer reviews, shall be filed by the City of Hollister with the State Geologist. We will be happy to review the required addendum report when it is available.

We recommend that the project geologist contact us to discuss specific details of the proposed project. Please contact me at (831) 443-6970 or bpapurello@landseteng.com if you have questions regarding this matter.

Respectfully,
LandSet Engineers, Inc.

PROFESSIONAL GEOLOGIST
BRIAN E. PAPURELLO
No. CEG 2226
CERTIFIED ENGINEERING GEOLOGIST
Exp 2-28-10
STATE OF CALIFORNIA

Brian Papurello, CEG 2226
Reviewing Geologist

Doc. No. 0903-119.REV

Attachments: Fault Investigation Report Review Form

Distribution: Ms. Mary Paxton, City of Hollister (mary.paxton@hollister.ca.gov)
Ms. Cynthia Iwanaga (cynthia@scounty.com)
Mr. Bret Faust, PG, CEG, Earth Systems Pacific (bfaust@earthsys.com)

FAULT INVESTIGATION REPORT REVIEW FORM

Project Information

Project:	Vista Meadows Senior Apartments (APN 056-290-001) East Park Street and Rancho Drive Hollister, CA
Case number:	GPA2007-1
Applicant:	South County Housing Corporation 9015 Murray Avenue, Suite 100 Gilroy, CA 95020 Ms. Cynthia Iwanaga, Project Manager
Consultant:	Earth Systems Pacific 400 Park Center Drive, Suite 1 Hollister, CA 95023 Phone: (831) 637-2133, Fax: (831) 637-0510 E-mail: bfaust@earthsys.com.com Responsible geologists: Mr. Brett Faust, PG 7025, CEG 2386
Reports and Plans Reviewed:	Earth Systems Pacific, 2008, Geologic fault investigation, Vista Meadows Senior Apartments, East Park Street and Rancho Drive, Hollister, California: unpublished report to Ms. Cynthia Iwanaga, South County Housing Corporation, dated August 12, 2008, 12 p., 5 fig., 3 appendices, 2 plates, scale 1:60. _____2008a, Work plan for supplemental fault investigation, Vista Meadows Fault Investigation, East Park Street and Rancho Drive, Hollister, San Benito County, California: unpublished letter to Ms. Cynthia Iwanaga, South County Housing Corporation, dated October 15, 2008, 2 p., 1 fig., 2 attachments. _____2008b, Supplemental geologic fault investigation, Vista Meadows Senior Apartments, East Park Street and Rancho Drive, Hollister, California: unpublished letter to Ms. Cynthia Iwanaga, South County Housing Corporation, dated October 28, 2008, 2 p., 1 map, scale 1:600, 1 trench log, scale 1:60.
Other information sources:	Bryant, W.A., 1979, Fault evaluation report, Calaveras (Hollister segment) and "Buena Vista Road" faults: California Division of Mines and Geology Fault Evaluation Report FER-94, 14 p., 4 plates, scale 1:24,000. Bryant, W.A. and Cluett, S.E., compilers, 1999, Fault number 54c, Calaveras fault zone, Southern Calaveras section, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, http//earthquakes.usgs.gov/regional/qfaults, accessed 02/13/2008 10:38 AM. California Department of Conservation, California Geological Survey, 2002,: Guidelines for evaluating the hazard of surface fault rupture, CGS Note 49. California Department of Conservation, California Geological Survey, 2008,: Guidelines for evaluating and mitigating seismic hazards in California: California Geological Survey Special Publication 117, 102 p.

FAULT INVESTIGATION REPORT REVIEW FORM
(CONTINUED)

Other information sources: (continued)	California Division of Mines and Geology, 1982, Revised Official Special Studies Zone Map of the Hollister quadrangle: State of California Alquist Priolo Earthquake Fault Zoning Act map, scale 1:24,000. Dibblee, T.W.., Jr., and Rogers, T.H., 1975, Geologic map of the Hollister quadrangle: U.S. Geological Survey Open-File Report 75-394, scale 1:62,500. Hart, E.W., and Bryant, W.A., 2007, Fault-rupture hazard zones in California: California Geological Survey Special Publication 42, 42 p. Levi, T., Weinberger, R., Aifat., Eyal, Y., and Marco, S., 2006, Injection mechanism of clay-rich sediments into dikes during earthquakes: G3 (Geochemistry, Geophysics, Geosystems), v.7, no. 12. Rosenberg, L.I., 1998, Liquefaction Susceptibility of the Hollister Area, San Benito County, California, U.S. Geological Survey, National Earthquake Hazards Reduction Program Final Technical Report, Award No. 1434-HQ-97-GR-03125, 40 p. Terratech, Inc., 1987, Investigation of the east branch of the Calaveras fault, Prune Street school site (Rancho San Justo tandem school site), Hollister, California, unpublished consultants report, 10p., 9 figures.

Report Requirements

Applicable codes & ordinances:	State of California, Public Resources Code, Division 2. Geology Mines and Mining, Chapter 7.5 Earthquake Fault Zones, Sections 2621, 2621.5, 2621.6, 2623, 2624, 3600, 3601 & 3603. City of Hollister, Municipal Code, Title 17, Chapter 17.14.040.
Review standards:	California Department of Conservation, California Geological Survey, Guidelines for reviewing geologic reports: CGS Note 41, 4 p. California Department of Conservation, California Geological Survey, 2002: Guidelines for evaluating the hazard of surface fault rupture, CGS Note 49. California State Board for Geologists and Geophysicists, 1998, Geologic guidelines for earthquake and/or fault hazard reports, 7 p. Hart, E.W., and Bryant, W.A., 2007, Fault-rupture hazard zones in California: California Geological Survey Special Publication 42, 42 p.
Plan, phase, project or report under consideration:	Construct a 72-unit, two story, senior citizen residential apartment complex with associated infrastructure improvements on a vacant approximate 3-acre parcel.

FAULT INVESTIGATION REPORT REVIEW FORM
(CONTINUED)
Reviewer's Notes

Field observations & meetings:	06/03/08: Site review and observations of exposures in trench T-1. Trench T-1 is approximately 220 feet long by 15 feet deep exposing conformable deposits of upper Holocene over-bank deposits. Sub-vertical clay dike parting and graben structure noted at ~Sta. 0+57 with about 4 in. vertical separation at 14.0 feet. Vertical separation is less pronounced at shallower depths becoming less than 1-inch at 10 feet with associated warping of overlying sediments. No warping or bedding offset noted above at depth of 5 feet. No discernable deformation or warping of strata beyond the zone of parting. Sub-vertical clay dikes observed at several other localities within the trench with no bedding offsets or warping. Recommended to Rick Gorman & Brett Faust of ESP that additional trenching should be excavated to the north and south of T-1 on-strike of the feature exposed at Sta. 0+57 to aid in the determination if the observed structure is fault related. 06/05/08: Site review and observations of exposures in trenches T-2 and T-3. Trench T-2 is approximately 35 feet long by 15 feet deep. Observed trench T-3 from Station 0+00 to ~Sta. 0+50. Both trenches exposing conformable deposits of upper Holocene over-bank deposits. Sub-vertical clay dikes observed at several other localities within both trenches with no discernable bedding offsets or warping. 06/11/08: Site review and observations of exposures in trenches T-3. Trench T-3 is approximately 220 feet long by 15 feet deep, exposing conformable deposits of upper Holocene over-bank deposits. Sub-vertical clay dikes observed at several other localities within with no discernable bedding offsets or warping. 06/12/08: Site review and observations of exposures in trench T-4, Trench T-4 is approximately 22 feet long by 15 feet deep, exposing conformable deposits of upper Holocene over-bank deposits. One sub-vertical clay dike with no discernable bedding offsets or warping. 07/08/08: Site review and observations of exposures in trench T-5, Trench T-5 is approximately 52 feet long by 20 feet deep exposing conformable deposits of upper Holocene over-bank deposits. The trench was located to the north of Trench T-1, on-strike with the fault feature identified at Sta. 0+57. Within trench T-5 between Sta. 0+30 to 0+35 a zone of slickensided, brecciated soil was observed, interpreted as fault gouge. No discernable vertical separation of soil strata was observed below a depth of 10 feet. Above a depth of 10-feet soil strata was locally warped. From a depth of five feet this feature manifested itself as a dark soil chimney extending to with 1.5 feet of the ground surface. 10/14/08: Meeting attendance at the City of Hollister to discuss preliminary review findings of the initial consultants report ESP

Field observations & meetings: (Continued)	10/14/08 (continued): (2008). Attendees included Ms. Mary Paxton of the City Hollister, Mr. Abraham Prado of the City of Hollister, Ms. Cynthia Iwanaga of South County Housing, Mr. Brett Faust, CEG 2386 of Earth Systems Pacific and reviewing Geologist Brian Papurello, CEG 2226 of Landset Engineers, Inc. Purpose of the meeting was to discuss the reviewing geologists request to perform supplemental exploratory trenching in northeastern portion of the site. 10/21/08: Site review and observations of exposures in trench T-6 located in the northeastern portion of the site as recommended by the reviewing geologist. Trench T-6 is approximately 137 feet long by 15 feet deep, exposing conformable deposits of upper Holocene over-bank deposits. Two sub-vertical clay dikes observed with no discernable bedding offsets.
Attachments:	None
Disposition:	08/20/08: Received copy of Earth Systems Pacific report (2008) from City of Hollister Development Services Planning Manager, Ms. Mary M. Paxton. 10/15/08: Received copy of Earth Systems Pacific letter (2008a) from City of Hollister Development Services Planning Manager, Ms. Mary M. Paxton. 10/16/08: Issued review letter for Earth Systems Pacific (2008a) Supplemental fault investigation work plan letter. 11/10/08: Received copy of Earth Systems Pacific report (2008b) from Mr. Abraham Prado with the City of Hollister Community Development Department, Planning Division. 03/25/09: Issued review letter for Earth Systems Pacific, geologic fault investigation & supplemental geologic fault investigation reports (ESP 2008 & 2008b)

FAULT INVESTIGATION REPORT REVIEW FORM
(CONTINUED)

The following checklist (modified after CGS Special Publication 42, Appendix C and CGS Note 49) is used as part of reviewing fault investigation reports. Explanatory notes are appended and keyed to each numbered item.

Checklist item within consulting report	Adequately described: satisfactory	Additional data needed: unsatisfactory
1. Purpose and scope of investigation	X	
2. Description of proposed development	X	
3. Geologic and tectonic setting	X	
4. Seismicity and earthquake history	X*	
5. Site description and conditions	X*	
6. Review of published and unpublished literature	X	
7. Stereoscopic interpretation of aerial photographs & remote sensing	X*	
8. Surface observations	X	
9. Subsurface investigation; trenches, borings, CPT testing	X	
10. Geophysical investigation	N/A	
11. Age dating techniques	X	
12. Location or existence (or absence) of hazardous faults	X	
13. Ages of past rupture events		X
14. Type of faults and nature of anticipated offset		X
15. Distribution of primary and secondary faulting and related deformation	X	
16. Probability of relative potential for future surface displacement		X
17. Degree of confidence and limitations of data and conclusions	X	
18. Setback distance determinations	X	
19. Additional mitigative measures to accommodate fault related deformation		X
20. Risk evaluation relative to the proposed development		X
21. Limitations of the investigation; need for additional studies		X
22. References for published & unpublished literature and aerial photographs	X	
23. Location map	X	
24. Regional geology map	X	
25. Fault and seismic epicenter map		X
26. Site location on Official Earthquake Fault Zone Map	X	
27. Site development map	X	
28. Original site geologic map	X	
29. Logs of exploratory trenches & borings, scale 1:60	X	
30. Appendix with supporting data (e.g. water well, geophysical, aerial photographs	X	
31. Authentication, report signed and stamped by PG/CEG with expiration date	X*	

X* denotes acceptable item with comment

EXPLANATORY NOTES KEYED TO CHECKLIST

4. Seismicity and earthquake history

The report (ESP 2008) does include a required discussion on earthquake history and presents site data obtained from the EQSEARCH computer program. However, the output files that depict the data are not presented in the report. The report also lacks a required earthquake epicenter map (see proceeding item no. 25).

5. Site description and conditions

Throughout most of the report, the site assessor's parcel number is shown as 056-290-001. However, on the signature page of the executive summary, the site assessor's parcel number is depicted as 20-28-46. It is assumed that this is a simple typographical error and that the former parcel number is the correct number for the site.

7. Stereoscopic interpretation of aerial photographs & remote sensing

The report includes a discussion of stereoscopic aerial photographic review of a stereo pair flown in 1959. These photos are cited in the references, but are not included in the report. We recommend that the project geologist include copies of all stereoscopic aerial photographs utilized in future reports submitted to the City of Hollister for review.

13. Age of past rupture events

The report concludes that active faulting (<11,000 ybp) has occurred on the site. However, the report does not specifically state the ages of these past event(s). Based on radiocarbon testing, the age of faulting is less than 3,000 ybp. Review of features identified in Trench T-5 indicates that the age of faulting may be substantially younger. The project geologist should review the field and laboratory data to quantitatively date the ages of the past rupture event(s) observed.

14. Type of faults and nature of anticipated offset

The report makes no statement with respect to the type (normal, reverse, strike slip) of faulting observed on the site, relative sense of movement, recurrence intervals and if the faulting is related to a single or multiple events. Anticipated offset has not been addressed. We recommend that the project geologist clarify and address these issues.

16. Probability of Relative Potential for Future Surface Displacement

The report has not addressed the potential for future fault related surface displacement to occur on the site. This may be stated in terms such as low, moderate, or high.

19. Additional mitigative measures to accommodate fault related deformation

The report recommends and depicts a 100-foot wide "building exclusion zone". However, the report has not addressed the need (if any) for additional mitigative measures related to fault deformation for site infrastructure improvements.

20. Risk evaluation relative to proposed development

The report has addressed faulting, ground shaking, liquefaction, lateral spreading, and seismically induced settlement. It is our opinion that the project geologist should re-evaluate the geologic risk to the planned development based on our preceding review comments Nos. 13, 14, 16 & 19.

21. Limitations of investigation; need for additional studies

The report references and cites a previous preliminary soils engineering investigation that was performed on the site (ESCNC, 2001). However, the reports reviewed provide no conclusions, recommendations, or comments that any further geotechnical review or analysis is needed. We recommend that the project geologist review their findings with the project geotechnical engineer, so that they may amend and/or update their design recommendations as warranted.

25. Fault and seismic epicenter map

The report does include a regional fault map depicting the approximate location of the site. However, this figure does not depict earthquake epicenter data as discussed in the earthquake history portion of the report. We recommend that the project geologist revise this figure to include pertinent earthquake epicenter information.

31. Authentication, report signed and stamped by PG/CEG with expiration date

The report is signed and stamped by Mr. Brett Faust, CEG 2386. However, the expiration data to be included as suggested by CGS Note 49 is not presented.

RECOMMEDATIONS

1. Report Suitability. The geologic fault investigations prepared by Earth Systems Pacific, dated August 12 and October 28, 2008 require additional information prior to final acceptance. The investigations' conclusions and recommendations should be reviewed and updated in order to satisfy the requirements of Division 2., Chapter 7.5, Section 3603 of the California Code of Regulations.

2. Respond to Review Comments. The project geologist needs to review the comments on the previous pages and address them in an addendum report. After the addendum report is submitted to the City of Hollister, it will be reviewed and considered for final acceptance.

Brian Papurello, CEG 2226
Reviewing Geologist

PROFESSIONAL GEOLOGIST
BRIAN E. PAPURELLO
No. CEG 2226
CERTIFIED
ENGINEERING
GEOLOGIST
Exp 2-28-10
STATE OF CALIFORNIA

Earth Systems Pacific

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E-mail: esp@earthsys.com

June 4, 2009

File No. SH-10941-GA

Mr. Andy Lief, Sr. Project Manager
South County Housing Corporation
7455 Carmel Street
Gilroy, CA 95020

PROJECT: VISTA MEADOWS SENIOR APARMENTS
EAST PARK STREET AND RANCHO DRIVE, APN 056-290-001
HOLLISTER, CALIFORNIA

SUBJECT: **Response to Review Comments**

REFERENCES:

1) Preliminary Soils Engineering Report, Vista Meadows Senior Apartments, Park Street, Hollister, California, by Earth Systems Consultants Northern California, File No. HO-07526-02, dated March 12, 2001.

2) Updated Geotechnical Engineering Recommendations, South County Housing Vista Meadows Senior Apartments, East Park Street, Hollister, California, by Earth Systems Pacific, File No. SH-10941-SC, dated August 11, 2008.

3) Geologic Fault Investigation, Vista Meadows Senior Apartments, East Park Street and Rancho Drive, APN 056-290-001, Hollister, California, by Earth Systems Pacific, File No. SH-10941-GA, dated August 12, 2008.

Dear Mr. Lief,

We have reviewed the comments and recommendations contained in the referenced Review of Geologic Fault Investigations letter for the Vista Meadows Senior Apartments project in Hollister. The letter recommends additional illustrations and discussion concerning geologic conditions at the site.

Our response to checklist items is summarized below

4. Seismicity and earthquake history: A Historical Earthquake Fault Map is attached.

5. Site description and conditions: The assessor's parcel number is 056-290-001

7. Stereoscopic interpretation of aerial photographs and remote sensing: As recommended, copies of aerial photographs utilized will be included in future geologic reports that are submitted to the City.

13. Age of past rupture events: Based on radiocarbon dating, the most recent rupture event on the site occurred within the last ±3,000 years and offset strata below a depth of about six feet. There is additional evidence at the site that suggests more recent fault rupture. Faulting, that was traceable to within about 0.5 feet of ground surface, was identified in trench T-5 on the northern portion of the site. Radiocarbon dating was not performed in connection with the faulting trench T-5. Therefore, it is assumed that this faulting occurred within that last several hundred years.

14. Type of faults and nature of anticipated offset: Regionally, the East Branch Calaveras fault exhibits normal faulting with down to the west sense of movement, and right-lateral strike-slip movement. A normal style of faulting was observed in trench T-1 where intact strata warps down to the west across the fault trace. Faulting observed in trench T-5 did not exhibit a clear sense of movement. It is likely that that a combination of normal and strike-slip faulting is present at the site. The total amount of apparent vertical offset observed in trench T-1 was about 1.5 feet. Based on the presence of an eastward step of the fault, it appears that the faulting observed on the site is related to at least two separate events. We anticipate that future offset would consist of a combination of normal and strike slip movement with vertical offset on the order of 1 foot. There was insufficient trench data to estimate the magnitude of anticipated horizontal offset.

16. Probability of relative potential for future displacement: Whereas the East Branch Calaveras fault offsets Holocene age sediments in the Hollister Valley, there is little evidence that the fault is actively creeping or has ruptured in recent historic times. However, evidence of faulting that extended upward to within about 0.5 feet of ground surface was observed in trench T-5 on the site suggesting more recent fault rupture. Therefore, the potential for future surface fault displacement to occur during the design life of the planned structures is considered to be low to moderate.

19. Additional mitigative measures to accommodate fault related deformation: The updated geotechnical engineering report (see *References* above) recommends rigid post-tension slab foundations for the planned apartment buildings. No mitigative measures, other than a 50-foot setback from the fault, are recommended to further accommodate fault related deformation.

20. Risk evaluation relative to proposed development: Considering our evaluation based on preceding review comments 13, 14, 16 and 19, geologic risk to the planned development is considered to be low to moderate.

21. Limitations of investigation; need for additional studies: An updated geotechnical engineering letter report dated August 11, 2008, that included consideration of fault rupture hazards at the site has been submitted (see *References* above).

25. Fault and seismic epicenter map: (see item *4* above).

31. Authentication, report signed and stamped by PG/CEG with expiration date: CEG license 2386, issued to Brett D. Faust, expires December 31, 2010. Future reports that are submitted to the City will include license expiration date.

We appreciate the opportunity to have been of service. If you have any questions or desire additional information, please do not hesitate to contact this office.

Sincerely,

EARTH SYSTEMS PACIFIC

Brett D. Faust
Engineering Geologist
EG 2386

PROFESSIONAL GEOLOGIST
BRETT D. FAUST
No. 2386
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA
Exp 12/10

Attachment: Historical Earthquake/Fault Map
Distribution: Addressee (2)
Landset Engineers, Inc., Attn: Mr. Brian Papurello (1)
City of Hollister, Attn: Ms Mary Paxton (email)

Document No. 0906-509.GEO

HISTORICAL EARTHQUAKE/ FAULT MAP

VISTA MEADOWS SENIOR APARTMENTS
East Park Street
Hollister, California

LEGEND

- Historic rupture (<200 years)
- Holocene fault (<10,000 years)
- Late Quaternary (<700,000 years)
- Quaternary fault (<1.6 million)

HISTORICAL EARTHQUAKE MAGNITUDE

5.0 to 5.9 | 6.0 to 6.9 | 7.0 to 7.9

FAULTS

1 San Andreas
2 Calaveras
3 Zayante
4 East Branch Calaveras
5 Sargent
6 Ortigalita

Note: Not all faults are shown on map

REFERENCES

Blake, T.F., EQSEARCH, updated 2005
Jennings, C.W, 1994

N

(Approximate Scale: 1" = 6 miles)

Earth Systems Pacific
June 2009

(831) 637-2133 - (831) 637-0510
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SH-10941-GA

LANDSET
ENGINEERS, INC.
ENGINEERING - LAND PLANNING
SURVEYING - ENVIRONMENTAL CONSULTING

June 10, 2009

File No.: LSG-0631-02

City of Hollister. Case No. GPA2007-1

Mr. Abraham Prado
City of Hollister
375 Fifth Street
Hollister, California 95023

Subject **Review of Response to Review Comments Earth Systems Pacific dated June 4, 2009**

Project: **Vista Meadows Senior Apartments (APN 056-290-001)**
East Park Street & Rancho Drive
Hollister, California

Reference: 1. Review of Geologic Fault Investigations, Earth Systems Pacific, dated August 12 & October 28, 2008, Vista Meadows Senior Apartments, (APN 056-290-001) East Park Street & Rancho Drive, Hollister California, prepared by Landset Engineers Inc., Doc. No. 0903-119.REV, dated March 25, 2009.

Dear Mr. Prado:

Thank you for providing us a copy of the *"Response to Review Comments"* report prepared by Earth Systems Pacific (ESP 2009). The purpose of this letter is to summarize our review findings of the above referenced addendum report. This firm previously prepared a review letter for *"Geologic Fault Investigation"* reports prepared by Earth Systems Pacific (ESP 2008 & 2008b) requesting of additional site specific geologic information and response to review comments (Reference 1).

The site being considered for development is located within the official Earthquake Fault Zone (EFZ) of the East Branch of the Calaveras fault, designated by the State of California as defined by the Alquist-Priolo Act. Based on our research, site observations within the exploratory trenches and report review, it is our opinion that there is substantive geologic evidence to support the existence of active Holocene age faulting within the sediments underlying the site.

We reviewed the reports (ESP 2008, 2008b & 2009) for conformance with State of California, Public Resources Code, Division 2. Geology Mines and Mining, Chapter 7.5 Earthquake Fault

520-B Crazy Horse Canyon Road, Salinas, CA 93907 • (831) 443-6970 • Fax (831) 443-3801

Zones, Sections 2621, 2621.5, 2621.6, 2623, 2624, 3600, 3601 & 3603 and City of Hollister Municipal Code, Title 17, Chapter 17.14.040.

It is our opinion that the site geologic conditions are accurately modeled as represented in the referenced reports. In general, our findings are congruent with the conclusions and recommendations of the reports prepared by Earth Systems Pacific (ESP 2008, 2008b & 2009), dated August 12 & October 28, 2008 and June 4, 2009 respectively.

The recommendations summarized in the referenced documents and the project updated geotechnical report dated August 11, 2008, should be included as conditions of approval prior to the issuance of building permits. It is our opinion that the project engineering geologic constraints have been adequately characterized and appropriate mitigative measures have been included for compliance with the State of California Alquist-Priolo Act.

As required by State Code and local municipal ordinance, the final approved surface fault investigation reports (ESP 2008, 2008b & 2009) along with supporting documentation and peer reviews, shall be filed by the City of Hollister with the State Geologist.

Please contact me at (831) 443-6970 or bpapurello@landseteng.com if you have questions regarding this matter.

Respectfully,
LandSet Engineers, Inc.

PROFESSIONAL GEOLOGIST
BRIAN E. PAPURELLO
No. CEG 2226
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Brian Papurello, CEG 2226
Reviewing Geologist

Exp 2-28-10

Doc. No. 0906-108.REV

Attachments: Fault Investigation Report Review Form

Distribution: Mr. Abraham Prado, City of Hollister (abraham.prado@hollister.ca.gov)
Mr. Andy Leif (andy@scounty.com)
Mr. Bret Faust, PG, CEG, Earth Systems Pacific (bfaust@earthsys.com)

FAULT INVESTIGATION REPORT REVIEW FORM

Project Information

Project:	Vista Meadows Senior Apartments (APN 056-290-001) East Park Street and Rancho Drive Hollister, CA
Case number:	GPA2007-1
Applicant:	South County Housing Corporation 9015 Murray Avenue, Suite 100 Gilroy, CA 95020 Mr. Andy Leif, Sr. Project Manager
Consultant:	Earth Systems Pacific 400 Park Center Drive, Suite 1 Hollister, CA 95023 Phone: (831) 637-2133, Fax: (831) 637-0510 E-mail: bfaust@earthsys.com.com Responsible geologists: Mr. Brett Faust, PG 7025, CEG 2386
Reports and Plans Reviewed:	Earth Systems Pacific, 2008, Geologic fault investigation, Vista Meadows Senior Apartments, East Park Street and Rancho Drive, Hollister, California: unpublished report to Ms. Cynthia Iwanaga, South County Housing Corporation, dated August 12, 2008, 12 p., 5 fig., 3 appendices, 2 plates, scale 1:60. _____2008a, Work plan for supplemental fault investigation, Vista Meadows Fault Investigation, East Park Street and Rancho Drive, Hollister, San Benito County, California: unpublished letter to Ms. Cynthia Iwanaga, South County Housing Corporation, dated October 15, 2008, 2 p., 1 fig., 2 attachments. _____2008b, Supplemental geologic fault investigation, Vista Meadows Senior Apartments, East Park Street and Rancho Drive, Hollister, California: unpublished letter to Ms. Cynthia Iwanaga, South County Housing Corporation, dated October 28, 2008, 2 p., 1 map, scale 1:600, 1 trench log, scale 1:60. _____2009, Response to review comments, Vista Meadows Senior Apartments, East Park Street and Rancho Drive, APN 056-290-001, Hollister, California: unpublished letter to Mr. Andy Leif, Sr. Project Manager, South County Housing Corporation, dated June 4, 2009, 3 p., 1 map.
Other information sources:	Bryant, W.A., 1979, Fault evaluation report, Calaveras (Hollister segment) and "Buena Vista Road" faults: California Division of Mines and Geology Fault Evaluation Report FER-94, 14 p., 4 plates, scale 1:24,000. Bryant, W.A. and Cluett, S.E., compilers, 1999, Fault number 54c, Calaveras fault zone, Southern Calaveras section, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, http//earthquakes.usgs.gov/regional/qfaults, accessed 02/13/2008 10:38 AM. California Department of Conservation, California Geological Survey, 2002,: Guidelines for evaluating the hazard of surface fault rupture, CGS Note 49.

FAULT INVESTIGATION REPORT REVIEW FORM
(CONTINUED)

Other information sources: (continued)	California Department of Conservation, California Geological Survey, 2008,: Guidelines for evaluating and mitigating seismic hazards in California: California Geological Survey Special Publication 117, 102 p. California Division of Mines and Geology, 1982, Revised Official Special Studies Zone Map of the Hollister quadrangle: State of California Alquist Priolo Earthquake Fault Zoning Act map, scale 1:24,000. Dibblee, T.W.., Jr., and Rogers, T.H., 1975, Geologic map of the Hollister quadrangle: U.S. Geological Survey Open-File Report 75-394, scale 1:62,500. Hart, E.W., and Bryant, W.A., 2007, Fault-rupture hazard zones in California: California Geological Survey Special Publication 42, 42 p. Levi, T., Weinberger, R., Aifat., Eyal, Y., and Marco, S., 2006, Injection mechanism of clay-rich sediments into dikes during earthquakes: G3 (Geochemistry, Geophysics, Geosystems), v.7, no. 12. Rosenberg, L.I., 1998, Liquefaction Susceptibility of the Hollister Area, San Benito County, California, U.S. Geological Survey, National Earthquake Hazards Reduction Program Final Technical Report, Award No. 1434-HQ-97-GR-03125, 40 p. Terratech, Inc., 1987, Investigation of the east branch of the Calaveras fault, Prune Street school site (Rancho San Justo tandem school site), Hollister, California, unpublished consultants report, 10p., 9 figures.

Report Requirements

Applicable codes & ordinances:	State of California, Public Resources Code, Division 2. Geology Mines and Mining, Chapter 7.5 Earthquake Fault Zones, Sections 2621, 2621.5, 2621.6, 2623, 2624, 3600, 3601 & 3603. City of Hollister, Municipal Code, Title 17, Chapter 17.14.040.
Review standards:	California Department of Conservation, California Geological Survey, Guidelines for reviewing geologic reports: CGS Note 41, 4 p. California Department of Conservation, California Geological Survey, 2002: Guidelines for evaluating the hazard of surface fault rupture, CGS Note 49. California State Board for Geologists and Geophysicists, 1998, Geologic guidelines for earthquake and/or fault hazard reports, 7 p. Hart, E.W., and Bryant, W.A., 2007, Fault-rupture hazard zones in California: California Geological Survey Special Publication 42, 42 p.
Plan, phase, project or report under consideration:	Construct a 72-unit, two story, senior citizen residential apartment complex with associated infrastructure improvements on a vacant approximate 3-acre parcel.

FAULT INVESTIGATION REPORT REVIEW FORM
(CONTINUED)
Reviewer's Notes

Field observations & meetings:	06/03/08: Site review and observations of exposures in trench T-1. Trench T-1 is approximately 220 feet long by 15 feet deep exposing conformable deposits of upper Holocene over-bank deposits. Sub-vertical clay dike parting and graben structure noted at ~Sta. 0+57 with about 4 in. vertical separation at 14.0 feet. Vertical separation is less pronounced at shallower depths becoming less than 1-inch at 10 feet with associated warping of overlying sediments. No warping or bedding offset noted above at depth of 5 feet. No discernable deformation or warping of strata beyond the zone of parting. Sub-vertical clay dikes observed at several other localities within the trench with no bedding offsets or warping. Recommended to Rick Gorman & Brett Faust of ESP that additional trenching should be excavated to the north and south of T-1 on-strike of the feature exposed at Sta. 0+57 to aid in the determination if the observed structure is fault related. 06/05/08: Site review and observations of exposures in trenches T-2 and T-3. Trench T-2 is approximately 35 feet long by 15 feet deep. Observed trench T-3 from Station 0+00 to ~Sta. 0+50. Both trenches exposing conformable deposits of upper Holocene over-bank deposits. Sub-vertical clay dikes observed at several other localities within both trenches with no discernable bedding offsets or warping. 06/11/08: Site review and observations of exposures in trenches T-3. Trench T-3 is approximately 220 feet long by 15 feet deep, exposing conformable deposits of upper Holocene over-bank deposits. Sub-vertical clay dikes observed at several other localities within with no discernable bedding offsets or warping. 06/12/08: Site review and observations of exposures in trench T-4, Trench T-4 is approximately 22 feet long by 15 feet deep, exposing conformable deposits of upper Holocene over-bank deposits. One sub-vertical clay dike with no discernable bedding offsets or warping. 07/08/08: Site review and observations of exposures in trench T-5, Trench T-5 is approximately 52 feet long by 20 feet deep exposing conformable deposits of upper Holocene over-bank deposits. The trench was located to the north of Trench T-1, on-strike with the fault feature identified at Sta. 0+57. Within trench T-5 between Sta. 0+30 to 0+35 a zone of slickensided, brecciated soil was observed, interpreted as fault gouge. No discernable vertical separation of soil strata was observed below a depth of 10 feet. Above a depth of 10-feet soil strata was locally warped. From a depth of five feet this feature manifested itself as a dark soil chimney extending to with 1.5 feet of the ground surface. 10/14/08: Meeting attendance at the City of Hollister to discuss preliminary review findings of the initial consultants report ESP

Field observations & meetings: (Continued)	10/14/08 (continued): (2008). Attendees included Ms. Mary Paxton of the City Hollister, Mr. Abraham Prado of the City of Hollister, Ms. Cynthia Iwanaga of South County Housing, Mr. Brett Faust, CEG 2386 of Earth Systems Pacific and reviewing Geologist Brian Papurello, CEG 2226 of Landset Engineers, Inc. Purpose of the meeting was to discuss the reviewing geologists request to perform supplemental exploratory trenching in northeastern portion of the site. 10/21/08: Site review and observations of exposures in trench T-6 located in the northeastern portion of the site as recommended by the reviewing geologist. Trench T-6 is approximately 137 feet long by 15 feet deep, exposing conformable deposits of upper Holocene over-bank deposits. Two sub-vertical clay dikes observed with no discernable bedding offsets.
Attachments:	None
Disposition:	08/20/08: Received copy of Earth Systems Pacific report (2008) from City of Hollister Development Services Planning Manager, Ms. Mary M. Paxton. 10/15/08: Received copy of Earth Systems Pacific letter (2008a) from City of Hollister Development Services Planning Manager, Ms. Mary M. Paxton. 10/16/08: Issued review letter for Earth Systems Pacific (2008a) Supplemental fault investigation work plan letter. 11/10/08: Received copy of Earth Systems Pacific report (2008b) from Mr. Abraham Prado with the City of Hollister Community Development Department, Planning Division. 03/25/09: Issued review letter for Earth Systems Pacific, geologic fault investigation & supplemental geologic fault investigation reports (ESP 2008 & 2008b) 06/09/08: Received copy of Earth Systems Pacific report (2009) from Mr. Abraham Prado with the City of Hollister Community Development Department, Planning Division. 06/10/09: Issued review letter for Earth Systems Pacific, response to review comments report (ESP 2009)

FAULT INVESTIGATION REPORT REVIEW FORM
(CONTINUED)

The following checklist (modified after CGS Special Publication 42, Appendix C and CGS Note 49) is used as part of reviewing fault investigation reports. Explanatory notes are appended and keyed to each numbered item.

Checklist item within consulting report	Adequately described: satisfactory	Additional data needed: unsatisfactory
1. Purpose and scope of investigation	X	
2. Description of proposed development	X	
3. Geologic and tectonic setting	X	
4. Seismicity and earthquake history	X	
5. Site description and conditions	X	
6. Review of published and unpublished literature	X	
7. Stereoscopic interpretation of aerial photographs & remote sensing	X	
8. Surface observations	X	
9. Subsurface investigation; trenches, borings, CPT testing	X	
10. Geophysical investigation	N/A	
11. Age dating techniques	X	
12. Location or existence (or absence) of hazardous faults	X	
13. Ages of past rupture events	X	
14. Type of faults and nature of anticipated offset	X	
15. Distribution of primary and secondary faulting and related deformation	X	
16. Probability of relative potential for future surface displacement	X	
17. Degree of confidence and limitations of data and conclusions	X	
18. Setback distance determinations	X	
19. Additional mitigative measures to accommodate fault related deformation	X	
20. Risk evaluation relative to the proposed development	X	
21. Limitations of the investigation; need for additional studies	X	
22. References for published & unpublished literature and aerial photographs	X	
23. Location map	X	
24. Regional geology map	X	
25. Fault and seismic epicenter map	X	
26. Site location on Official Earthquake Fault Zone Map	X	
27. Site development map	X	
28. Original site geologic map	X	
29. Logs of exploratory trenches & borings, scale 1:60	X	
30. Appendix with supporting data (e.g. water well, geophysical, aerial photographs	X	
31. Authentication, report signed and stamped by PG/CEG with expiration date	X	

GEOLOGICAL FAULT INVESTIGATION
HOLLISTER FIRE STATION NO. 1
110 5TH STREET
HOLLISTER, CALIFORNIA

December, 2010

Prepared for

City of Hollister Redevelopment Agency

Prepared by

Earth Systems Pacific
400 Park Center Drive, Suite 1
Hollister, California

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December 8, 2010 File No.: SH-11132-GA

Ms. Renee Perales
Hollister Redevelopment Agency
550 Monterey Street
Hollister, CA 95023

PROJECT: HOLLISTER FIRE STATION NO.1
110 5TH STREET
HOLLISTER, CALIFORNIA

SUBJECT: **Geologic Fault Investigation**

REFERENCE: Proposal to Perform a Geologic Fault Study, Hollister Fire Station No. 1, 110 5th Street, Hollister, California, by Earth Systems Pacific, dated October 23, 2009.

Dear Ms. Perales:

In accordance with the City's authorization of the above-referenced proposal, we are submitting herewith the results of our Geological Fault Investigation that was performed for the Hollister Fire Station No. 1 rebuild project at 110 5th Street. This report is based upon the results of our review of geologic maps and literature, and field exploration. In the report we describe the general geologic characteristics of the site, identify potential geologic hazards, and provide guidance for site development. Six copies of this report have been furnished for your use.

We appreciate the opportunity to have provided geologic services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

Earth Systems Pacific

PROFESSIONAL GEOLOGIST
BRETT D. FAUST
No. 2386
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Brett Faust
Engineering Geologist
EG 2386

Distribution: 6 to Addressee

Document No. 1012-550.GEO

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APPENDIX C Beat Analytical Inc., Report of Radiocarbon Dating

1.0 INTRODUCTION

This report presents the results of our geologic fault investigation for the Hollister Fire Station No. 1 rebuild project at 110 5th Street in Hollister, California. The site location is shown on the Vicinity Map in Appendix A. Plans for the rebuild were not available at the time of our investigation, but we understand that the new fire station will occupy the same location.

The subject site is located within a State of California Earthquake Fault Zone. The Alquist-Priolo Earthquake Fault Zoning Act is intended to provide policies and criteria to assist cities, counties, and state agencies in the exercise of their responsibility to prohibit the location of developments and structures for human occupancy across the trace of an active fault. A concealed northwest-trending trace of the East Branch of the Calaveras fault is depicted approximately 300 feet southwest of the site (see Vicinity Map in Appendix A). The primary purpose of this fault study was to identify fault features within the Earthquake Fault Zone on the site.

2.0 SCOPE OF SERVICES

The scope of work for this geologic fault study included a general site reconnaissance, review of available geologic reports and maps, review of a pair of stereo aerial photos covering the site and its immediate vicinity, interpretation of the subsurface information derived from detailed logging of an exploratory fault trench, radiocarbon dating, evaluation of the data collected, and preparation of this report. The scope of our work is intended to comply with the requirements of California Geological Survey Note 49, Guidelines for Evaluating the Hazard of Surface Fault Rupture.

Our scope of our services did not include evaluation of the presence of radioisotopes or asbestos (either naturally occurring or man made); nor environmental investigation for the presence or absence of hazardous or toxic materials in the soil, surface water, groundwater or air, on, below, or around the site. An initial foundation and site investigation report was prepared for the site and submitted separately.

3.0 SITE SETTING

The site is located on the Hollister, California, 7½-minute topographic quadrangle (U.S. Geological Survey, 1995) at coordinates 36.8517 degrees north and -121.4003 degrees west (see Vicinity Map in Appendix A). The site is a rectangular parcel located on the northwest corner of 5th and Sally Streets

in a commercial and industrial district of Hollister. Topographically, the site is flat and lies at an elevation of about 290 feet.

4.0 FIELD EXPLORATION

From March 17 through March 29, 2010, exploratory trench T-1 was excavated and logged on 5th Street adjacent to the Fire Station and eastward across Sally Street. The trench was excavated utilizing an excavator equipped with a 60-inch wide bucket and was limited to a maximum depth of about 14 feet. Because of loose caving soil conditions, we were unable to safely shore the trench to the planned depth of 15 to 17 feet. Trench T-1 was 185-feet in length extending approximately 50-feet west of the existing building and about 45-feet east of the building to within about five feet of a storm drain. The trench location is shown on the Geologic and Exploratory Trench Location Map in Appendix A. The materials encountered in the trenches were logged by a Certified Engineering Geologist and Mr. Brain Pappaurello, the City's reviewing engineering geologist, viewed the trench exposures. Copies of the trench logs are presented in Appendix B. Trench excavation restoration consisted of placement and compaction of backfill material capped with asphaltic concrete.

5.0 GEOLOGY

Geologic Site Conditions

The site is located in the seismically active central California Coast Ranges geomorphic province and is situated on the floor of the Hollister Valley. Structurally, the valley is divided into two structural blocks with the San Justo block west of the Calaveras fault and the Diablo Block east of the fault (Rogers, 1993). The Diablo block underlies the subject site. Based on Rogers (1993), the overlying geologic unit consists of alternating lake and alluvial deposits of Quaternary age (Ql-Qal) and were described as unconsolidated, well sorted, gray to blue silt, clay and sand. Rosenberg (1998) further divided the surficial deposits in the region and mapped younger flood-plain deposits (Qyfm) on and in the site vicinity. Rosenberg (1998) describes these sediments as medium-textured flood-plain deposits consisting of mainly stiff sandy silt and silty clay with lenses of clean sand. Radiocarbon dates of the surficial units were reported to be 3,720± 90 yr B.P at 3.6 m (11.8 ft) depth and 18,110± 190 yr B.P at 5.2 m (17.1 ft) depth (Rosenberg, 1998). A Regional Geologic Map is presented in Appendix A. Site specific geology is shown on Geologic and Exploratory Trench Location Map, and Geologic Cross Section A – A', also in Appendix A.

Faulting

The site is located within the seismically active central California Coast Ranges geomorphic province. The major active fault recognized in this region of California is the San Andreas fault. In addition to the East Branch of the Calaveras fault, other active faults in the site region include the Main Branch Calaveras, Sargent, Quien Sabe, Ortigalita and San Gregorio-Hosgri faults (see Regional Faults and Earthquakes Map in Appendix A for the location of these faults relative to the site). Active faults are defined by the State of California as exhibiting well-defined evidence of displacement within Holocene time, or the last 11,000 years (Hart, 1997).

The nearest fault is the Calaveras which is a major branch of the San Andreas Fault system that merges with the San Andreas Fault approximately 7 miles south of the site. The Calaveras fault in the Hollister area is comprised of two northwest trending fault traces, the Main and East branches. The Main branch, or creeping trace, is historically active, having evidence of fault offset within the last 200 years (and up to the present), whereas the East branch is defined by the state as "recently active" having evidence of fault offset within the last 11,000 years. In the Hollister area south of the site, the East Branch forms a subdued west-facing scarp where evidence of faulting has been observed (Terratech, 1987; Earth Systems Consultants Northern California, 1992 and 1998; Earth Systems Pacific, 2008_1). The scarp is not apparent north of 6th Street where that State Mapped trace is shown to be concealed and evidence of faulting associated with the East Branch was not observed in the Park Hill area where it is mapped north of the site (Earth Systems Consultants Northern California, 1992; Earth Systems Pacific, 2008_2). Those studies exposed un-faulted Quaternary-Tertiary age (2.6 million years before present) San Benito formation deposits. We are not aware of other studies to the north or where there has been evidence of displacement associated with the East Branch north of 6th Street. A previous study (Earth Systems Pacific, 2008_1), located approximately 0.5 mile to the south, showed evidence of faulting within upper most geologic units that were on the same order of age as those at the Fire Station site.

According to Templeton et al (2001), the juncture of the San Andreas and Calaveras faults is a complex area where subsurface seismicity does not always follow surface fault traces, and secondary faults such as the Quien Sabe fault zone may play an active role accommodating deformation. Specifically, Templeton et al (2001) found that seismicity on the San Andreas and southern Calaveras faults is offset to the west of their surface traces indicating that these faults are slipping at depth even though there may be little surface expression of slip. Templeton et al (2001) estimated a slip rate on the Calaveras fault in the Hollister region of 4-13 mm/year. The California Geological Survey (1996)

has assigned a slip rate of 15 mm/year to the southern Calaveras fault.

McClellan and Hay (1989) indicated that the Calaveras fault at San Felipe Lake, northeast of the site, and in Hollister experienced slip of up to 5 mm at the ground surface near the time of the M7.1 Loma Prieta earthquake on October 17, 1989. It was calculated that the slip was triggered by dynamic strain (ground shaking) resulting from the Loma Prieta earthquake on the nearby San Andreas fault.

City of Hollister Fault Study

We reviewed a Fault Study report prepared for the City of Hollister by Applied Soil Mechanics and dated June 1991. The study encompassed several locations in the downtown area and included a combination of exploratory trenches and borings. Two of the trenches (ET-2 and ET-3) where excavated on 5th Street just west of the subject site. The soils there were described as nearly flat-lying lacustrine and fluvial sand, silt and clay deposits present to depths of at least 15 feet, the maximum depth explored. It was reported that the radiocarbon age of a charcoal sample collected at a depth of 12 feet in one of their trenches was 3,720 ± 90 years before present. They concluded that there was no evidence of faulting present in the trench exposures. The locations of trenches ET-2 and ET-3 relative to the subject site are shown on the Geologic and Exploratory Trench Location Map in Appendix A.

6.0 ANALYSIS AND CONCLUSIONS

Site Reconnaissance

A geologic reconnaissance of the project site was performed in March 2010. The purpose of the reconnaissance was to observe the nearby streets, sidewalks and buildings for potential evidence of faulting. During the site reconnaissance, no evidence of faulting was observed in the area of the Fire Station No. 1.

Aerial Photographs and Images

Stereoscopic aerial photographs reviewed for this study were taken in 1959 and 1967. We also reviewed bare ground light detection and ranging (LIDAR) imaging available from the U.S. Geological Survey for the southern Calaveras fault. The photographs and image were reviewed for relief and tonal lineations that may indicate the presence of faulting on and near the study area. The ground surface is obscured by buildings and other cultural features in the photographs and we could not discern the presence of possible lineaments on and near the site. However, we observed several apparent northwest-trending lineaments near the site on the LIDAR image. One lineament with a

trend that intersects the subject site is present beyond the northwest site corner. Based on our trench interpretations presented below, we observed no evidence that this lineament is related to faulting at the site. Copies of the photographs reviewed and the LIDAR image for southern Calaveras fault showing the observed lineaments is included in Appendix A.

Trench Interpretations

Generally laterally continuous, flat-lying fluvial sand and silt, and lacustrine clay deposits were exposed in the trench. The fluvial deposits consisted of massive moderately well-sorted fine to medium-grained silty sand and sandy silt deposits with thin discontinuous clay beds. These units contained a few cut-fill structures and sparse quantities of charred material that was collected for radiocarbon testing. The overlying lacustrine deposits consisted of clay with minor amounts of sand. The area of the contact between the fluvial and lacustrine deposits was bioturbated and contained an apparent burn layer. This soil exhibited some minor soil development with an "A"-horizon and a weak "B"-horizon containing small caliche blotches and filaments. The lacustrine deposits were capped by up to four feet of fill soil. There was no evidence of faulting observed in the trench exposures.

Radiocarbon (Soil) Age Dating

During the field exploration, two samples of charcoal were taken from the trench at depths of about 12 and 13.5 feet. The samples were submitted to Beta Analytic, Inc., where Accelerator Mass Spectrometry (AMS) tests were performed to obtain their approximate ages. The sample collected at a depth of 12 feet (STA 1+39) consisted of disseminated charred material and had a calibrated age of 2,740 ± 40 years before present (BP). The sample at 13.5 feet (STA 1+51.5) consisted of a coarse sand-sized piece of charred material that had a calibrated age of 2,500 ± 40 BP. Beta Analytical's test report is presented in Appendix C.

Earthquake History

In assessing the seismic hazards for a given area, it is useful to examine records of historic local earthquakes. This information can be extrapolated to estimate the recurrence of local earthquakes. A number of strong earthquakes that have damaged man-made structures have occurred on the active faults in the central California region within the last 200 years. The locations and magnitudes of significant regional earthquakes are given on the Regional Faults and Earthquakes Map and Summary of Significant Earthquakes figures in Appendix A.

According to the Working Group on California Earthquake Probabilities (2003), there is a 62 percent probability that a 6.7M or greater earthquake will occur between 2002 and 2031 in the region.

The Northern California Earthquake Data Center (NCEDC) catalog was used to search for earthquakes that have affected the site in historic times. In addition to those mentioned above, many minor to moderate earthquakes have affected the site region, with most having magnitudes of less than about 5.0M. Within a 100 kilometer (62 mile) radius of the site, 34 earthquakes with reported magnitudes of 5.0 and greater are listed for the years 1910 through the present. The largest magnitude earthquake within our search radius was the October 18, 1989 7.1M Loma Prieta earthquake that occurred about 47.5 km (29.5 miles) to the northwest. The nearest historic earthquake with a magnitude greater than about 5.0 was a June 24, 1939 5.5M earthquake located about 7.5 km (4.5 miles) to the southwest.

Seismicity

Surface Ground Rupture

The project site is located in a State Earthquake Fault Zone. The State-mapped trace of the East Branch Calaveras fault trends northwest and is shown to be concealed about 260-feet to the southwest (see Vicinity Map in Appendix A). We did not observe evidence of faulting in the exploratory trench or within the nearby streets, sidewalks or buildings.

Ground Shaking

As the site is within 10 km of the active Calaveras fault (East Branch), a site-specific response analysis was performed per Section 1614.1.2, of the 2007 California Building Code (CBC). A full discussion of that analysis is given in our Initial Foundation and Site Investigation report (Earth Systems Pacific, 2010) submitted separately. A summary of our analysis is given below.

The analysis consisted of development of the following site-specific seismic information: 1) the Probabilistic Maximum Considered Earthquake (MCE) response curve; 2) the Site-Specific Deterministic MCE response curve; 3) the Site Design response curve (2/3 Site-Specific Deterministic MCE); and 4) Design Acceleration Parameters. The deterministic and probabilistic ground motions were calculated using the Next Generation Attenuations (NGA).

SUMMARY OF DESIGN RESPONSE ACCELERATION PARAMETERS

Mapped Acceleration Values for Site Class B		Site-Specific Design Response Spectrum Acceleration Values for Site Class E					
Seismic Parameter	Value (g)	Site Coefficients	Value	Seismic Parameter	Value (g)	Seismic Parameter	Value (g)
S_S	1.816	F_a	0.9	S_{MS}	1.350	S_{DS}	0.900
S_1	0.742	F_v	2.4	S_{M1}	1.787	S_{D1}	2.301

Liquefaction and Seismically Induced Settlement

Soil liquefaction is the softening of soil during a significant seismic event. It occurs primarily in saturated, loose to medium-dense, fine to medium-grained sands and sandy silts. Seismically-induced settlement of sufficient magnitude to cause structural damage is normally associated with poorly consolidated, predominantly sandy soils, or variable consolidation characteristics within the building areas. Based on data obtained from ESP's Initial Foundation and Site Investigation report (Earth Systems Pacific, 2010), it is anticipate that measures to mitigate potential soil liquefaction and seismically-induced should not be necessary for the project. Additionally, the site is located in an area designated as having a low liquefaction potential (Rosenberg, 1998).

Lateral Spreading

Lateral spreading can occur as a consequence of liquefaction. This phenomenon is confined to areas where the terrain is sloping, or where the liquefied zone extends below sloping terrain, and generally affects slopes along creeks, bays, or other water features bordered by slopes. Liquefaction of the soil induces instability of the soils on the slopes, resulting in the "spreading" of the soil into the inundated zone.

As the site is essentially flat and no creeks, ponds or other water features are on or immediately adjacent to the site, the potential for lateral spreading to occur at the site is low.

Summary of Findings and Conclusions

1. The site is located in the central Hollister Valley in downtown Hollister on the northwest corner of 5th Street and Sally Street. The site is occupied by Hollister Fire Station No.1.

2. Evidence of faulting was not observed in the fluvial and lacustrine deposits exposed in the trench. However, based on the radiocarbon ages of the deposits, soils approaching 11,000 years BP were not present in the trench. Active faults are defined by the State of California as exhibiting well-defined evidence of displacement within Holocene time, or the last 11,000 years (Hart, 1997). Applied Soil Mechanics (1991) excavated two nearby trenches along 5th Street, one of which intersected the State-mapped trace of the East Branch Calaveras fault, and reported that there was no evidence of faulting in sedimentary units similar to those encountered during the subject study. Also, we are not aware of any evidence of well-defined displacement where the State-mapped trace of the East Branch is shown to be concealed near the site or to the north. Additionally, we are not aware of any historic records of observed surface displacement along the East Branch.

3. According to Rosenberg, L.I., 1998, the site is located in an area having a very low liquefaction potential. Based on ESP's Initial Foundation and Site Investigation, 2010, potentially liquefiable soils were not identified at the site. Thus, we anticipate that measures to mitigate potential soil liquefaction should not be necessary for the project. Additionally, the Initial Foundation and Site Investigation report deemed that the loose silty sands have a low potential for seismically-induced settlement.

4. Based on the Initial Foundation and Site Investigation report, moderately-high expansive soils are present on the site. It was deemed that typical measures such as soil moisture conditioning during grading, deepened footings and placement of nonexpansive material will be suitable to mitigate soil expansion at the site.

7.0 RECOMMENDATIONS

Because evidence of faulting was not present on the site, no measures to avoid surface fault rupture hazards at the site are recommended. The structure should be designed to resist seismic shaking in accordance with recommendations presented in ESP's Initial Foundation and Site Investigation report.

8.0 CLOSURE

The conclusions and recommendations of this report are based on data acquired and evaluated during this study and are intended to apply only to the proposed development of the project as described in the "Introduction" section of this report. This report is valid for conditions as they exist at this time for the type of project described herein. If changes with respect to project type or location become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report.

The conclusions presented in this report are based upon the assumption that the site geologic conditions do not deviate substantially from those disclosed during our research and field exploration. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that planned at the present time, Earth Systems Pacific should be notified so that supplemental recommendations can be prepared as applicable.

Our intent was to perform this study in a manner consistent with the level of care and skill commonly exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client for the subject project. Application beyond the stated intent is strictly at the user's risk.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. All other rights are retained by Earth Systems Pacific and any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

End of Text

REFERENCES

Applied Soil Mechanics, 1991, Fault Study, Sites 1, 3-6 and 10, City of Hollister, California, unpublished consultant's report, June

Blake, T. F., FRISKSP (ver. 4.0), 2000, A Computer Program for the Probabilistic Estimation of Peak Acceleration and Uniform Hazard Spectra Using 3-D Faults as Earthquake Sources," User's Manual, Newbury Park, California.

Boore, D. M. and others, 1997, "Estimating Response Spectra and Peak Accelerations from Western North American Earthquakes: a Summary of Recent Work," Seismology Research Letters, 68-1, January-February.

Bryant, W.A., 1979, California Division of Mines and Geology, Fault Evaluation Report – FER-94, October 19.

California Geological Survey, 1982, Sate of California Special Studies Zones Map of the 7½-minute Hollister Quadrangle.

California Geological Survey, 1996, Probabilistic Seismic Hazard Assessment for the State of California, Open-File Report 96-08

Earth Systems Consultants Northern California, 1992, Fault Study, Hart Properties, APN 053-37-0-002-0 and 091-13-0-024-0, North Street, Hollister, California, unpublished consultant's report

Earth Systems Consultants Northern California, 1998, Geologic Fault Study, San Benito Foods, Storage Building, Hollister, California, July.

Earth Systems Pacific, 2008_1, Geologic Fault Investigation, Vista Meadows Senior Apartments, East Park Street and Rancho Drive, APN 056-290-001, Hollister, California, August.

Earth Systems Pacific, 2008_2, Geologic Fault Investigation, Park Hill Development, North Street, APN 53-37-02, Hollister, California, unpublished consultants report, December.

Earth Systems Pacific, 2010, Initial Foundation and Site Investigation, Hollister Fire Station No.1, 110 5th Street, Hollister, California, June.

Hart, E.W., and Bryant W.A., 1997, Fault Rupture Hazard Zones in California, California Division of Mines and Geology Special Publication 42, 24 p.

Majmundar, H.H., 1994, Landslide Hazards in the Hollister Area, San Benito County, California, Landslide Hazards Identification Map 30, DMG Open-File Report 94-02, 1:24,000 scale

(3 sheets-Relative Landslide Susceptibility, Landslides and Related Features and Geologic Map (after Dibblee et al.)).

McClellan, P.H. and Hay, E.A., 1989, Geologic Evidence for Triggered Slip on the Calaveras Fault During the Magnitude 7.1 Loma Prieta Earthquake of October 17, 1989, USGS Open-File Report 89-641.

Northern California Earthquake Data Center Catalog, December 2008, contributed by Northern California Seismic Network and U.S. Geological Survey, Menlo Park, California, http://quake.geo.berkeley.edu

Rogers, T.H., 1993, Geology of the Hollister and San Felipe quadrangles, San Benito, Santa Clara and Monterey Counties, California: California Division of Mines and Geology Open-File Report 93-01, 21 p., 3 appendices, 3 sheets, scale 1:24,000.

Rosenberg, L.I., 1998, Liquefaction Susceptibility of the Hollister Area, San Benito County, California, Final Technical Report", USGS Award No. 1434-HQ-97-GR-03125

Templeton, D.C., Nadeau, R.M. and Burgmann, R., 2001, Structure and Kinematics at the Juncture Between the San Andreas and Southern Calaveras Faults, 2001 Fall AGU Abstract.

Terratech, Inc., June 1987, Investigation of the East Branch of The Calaveras Fault, Prune Street School Site (Rancho San Justo Tandem School Site), Hollister, California, unpublished consultants report

U.S. Geological Survey, 1995, Topographic Map of the Hollister 7½-Minute Quadrangle

Working Group on California Earthquake Probabilities, 2003, Probabilities of Large Earthquakes in the San Francisco Bay Region, California, U.S. Geological Survey Circular.

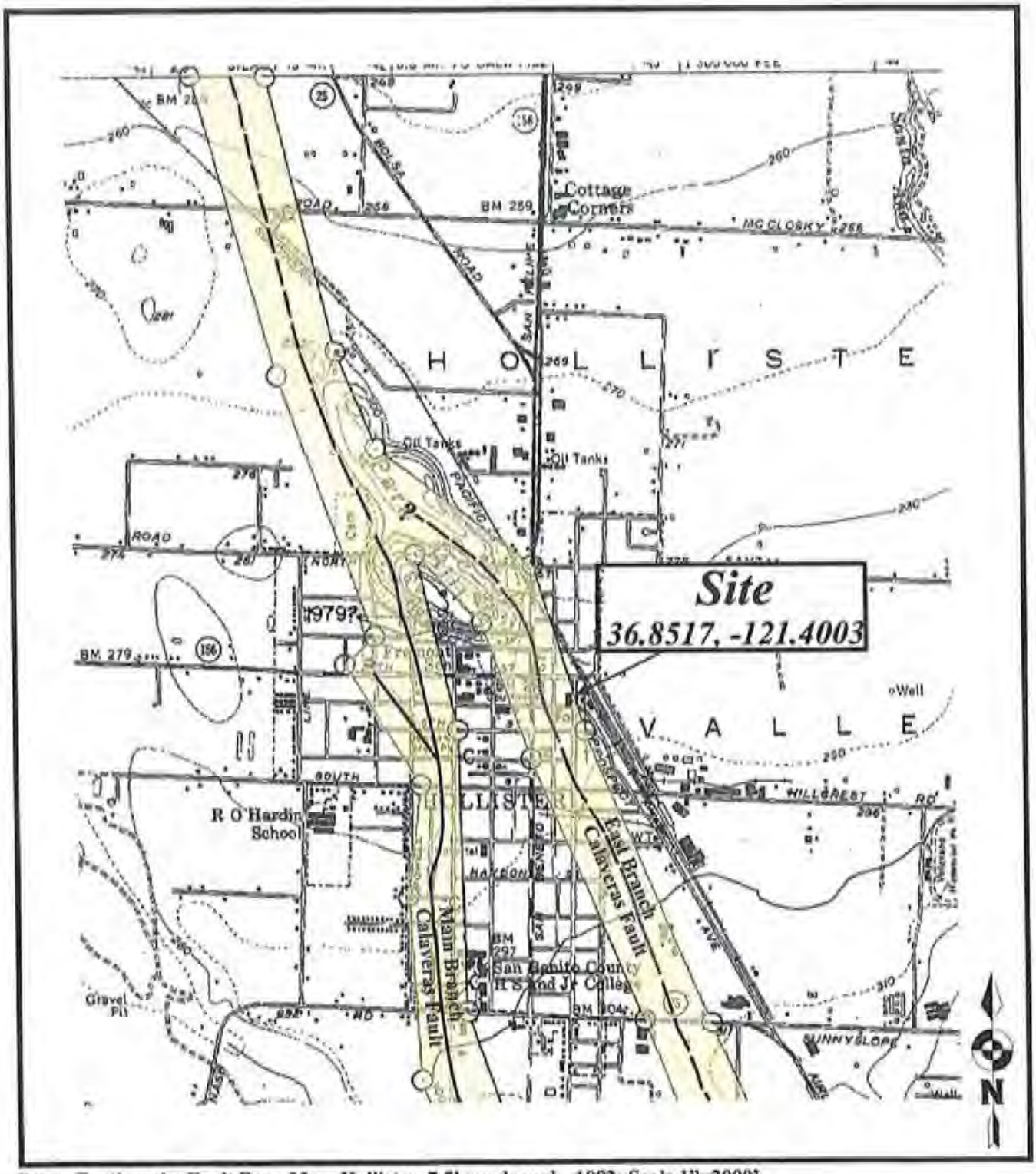
AERIAL PHOTOGRAPHS REVIEWED

Date	Agency	Type	Roll & Frame	Scale
6/13/59	USDA	B&W	BUX – 7V-47&48	±1:20,000
5/15/67	USDA	B&W	BUX – 1HH – 90&91	±1:20,000

APPENDIX A

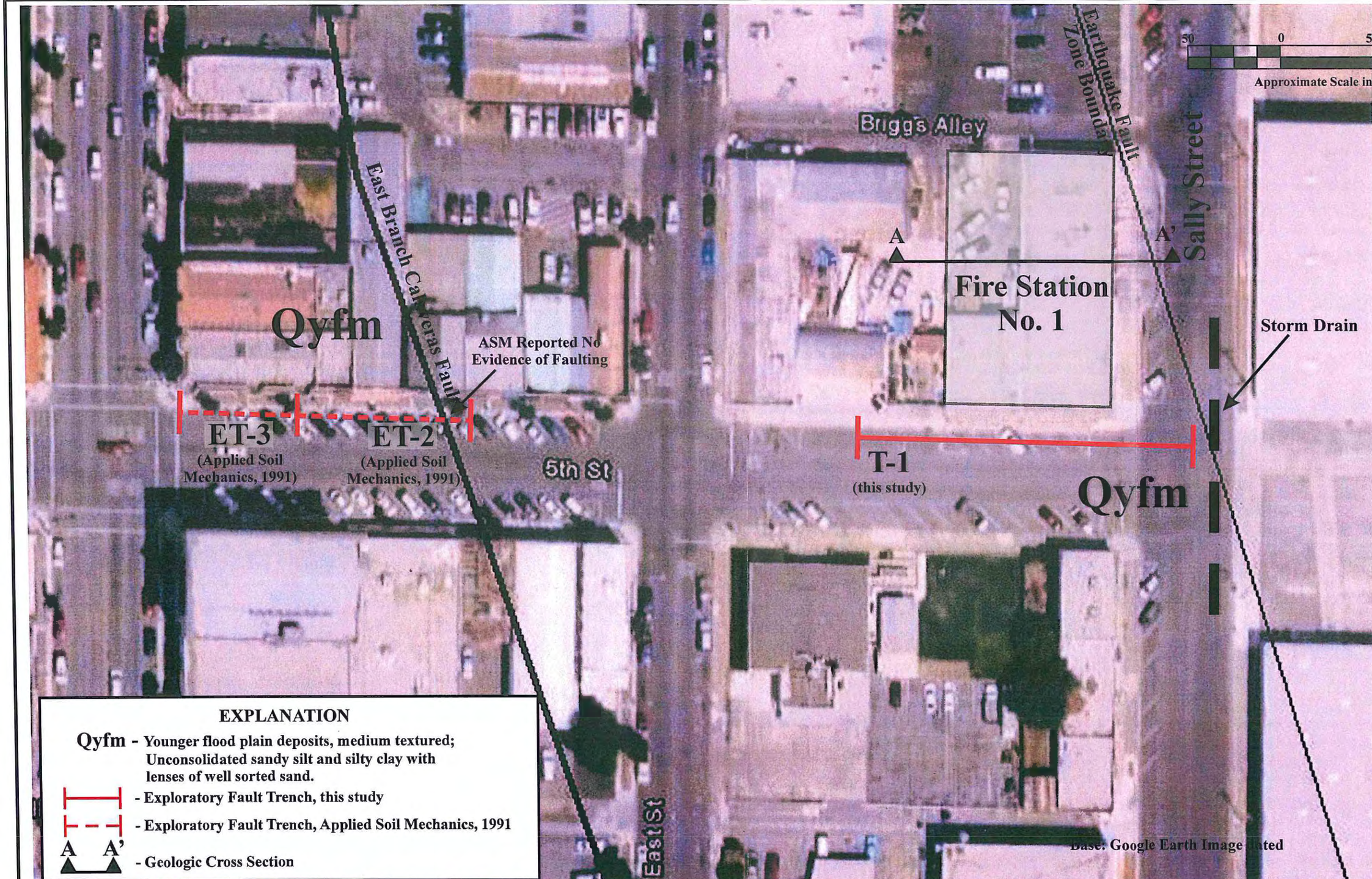
Vicinity Map
Engineering Geologic Site Map
Geologic Cross-Section A – A'
Regional Geologic Map
Regional Faults and Earthquakes Map
Summary of Significant Earthquakes
Aerial Photographs – 1959
Aerial Photographs - 1967
LIDAR-Southern Calaveras Fault

Vicinity Map

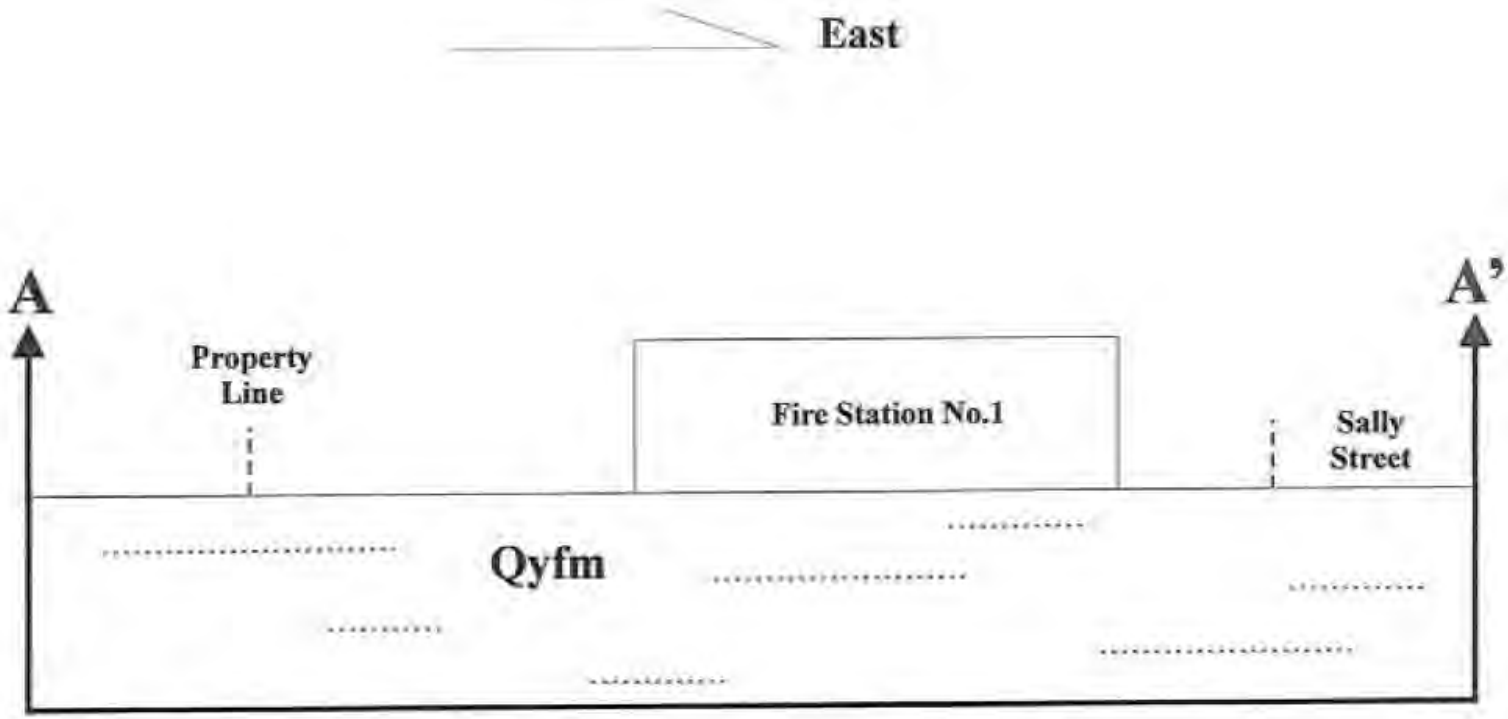


Base: Earthquake Fault Zone Map, Hollister 7.5' quadrangle, 1982; Scale 1"=2000'

Earth Systems Pacific



Earth Systems Pacific	Hollister Fire Station No. 1 110 5th Street Hollister, California	**Geologic and Exploratory Trench Location Map**		
		December, 2010	Scale 1"=50'	SH-11132-GA



Explanation

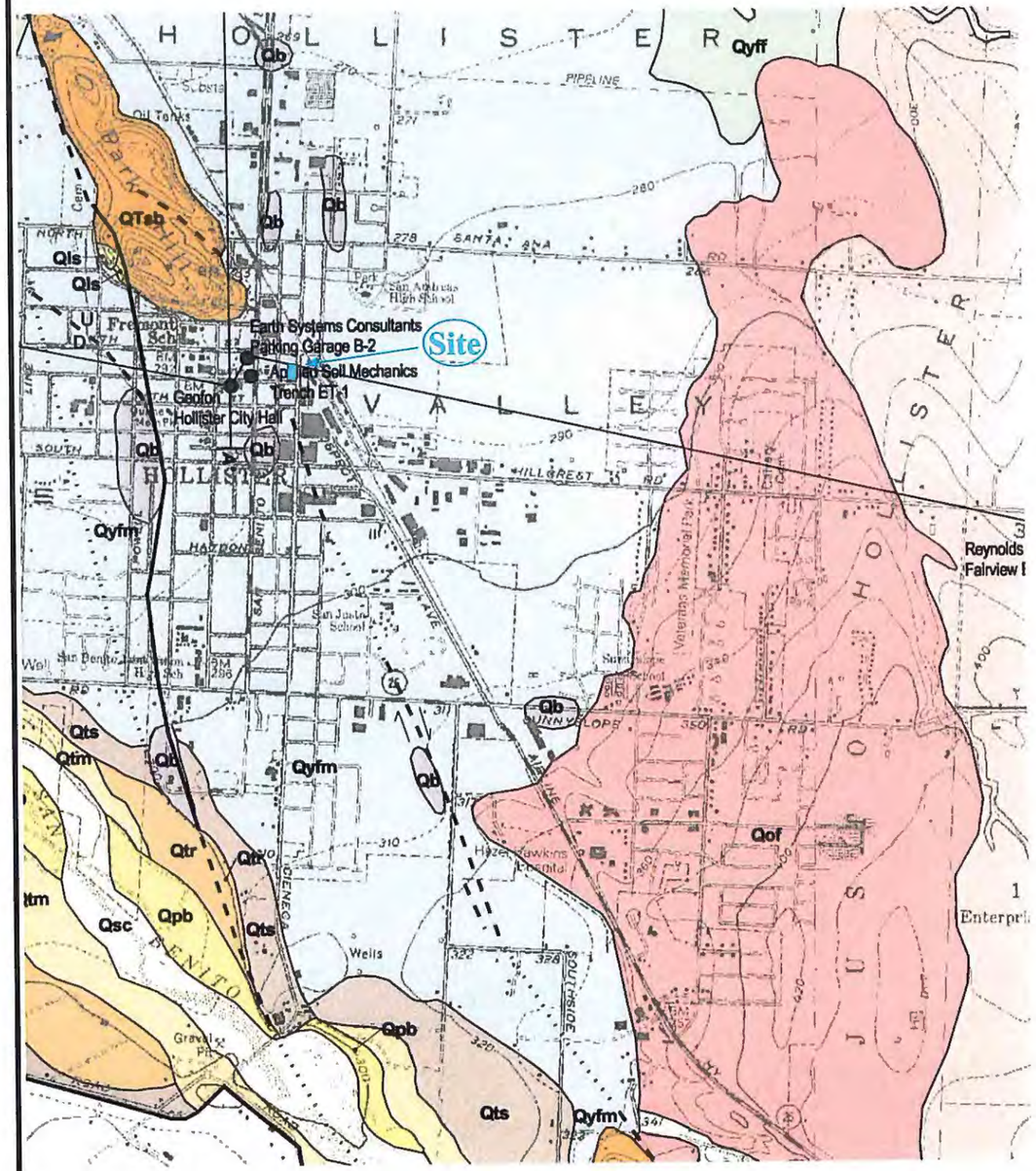
Qyfm Younger flood plain deposits

Scale: 1"=20'
(H=V)

Earth Systems Pacific

Hollister Fire Ststion No.1
110 5th Street
Hollister, California

Geologic Cross Section A - A'
File No.: SH-11132-GA



North

DESCRIPTION OF MAP UNITS

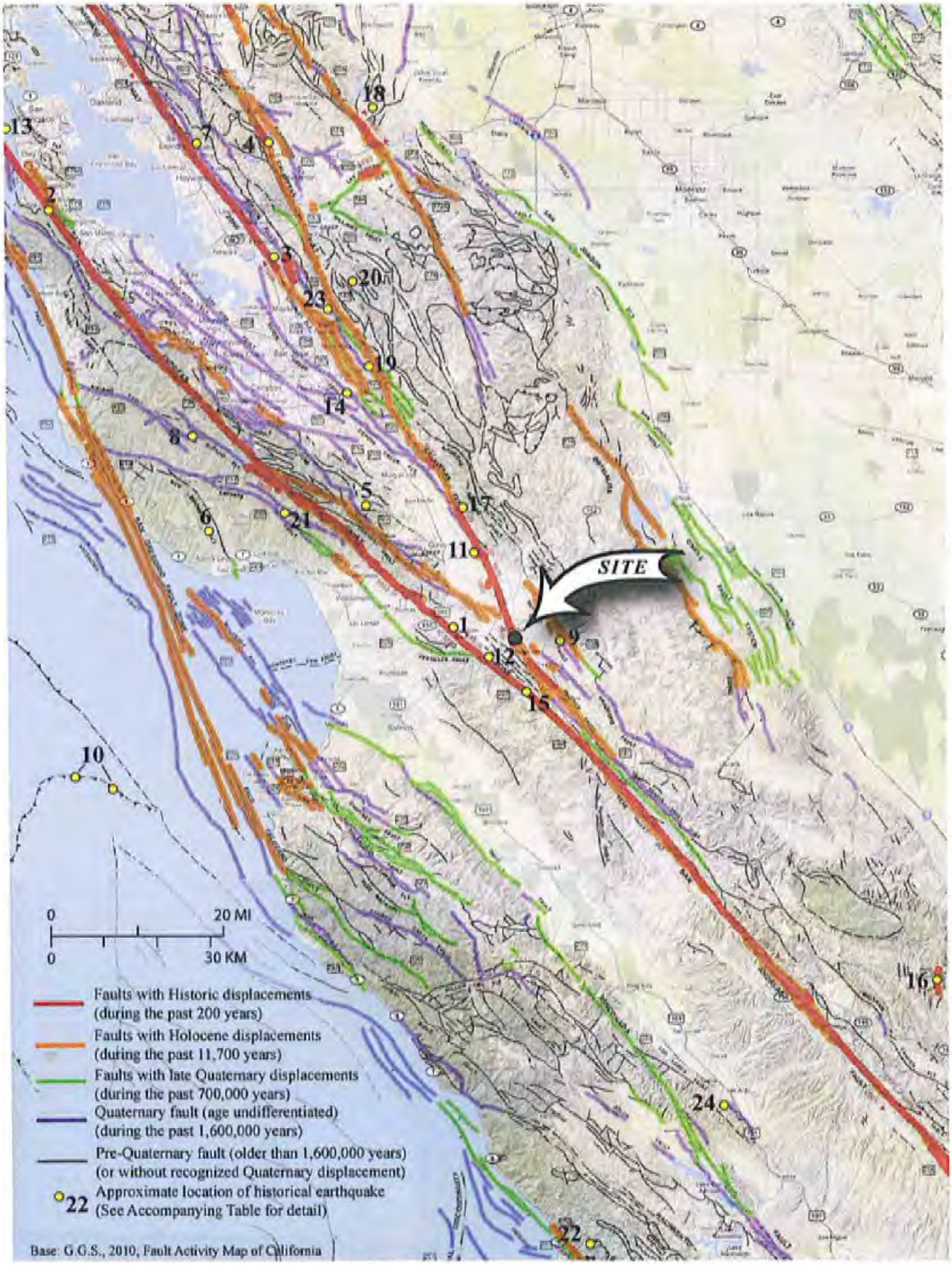
Qal	**Alluvial deposits, undivided (Holocene)** —Unconsolidated, heterogeneous, moderately sorted silt and sand with discontinuous lenses of clay and silty clay
Qsc	**Stream channel deposits (Holocene)** —Unconsolidated, well-sorted sand, gravel, and cobbles within in the beds of the larger streams
Qpb	**Point bar deposits (Holocene)** —Unconsolidated moderately sorted, fine-grained sand and silt underlain by coarse sand and gravel
Qb	**Basin deposits (Holocene)**—Unconsolidated, plastic clay and silty clay containing much organic material; locally contains interbedded thin layers of silt and silty sand
Qtm	**Metz terrace (Holocene)** —Unconsolidated silty sand underlain by layers of coarse sand and gravel. Capped by minimally developed soils
Qtr	**Reiff terrace (Holocene)**—Unconsolidated silty sand and silt with lenses of gravelly sand. Capped by minimally developed soils
Qts	**Sorrento terrace (Holocene)**—Unconsolidated sandy silt. Capped by undeveloped to minimally developed soils
Qyff	**Younger flood-plain deposits, fine-textured (Holocene)** —Unconsolidated silty clay and clayey silt with lenses of sandy silt and clean sand
Qyfm	**Younger flood-plain deposits, medium-textured (Holocene)** —Unconsolidated sandy silt and silty clay with lenses of well-sorted sand
Qls	**Landslide deposits (Quaternary)** —Rotational soil slides, earthflow, and debris flow deposits
Qof	**Older flood-plain deposits (Pleistocene)** —Poorly consolidated, moderately sorted gravel, sand and silt with Monterey Shale fragments. Capped by maximally developed soils
Qf	**Alluvial fan deposits (Pleistocene)** —Moderately consolidated, moderately to poorly sorted gravel, sand and silt. Capped by maximally developed soils
QTsb	**San Benito Gravels (Pleistocene-Pliocene)** —Poorly consolidated, moderately to well-sorted sand and gravel with silt; commonly crossbedded
Tı	**ıe sedimentary rocks of Dibblee (1975) (Pliocene)** —Greenish-gray to rarely reddish claystone, siltstone, and interbedded friable buff-gray sandstone

EXPLANATION OF MAP SYMBOLS

———	**Contact, approximately located**
⇌	**Fault, well-defined**—relative lateral displacement indicated by half arrows. On cross section, "A" denotes movement away from viewer, "T" denotes movement toward viewer
– U/D –	**Fault, approximately located** —relative vertical displacement indicated by U/D, queried where existence uncertain
· · U/D · ·	**Fault, concealed**—relative vertical displacement indicated by U/D, queried where existence uncertain
A—A'	**Line of geologic cross section**
⌇	**Approximate boundary of study area**
●	**Borehole depicted in cross section** —N denotes field blow counts (triangle), m/s denotes downhole shear wave velocity, small dot denotes radiocarbon date, TD denotes total depth of boring
	2-1/4" diameter cone penetration log depicted in cross section —driving rate in seconds per foot using a No. 2 McKiernan-Terry air hammer at 115 psi

Base: Rosenberg, L.I., 1998, Liquefaction Susceptibility of the Hollister Area, San Benito County, California

Earth Systems Pacific	Hollister Fire Station No. 1 110 5th Street Hollister, California	**Regional Geologic Map**		
		December, 2010	Scale 1"=2,000'	SH-1132-GA



Earth Systems Pacific	Hollister Fire Station #1 110 5th Street Hollister, California	**Regional Faults and Earthquakes Map** **SH-11132-GA**

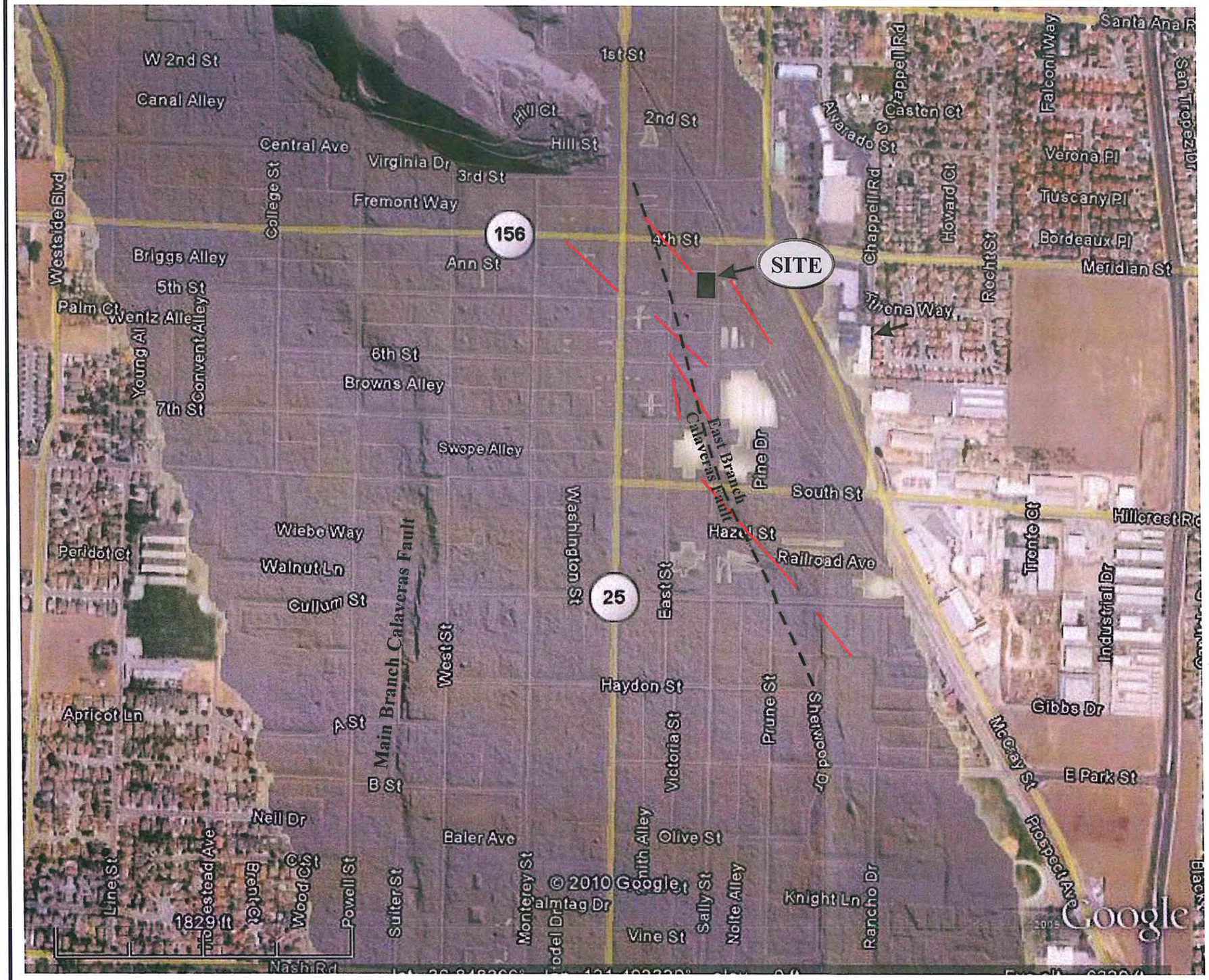
Selected San Francisco/Monterey Bay Area Earthquakes

Location Number	Earthquake and Year	Magnitude Reported	Reference
1	Monterey Bay Area, 1836	M 6.8	Toppozada, 1998
2	San Francisco, 1838	M 7.0	Toppozada, 1981
3	Hayward, 1858	M 6.1	Toppozada, 1981
4	Calaveras-Dublin, 1861	M 5.9	Toppozada, 1981
5	Santa Clara Valley, 1864	M 5.9	Toppozada, 1981
6	Santa Cruz, 1865	M 6.3	Toppozada, 1981
7	Hayward, 1868	M 6.8	Toppozada, 1981
8	San Andreas, 1870	M 5.8	Toppozada, 1981
9	Quien Sabe, 1986	M 5.5	NCDEC, 2010
10	Monterey Bay		
	1926	M 6.1	NCDEC, 2010
	1926	M 6.1	NCDEC, 2010
11	Calaveras, 1897	M 6.2	Toppozada, 1981
12	Hollister Area, 1939	M 5.5	NCDEC, 2010
13	San Francisco, 1906	M 7.8	U.S. Geological Survey, 2010
14	San Jose, 1911	M 6.5	Toppozada and Parke, 1982
15	San Andreas, 1961	M 5.6	NCDEC, 2010
16	Nunez Fault, 1982	M 5.4	NCDEC, 2010
17	Coyote Lake, 1979	M 5.9	Hart, 1988
18	Greenville, 1980	M 5.8	Oppenheimer, 1990
19	Morgan Hill, 1984	M 6.2	Oppenheimer, 1990
20	Mount Lewis, 1986	M 5.7	U.S. Geological Survey, 1989
21	Loma Prieta, 1989	M 7.1	U.S. Geological Survey, 1989
22	Central California		
	1983	M 5.2	NCDEC, 2010
	1991	M 5.2	NCDEC, 2010
23	Calaveras Reservoir, 2007	M 5.4	U.S. Geological Survey, 2009
24	San Ardo, 1955	M 5.2	NCDEC, 2010

NOTE: Modified After Geomatrix, (1992)
Update, 2010

Earth Systems Pacific	Hollister Fire Station No. 1 110 5th Street Hollister, California	**Aerial Photographs-1959**		
		December, 2010	Not to scale	SH-11132-GA

Earth Systems Pacific	Hollister Fire Station No. 1 110 5th Street Hollister, California	**Aerial Photographs-1967**		
		December, 2010	Not to scale	SH-11132-GA



Explanation

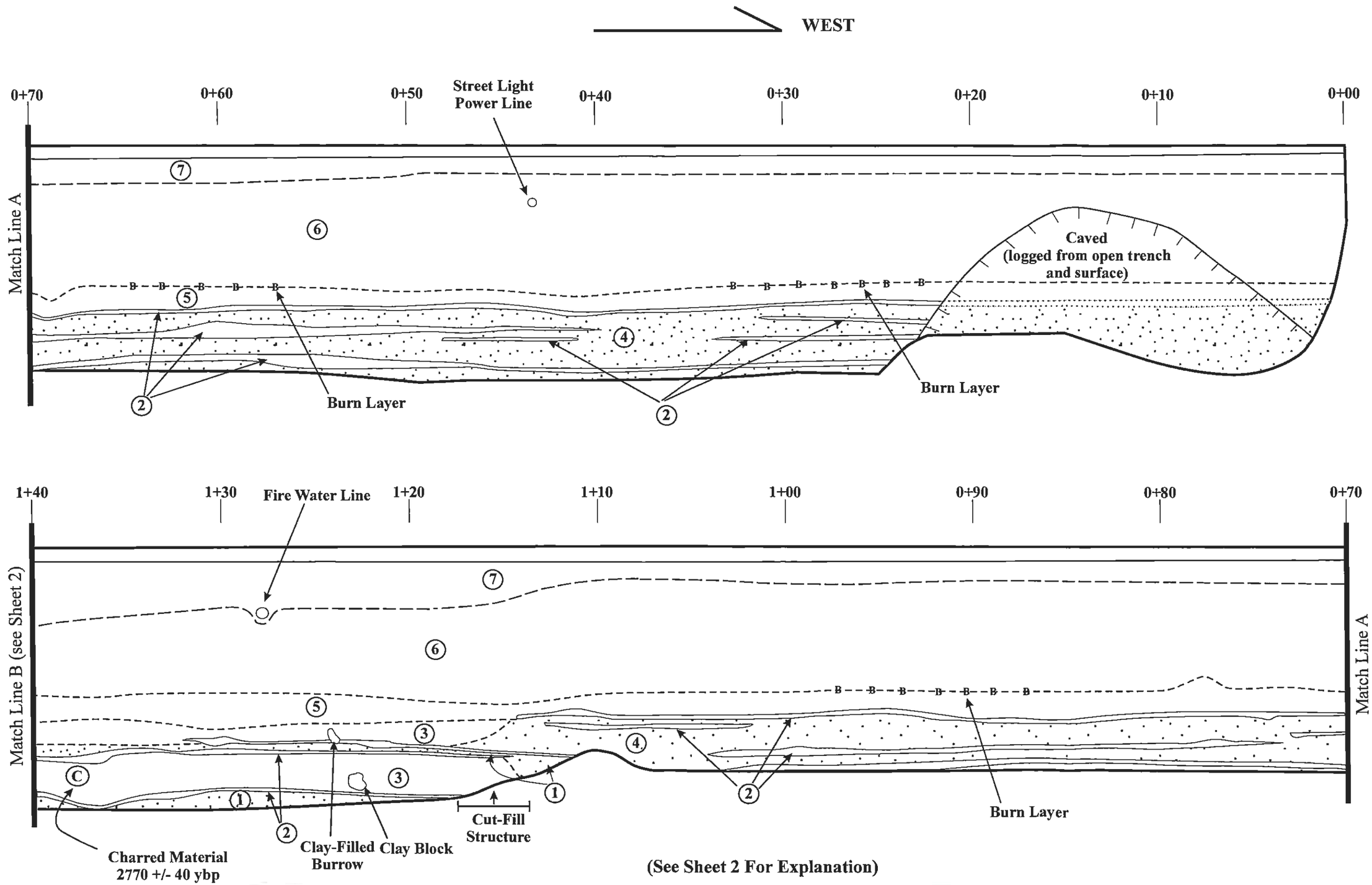
Apparent lineament

State-mapped trace
East Branch Calaveras fault

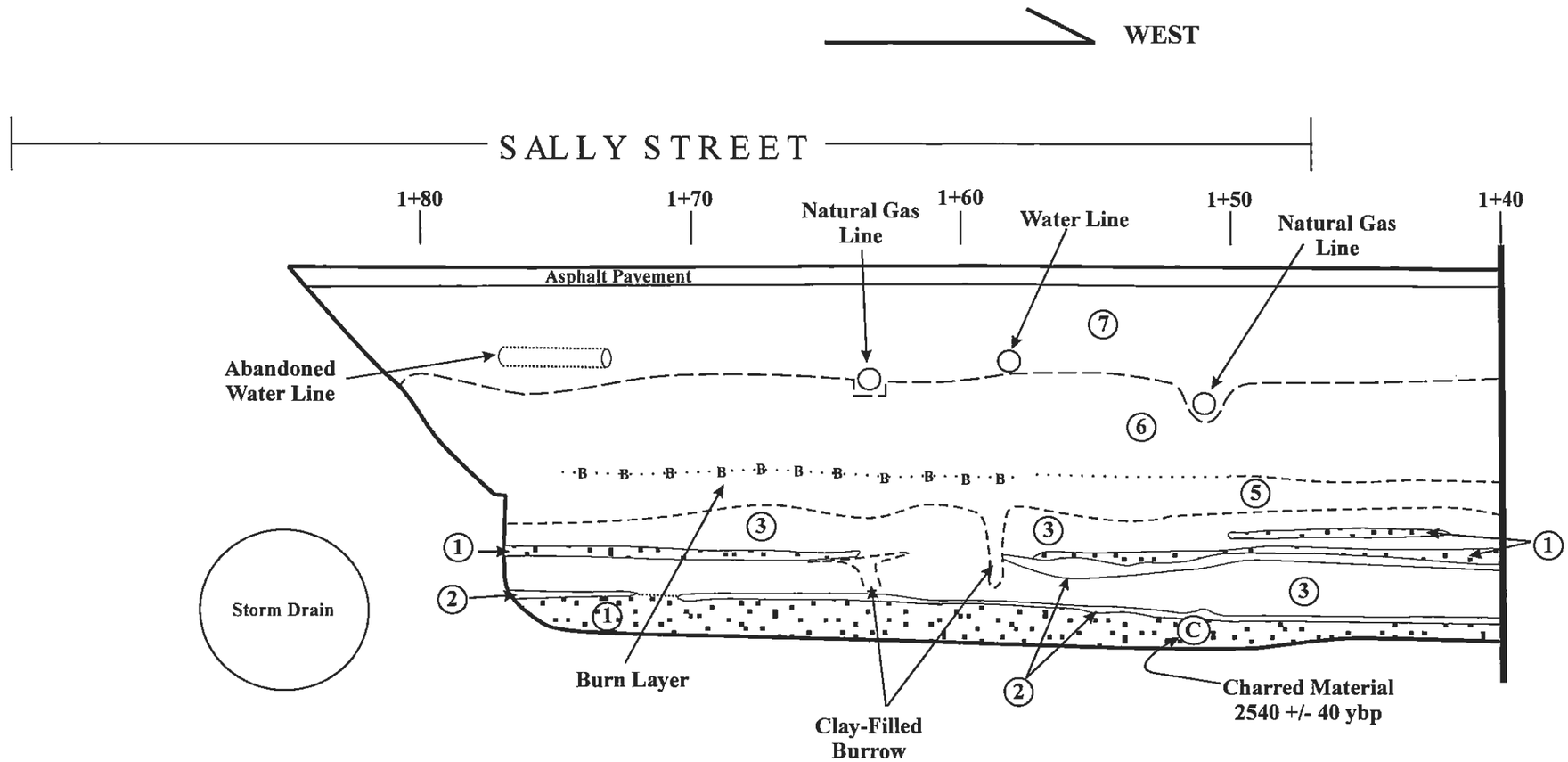
Earth Systems Pacific	Hollister Fire Station No. 1 110 5th Street Hollister, California	**LIDAR - Southern Calaveras Fault**		
		December, 2010	Scale 1"~ 630'	SH-11132-GA

APPENDIX B

Log of Exploratory Trench T-1 (2 pgs)



Earth Systems Pacific	Hollister Fire Station No. 1 110 5th Street Hollister, California	**Log of Exploratory Fault Trench T-1 (Sheet 1 of 2)**		
		December, 2010	Scale 1"=5'	SH-11032-GA



FLUVIAL

1. Qla - Poorly Graded Sand; yellow brown, moist, loose; massive; mostly medium-grained sand.
2. Qla - Lean Clay; yellow brown, moist, medium stiff; occurs as thin semi-continuous and discontinuous beds.
3. Qla - Silty Sand to Sandy Silt; yellow brown, moist, medium dense; fine grained sand; massive.
4. Qla - Poorly Graded Sand; gray, moist, loose; fine to trace coarse-grained sand; massive
5. Qla - Clayey Sand; dark yellow brown, moist, medium dense; contains thin silty sand stringers

LACUSTRINE

6. Qla - Lean Clay; yellow brown to dark brown, very moist, medium stiff; exhibits soil development

FILL

7. Clayey Sand with gravel

Earth Systems Pacific	Hollister Fire Station No. 1 110 5th Street Hollister, California	**Log of Exploratory Fault Trench T-1 (Sheet 2 of 2)**		
		December, 2010	Scale 1"=5'	SH-11032-GA

APPENDIX C

Beta Analytical Inc., Report of Radiocarbon Dating

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Mr. Brett Faust

Report Date: 4/26/2010

Earth Systems Pacific

Material Received: 4/2/2010

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 277842 SAMPLE : T-1@STA1+39 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal BC 1010 to 820 (Cal BP 2960 to 2770)	2740 +/- 40 BP	-23.0 o/oo	2770 +/- 40 BP
Beta - 277843 SAMPLE : T1@STA1+51.5 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid 2 SIGMA CALIBRATION : Cal BC 800 to 720 (Cal BP 2750 to 2670) AND Cal BC 700 to 540 (Cal BP 2650 to 2490)	2500 +/- 40 BP	-22.6 o/oo	2540 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23:lab. mult=1)

Laboratory number: **Beta-277842**

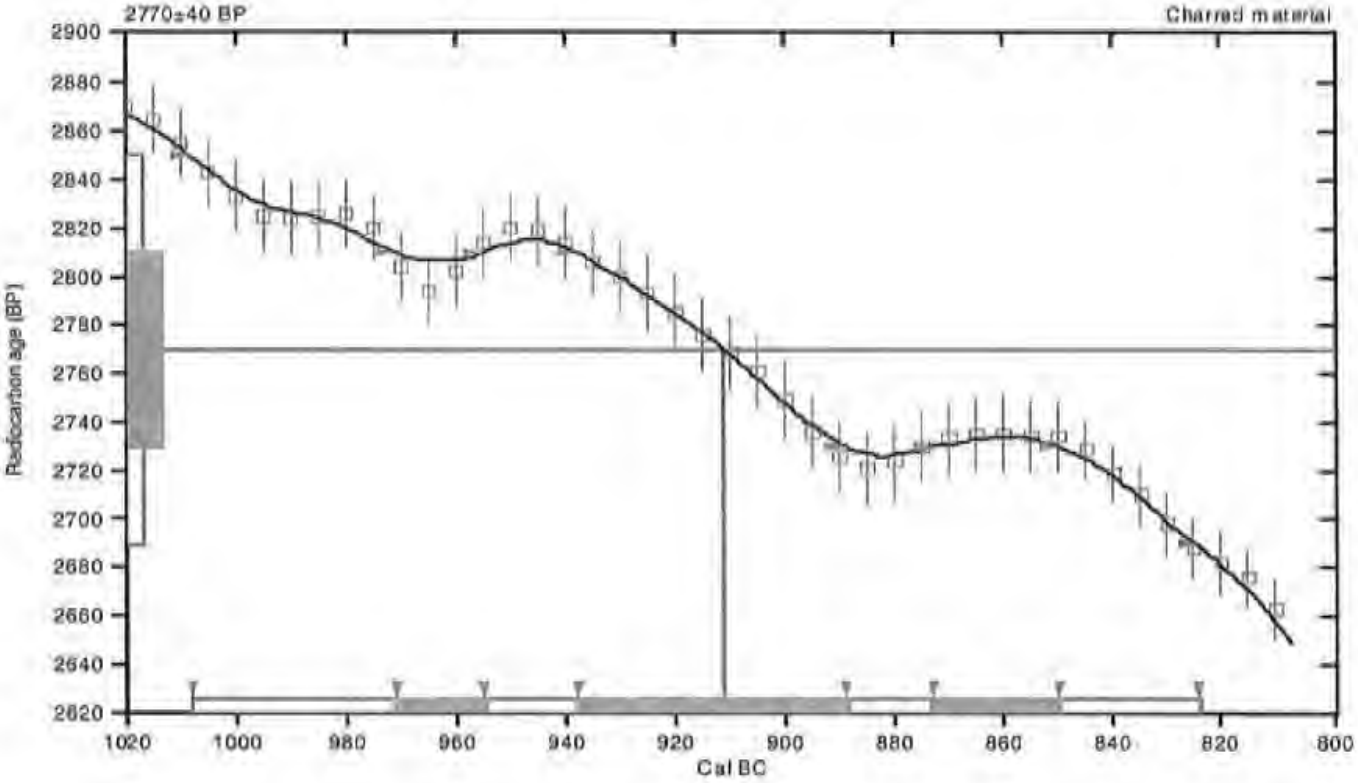
Conventional radiocarbon age: **2770±40 BP**

2 Sigma calibrated result: **Cal BC 1010 to 820 (Cal BP 2960 to 2770)**
(95% probability)

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 910 (Cal BP 2860)

1 Sigma calibrated results: (68% probability) Cal BC 970 to 960 (Cal BP 2920 to 2900) and
Cal BC 940 to 890 (Cal BP 2890 to 2840) and
Cal BC 870 to 850 (Cal BP 2820 to 2800)



References:

Database used
INTCAL04
Calibration Database
INTCAL04 Radiocarbon Age Calibration
IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).
Mathematics
A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Radiocarbon Dating Laboratory

4983 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com

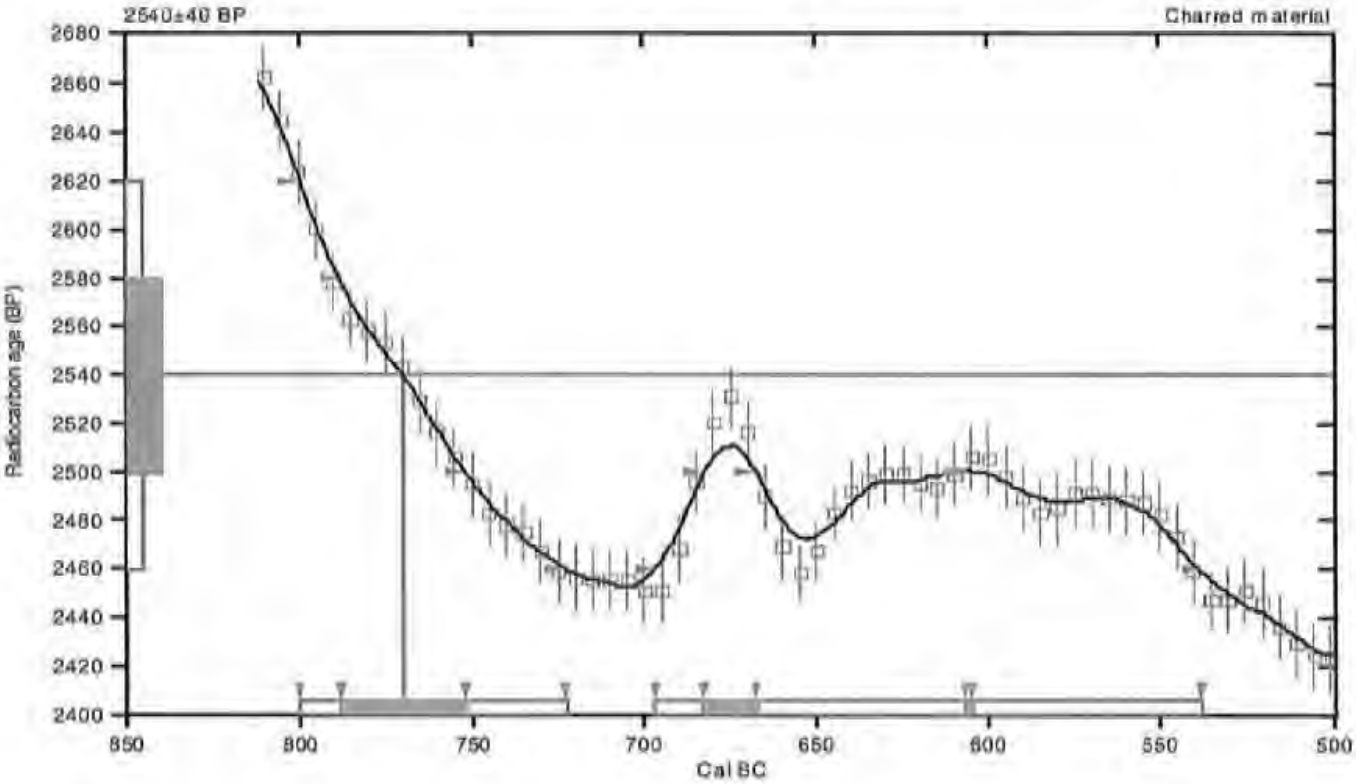
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-22.6:lab, mult=1)

Laboratory number:	**Beta-277843**
Conventional radiocarbon age:	**2540±40 BP**
2 Sigma calibrated results: (95% probability)	**Cal BC 800 to 720 (Cal BP 2750 to 2670) and Cal BC 700 to 540 (Cal BP 2650 to 2490)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 770 (Cal BP 2720)
1 Sigma calibrated results: (68% probability)	Cal BC 790 to 750 (Cal BP 2740 to 2700) and Cal BC 680 to 670 (Cal BP 2630 to 2620) and Cal BC 610 to 600 (Cal BP 2560 to 2560)



References:

Database used

INTCAL04

Calibration Database

INTCAL04 Radiocarbon Age Calibration

IntCal04: Calibration Issue of Radiocarbon (Volume 46, nr 3, 2004).

Mathematics

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

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Mr. Darden Hood
President

Mr. Ronald Hatfield
Mr. Christopher Patrick
Deputy Directors

The Radiocarbon Laboratory Accredited to ISO-17025 Testing Standards (PJLA Accreditation #59423)

Final Report

The final report package includes the final date report, a statement outlining our analytical procedures, a glossary of pretreatment terms, calendar calibration information, billing documents (containing balance/credit information and the number of samples submitted within the yearly discount period), and peripheral items to use with future submittals. The final report includes the individual analysis method, the delivery basis, the material type and the individual pretreatments applied. The final report has been sent by mail and e-mail (where available).

Pretreatment

Pretreatment methods are reported along with each result. All necessary chemical and mechanical pretreatments of the submitted material were applied at the laboratory to isolate the carbon, which may best represent the time event of interest. When interpreting the results, it is important to consider the pretreatments. Some samples cannot be fully pretreated, making their ^{14}C ages more subjective than samples, which can be fully pretreated. Some materials receive no pretreatments. Please look at the pretreatment indicated for each sample and read the pretreatment glossary to understand the implications.

Analysis

Materials measured by the radiometric technique were analyzed by synthesizing sample carbon to benzene (92% C), measuring for ^{14}C content in one of 53 scintillation spectrometers, and then calculating for radiocarbon age. If the Extended Counting Service was used, the ^{14}C content was measured for a greatly extended period of time. AMS results were derived from reduction of sample carbon to graphite (100 %C), along with standards and backgrounds. The graphite was then detected for ^{14}C content in one of 9 accelerator-mass-spectrometers (AMS).

The Radiocarbon Age and Calendar Calibration

The "Conventional ^{14}C Age (*)" is the result after applying $^{13}C/^{12}C$ corrections to the measured age and is the most appropriate radiocarbon age. If an "*" is attached to this date, it means the $^{13}C/^{12}C$ was estimated rather than measured (The ratio is an option for radiometric analysis, but included on all AMS analyses.) Ages are reported with the units "BP" (Before Present). "Present" is defined as AD 1950 for the purposes of radiocarbon dating.

Results for samples containing more ^{14}C than the modern reference standard are reported as "percent modern carbon" (pMC). These results indicate the material was respiring carbon after the advent of thermo-nuclear weapons testing and is less than ~ 50 years old.

Applicable calendar calibrations are included for materials between about 100 and 19,000 BP. If calibrations are not included with a report, those results were too young, too old, or inappropriate for calibration. Please read the enclosed page discussing calibration.

PRETREATMENT GLOSSARY
Standard Pretreatment Protocols at Beta Analytic
(Continued)

"collagen extraction: with alkali" or "collagen extraction: without alkali"

The material was first tested for friability ("softness"). Very soft bone material is an indication of the potential absence of the collagen fraction (basal bone protein acting as a "reinforcing agent" within the crystalline apatite structure). It was then washed in de-ionized water, the surface scraped free of the outer most layers and then gently crushed. Dilute, cold HCl acid was repeatedly applied and replenished until the mineral fraction (bone apatite) was eliminated. The collagen was then dissected and inspected for rootlets. Any rootlets present were also removed when replenishing the acid solutions. "With alkali" refers to additional pretreatment with sodium hydroxide (NaOH) to ensure the absence of secondary organic acids. "Without alkali" refers to the NaOH step being skipped due to poor preservation conditions, which could result in removal of all available organics if performed.

Typically applied to: bones

"acid etch"

The calcareous material was first washed in de-ionized water, removing associated organic sediments and debris (where present). The material was then crushed/dispersed and repeatedly subjected to HCl etches to eliminate secondary carbonate components. In the case of thick shells, the surfaces were physically abraded prior to etching down to a hard, primary core remained. In the case of porous carbonate nodules and caliches, very long exposure times were applied to allow infiltration of the acid. Acid exposure times, concentrations, and number of repetitions, were applied accordingly with the uniqueness of the sample.

Typically applied to: shells, caliches, and calcareous nodules

"neutralized"

Carbonates precipitated from ground water are usually submitted in an alkaline condition (ammonium hydroxide or sodium hydroxide solution). Typically this solution is neutralized in the original sample container, using deionized water. If larger volume dilution was required, the precipitate and solution were transferred to a sealed separatory flask and rinsed to neutrality. Exposure to atmosphere was minimal.

Typically applied to: Strontium carbonate, Barium carbonate
(i.e. precipitated ground water samples)

"carbonate precipitation"

Dissolved carbon dioxide and carbonate species are precipitated from submitted water by complexing them as ammonium carbonate. Strontium chloride is added to the ammonium carbonate solution and strontium carbonate is precipitated for the analysis. The result is representative of the dissolved inorganic carbon within the water. Results are reported as "water DIC".

Applied to: water

"solvent extraction"

The sample was subjected to a series of solvent baths typically consisting of benzene, toluene, hexane, pentane, and/or acetone. This is usually performed prior to acid/alkali/acid pretreatments.

Applied to: textiles, prevalent or suspected cases of pitch/tar contamination, conserved materials.

"none"

No laboratory pretreatments were applied. Special requests and pre-laboratory pretreatment usually accounts for this.

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President

Mr. Ronald Hatfield
Mr. Christopher Patrick
Deputy Directors

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Calendar Calibration at Beta Analytic

Calibrations of radiocarbon age determinations are applied to convert BP results to calendar years. The short-term difference between the two is caused by fluctuations in the heliomagnetic modulation of the galactic cosmic radiation and, recently, large scale burning of fossil fuels and nuclear devices testing. Geomagnetic variations are the probable cause of longer-term differences.

The parameters used for the corrections have been obtained through precise analyses of hundreds of samples taken from known-age tree rings of oak, sequoia, and fir up to about 10,000 BP. Calibration using tree-rings to about 12,000 BP is still being researched and provides somewhat less precise correlation. Beyond that, up to about 20,000 BP, correlation using a modeled curve determined from U/Th measurements on corals is used. This data is still highly subjective. Calibrations are provided up to about 19,000 years BP using the most recent calibration data available.

The Pretoria Calibration Procedure (Radiocarbon, Vol 35, No.1, 1993, pg 317) program has been chosen for these calendar calibrations. It uses splines through the tree-ring data as calibration curves, which eliminates a large part of the statistical scatter of the actual data points. The spline calibration allows adjustment of the average curve by a quantified closeness-of-fit parameter to the measured data points. A single spline is used for the precise correlation data available back to 9900 BP for terrestrial samples and about 6900 BP for marine samples. Beyond that, splines are taken on the error limits of the correlation curve to account for the lack of precision in the data points.

In describing our calibration curves, the solid bars represent one sigma statistics (68% probability) and the hollow bars represent two sigma statistics (95% probability). Marine carbonate samples that have been corrected for $^{13}C/^{12}C$, have also been corrected for both global and local geographic reservoir effects (as published in Radiocarbon, Volume 35, Number 1, 1993) prior to the calibration. Marine carbonates that have not been corrected for $^{13}C/^{12}C$ are adjusted by an assumed value of 0 %0 in addition to the reservoir corrections. Reservoir corrections for fresh water carbonates are usually unknown and are generally not accounted for in those calibrations. In the absence of measured $^{13}C/^{12}C$ ratios, a typical value of -5 %0 is assumed for freshwater carbonates.

(Caveat: the correlation curve for organic materials assume that the material dated was living for exactly ten years (e.g. a collection of 10 individual tree rings taken from the outer portion of a tree that was cut down to produce the sample in the feature dated). For other materials, the maximum and minimum calibrated age ranges given by the computer program are uncertain. The possibility of an "old wood effect" must also be considered, as well as the potential inclusion of younger or older material in matrix samples. Since these factors are in determinant error in most cases, these calendar calibration results should be used only for illustrative purposes. In the case of carbonates, reservoir correction is theoretical and the local variations are real, highly variable and dependent on provenience. Since imprecision in the correlation data beyond 10,000 years is high, calibrations in this range are likely to change in the future with refinement in the correlation curve. The age ranges and especially the intercept ages generated by the program must be considered as approximations.)

LANDSET
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SURVEYING - ENVIRONMENTAL CONSULTING

April 14, 2011 File No.: 0865-01

Ms. Mary Paxton
City of Hollister
375 Fifth Street
Hollister, California 95023

Subject **Review of Geologic Fault Investigation**
Earth Systems Pacific dated December 8, 2010

Project: **City of Hollister, Fire Station No. 1**
110 Fifth Street
Hollister, California

Dear Ms. Paxton:

Thank you for providing us a copy of the *"Geologic Fault Investigation"* report prepared by Earth Systems Pacific dated December 8, 2010. The purpose of this letter is to summarize our findings and observations of site visits performed at the City of Hollister Fire Station No. 1 project between the period of March 17 through March 30, 2010 and review of the above noted report.

The site being considered for development is located within the official Earthquake Fault Zone (EFZ) of the East Branch of the Calaveras fault, designated by the State of California as defined by the Alquist-Priolo Act. Based on our research, site observations within the exploratory trench and report review, it is our opinion that *there is insufficient geologic evidence to rule out the possibility of active Holocene age faulting within the sediments underlying the site.*

We reviewed the report for conformance with State of California, Public Resources Code, Division 2. Geology Mines and Mining, Chapter 7.5 Earthquake Fault Zones, Sections 2621, 2621.5, 2621.6, 2623, 2624, 3600, 3601 & 3603 and City of Hollister Municipal Code, Title 17, Chapter 17.14.040. It is our opinion that the site geologic conditions are accurately modeled as represented in the above referenced report.

520-B Crazy Horse Canyon Road, Salinas, CA 93907 • (831) 443-6970 • Fax (831) 443-3801

The geologic fault investigation prepared by Earth Systems Pacific requires additional information prior to final acceptance for site development. The project studies, conclusions and recommendations should be reviewed and updated in an addendum report in order to satisfy the requirements of Division 2., Chapter 7.5, Section 3603 of the California Code of Regulations.

As required by State Code and local municipal ordinance, the final approved surface fault investigation report along with supporting documentation and peer reviews, shall be filed by the City of Hollister with the State Geologist. We will be happy to review the required addendum report when it is available.

We recommend that the project geologist contact us to discuss specific details of the proposed project. Please contact me at (831) 443-6970 or bpapurello@landseteng.com if you have questions regarding this matter.

Respectfully,
LandSet Engineers, Inc.

PROFESSIONAL GEOLOGIST
BRIAN E. PAPURELLO
No. CEG 2226
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

Brian Papurello, CEG 2226
Reviewing Geologist

Doc. No. 1104-104.REV

Attachments: Fault Investigation Report Review Form

Distribution: Ms. Mary Paxton, City of Hollister (mary.paxton@hollister.ca.gov)
Mr. Bret Faust, PG, CEG, Earth Systems Pacific (bfaust@earthsys.com)

FAULT INVESTIGATION REPORT REVIEW FORM

Project Information

Project:	City of Hollister, Fire Station No. 1 110 Fifth Street Hollister, CA
Case number:	N/A
Applicant:	City of Hollister, Development Services Department 375 Fifth Street Hollister, CA 95023 Attn. Ms. Mary M. Paxton
Consultant:	Earth Systems Pacific 400 Park Center Drive, Suite 1 Hollister, CA 95023 Phone: (831) 637-2133, Fax: (831) 637-0510 E-mail: bfaust@earthsys.com.com Responsible geologist: Mr. Brett Faust, PG 7025, CEG 2386
Reports and Plans Reviewed:	Earth Systems Pacific, 2010, Work plan for fault investigation, Hollister Fire Station No. 1, 110 5th Street, Hollister, California: unpublished letter to Mr. Bill Avery (sic), City of Hollister Redevelopment Agency, dated February 22, 2010, 2 p., 1 fig., 2 attachments. _____2010a, Geologic fault investigation, Hollister Fire Station No. 1, 110 5th Street, Hollister, California: unpublished report to Ms. Renee Perales, Hollister Redevelopment Agency, dated December 8, 2010, 14 p., 9 fig., 3 appendices, 2 plates, scale 1:60.
Other information sources:	Bryant, W.A., 1979, Fault evaluation report, Calaveras (Hollister segment) and "Buena Vista Road" faults: California Division of Mines and Geology Fault Evaluation Report FER-94, 14 p., 4 plates, scale 1:24,000. California Department of Conservation, California Geological Survey, 2002,: Guidelines for evaluating the hazard of surface fault rupture, CGS Note 49. California Department of Conservation, California Geological Survey, 2008,: Guidelines for evaluating and mitigating seismic hazards in California: California Geological Survey Special Publication 117, 102 p. California Division of Mines and Geology, 1982, Revised Official Special Studies Zone Map of the Hollister quadrangle: State of California Alquist Priolo Earthquake Fault Zoning Act map, scale 1:24,000. Dibblee, T.W.., Jr., and Rogers, T.H., 1975, Geologic map of the Hollister quadrangle: U.S. Geological Survey Open-File Report 75-394, scale 1:62,500. Hart, E.W., and Bryant, W.A., 2007, Fault-rupture hazard zones in California: California Geological Survey Special Publication 42, 42 p.

FAULT INVESTIGATION REPORT REVIEW FORM
(CONTINUED)

Other information sources: (continued)	Levi, T., Weinberger, R., Aifat., Eyal, Y., and Marco, S., 2006, Injection mechanism of clay-rich sediments into dikes during earthquakes: G3 (Geochemistry, Geophysics, Geosystems), v.7, no. 12. Rosenberg, L.I., 1998, Liquefaction Susceptibility of the Hollister Area, San Benito County, California, U.S. Geological Survey, National Earthquake Hazards Reduction Program Final Technical Report, Award No. 1434-HQ-97-GR-03125, 40 p.

Report Requirements

Applicable codes & ordinances:	State of California, Public Resources Code, Division 2. Geology Mines and Mining, Chapter 7.5 Earthquake Fault Zones, Sections 2621, 2621.5, 2621.6, 2623, 2624, 3600, 3601 & 3603. City of Hollister, Municipal Code, Title 17, Chapter 17.14.040.
Review standards:	California Department of Conservation, California Geological Survey, Guidelines for reviewing geologic reports: CGS Note 41, 4 p. California Department of Conservation, California Geological Survey, 2002: Guidelines for evaluating the hazard of surface fault rupture, CGS Note 49. California State Board for Geologists and Geophysicists, 1998, Geologic guidelines for earthquake and/or fault hazard reports, 7 p. Hart, E.W., and Bryant, W.A., 2007, Fault-rupture hazard zones in California: California Geological Survey Special Publication 42, 42 p.
Plan, phase, project or report under consideration:	Demolition of existing municipal fire station and replacement with new fire station.

FAULT INVESTIGATION REPORT REVIEW FORM
(CONTINUED)
Reviewer's Notes

Field observations & meetings:	03/17/10: Site review and observations of exposures in trench T-1 from Sta. 0+00 to Sta. 0+50. Severe caving of non-cohesive sands was observed from Sta. 0+00 to Sta. 0+20. This portion of trench was unsafe to enter, which limited observations from ground surface only. Trench sidewalls expose ~8 feet of clay & silt soils underlain by ~4 feet of interbedded poorly graded sand, silty sand and well graded sand. Observed <½" thick organic burn layers within lower portion of clay. Trench depth varies from 12.0' to 12.5' deep. No warping or bedding offset noted. 03/22/10: Site review and observations of exposures in trench T-1 from Sta. 0+50 to Sta. 1+08. Observed conformable deposits of upper Holocene over-bank deposits. Continuous sand marker bed @ 8.0'. No discernable bedding offsets or warping. Trench depth varies from 12.0' to 12.5' deep. 03/26/10: Site review and observations of exposures in trench T-1 from Sta. 1+55 to Sta. 1+89. Observed conformable deposits of upper Holocene over-bank deposits. No discernable bedding offsets or warping. Trench depth varies from 13.0' to 14.5' deep. 03/30/10: Site review and observations of exposures in trench T-1 from Sta. 1+55 to Sta. 1+89. Observed conformable deposits of upper Holocene over-bank deposits. No discernable bedding offsets or warping. 03/17/11: Meeting attendance with principal investigator Mr. Brett Faust at the offices of ESP. Discussed preliminary review findings of initial consultants report (ESP 2010a)
Attachments:	None
Disposition:	02/25/10: Received copy of Earth Systems Pacific report (2010) from City of Hollister Redevelopment Manager, Mr. Bill Avera 03/02/10: Issued review letter for Earth Systems Pacific (2010) Fault investigation work plan letter. 03/14/11: Received copy of Earth Systems Pacific letter (2010a) from City of Hollister Development Services Planning Manager, Ms. Mary M. Paxton. 04/14/11: Issued review letter for Earth Systems Pacific, geologic fault investigation report (ESP 2010a)

FAULT INVESTIGATION REPORT REVIEW FORM
(CONTINUED)

The following checklist (modified after CGS Special Publication 42, Appendix C and CGS Note 49) is used as part of reviewing fault investigation reports. Explanatory notes are appended and keyed to each numbered item.

Checklist item within consulting report	Adequately described: satisfactory	Additional data needed: unsatisfactory
1. Purpose and scope of investigation	X	
2. Description of proposed development	X	
3. Geologic and tectonic setting	X	
4. Seismicity and earthquake history	X	
5. Site description and conditions	X	
6. Review of published and unpublished literature	X	
7. Stereoscopic interpretation of aerial photographs & remote sensing	X	
8. Surface observations	X	
9. Subsurface investigation; trenches, borings, CPT testing		X
10. Geophysical investigation	N/A	
11. Age dating techniques	X	
12. Location or existence (or absence) of hazardous faults		X
13. Ages of past rupture events		X
14. Type of faults and nature of anticipated offset		X
15. Distribution of primary and secondary faulting and related deformation	X	
16. Probability of relative potential for future surface displacement		X
17. Degree of confidence and limitations of data and conclusions	X	
18. Setback distance determinations		X
19. Additional mitigative measures to accommodate fault related deformation		X
20. Risk evaluation relative to the proposed development		X
21. Limitations of the investigation; need for additional studies	X*	
22. References for published & unpublished literature and aerial photographs	X	
23. Location map	X	
24. Regional geology map	X	
25. Fault and seismic epicenter map	X	
26. Site location on Official Earthquake Fault Zone Map	X	
27. Site development map		X
28. Original site geologic map		X
29. Logs of exploratory trenches & borings, scale 1:60		X
30. Appendix with supporting data (e.g. water well, geophysical, aerial photographs	X	
31. Authentication, report signed and stamped by PG/CEG with expiration date	X	

X* denotes acceptable item with comment

EXPLANATORY NOTES KEYED TO CHECKLIST

9. Subsurface investigation; trenches, borings, CPT Testing
The geologic and exploratory trench location map depicts the locations of trenches ET-2 & ET-3 (ASM, 1991) but does not include the logs of these trenches. Also exploratory boring locations and logs for work performed as part of the geotechnical investigation are not presented. The map should be amended and logs of trenches and test borings must be included for review (see proceeding review comments nos. 28 & 29).

12. Location or existence of (or absence) of hazardous faults
The project geologist concluded that evidence for faulting was not observed in trench T-1. However, based on radiometric age dating, the earth materials encountered were younger than 3,000 years BP of latest Holocene age. As required by the State of California the project geologist should address the for the potential existence of hazardous faulting through the whole of the Holocene (11,700 YBP).

13. Age of past rupture events
The report does not adequately address the ages of past rupture events that have been documented (Terratech, 1987; ESCNC, 1998 & 1992; and ESP 2008_1) on the East Branch of the Calaveras fault (EBCF). The project geologist should review these reports and present the ages of the past rupture event(s) observed of the East Branch of the Calaveras fault (see proceeding review comment no. 14).

14. Type of faults and nature of anticipated offset
The report makes no statement with respect to the type (normal, reverse, strike slip) of faulting for past studies on the EBCF. The relative sense of movement, recurrence intervals and if the faulting is related to a single or multiple events should be addressed. We recommend that the project geologist clarify and address these issues.

16. Probability of Relative Potential for Future Surface Displacement
The report has not addressed the potential for future fault related surface displacement to occur on the site. This may be stated in terms such as low, moderate, or high.

18. Setback distance determinations

The report does not recommend any setback distance. We recommend that the project geologist clarify and address this issue.

19. Additional mitigative measures to accommodate fault related deformation

The report recommends no mitigative measures to avoid surface fault rupture, because evidence of faulting was not present on the site. It is our opinion that the geologic evidence presented in the report reviewed is insufficient to support that conclusion. We recommend that the project geologist provide additional scientific evidence that would support the absence of faulting for the site through the whole of the Holocene.

20. Risk evaluation relative to proposed development

It is our opinion that the project geologist should re-evaluate the geologic risk to the planned development based on our preceding review comments Nos. 12, 13, 14, 16, 18 & 19.

21. Limitations of investigation; need for additional studies

The report references an initial foundation and geotechnical site investigation that was performed on the site (ESP 2010). We recommend that the project geologist review their findings with the project geotechnical engineer, so that they may amend and/or update their design recommendations as warranted.

27. Site development map

The report does not include a site development map as required. We recommend that the project geologist add this figure.

28. Original site geologic map

Include locations of exploratory borings drilled as part of the project geotechnical investigation.

29. Logs of exploratory trenches & borings, scale 1:60

Include the logs of exploratory trenches for the ASM, 1991 fault study.

RECOMMEDATIONS

1. Report Suitability. The geologic fault investigation prepared by Earth Systems Pacific, dated December 8, 2010 requires additional information prior to final acceptance. The investigations' conclusions and recommendations should be reviewed and updated in order to satisfy the requirements of Division 2., Chapter 7.5, Section 3603 of the California Code of Regulations.

2. Respond to Review Comments. The project geologist needs to review the comments on the previous pages and address them in an addendum report. After the addendum report is submitted to the City of Hollister, it will be reviewed and considered for final acceptance.

PROFESSIONAL GEOLOGIST
BRIAN E. PAPURELLO
No. CEG 2226
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Brian Papurello, CEG 2226
Reviewing Geologist

Earth Systems Pacific

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May 1, 2012 File No. SH-11132-GA

Ms. Mary Paxton
City of Hollister
375 Fifth Street
Hollister, CA 95023

PROJECT: HOLLISTER FIRE STATION NO. 1
110 FIFTH STREET
HOLLISTER, CALIFORNIA

SUBJECT: **Response to Review Comments**

REFERENCES:
1) Initial Foundation and Site Investigation, Hollister Fire Station No.1, 110 5th Street, Hollister, California, by Earth Systems Pacific, dated April 15, 2010.
2) Geologic Fault Investigation, Hollister Fire Station No.1, 110 5th Street, Hollister, California, by Earth Systems Pacific, dated December 8, 2010.
3) Review of Geologic Fault Investigation…, City of Hollister Fire Station No.1, 110 5th Street, Hollister, California, by Landset Engineers dated April 14, 2011.

Dear Ms. Paxton,

We have reviewed the comments and recommendations contained in the referenced Review of Geologic Fault Investigation letter for the Hollister Fire Station No. 1 project in Hollister. The letter recommends additional illustrations and discussion concerning geologic conditions at the site.

Our response to checklist items is summarized below.

9. **Subsurface investigations; trenches, borings CPT testing:** Copies of trench logs for ET-2 and ET-3 (ASM, 1991) are attached. Copies of exploratory boring logs presented in reference 1 above and an updated Geologic and Exploratory Trench Location Map showing the boring locations are also attached.

12. **Location or existence of (or absence) of hazardous faults:** Evidence of faulting was not observed in sediments exposed in trench T-1 between depths of 12 to 13.5 feet with radiometric ages of 2,770 and 2,540 years before present (YBP), the late Holocene Epoch. Evidence of faulting on the East Branch Calaveras fault was reported at sites located about 1,000 and 3,000 feet south-southeast from the site (ESCNC, 1998 and ESP 2008_1. At these locations, evidence of faulting was observed in strata with radiometric ages of about 2,570 to

2,650 YBP and 2,820 to 2,960 YBP with down-to-the-west warping of the overlying strata. There was no evidence of warping of the strata exposed in trench T-1 that are of ages similar to the locations where faulting on the East Branch Calaveras fault has been documented.

Based on radiocarbon data presented in Rosenberg (1998) and in reports for nearby fault studies (ASM, 1991; ESCNC, 1998 and ESP, 2008_1) a trench depth of 15 to 17 feet was planned for the Fire Station No.1 study. It is possible that depth to pre-Holocene materials is somewhat more than 17 feet in the site vicinity and, based on ASM (1991), could be as much as about 20 feet. Clear evidence of pre-Holocene sediments, such as San Benito Formation gravels, was not encountered in the geotechnical borings for the fire station drilled to maximum depths of 50 feet. The trench was not excavated to the planned depth as site soils were found to be unstable and could not be safely shored at depths greater than about 14 feet. An open cut was considered to achieve a greater depth, though given space constraints on 5th Street, a trench width of 60 to 80 feet using this methodology was not feasible.

We are not aware of other fault studies of the East Branch Calaveras fault within the low lying portions of the City of Hollister where pre-Holocene materials were encountered. Because evidence similar to that described elsewhere, such as warping of sedimentary beds with comparable, was not present within trench T-1, it is our opinion that potential for surface fault rupture through the building area is considered to be low.

13. **Age of past rupture events:** Based on data presented in ESCNC (1998) and ESP (2008_1), the most recent rupture event appears to have occurred sometime in the range of 2,570 to 2,960 YBP with offsets up to about 1.5 feet. Evidence of faulting was not reported to have been observed in ESCNC (1992) and therefore no past rupture event could be evaluated. Fault rupture was identified by Terratech (1987) within the upper 6 to 9 feet of the site, though there was no site-specific soil dating performed for that study. However, Terratech notes that radiocarbon dating suggests an age of approximately 4,000 years for the uppermost beds of the near-surface sediments near the city of Hollister. It appears that the most recent rupture event occurred sometime in the range of about 2,500 to 4,000 YBP, and likely closer to the range of 2,500 to 3,000 YBP.

14. **Type of faults and nature of anticipated offset:** Geomorphically, the East Branch Calaveras fault is marked by a subtle west-facing scarp in the southern Hollister city area and exhibits a normal sense of offset where exposed in fault trenches. The actually overall sense of movement is likely a combination of normal and strike-slip offset. Terratech (1987) described three to five distinct fault traces within a zone of warped beds that generally describe a westward-dipping monoclinal flexure. Net apparent vertical displacement across the zone of deformation was estimated to be 1.5 to 3 feet by Terratech. ESCNC (1998) could not reliably ascertain the magnitude of offset along the fault, but note that 1 to 4 feet of vertical offset was observed in trenches at other investigations to the south. About 1.5-feet of vertical offset was reported by ESP (2008_1). In all of these cases, the overlying strata were described as being warped in zones of about 10 to 30 feet in width. Based on fault rupture

area-magnitude relationships, ESCNC (1998) estimated a maximum of 17-inches of horizontal offset and 5-inches of vertical offset.

In the northern City area, in the vicinity of the subject site, there is no obvious scarp or other geomorphic evidence of the East Branch Calaveras fault. Also, faulting was not present in studies performed by ASM (1991), ESCNC (1992) and ESP (2008_2) in the northern City of Hollister area, so the nature of offset in this area is uncertain. Based on these studies, it is possible that the East Branch Calaveras fault is poorly defined or insufficiently active in this area.

16. **Probability of relative potential for future displacement:** The East Branch Calaveras fault offsets Holocene age sediments in the Hollister Valley. However, there is little evidence that the fault is actively creeping or has ruptured in recent historic times. Based on radiometric dating for other studies in the Hollister city area (ESP, 2008_1; and ESCNC, 1998) the most recent rupture on the East Branch in the Hollister city area appears to have occurred between about 2,500 and 3,000 YBP, and possibly more recently. Radiometric dating places the oldest observed soils at the subject site (2,540 to 2,770 YBP) within this range. Had surface fault rupture occurred within the building area, it is reasonable to expect that evidence of faulting such as warped beds, offset of beds, or clay seams that have been observed associated with the East Branch elsewhere, would have been present in the trench exposures. No evidence, such as warping of beds or vertical offsets, of faulting was present in the trench exposure and as such, the potential for future surface fault displacement to occur during the design life of the planned structure is considered to be low.

18. **Setback Distance Determination:** The fire station structure occupies essential the same area as the former structure. Evidence of faulting was not present in the exposures of trench T-1 that extended approximately 55 feet beyond the west side of the planned building footprint and about 45 feet beyond the east side to within about 5-feet of a storm drain and Earthquake Fault Zone boundary.

    Evidence of faulting was not present in the trench exposures and although the trench did not extend 50 feet beyond the building on the east, it is our opinion that the potential for surface fault rupture at the site is low and therefore no setback is recommended.

19. **Additional mitigative measures to accommodate fault related deformation:** Earth Systems Pacific geotechnical recommendations included overexcavation of the building pad. During construction, the area of the building pad was excavated to a depth of 5 feet and refilled with compacted native soil. Whereas overexcavation was recommended from a geotechnical point of view, it is our opinion that if fault rupture were to occur within the building area, the surrounding low-strength sediments would be more susceptible to rupture and rupture would preferentially occur within these materials and avoid the building pad. No additional mitigation measures are recommend.

20. Risk evaluation relative to proposed development: Considering our evaluation based on preceding review comments 12, 13, 14, 16, 18 and 19, geologic risk to Fire Station No. 1 is considered to be low.

21. Limitations of investigation; need for additional studies: Based on our discussion of the preceding review comments, additional studies were deemed unfeasible and geotechnical recommendations

27. Site development map: Site development is shown on the attached Geologic and Exploratory Trench Location Map.

28. Original site geologic map: The locations of exploratory borings drilled as part of the project geotechnical investigation are shown on the attached Geologic and Exploratory Trench Location Map.

29. Logs of exploratory trenches & borings: Copies of logs of exploratory trenches for thye ASM, 1991 fault study are attached

We appreciate the opportunity to have been of service. If you have any questions or desire additional information, please do not hesitate to contact this office.

Sincerely,

EARTH SYSTEMS PACIFIC

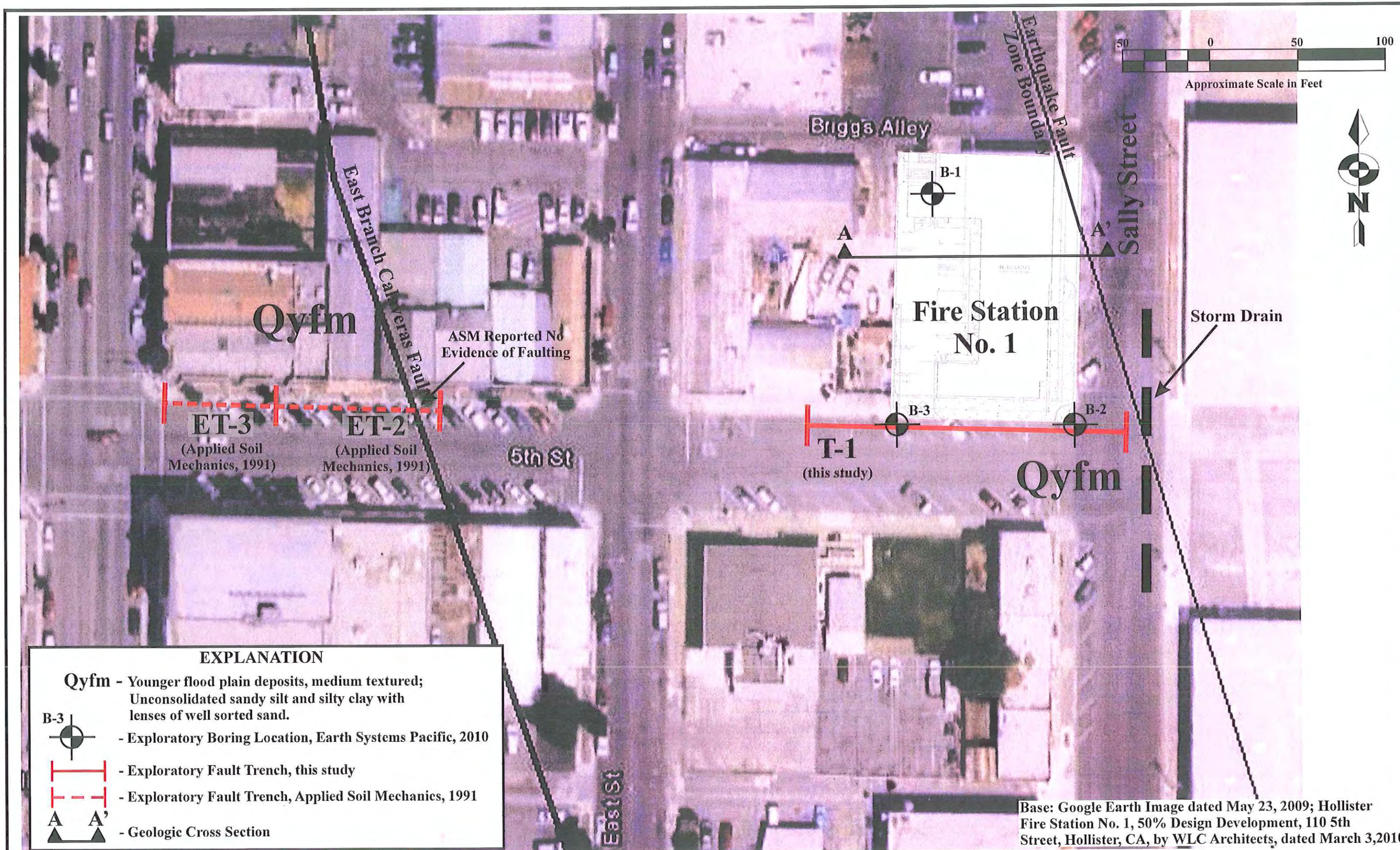
PROFESSIONAL GEOLOGIST
BRETT D. FAUST
No. 2386
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

Brett D. Faust
Engineering Geologist
EG 2386

Attachments: Geologic and Exploratory Trench Location Map (update)
Logs of Boring B-1, B-2 and B-3
Logs of ASM (1991) Rxploratory Trench No. 2 and No. 3

Distribution: Addressee (2)
Landset Engineers, Inc., Attn: Mr. Brian Papurello (1)
City of Hollister, Attn: Ms Mary Paxton (email)

Document No. 1205-100.GEO



Base: Google Earth Image dated May 23, 2009; Hollister Fire Station No. 1, 50% Design Development, 110 5th Street, Hollister, CA, by WLC Architects, dated March 3,2010

Earth Systems Pacific	Hollister Fire Station No. 1 110 5th Street Hollister, California	**Geologic and Exploratory Trench Location Map**		
		May 2012	Scale 1"=50'	SH-11132-CA

Earth Systems Pacific

Boring No. 1
PAGE 1 OF 2

LOGGED BY: B. Faust
DRILL RIG: Mobile B-53
AUGER TYPE: 8" Hollow Stem

JOB NO.: SH-11132-SB
DATE: 02/2/10

HOLLISTER FIRE STATION NO. 1
110 5th Street
Hollister, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 12 IN.
0			Concrete					
1–2	SM		Blue gray silty SAND, very moist, loose, fine to medium sand, brick fragments; Fill	1.0–2.5	Ring	104.3	18.4	11
3–7	CL		Olive brown lean CLAY, very moist, stiff, fine to medium sand; Native	3.5–5.0	Ring	93.6	25.8	17
8–12	SM		Yellow brown silty SAND, moist to very moist, loose, fine to medium sand	8.5–10.0	Ring	91.9	15.1	11
			–medium dense	13.5–15.0	SPT			13
16–17			–local thin clay zones					
18–19			–loose	18.5–20.0	SPT			5
20–26	CL		Yellow brown with gray to orange lean CLAY, mottling, very moist, medium stiff	23.5–25.0	SPT			5
24–26			–very silty, abundant fine sand					

LEGEND: Ring Sample ◯ Bulk Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 1
PAGE 2 OF 2

LOGGED BY: B. Faust
DRILL RIG: Mobile B-53
AUGER TYPE: 8" Hollow Stem

JOB NO.: SH-11132-SB
DATE: 02/2/10

HOLLISTER FIRE STATION NO. 1
110 5th Street
Hollister, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 12 IN.
27	CL		(see previous description)					
28			–stiff	28.5–30.0	●			9
29								
30			–burn layer, local medium grained wet sand stringers					
31								
32								
33	SM		Yellow brown silty SAND with gravel, moist, medium dense	33.5–35.0	●			22
34								
35								
36	CL		Yellow brown lean CLAY, very moist, medium stiff					
37								
38			–thin zones of wet sandy silt	38.5–40.0	●			8
39								
40								
41			–stiff, some fine sand					
42								
43				43.5–45.0	●			9
44								
45								
46								
47	SM		Yellow brown silty SAND, very moist, medium dense, fine to medium sand					
48				48.5–50.0	●			23
49								
50			End of Boring @ 50.0'					
51			No subsurface water was encountered					
52								
53								

LEGEND: ▬ Ring Sample ◯ Bulk Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2
PAGE 1 OF 1

LOGGED BY: B. Faust
DRILL RIG: Mobile B-53
AUGER TYPE: 8" Hollow Stem

JOB NO.: SH-11132-SB
DATE: 02/2/10

HOLLISTER FIRE STATION NO. 1
110 5th Street
Hollister, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 12 IN.
0			6" AC / 12" AB					
1				1.5–3.0	Ring	91.0	27.2	7
2	CL		Yellow brown lean CLAY with sand, very moist, medium stiff to stiff	1.5–5.0	Bulk			
3				3.5–5.0	Ring	88.8	27.2	8
4								
5								
6								
7								
8				8.5–10.0	SPT			5
9			–silty, local sand stringers					
10								
11								
12	SM		Yellow brown silty SAND, moist to very moist, loose, medium sand					
13				13.5–15.0	SPT			8
14								
15								
16			–local thin clay zones					
17								
18				18.5–20.0	SPT			4
19			–wet (perched water)					
20	CL		Yellow brown lean CLAY, very moist, soft					
21			End of Boring @ 20.0' No subsurface water was encountered					
22								
23								
24								
25								
26								

LEGEND: Ring Sample ◯ Bulk Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3
PAGE 1 OF 1

LOGGED BY: B. Faust
DRILL RIG: Mobile B-53
AUGER TYPE: 8" Hollow Stem

JOB NO.: SH-11132-SB
DATE: 02/2/10

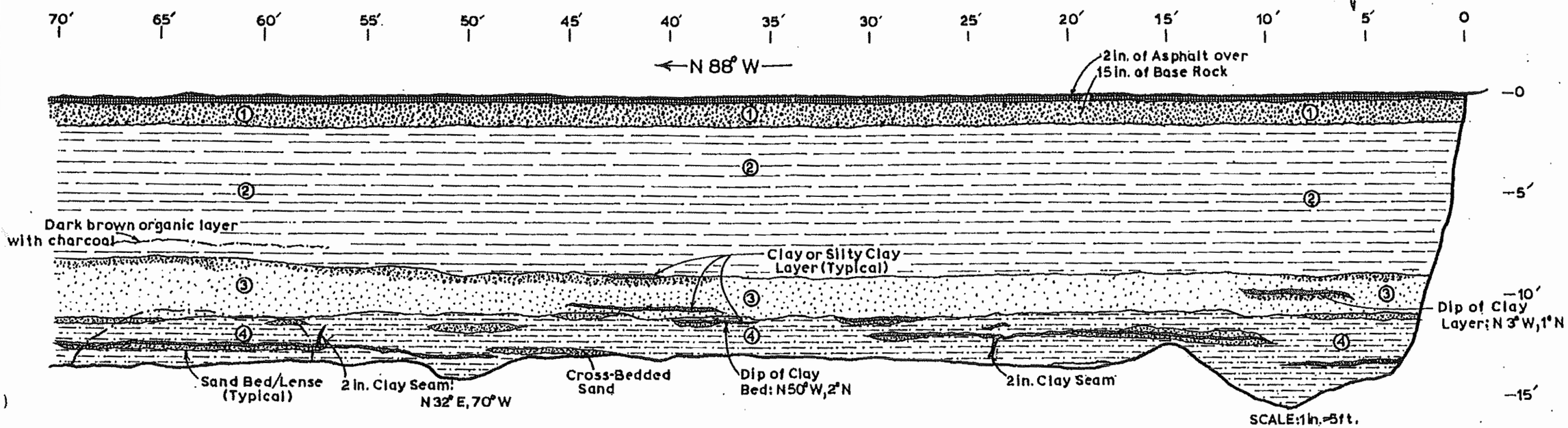
HOLLISTER FIRE STATION NO. 1
110 5th Street
Hollister, California

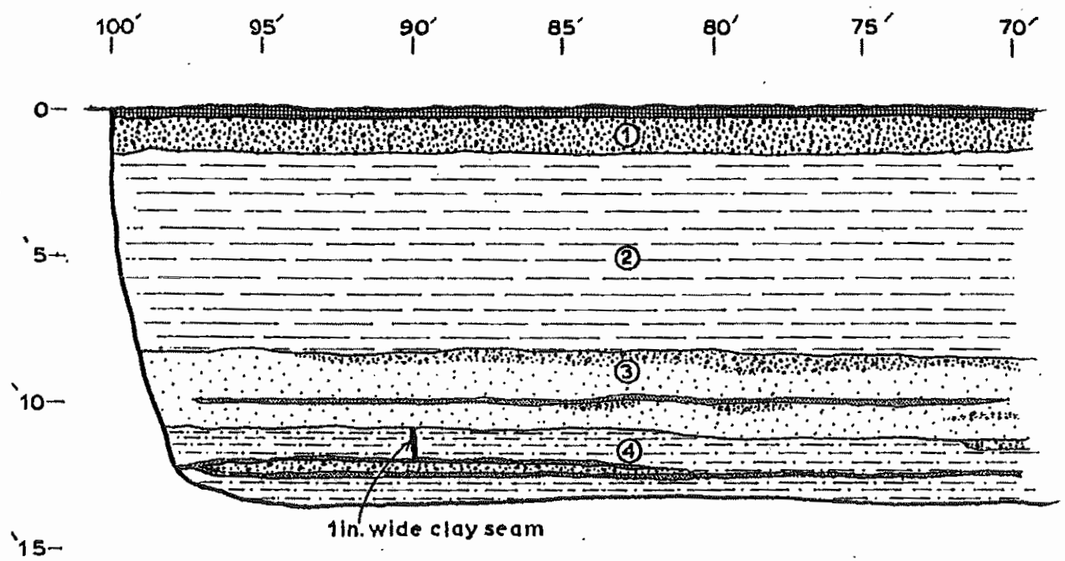
DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 12 IN.
0			6" AC / 12" AB					
1								
2	CL		Yellow brown lean CLAY, very moist, stiff	1.5–3.0	Ring			15
3			–medium stiff	3.5–5.0	Ring	90.8	26.2	8
4								
5								
6								
7								
8				8.5–10.0	SPT			5
9	SM		Yellow brown silty SAND, moist to very moist, loose, fine to medium sand					
10								
11								
12								
13				13.5–15.0	SPT			5
14								
15								
16			–medium dense					
17								
18				18.5–20.0	SPT			13
19								
20								
21			End of Boring @ 20.0' No subsurface water was encountered					
22								
23								
24								
25								
26								

LEGEND: Ring Sample ◯ Bulk Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Exploratory Trench No. 2





EXPLANATION OF UNITS

Artificial fill

Unit 1: 2 inches of asphaltic concrete over 15-inches aggregate base material.

Lacustrine deposits

Unit 2: Olive brown (2.5Y 4/3) to dark grayish-brown (2.5Y 4/2) silty clay, with thin sandy layers, very moist, firm to stiff, extensively bioturbated, blocky ped structure. Sharp upper and lower contacts with charcoal scattered fragments along lower contact.

Fluvial deposits

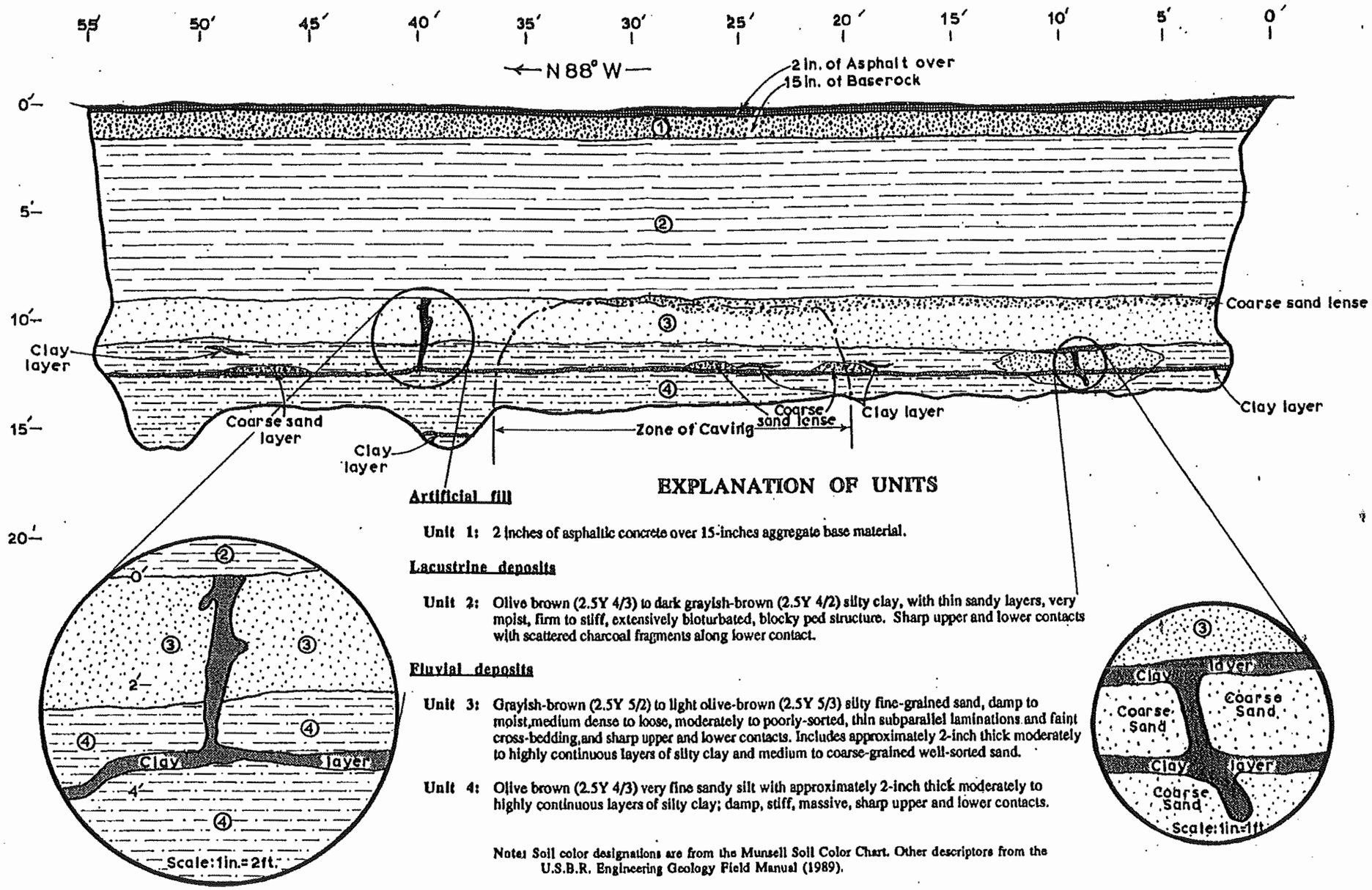
Unit 3: Grayish-brown (2.5Y 5/2) to light olive-brown (2.5Y 5/3) silty fine-grained sand, damp to moist, medium dense to loose, moderately to poorly-sorted, thin subparallel laminations and faint cross-bedding, sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay and medium to coarse-grained well-sorted sand.

Unit 4: Olive brown (2.5Y 4/3) very fine sandy silt with approximately 2-inch thick moderately to highly continuous layers of silty clay; damp, stiff, massive, sharp upper and lower contacts.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A2 - Log of Exploratory Trench No. 2

Exploratory Trench No. 3



EXPLANATION OF UNITS

Artificial fill

Unit 1: 2 inches of asphaltic concrete over 15-inches aggregate base material.

Lacustrine deposits

Unit 2: Olive brown (2.5Y 4/3) to dark grayish-brown (2.5Y 4/2) silty clay, with thin sandy layers, very moist, firm to stiff, extensively bioturbated, blocky ped structure. Sharp upper and lower contacts with scattered charcoal fragments along lower contact.

Fluvial deposits

Unit 3: Grayish-brown (2.5Y 5/2) to light olive-brown (2.5Y 5/3) silty fine-grained sand, damp to moist, medium dense to loose, moderately to poorly-sorted, thin subparallel laminations and faint cross-bedding, and sharp upper and lower contacts. Includes approximately 2-inch thick moderately to highly continuous layers of silty clay and medium to coarse-grained well-sorted sand.

Unit 4: Olive brown (2.5Y 4/3) very fine sandy silt with approximately 2-inch thick moderately to highly continuous layers of silty clay; damp, stiff, massive, sharp upper and lower contacts.

Note: Soil color designations are from the Munsell Soil Color Chart. Other descriptors from the U.S.B.R. Engineering Geology Field Manual (1989).

Figure A3 - Log of Exploratory Trench No. 3

LANDSET
ENGINEERS, INC.
ENGINEERING - LAND PLANNING
SURVEYING - ENVIRONMENTAL CONSULTING

May 21, 2012

File No.: 0865-01

Ms. Mary Paxton
City of Hollister
375 Fifth Street
Hollister, California 95023

Subject **Review of Response to Review Comments Earth Systems Pacific dated May 1, 2012**

Project: **City of Hollister, Fire Station No. 1**
110 Fifth Street
Hollister, California

Reference: 1. Review of Geologic Fault Investigation, Earth System Pacific, dated December 8, 2010, Hollister Fire Station No. 1, 110 5th Street, Hollister California, prepared by Landset Engineers Inc., Doc. No. 1104-104.REV, dated April 14, 2011.

Dear Ms. Paxton:

Thank you for providing us a copy of the *"Response to Review Comments"* report prepared by Earth Systems Pacific (ESP 2012). The purpose of this letter is to summarize our review findings of the above referenced addendum report. This firm previously prepared a review letter for *"Geologic Fault Investigation"* report prepared by Earth Systems Pacific (ESP 2010a) requesting of additional site specific geologic information and response to review comments (Reference 1).

The site being considered for development is located within the official Earthquake Fault Zone (EFZ) of the East Branch of the Calaveras fault, designated by the State of California as defined by the Alquist-Priolo Act. Based on our research, site observations within the exploratory trench and report review; it is our opinion that *there is sufficient geologic evidence to support the absence of active Holocene age faulting within the sediments underlying the site.*

We reviewed the reports (ESP 2010a & 2012) for conformance with State of California, Public Resources Code, Division 2. Geology Mines and Mining, Chapter 7.5 Earthquake Fault Zones, Sections 2621, 2621.5, 2621.6, 2623, 2624, 3600, 3601 & 3603 and City of Hollister Municipal Code, Title 17, Chapter 17.14.040.

It is our opinion that the site geologic conditions are accurately modeled as represented in the referenced reports. In general, our findings are congruent with the conclusions and recommendations of the reports prepared by Earth Systems Pacific (ESP 2010a & 2012), dated December 8, 2010 and May 1, 2012 respectively.

The recommendations summarized in the referenced documents and the project updated geotechnical report dated August 11, 2008, should be included as conditions of approval prior to the issuance of building permits. It is our opinion that the project engineering geologic constraints have been adequately characterized and appropriate mitigative measures have been included for compliance with the State of California Alquist-Priolo Act.

As required by State Code and local municipal ordinance, the final approved surface fault investigation reports (ESP 2010a & ESP 2012) along with supporting documentation and peer reviews, shall be filed by the City of Hollister with the State Geologist.

Please contact me at (831) 443-6970 or bpapurello@landseteng.com if you have questions regarding this matter.

Respectfully,
LandSet Engineers, Inc.

PROFESSIONAL GEOLOGIST
BRIAN E. PAPURELLO
No. CEG 2226
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Exp 2-28-14

Brian Papurello, CEG 2226
Reviewing Geologist

Doc. No. 1205-111.REV

Attachments: Fault Investigation Report Review Form

Distribution: Ms. Mary Paxton, City of Hollister (mary.paxton@hollister.ca.gov)
Mr. Bret Faust, PG, CEG, Earth Systems Pacific (bfaust@earthsys.com)

FAULT INVESTIGATION REPORT REVIEW FORM

Project Information

Project:	City of Hollister, Fire Station No. 1 110 Fifth Street Hollister, CA
Case number:	N/A
Applicant:	City of Hollister, Development Services Department 375 Fifth Street Hollister, CA 95023 Attn. Ms. Mary M. Paxton
Consultant:	Earth Systems Pacific 400 Park Center Drive, Suite 1 Hollister, CA 95023 Phone: (831) 637-2133, Fax: (831) 637-0510 E-mail: bfaust@earthsys.com.com Responsible geologist: Mr. Brett Faust, PG 7025, CEG 2386
Reports and Plans Reviewed:	Earth Systems Pacific, 2010, Work plan for fault investigation, Hollister Fire Station No. 1, 110 5th Street, Hollister, California: unpublished letter to Mr. Bill Avery (sic), City of Hollister Redevelopment Agency, dated February 22, 2010, 2 p., 1 fig., 2 attachments. _____2010a, Geologic fault investigation, Hollister Fire Station No. 1, 110 5th Street, Hollister, California: unpublished report to Ms. Renee Perales, Hollister Redevelopment Agency, dated December 8, 2010, 14 p., 9 fig., 3 appendices, 2 plates, scale 1:60. _____2012, Response to Review Comments, Hollister Fire Station No. 1, 110 5th Street, Hollister, California: unpublished report to Ms. Marry Paxton, City of Hollister, dated May 1, 2012, 2010, 4 p., 4 fig., 3 plates, scale 1:60.
Other information sources:	Applied Soil Mechanics, 1991, Fault study. Sites 1, 3-6 and 10, Hollister, California: unpublished report to Mr. Christopher M. Reyes, City of Hollister Redevelopment Agency, dated June 12, 1991, 40 p., 7 fig., 1 appendix, 14 plates, scale 1:60. Bryant, W.A., 1979, Fault evaluation report, Calaveras (Hollister segment) and "Buena Vista Road" faults: California Division of Mines and Geology Fault Evaluation Report FER-94, 14 p., 4 plates, scale 1:24,000. California Department of Conservation, California Geological Survey, 2002,: Guidelines for evaluating the hazard of surface fault rupture, CGS Note 49. California Department of Conservation, California Geological Survey, 2008,: Guidelines for evaluating and mitigating seismic hazards in California: California Geological Survey Special Publication 117, 102 p.

FAULT INVESTIGATION REPORT REVIEW FORM
(CONTINUED)

Other information sources: (continued)	California Division of Mines and Geology, 1982, Revised Official Special Studies Zone Map of the Hollister quadrangle: State of California Alquist Priolo Earthquake Fault Zoning Act map, scale 1:24,000. Dibblee, T.W.., Jr., and Rogers, T.H., 1975, Geologic map of the Hollister quadrangle: U.S. Geological Survey Open-File Report 75-394, scale 1:62,500. Earth Systems Consultants Northern California, 1998, Geologic study, San Benito Foods 60,000 square foot storage building, northwest corner of Sally and South streets, Hollister, California: unpublished report to Mr. Mike Mullen, San Benito Foods, dated July 16, 1998, 22 p., 7 fig., 4 appendices, 4 plates, scale 1:60, 1 plates, scale 1:240. Earth Systems Pacific, 2008, Geologic fault investigation, Vista Meadows Senior Apartments, East Park Street and Rancho Drive, Hollister, California: unpublished report to Ms. Cynthia Iwanaga, South County Housing Corporation, dated August 12, 2008, 12 p., 5 fig., 3 appendices, 2 plates, scale 1:60. Hart, E.W., and Bryant, W.A., 2007, Fault-rupture hazard zones in California: California Geological Survey Special Publication 42, 42 p.Levi, T., Weinberger, R., Aifat., Eyal, Y., and Marco, S., 2006, Injection mechanism of clay-rich sediments into dikes during earthquakes: G3 (Geochemistry, Geophysics, Geosystems), v.7, no. 12. Rosenberg, L.I., 1998, Liquefaction Susceptibility of the Hollister Area, San Benito County, California, U.S. Geological Survey, National Earthquake Hazards Reduction Program Final Technical Report, Award No. 1434-HQ-97-GR-03125, 40 p.

Report Requirements

Applicable codes & ordinances:	State of California, Public Resources Code, Division 2. Geology Mines and Mining, Chapter 7.5 Earthquake Fault Zones, Sections 2621, 2621.5, 2621.6, 2623, 2624, 3600, 3601 & 3603. City of Hollister, Municipal Code, Title 17, Chapter 17.14.040.
Review standards:	California Department of Conservation, California Geological Survey, Guidelines for reviewing geologic reports: CGS Note 41, 4 p. California Department of Conservation, California Geological Survey, 2002: Guidelines for evaluating the hazard of surface fault rupture, CGS Note 49. California State Board for Geologists and Geophysicists, 1998, Geologic guidelines for earthquake and/or fault hazard reports, 7 p. Hart, E.W., and Bryant, W.A., 2007, Fault-rupture hazard zones in California: California Geological Survey Special Publication 42, 42 p.
Plan, phase, project or report under consideration:	Demolition of existing municipal fire station and replacement with new fire station.

FAULT INVESTIGATION REPORT REVIEW FORM

(CONTINUED)
Reviewer's Notes

Field observations & meetings:	03/17/10: Site review and observations of exposures in trench T-1 from Sta. 0+00 to Sta. 0+50. Severe caving of non-cohesive sands was observed from Sta. 0+00 to Sta. 0+20. This portion of trench was unsafe to enter, which limited observations from ground surface only. Trench sidewalls expose ~8 feet of clay & silt soils underlain by ~4 feet of interbedded poorly graded sand, silty sand and well graded sand. Observed <½" thick organic burn layers within lower portion of clay. Trench depth varies from 12.0' to 12.5' deep. No warping or bedding offset noted. 03/22/10: Site review and observations of exposures in trench T-1 from Sta. 0+50 to Sta. 1+08. Observed conformable deposits of upper Holocene over-bank deposits. Continuous sand marker bed @ 8.0'. No discernable bedding offsets or warping. Trench depth varies from 12.0' to 12.5' deep. 03/26/10: Site review and observations of exposures in trench T-1 from Sta. 1+55 to Sta. 1+89. Observed conformable deposits of upper Holocene over-bank deposits. No discernable bedding offsets or warping. Trench depth varies from 13.0' to 14.5' deep. 03/30/10: Site review and observations of exposures in trench T-1 from Sta. 1+55 to Sta. 1+89. Observed conformable deposits of upper Holocene over-bank deposits. No discernable bedding offsets or warping. 03/17/11: Meeting attendance with principal investigator Mr. Brett Faust at the offices of ESP. Discussed preliminary review findings of initial consultants report (ESP 2010a)
Attachments:	None
Disposition:	02/25/10: Received copy of Earth Systems Pacific report (2010) from City of Hollister Redevelopment Manager, Mr. Bill Avera 03/02/10: Issued review letter for Earth Systems Pacific (2010) Fault investigation work plan letter. 03/14/11: Received copy of Earth Systems Pacific report (2010a) from City of Hollister Development Services Planning Manager, Ms. Mary M. Paxton. 04/14/11: Issued review letter for Earth Systems Pacific, geologic fault investigation report (ESP 2010a) 05/01/12: Received PDF copy of Earth Systems Pacific report (ESP 2012), response to review comments from City of Hollister Development Services Planning Manager, Ms. Mary M. Paxton. 05/16/12: Received wet signed hard copy of Earth Systems Pacific report (ESP 2012), response to review comments from Earth Systems Pacific, Mr. Brett Faust. 05/21/12: Issued review letter for Earth Systems Pacific, response to review comments report (ESP 2012)

FAULT INVESTIGATION REPORT REVIEW FORM
(CONTINUED)

The following checklist (modified after CGS Special Publication 42, Appendix C and CGS Note 49) is used as part of reviewing fault investigation reports. Explanatory notes are appended and keyed to each numbered item.

Checklist item within consulting report	Adequately described: satisfactory	Additional data needed: unsatisfactory
1. Purpose and scope of investigation	X	
2. Description of proposed development	X	
3. Geologic and tectonic setting	X	
4. Seismicity and earthquake history	X	
5. Site description and conditions	X	
6. Review of published and unpublished literature	X	
7. Stereoscopic interpretation of aerial photographs & remote sensing	X	
8. Surface observations	X	
9. Subsurface investigation; trenches, borings, CPT testing	X	
10. Geophysical investigation	N/A	
11. Age dating techniques	X	
12. Location or existence (or absence) of hazardous faults	X	
13. Ages of past rupture events	X	
14. Type of faults and nature of anticipated offset	X	
15. Distribution of primary and secondary faulting and related deformation	X	
16. Probability of relative potential for future surface displacement	X	
17. Degree of confidence and limitations of data and conclusions	X	
18. Setback distance determinations	X	
19. Additional mitigative measures to accommodate fault related deformation	X	
20. Risk evaluation relative to the proposed development	X	
21. Limitations of the investigation; need for additional studies	X	
22. References for published & unpublished literature and aerial photographs	X	
23. Location map	X	
24. Regional geology map	X	
25. Fault and seismic epicenter map	X	
26. Site location on Official Earthquake Fault Zone Map	X	
27. Site development map	X	
28. Original site geologic map	X	
29. Logs of exploratory trenches & borings, scale 1:60	X	
30. Appendix with supporting data (e.g. water well, geophysical, aerial photographs	X	
31. Authentication, report signed and stamped by PG/CEG with expiration date	X	

PACIFIC GEOTECHNICAL ENGINEERING

16055-D Caputo Drive, Morgan Hill, CA 95037
(408) 778-2818 • FAX (408) 779-6879
info@pacific-geotechnical.com

January 6, 2012
Project 2010.0177

Ms. Mary Paxton
City of Hollister Redevelopment Agency
375 Fifth Street
Hollister, CA 95023

Subject: **Cumulative Assessment of Fault Hazard Data in Downtown Hollister**
Summary Letter Report and GIS Map Transmittal
Downtown Redevelopment Area
Hollister, California

Dear Ms. Paxton:

As requested, we are pleased to present our Summary Letter Report for Geologic Assessment of Fault Hazards in Downtown Hollister. The work product presented here includes a Geographic Information System (GIS)-based map compilation of previous fault investigations in the designated downtown study area (with relevant associated data) and this Summary Letter Report, in which we describe the scope, methods, and findings of the project. A brief discussion of the potential to clear additional property of fault rupture hazard based on the data reviewed for this study is included in this report.

INTRODUCTION

The revitalization of the downtown area of the City of Hollister is one of the goals of the City's Redevelopment Agency (RDA). The downtown area is characterized by many older structures, many of which are multi-story buildings. Re-zoning of these buildings for residential use on the upper stories is viewed by the City as a desirable milestone in paving the way for redevelopment and revitalization of the downtown area.

A significant portion of downtown Hollister lies within a California Geological Survey (formerly California Division of Mines and Geology, or CDMG) Earthquake Fault Zone (EFZ) developed around the east branch of the Calaveras fault (Figure 1). This map series addresses the potential for surface fault rupture along "sufficiently active and well-defined" faults for development sites within the State of California. The CGS Earthquake Fault Zones are defined by the Alquist-Priolo Earthquake Fault Zoning Act ("AP Act"), which became law in 1972. The AP Act specifically regulates developments classified as a "project", or a structure(s) for human occupancy. It is our understanding that redevelopment of existing buildings for residential use, as is planned for the downtown Hollister area, meets the definition of a "project", and as such is regulated by the Act (W.A. Bryant, personal communication, 2009).

Approval of a "project" within a CGS Earthquake Fault Zone requires establishing an acceptably low level of surface fault rupture hazard for the planned development. This is typically accomplished in a fault investigation by means of a trench excavated approximately perpendicular to the regional trend of the fault in question so as to intercept any geologically reasonable active fault that would pass through the project footprint. The width of the investigated interval is greater than the width of the project itself. The AP Act defines an "active" fault as having ruptured during Holocene time (approximately the last 11,000 years).

PURPOSE AND SCOPE

The purpose of this report is to assess the current state of knowledge regarding surface fault rupture hazard potential of the East Branch of the Calaveras fault in anticipation of proposed residential redevelopment within the designated assessment area. To that end, we completed the following tasks:

- Meeting with the City of Hollister Planning Department/Redevelopment Agency (RDA) to discuss project goals and define the assessment area boundary.
- Archival search of prior fault investigations prepared for development projects within the downtown study area, and provided to us by the City.
- Map compilation of properties previously investigated for surface fault rupture, including locations of exploratory trenches, geophysical lines, and borings.
- Digitization of data for inclusion in the City of Hollister Geographic Information System (GIS) database (the City presently uses the San Benito County GIS database).
- Preliminary assessment of which areas/parcels are likely cleared of surface fault rupture by prior investigations.
- Consultation with CGS regarding implementation of Alquist-Priolo Act criteria.
- Preparation of this Summary Letter Report.

METHODS

In the following sections, we discuss the methods and organizational approach to data collection for each of the key tasks of our assessment.

Designated Assessment Area

Based on our discussions with the City of Hollister Planning Division and RDA, the assessment area boundary for this project is defined as follows: an area bounded by North Street/Santa Ana Road on the north, West Street on the west, Hawkins Street on the south, and McCray Street on the east (Figure 1 – Earthquake Fault Zone Map). This area forms a rough outline of the area of interest for redevelopment. It should be noted that this area extends past the CGS EFZ boundaries on the east and west. Given the nature of this assessment, we primarily reviewed reports and data prepared for previous projects within the CGS EFZ, as this regulatory boundary is the driving factor for a fault investigation for most projects. The CGS EFZ developed around the East Branch Calaveras fault trends approximately north-northwest and varies between 800-900 feet in width in this area of Hollister. At the request of the City, we reviewed one report along the CGS EFZ for the West Branch Calaveras fault. We also reviewed a recent study (2008) prepared for the old Fremont School site (proposed new Courthouse site), which lies between, but not within, the EFZs for the East Branch and West Branch Calaveras faults. Aside from these outlying parcels, this assessment is concerned with projects situated exclusively within the EFZ established around the East Branch Calaveras fault.

We have included in the database two additional studies situated immediately to the south of the designated assessment area, primarily because faulting was clearly identified in each of these studies. Because of the conspicuous absence of identified faulting in much of the

designated assessment area, inclusion of these two investigations lends confidence to the actual location of the fault at the southern end of the assessment area, as well as providing a good example of the style and geometry of faulting that appears to be typical of the East Branch Calaveras fault.

Archival Search

The primary and central task to this assessment was to perform an archival search of maps, literature, and fault investigations prepared for development sites in the designated assessment area. We reviewed the following information as part of our archival search:

- Fault investigation reports on file with the City of Hollister Development Services Department, Planning Division
- Alquist-Priolo reports on file with CGS
- Two CGS CD archives: *Fault Investigation Reports for Development Sites within Alquist-Priolo Earthquake Fault Zones in Northern California, 1974-2000*, and *Fault Evaluation Reports Prepared Under the Alquist-Priolo Fault Zoning Act*
- Reports not currently on file with the CGS or the City prepared by other engineering geologic and geotechnical consultants
- A preliminary working compilation of fault investigation reports through November 2008 in Kmz format (W.A. Bryant, personal communication, 2009)

We identified and reviewed a total of 17 reports as part of our assessment. These reports were prepared between 1978 and 2010. Some of the reports address multiple parcels. In some cases, our review of a report led to the discovery of additional reports referenced in that document that had not been filed with the City or State. One of these additional reports was unavailable for review, and is cited in the References section of this report.

For each investigation we identified, we briefly reviewed the text, site plans, and trench logs. We specifically focused on the outcome of the investigation (ie fault found/not found), location of exploratory trenching, quality of the report, and applicability of the exploration methods used to assess fault ground rupture. At the time of our review, we gathered relevant information for later inclusion as attributes in data tables linked to features included in the GIS files that accompany this report. As an example, for a given exploratory trench (a GIS database feature), we noted attributes such as outcome (fault found/not found), depth of excavation, any caving conditions encountered, maximum geologic age encountered, and C^{14} radiocarbon dates, amongst others.

During our file review we also made a preliminary assessment of the confidence in findings of the report and quality of data. As an example, a trench excavated at a very low angle to the mapped regional trend of the fault would be poorly situated to expose any faulting, and would result in a low level of confidence in the findings of the report.

Map Compilation

Selected graphical data gathered during our archival search was organized and compiled on a parcel base map derived from the San Benito County GIS database provided by the San Benito County Planning Department. These data were organized and compiled with the end goal of seamless integration of the map data into the City (County) GIS database. We compiled the following map features from each fault investigation report we reviewed, each of which is

included as a separate layer, or overlay, in the GIS database provided on a CD accompanying this report:

- Parcels with investigations (parcel outlines adopted from the San Benito County GIS database)
- Trenches (including geophysical lines)
- Borings
- Fault Traces
- Fault Zones
- Building Exclusion Zones (consultant's interpretation)

Graphics for each feature were scaled directly from the consultant's reports using a copy machine. Compilation was accomplished by tracing each scaled feature onto a paper copy of the San Benito County GIS parcel map at a scale of 1"=50'. Parcels were adopted from the current parcel outlines present on the San Benito County GIS database as of mid-2010. Fault traces mapped by the CGS are digitized from source maps with a scale of 1" = 2,000'.

Many of the reports we reviewed were copies or scans of previous copies. Multiple iterations of copying have resulted in scaling errors. For this reason, our compilation line work is a best estimate, and likely accurate within ±5 feet.

Map features compiled as part of our assessment are presented in paper format as Figure 2 of this report, which uses the San Benito County GIS "parcel" and "street centerlines" layers as a base map. The map features presented on Figure 2 have been modified (color, shading, and line-weight changed) for clarity and presentation with this report. These features will appear as simple line, area, and point features in the digital dataset included on the CD accompanying this report. It is anticipated that color, shading, and lineweight modifications will be made at the discretion of the City once the data is merged with the City (County) GIS database.

Data Organization

Data compiled for each report was organized with a GIS end product in mind. Accordingly, each of the map features, or feature classes, discussed above is grouped into a separate layer (or overlay) of shapefiles (.shp files) within the data set. As an example, all of the "trenches" are grouped within a single layer/overlay that can be toggled on or off with the GIS software used to view the data. "Trenches" and "fault traces" were digitized as line features. "Parcels with investigations", "fault zones", "building exclusion zones", and "cleared areas" were digitized as area features. "Borings" were digitized as point features.

Each individual feature within a feature class (i.e trench, boring, fault trace, etc.) is accompanied by a linked attribute table (data table) that is accessed simply by clicking on the individual feature when viewed with GIS software. Typical attributes include site APN, site address, consultant, report date, etc. Key elements of attribute organization are presented as follows:

- *Common Attributes*: Site address and assessor's parcel number (APN) are assigned as common attributes for each feature to facilitate querying and efficient data management.
- *Trench Identification Number*: Each of the 66 trenches identified in the study are assigned a unique identification number to distinguish trench labels common to different investigations (ie many reports describe exploratory trenches as "T-1").

- *Report Title Code*: Each consultant's report is assigned a title code for ease of reference. Report title codes are sequential by report date, with the exception of the single report reviewed along the West Branch Calaveras fault (Report Title Code 17). Abbreviated report citations are included in each attribute table. Full report citations, listed by report title code, are presented in the references section of this report.

FINDINGS

Geologic Summary

Faulting was identified in four of the studies we reviewed, as follows:

- *Terratech, Inc., 1978 (321 and 341 First Street; Report Title Code 1)*: Two fault traces were identified during the investigation. This report was unavailable for our review. However, the exploratory trench and fault trace locations were referenced and included on the site map for a subsequent study of the same property by Pacific Rim Geologic in 2002 (341 First Street, Report Title Code 13), and are included here as part of our compilation. The presence of faulting identified in the 1978 study is disputed by the findings of the 2002 study, as no faulting was identified in the latter investigation. The fault traces identified in the 1978 investigation are the northernmost fault occurrences documented in the designated assessment area.
- *Terratech, Inc., 1987 (Report Title Code 4)*: Very good exposures of faulting were observed in seven trenches as part of this investigation. These exposures define a well-documented curvilinear fault zone. The consultant (Terratech) recommended a building exclusion zone based on their findings. The fault zone and associated building exclusion zone are both included in our compilation. The faulting identified in this study is the southernmost occurrence of faulting documented in this assessment.
- *Earth Systems Consultants, 1998 (East, South, Sally, and Seventh Streets; report title code 11)*: Faulting was identified at a depth of approximately 15 to 17 feet below ground surface. A C^{14} radiocarbon age of 2,650±80 years before present in warped and faulted sediments at a depth of approximately 15.5 feet below ground surface attests to a relatively young age of faulting and burial of the most recent faulting event by a thick accumulation of sediments.
- *Earth Systems Pacific, 2008 (East Park Street and Rancho Drive; Report Title Code 14)*: Fault traces were identified in three trenches on property adjacent to (east of) the Terratech, Inc. (1987) study.

Our archival search identified an additional reference to an investigation where faulting was identified at 49, 53, and 57 Hawkins Street (Applied Soil Mechanics, Inc., 1991a). This report was unavailable for our review. A full report citation is included in the references section of this report. We have not included this report in our GIS database.

We make the following noteworthy geologic observations based on the geologic findings of other consultants compiled in our assessment:

- No faulting has been identified between Seventh Street and the approximate area of First Street. Although most of the trenching has been conducted west of the State-mapped fault trace, at least one investigation (Report Title Code 6, 335 San Benito Street) trenched directly across the mapped CGS trace with no discovery of a fault.

Likewise, no other evidence of faulting, such as warped sedimentary bedding, was observed in the trench logs we reviewed in this area.

- No evidence of a fault scarp is present between Seventh Street and the vicinity of First Street, whereas a well-defined, albeit degraded fault scarp is present south of Seventh Street and is so noted in several of the investigations we reviewed. Our review of LiDAR (Light Detection and Ranging) hillshade imagery using different illumination angles also suggests that the fault scarp is not present north of Seventh Street (GeoEarthScope NoCal dataset, www.opentopography.org).
- Most of the investigations in the downtown area encountered a thick accumulation of relatively young sedimentary deposits. Applied Soil Mechanics performed extensive investigations in the downtown area in 1991. These studies consistently cite Late Pleistocene to Early Holocene soils for the downtown area based on radiocarbon dates obtained in several of the investigations. Only one study (Report Title Code 8) cites a Pleistocene radiocarbon date (18,110±190 years before present); all other radiocarbon dates in the study area reveal Holocene ages.
- Successful exploration for a fault is routinely performed with great difficulty in the downtown area. Loose, caving conditions in sandy soil, combined with the apparent thick accumulation of relatively young sediments have proven to be significant obstacles in fault investigations. In many cases, it appears that the base of the Holocene is not within reach of a normal backhoe (about 15 feet). As an example, faulting was identified at depths between 15 and 17 feet below ground surface at the San Benito Foods warehouse near Seventh Street (Report Title Code 11). A late Holocene radiocarbon date (2,570±50 years before present) was recovered at a depth of 17 feet in faulted sediments at this locality. These are challenging conditions in the streetscape setting of downtown, where deeper, benched excavations are not feasible.

The conspicuous absence of documented Holocene faulting between Seventh Street and the approximate area of First Street may be due to any number of reasons. Most of the trenching completed to date has been conducted in the western portion of the EFZ, leaving room for the fault to pass through the eastern half of the EFZ. However, based on the geologic observations noted above, we suggest that the fault is likely buried, or simply dies out northward, in this part of downtown Hollister.

Property Clearance

Property "clearance" of fault rupture hazard in the downtown area is one of the central aims of the City of Hollister RDA. Accordingly, we present the following generalized approach to property clearance using the results of this assessment.

Our approach is based on establishing a reasonable "shadow" of coverage for any given exploratory trench. We established a "shadowed", or "cleared" area by using the observed and/or mapped local variation in fault trend to define a polygon around each exploratory trench on the map. A fault is assumed to be present passing immediately adjacent to either end of the trench, with a possible trend within the local mapped range of variation of fault trend. In the absence of a parallel trench nearby, a single trench "clears" a trapezoid, with ends tapering away from the trench (see Figure 2). For the majority of the assessment area, we used a variation in fault trend between N34°W and N09°W based on the variation in trend as mapped on the CGS EFZ map. In the vicinity of North Street, where the State-mapped fault trends more westerly, we used a variation between N43°W and N09°W. At the southern end of our assessment area, we used a variation between N19°W and N10°E. This latter variation reflects

the north-northeast trend of faulting indentified in two studies in the vicinity of Rancho Drive (Report Title Codes 4 and 14). These trapezoids, or polygons, are presented on a separate GIS layer, or overlay, in the GIS database that accompanies this report.

It should be noted that our approach to property clearance is necessarily generalized, and is presented as a starting point for the City to make educated decisions regarding clearance of properties of fault rupture hazard. Our approach is not intended to provide a blanket clearance of properties. Rather, it is intended that the findings of this study, and in particular the "cleared" polygons presented therein, are to be used in concert with the engineering geologic judgment of practicing consulting geologists in the study of any given parcel. It should also be noted that the following assumptions were made as part of our approach to property clearance:

- "Cleared" zones are drawn around all trenches, except where building exclusion zones are already established by the consultant around trenches in which faulting was encountered. In the case of trench ID#45 (Report Title Code 11), in which a fault was observed, no building exclusion zone was established by the consultant. We placed cleared polygons around those portions of the trench set back 50 feet perpendicular from either side of the fault.
- No "cleared" polygons were drawn around trenches for the two investigations on the south side of First Street (Report Title Codes 1 and 13). Faulting was identified in Report 1, but was disputed in Report 13.
- A "cleared" zone does not indicate City or State approval. Many of the studies we reviewed did not include proof of either City approval or State review.
- Some trenches caved during or soon after excavation, in some cases prohibiting logging of the trench in detail. Caved trenches are so described in the notes section of the attribute table for the trench in question. In some cases, these caved trenches were used by the consultant to clear the site of fault rupture hazard. "Cleared" polygons are drawn for these caved trenches regardless of the caving conditions encountered. However, we have assigned a "low" confidence rating in the attribute table of each caved trench.

CONCLUSIONS AND RECOMMENDATIONS

Based on the compilation work conducted as part of this study, and our generalized approach to property clearance, we suggest that a select portion of the downtown assessment area presents a likely candidate for blanket clearance of multiple properties of fault rupture hazard. This target area is roughly bounded by the State-mapped trace of the East Branch Calaveras fault on the east, the western edge of the East Branch Calaveras EFZ boundary on the west, Fourth Street on the north, and Sixth Street on the south. The closely-spaced distribution of exploratory trenches and associated "cleared" polygons in this area makes the probability of a through-going fault in this area highly unlikely. While there are some narrow gaps between trenches and cleared areas, the probability that a fault passes through all of them is judged to be low. We preliminarily suggest that this area be considered as potential ground that could be cleared of fault rupture hazard with little or no further exploratory trenching.

The area west of the CGS-mapped fault trace between Sixth and South streets also has a closely-spaced distribution of trenches and associated "cleared" polygons, making it another likely candidate for property clearance. We also suggest that the adjacent trenches and

associated "cleared" polygons at Fremont Way and San Benito Street could be linked to form a larger area of "cleared" ground (Report Title Code 6).

One of the best opportunities to efficiently and strategically clear additional ground in the downtown area is present along Fifth Street, which passes directly through the aforementioned target area. Between San Benito Street and East Street, nearly half of the block along Fifth Street has been trenched, with no fault found (Applied Soil Mechanics, 1991; Report Title Code 7). Between East and Sally Street, a significant portion of the block was recently trenched for the City of Hollister Fire Station No. 1 project (Earth Systems Pacific, 2010; Report Title Code 16) with no faulting identified. Supplemental trenching between these two studies across East Street would have the potential to clear nearly two thirds of the width of the East Branch Calaveras EFZ along Fifth Street with continuous trench.

We look forward to discussing these and other potential strategies for clearance of downtown Hollister with you in the near future.

If you have any questions, please contact us.

Sincerely,

PACIFIC GEOTECHNICAL ENGINEERING

John Feltman
CEG #2530

PROFESSIONAL GEOLOGIST
JOHN A. FELTMAN
No. 2530
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

G. Reid Fisher, Ph.D.
CEG #1858

G. REID FISHER
No. 1858

REFERENCES

Reviewed Reports (listed by Report Title Code):

1. Terratech, Inc., 1978, Geologic/Geotechnical Investigation, First Street Commercial Property, Hollister, California: unpublished consultants report.
2. Geoconsultants, Inc., Geologic Hazard Investigation for Proposed Commercial Development, Park Hill and San Benito Streets, Hollister, CA: unpublished report prepared for Mr. Ronald J. Koll c/o Mr. James Paxton, Attorney at Law. Project No. G221-01
3. Jo Crosby and Associates, 1983, Fault Trace Study, 29 Hawkins Street near Prospect Avenue, Hollister, California: unpublished report prepared for Joe Piini Realty. File No. 3232 A-7
4. Terratech, Inc., 1987, Investigation of the East Branch of the Calaveras Fault, Prune Street School Site (Rancho San Justo Tandem School Site), Hollister, California: unpublished report prepared for Hollister School District. Project 7973.
5. Terratech, Inc., 1990, Limited Geologic Evaluation, Lands of Reardon and Whittrock, Southeast Corner of Park Hill, Hollister, California: unpublished report prepared for Mr. Chris Reardon c/o Conservative Developers, Inc. Project 8286.
6. Applied Soil Mechanics, Inc., 1991, Fault Study, Poletti Property, 335 San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2279-S1
7. Applied Soil Mechanics, Inc., 1991, Fault Study, Sites 1, 3-6, and 10, City of Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2280-S1
8. Applied Soil Mechanics, Inc., 1991, Fault Study, Bruhn and Peterson Properties, Building Sites 7 & 8, 515, 525, and 530 San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2281-S1
9. Applied Soil Mechanics, Inc., 1991, Fault Study, "600 - block" Properties, SE Corner of Sixth and San Benito Streets, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2323-S1
10. Applied Soil Mechanics, Inc., Fault Study, Building Site 9, Showcase Theatre, 705 San Benito Street, Hollister, California: unpublished report prepared for City of Hollister Redevelopment Agency. File No. A0-2282-S1.
11. Earth Systems Consultants Northern California, 1998, Geologic Fault Study, San Benito Foods Storage Building, Hollister, California: unpublished report prepared for San Benito Foods. File No. NHW-7197-01
12. Pacific Rim Geologic, 1998, Fault Investigation of the East Branch of the Calaveras Fault, Ranchers Feed, 354 First Street, Hollister, California: unpublished report prepared for Mr. Don Marcus, Marcus Building Systems, Inc. Project 1058
13. Pacific Rim Geologic, 2002, Fault Location and Engineering Geologic Investigation, Grace Property - Parcel 1, APN 54-19-09, 341 First Street, Hollister, California: unpublished report prepared for Mr. Michael Grace. Project 1093
14. Earth Systems Pacific, 2008, Geological Fault Investigation, Vista Meadows Senior Apartments, East Park Street and Rancho Drive, APN 056-290-001, Hollister, California; with Supplemental Geologic Fault Investigation: unpublished report prepared for South County Housing Corporation. File No. SH-10941-GA
15. William Lettis and Associates, Inc., 2008, Fault Rupture Hazard Study, Fremont School Site, Hollister, California (Draft Report): unpublished report prepared for City of Hollister.
16. Earth Systems Pacific, 2010, Exploratory Trench Location Map, Hollister Fire Station No. 1, 110 Fifth Street, Hollister, California: unpublished report for City of Hollister

Redevelopment Agency (report in progress June 2010). File No. SH-11132-GA

17. Weber and Associates, 1989, Geologic Investigation of the Siletto Property, APN 55-14-21, 1202 West Street, Hollister, San Benito County, California: unpublished report prepared for Dave Ames, Coldwell Banker/Pavetti Real Estate. Job # 89089-SB

Additional References:

Applied Soil Mechanics, Inc., 1991a, Geologic Evaluation, Proposed Three-Lot Subdivision, 49, 53, and 57 Hawkins Street, Hollister, California: unpublished report prepared for Dean Rodrigues. File No. A0-2303-S1 *(unavailable for review)*

California Division of Mines and Geology, 1982, Special Studies Zones Map (Alquist-Priolo Eartquake Fault Zone Map), Revised Official Map, Hollister quadrangle, 1:24,000

California Division of Mines and Geology, rev. 1987, Guidelines for preparing engineering geologic reports: CDMG Note 44.

California Division of Mines and Geology, 1997, Guidelines for evaluating and mitigating seismic hazards in California: CDMG Special Publication 117.

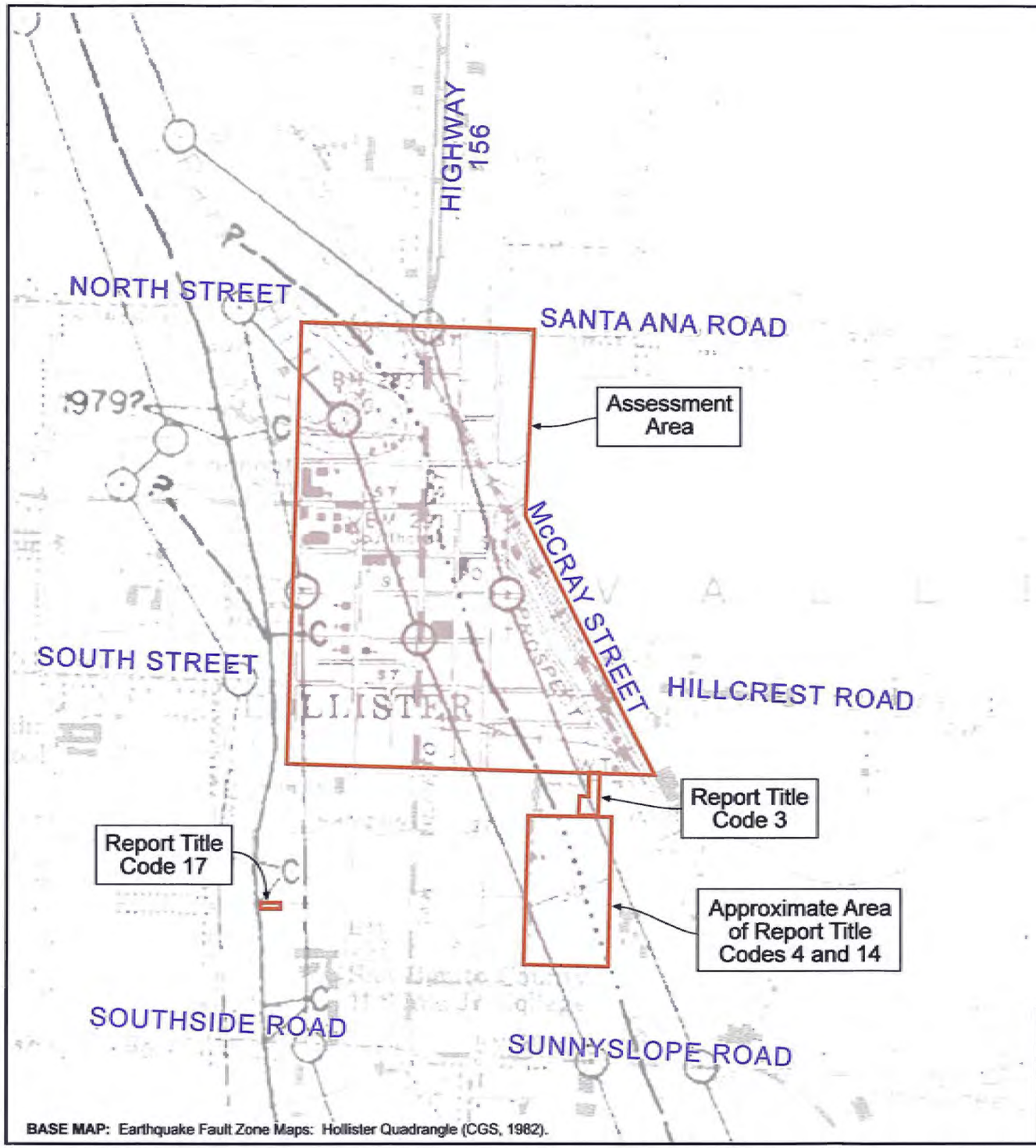
California Geological Survey, 2002, Fault Evaluation Reports Prepared Under the Alquist-Priolo Earthquake Fault Zoning Act, CGS CD 2002-01 (CGS digital archive).

California Geological Survey, 2003, Fault Investigation Reports for Development Sites Within Alquist-Priolo Earthquake Fault Zones in Northern California, 1974-2000, CGS CD 2003-01 (CGS digital archive).

GeoEarthScope NoCal LiDAR data set, accessed online and downloaded from www.opentopography.org

Hart, E.W., 2007 (interim rev.), Fault-rupture hazard zones in California, Alquist-Priolo Earthquake Fault Zoning Act with index to Earthquake Fault Zones maps: California Division of Mines and Geology Special Publication 42, revised.

Jennings, C.W., 1994 (and 2010 online update), Fault activity map of California and adjacent areas: California Division of Mines And Geology, California Geologic Data Map Series, Map No. 6, scale 1:750,000; digitally issued in 2000 by California Division of Mines and Geology as CD 2000-004.



BASE MAP: Earthquake Fault Zone Maps: Hollister Quadrangle (CGS, 1982).

EXPLANATION

Potentially Active Faults

Faults considered to have been active during Quaternary time; solid line where accurately located, long dash where approximately located, short dash where inferred, dotted where concealed; query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated recent or C for displacement caused by creep or possible creep.

Aerial photo lineaments (not field checked): based on youthful geomorphic and other features believed to be the results of Quaternary faulting.

Special Studies Zone Boundaries

These are delineated as straight-line segments that connect consecutively numbered turning points so as to define one or more special studies zone segments.

-N-

0 1000 ft

NOTE: Report Title Codes refer to reports reviewed as part of this assessment.

PACIFIC GEOTECHNICAL ENGINEERING	DATE JANUARY 2012	EARTHQUAKE FAULT ZONE MAP HOLLISTER FAULT ASSESSMENT HOLLISTER, CALIFORNIA	FIGURE 1 PROJECT 2010.0177

EXPLANATION

- CGS-mapped fault (dashed)
- Documented fault/fault zone (solid)
- Building exclusion zone around documented fault/fault zone
- CGS Earthquake Fault Zone boundary
- Parcel with investigation
- Exploratory trench
- "Cleared" area (see text)
- (17) Report Title code

BASE: San Benito County GIS database.

PACIFIC GEOTECHNICAL ENGINEERING

DATE	FAULT HAZARD MAP	FIGURE
JANUARY 2012	HOLLISTER FAULT ASSESSMENT HOLLISTER, CALIFORNIA	2
		PROJECT 2010.0177

CITY OF HOLLISTER
375 FIFTH • HOLLISTER, CA 95023-3876

May 24, 2012

Mr. Bill Bryant
Office of the State Geologist
California Geological Survey
801 K Street, MS 12-30
Sacramento, CA 95814

Subject: Cumulative Assessment of Fault Hazard Data in Downtown Hollister

Dear Mr. Bryant,

Thank you for meeting with Clint Quilter, John Feltman, Mary Paxton and I last June to discuss the preliminary findings of the assessment of prior fault hazard studies in Downtown Hollister. Enclosed is a copy of the 'Cumulative Assessment of the Fault Hazard Data in Downtown Hollister' prepared by Pacific Geotechnical Engineering.

At our meeting, we discussed the possibility of conducting cone pentameter tests to gain a better understanding of the depth of the aggregate layer in the downtown area in the Alquist Priolo Earthquake Fault Zone for the East Branch of the Calaveras Fault. The City of Hollister Redevelopment Agency approved a contract to fund the testing but in short the Hollister RDA was unable to proceed with the contract due to the logistical obstacles related to legislation passed at the end of June (the Dissolution Act and the Voluntary Program Act), the ensuing lawsuit that resulted in an August 2011 Supreme Court stay on pursuing contracts and a December 2011 ruling that has resulted in the dissolution of redevelopment agencies on February 1, 2012. For this reason, the report does not include the cone pentameter tests. The City of Hollister will continue to seek other sources of funding for the tests. In the meantime, the City is still interested in exploring a method to clear some properties in compliance with the Alquist Priolo Earthquake Fault Zoning Act based on the previous fault hazard investigations. We would like to schedule a meeting to discuss the enclosed report with you. Could you please call or e-mail you when you have had an opportunity to review the report and your schedule with possible dates that you would be available to meet? My e-mail address is bill.avera@hollister.ca.gov. I can also be reached by telephone at (831) 636-4360.

Sincerely,

William B. Avera
Development Services Director
City of Hollister

Cc: Clint Quilter, City Manager
Mary Paxton, City of Hollister
Brian Papurello, Landset Engineering
John Feltman, Pacific Geotechnical Engineering

CITY OF HOLLISTER
375 FIFTH • HOLLISTER, CA 95023-3876

December 20, 2012

Mr. Bill Bryant
Office of the State Geologist
California Geological Survey
801 K Street, MS 12-30
Sacramento, CA 95814

Subject: 1991 Geologic Reports for City of Hollister in Downtown Hollister, San Benito County, California

Dear Mr. Bryant:

Earlier this year, the City of Hollister forwarded a Cumulative Assessment of Fault Hazard Data in Downtown Hollister, 2012 prepared by Pacific Geotechnical Engineering. The Pacific Geotechnical Consulting cumulative assessment noted that some of the surface fault hazard investigations that were part of a 1991 Surface Fault Hazard Investigations had not been filed with the Office of the State Geologist. It has come to our attention that the following 1991 Geologic Fault hazard investigations were not filed with the State Geologist:

1. Applied Soil Mechanics Incorporated, Fault Study, 335 Poletti Property, City of Hollister, File Number AO-2279-S1, June 1991
2. Applied Soil Mechanics Incorporated, Fault Study Sites 1, 3-6 and 10, City of Hollister, File Number AO-2280-S1, June 1991
3. Applied Soil Mechanics Incorporated, Fault Study Building Sites 7 and 8, Bruhn and Peterson Properties 515, 525 and 530 San Benito Street, City of Hollister, File Number AO-2281-S1, July 1991
4. Applied Soil Mechanics Incorporated, Fault Study Building Site 9, Showcase Theatre, City of Hollister, File Number AO-2282-S1, July 1991
5. Applied Soil Mechanics Incorporated, Fault Study "600-block" Properties SE Corner of Sixth & San Benito Street, File Number AO-2323-S1, July 1991

Last Spring staff located information related to 1991 Downtown Fault Hazard Investigations that was not incorporated into the Pacific Geotechnical Report.
A request for additional information and peer review acceptance letter for the surface fault hazard investigations of the Poletti Property and Sites 1, 3-6 and 10 is enclosed as Attachment 1. The City of Hollister is now submitting the

Downtown Hollister 1991 fault studies for Site 2, the Poletti Property and Sites 3-6 and 10 and the peer review in compliance Section 3603 of Article 3 Policies and Criteria of the State Mining and Geology Board with Reference to the Alquist-Priolo Earthquake Fault Zoning Act. The peer review letter in Attachment 1 explains that a planned surface fault investigation was not conducted on Site 1 because it was determined that 1991 trenching excavated to the east and south cleared the property. The City of Hollister does not have evidence that a request for a waiver was filed in compliance with Section 2623 of the Act for Site 1. Consequently, this submittal is not intended to cover Site 1.

Staff did not locate evidence of a formal peer review acceptance letter of the Downtown Hollister 1991 surface fault hazard investigations for Buildings Sites 7 and 8 (Bruhn and Peterson properties, Site 9 (Showcase Theatre) and the "600" Block properties. However the City maintains there is substantial evidence in Attachments 2 through 5 to this letter that the peer review geologist, John Kingsley, reviewed and accepted the surface fault hazard investigations for the properties.

Attachment 2: A July 30, 1991 draft proposed scope of work prepared by John Kingsley to conduct supplemental geologic work with an objective to redefine the Alquist-Priolo Zone along the east branch of the Calaveras fault in downtown Hollister.

Attachment 3: January 1992 Transmittal to the Redevelopment Agency Board for a presentation by Applied Soils Mechanics and John Kingsley of the findings from the Downtown Surface Fault Investigation. The memorandum states there was "No evidence of active faulting observed in the exploratory trenches".

Attachment 4: Minutes to the January 1992 Redevelopment Agency meeting.

Attachment 5: A 1994 proposal for peer review by John Kingsley and a proposal from Earth Systems Consulting (formerly Applied Soils Mechanics) to conduct a Phase 2 geologic study of downtown Hollister to clear additional properties. The proposal includes a map of a large geographic area in Downtown Hollister where there was consensus that the 1991 fault studies provided evidence that there is not a risk of surface fault rupture.

The City of Hollister is now submitting the fault studies for Sites 7, 8 and 9 and the "600 Block" properties in compliance with Section 3603 of Article 3 Policies and Criteria of the State Mining and Geology Board with Reference to the Alquist-Priolo Earthquake Fault Zoning Act.

The City of Hollister is requesting a written determination acknowledging that the reports for Sites 1, 3-10 have been filed. If you have any questions or comments please contact me at 831-636-4316 Ext.16 or mary.paxton@hollister.ca.gov.

Hours of operation are Monday through Thursday 8:00 a.m. to 12:00 p.m. and 1:00 p.m. to 5:00 p.m.

Sincerely,

William B. Avera
Development Services Director

Cc: City Manager, Clint Quilter

KINGSLEY ASSOCIATES
Geologists & Geohydrologists
1595 Josselyn Canyon Road
Monterey, CA 93940
408 373 0909

July 12, 1991

Hugh Riley
City Manager
City of Hollister
375 Fifth St
Hollister, Ca. 95023

Dear Mr. Riley,

I recently reviewed the *Fault Study (sites 1,3-6 and 10)* submitted to the City of Hollister by Applied Soil Mechanics and suggested some revisions for the final report. I judge the final report is complete and meets the objectives of the Alquist-Priolo requirements for properties the investigated with the exception of site 1. I discussed this omission with the Applied geologists, Lew Rosenberg and Rick Gorman. They agreed the write an addendum presenting the rationale for not trenching this site.

The interpretation by Rick Gorman is satisfactory if the trend of the Calaveras Fault is consistent with the now known fault information secured from the trench studies completed to date. The trace of the east branch of the Calaveras Fault, as mapped by the California Division of Mines and Geology in the city, lies about one block east of site 1.

If the city seeks to eliminate and/or modify the Alquist-Priolo Special Studies Zone up to Park Hill, I suggest a trench long enough to satisfy the State. This additional trench, sited on Third street, should supply adequate geological data to detail both site 1 and extend the fault data to the northernmost edge of the buildable area in town.

As you are aware, I reviewed the geology in each trench with the Applied geologists while the trenches were open. I state with certainty that no evidence for faulting was observed in any of the trenches included in this report.

Respectfully submitted,

John Kingsley
Certification number 2987

cc: Chris Reyes
Lew Rosenberg
Rick Gorman

APPLIED SOIL MECHANICS ADDENDUM LETTER

File No. A0-2280-S1 July 10, 1991

City of Hollister Redevelopment Agency
375 Fifth Street
Hollister, CA 95023

Attention: Mr. Hugh Riley, City Manager

Subject: Sites 1, 3-6, and 10:
City of Hollister, California
ADDENDUM LETTER TO FAULT STUDY DATED JUNE 12, 1991

Gentlemen:

At the request of the Reviewing Geologist, Mr. John Kingsley, we have written this addendum letter to the Fault Study for the subject properties. Mr. Kingsley asked that we explain our rationale for not trenching Site 1 (I.O.O.F and Caputo Printing Building) of the downtown fault study. The following comments explain our basis for this decision.

In our proposal, we originally planned on trenching Site 1. An exploratory trench was not excavated on or adjacent to Site 1 as part of this study. However, additional trenches were excavated during the downtown fault study (ET-5 on Site 2, ET-5 on Site 10, and ET-5 and ET-6 on Site 8). The additional exposures provided by these trenches revealed no indication of faulting. In addition, Terratech excavated two exploratory trenches in 1985 on the J.C. Penney property which borders the east side of Site 1. Terratech reported no indication of faulting in these trenches.

Considering the north-northwest strike of the East Branch of the Calaveras fault, evidence of faulting extended across Site 1 would have been observed in the above mentioned trenches excavated as part of this study and Terratech's 1985 study. Based on the data gathered in this study and the known structure in the area, it is unlikely that an active fault trace crosses Site 1.

Sincerely,

APPLIED SOIL MECHANICS, INC.

Written by:

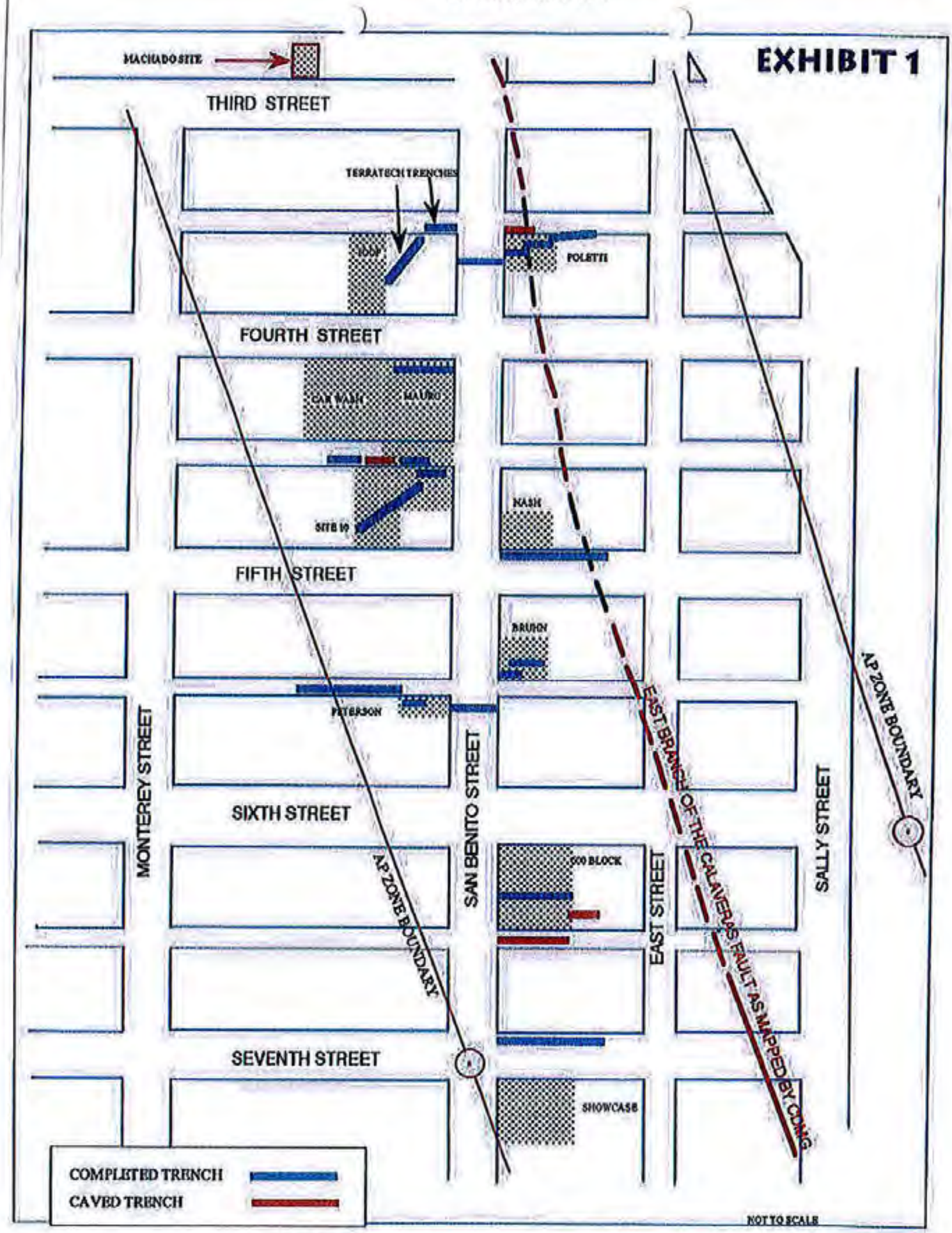
Lewis Rosenberg
Project Geologist

Reviewed by:

Richard T. Gorman, C.E.G. 1325
Consulting Geologist

Copies: 1 to Addressee
1 to City of Hollister Redevelopment Agency

ATTACHMENT 1



HOLLISTER FAULT STUDY

TRENCH MAP

6/30/91/2/4/93

Geology by: KINGSLEY & ASSOCIATES

EXHIBIT 2

File No. AP-1179

November 13, 1990

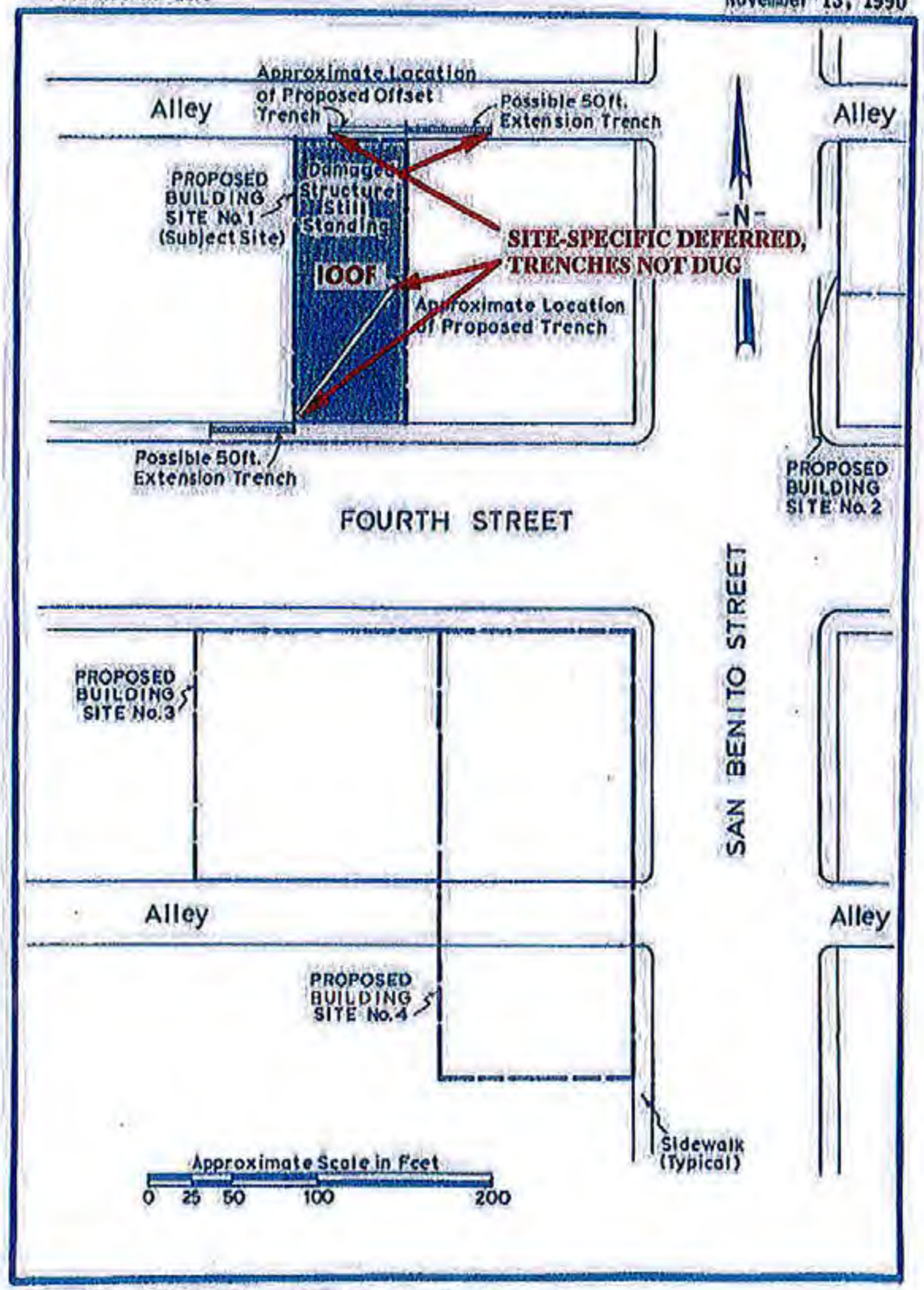


Figure 1 - Location Map, IOOF / Caputo Printing Site

SOURCE: PROPOSAL MAP, APPLIED SOIL MECHANICS

DRAFT

KINGSLEY ASSOCIATES
Geologists & Geohydrologists
1595 Josselyn Canyon Road
Monterey, CA 93940
408 373 0909

July 30, 1991

Hugh Riley
City Manager
City of Hollister
375 Fifth St
Hollister, Ca. 95023

Dear Mr. Riley,

This letter with the attached map is the suggested proposal for additional geologic work in the city of Hollister. The objective of the investigation is to redefine the Alquist-Priolo Zone along the east branch of the Calaveras fault in the downtown area.

SCOPE OF WORK:

1. Research and evaluate past literature and consultant reports.

2. Obtain, analyze, and plot water well data from local drillers, Department of Water Resources, and U.S. Bureau of Reclamation files to identify the water table and "blue clay" depths on either side of the west and east branches of the Calaveras fault zone.

3. Drill 14 core holes along the proposed profile lines (attached map) with continuous cores to a minimum of 30 feet in order to produce a stratigraphic subsurface structure cross-section. The core holes should be measured using electric resistivity and/or gamma geophysical logs for comparison with the cores and correlation across the fault zone. Each hole should be cased with slotted P.V.C., gravel packed and completed with a locked Christy box. The core holes are then available for future monitoring activities. The cores should be preserved and stored by the city for future study. Laboratory testing of the core samples is not required to meet the objective of this investigation.

DRAFT

4. One initial trench is required to evaluate the California Department of Mines and Geology mapped trace of the east branch on the South Street east of the intersection of South and Sally streets (See attached map). This trench is critical because it will cross a break in slope which is interpreted as a fault scarp along the east branch. Additional trenches can be located from the results of the core hole program.

Hugh, this investigation should stand on its own two feet and not rely on previous, unverifiable consultant reports or projected fault locations (trendology). Also, the trenches should be covered and left available for inspection by other geologists studying the extended Hollister area for about a week after the contracted consultant's trench-logging and interpretation is completed.

If you have any questions or comments about this please contact me.

Sincerely,

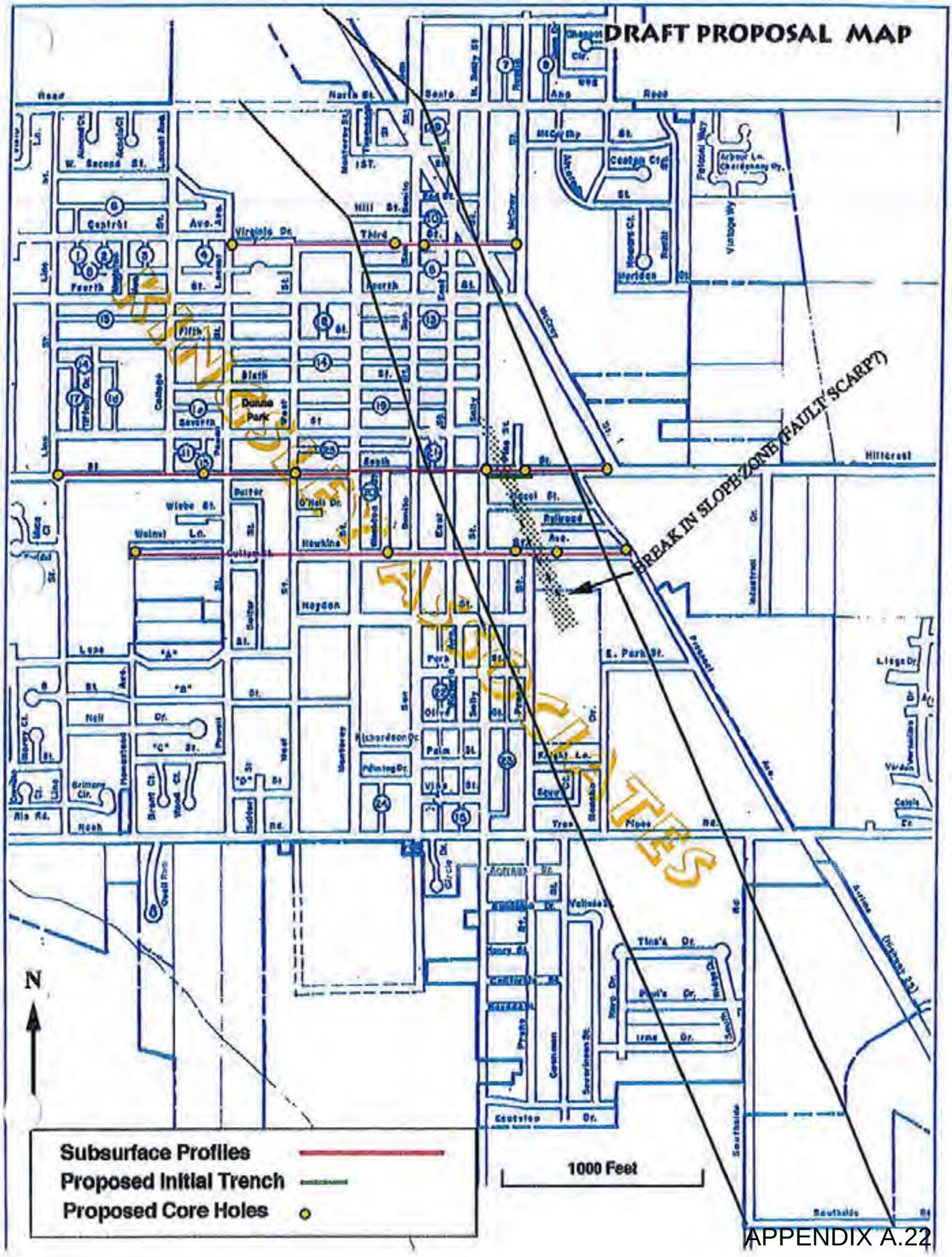
ccccc jk ccccc

John Kingsley

Registered Geologist

Cert. No. 2987

ATTACHMENT 2



MEMORANDUM 44 (#231)

DATE: January 15, 1992

TO: Honorable Chairman and Members
Hollister Redevelopment Agency

FROM: Christopher Reyes, Redevelopment Program Manager

APPROVED: Executive Director

SUBJECT: Presentation of Final Report on Downtown Geologic Fault Program

BACKGROUND

Agency Staff, Applied Soil Mechanics and the City's contract geologist want to brief the Agency on the final results of the downtown geologic trenching program.

The purpose of the presentation is to summarize the completed downtown trenching program reviewing the purpose, methods of study, conclusions, and recommendations. The audio visual presentation will cover the following:

1. Introduction

2. Alquist Priolo Act of 1972

3. Regional Geology

   a. Active and Potentially Active Faults in the Hollister Area
   b. Geologic Hazards in areas of Active Faulting

      * Fault Rupture
      * Strong Ground Shaking
      * Liquefaction
      * Landslides

4. Methods of Study

   a. Geologic literature review
   b. Aerial photograph interpretaion
   c. Exploratory trenching
   d. Radiocarbon dating of strata

5. Conclusions

   a. No evidence of active faulting observed in the exploratory trenches.
   b. Radiocarbon dating shows that strata are 3,000 to 18,000 years old
   c. Horizontally continuous, flat-lying strata
   d. Fault fractures do not offset strata

6. Recommendations

   a. Structures should be engineered to resist strong ground shaking
   b. Liquefaction and ground settlement potential should be investigated on a site-specific basis
   c. Future studies along the East Branch of the Calaveras fault

      1. City can use results of downtown study for other nearby sites and possibly waive trenching at some locations
      2. Additional studies on the east side of downtown to investigate "scarp-like" features crossing Hawkins, Sally, and Hazel Streets.

7. Future Activities

RECOMMENDATION

1. Receive report from Redevelopment Program Manager Reyes.

2. Receive presentation from Applied Soil Mechanics and John Kingsley.

Earth Systems Consultants **Applied Soil Mechanics Division**
Northern California
400 Park Center Drive, Suite 7
Hollister, CA 95023
(408) 637-2133
FAX (408) 637-0510

January 14, 1992

File No. A0-2279-S1
File No. A0-2280-S1
File No. A0-2281-S1
File No. A0-2282-S1
File No. A0-2323-S1

Hollister Redevelopment Agency
City Hall
375 Fifth Street
Hollister, California 95023

Attention: Mr. Chris Reyes
Program Manager

Subject: General Outline for Fault Study Presentation

Dear Mr. Reyes:

We are pleased to submit herein a outline of our upcoming presentation to be conducted at the upcoming Hollister City Council meeting to be held on January 21, 1992. This outline is based on the discussions with you, Mr. Hugh Riley, and work completed to this date by our firm. The purpose of this outline is to summarize the completed downtown trenching program relative to the purpose, methods of study, conclusions, and recommendations. Our presentation will cover the following topics.

1. Introduction

2. Alquist Priolo Act of 1972

3. Regional Geology
   a. Active and Potentially Active Faults in thew Hollister Area
   b. Geologic Hazards in areas of Active Faulting
      * Fault Rupture
      * Strong Ground Shaking
      * Liquefaction
      * Landslides

File No. A0-2279-S1
File No. A0-2280-S1
File No. A0-2281-S1
File No. A0-2282-S1
File No. A0-2323-S1

January 14, 1992

4. Methods of Study

5. Conclusions

6. Recommendations

7. Future Studies

If you have any questions regarding this letter, or time schedules, please do not hesitate to call at 637-2133.

Sincerely,

EARTH SYSTEMS CONSULTANTS
NORTHERN CALIFORNIA, INC.

Brian Papurello
Staff Geologist

Copies: 2 to Addressee

140.

ATTACHMENT 4

CITY OF HOLLISTER
REDEVELOPMENT AGENCY
REGULAR MEETING - MINUTES

JANUARY 21, 1992

CALL TO ORDER:

The regular meeting of the Hollister Redevelopment Agency was called to order on January 21, 1992 by Chairman Hallberg at 9:55 p.m. in the City Council Chambers.

ROLL CALL: Roll was answered as follows:

PRESENT: Agency Members Irish, Escover, Kuckenbaker, Camacho-Light, Chairman Hallberg, Executive Director Riley, Secretary Pidd.

ABSENT: None.

VERIFICATION OF AGENDA POSTING:

The Agenda for the City of Hollister Redevelopment Agency Meeting of January 21, 1992 was posted at the San Benito County Library on January 17, 1992, at 2:26 p.m. per Government Code Section 54954.2.

ADDITION TO TRE AGENDA:

Agency Member Camacho-Light moved to add to the agenda as an item that arose after the agenda was posted item #4, Request for Rental Assistance Commitment - Prospect Villa III Apartments. Motion seconded by Agency Member Kuckenbaker and carried by a 4-1 vote, Agency Member Escover No.

1. Minutes of January 6, 1992.

(a) Agency Member Kuckenbaker moved to approve the minutes as submit Motion seconded by Agency Member Camacho-Light and carried by unanimous vote.

2. Warrant Register.

(a) Agency Member Kuckenbaker moved to ratify and approve warrant register dated January 9, 1992 in the amount of $172,001.30. Motion seconded by Agency Member Camacho-Light and carried by unanimous vote.

3. Final Report on Downtown Geologic Fault Program.

(a) Report of January 15, 1992, Presentation of Final Report on Down town Geologic Fault Program, received from Redevelopment Program Manager Reyes.

Agency Member Escover absent as of 10:05 p.m.

(b) Slide presentation made by Applied Soil Mechanics and John Kingsley.

(c) Agency Member Irish moved to receive the presentation from Applied Soil Mechanics and John Kingsley. Motion seconded by Agency Member Camacho-Light and carried by a 4-0 vote, Agency Member Escover absent.

4. Request for Rental Assistance Committment, Prospect Villa III Apartments.

(a) Report of January 21, 1992, Request for Rental Assistance Commitment - Prospect Villa III Apartments, received from Executive Director Riley.

(b) Agency Member Kuckenbaker moved to authorize a letter of commitment which makes it clear that funds would not be available until after July 1, 1992 for Private Rental Assistance for Hollister Prospect Villa III Apartments. Motion seconded by Agency Member Camacho-Light and carried by a 4-0 vote, Agency Member Escover absent.

There being no further business to come before the Hollister Redevelopment Agency, the meeting was adjourned at 11:02 p.m. by motion of Agency Member Camacho-Light. Motion seconded by Agency Member Kuckenbaker and carried by a 4-0 vote, Agency Member Escover absent.

Respectfully submitted,

Margaret L. Pidd
Agency Secretary

Chairman Dean A. Hallberg

PROPOSAL FOR
ENGINEERING GEOLOGY SERVICES
and
GEOLOGIC FAULT TRENCHING

for

THE CITY OF HOLLISTER
HOLLISTER REDEVELOPMENT AGENCY
HOLLISTER, CALIFORNIA

submitted by

EARTH SYSTEMS CONSULTANTS
NORTHERN CALIFORNIA

JULY 15, 1994

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Earth Systems Consultants Northern California
A Member of The Earth Systems Group
400 Park Center Drive Ste. 7 • Hollister, CA 95023 • (408) 637-2133 • FAX (408) 637-0510

July 15, 1994

Hollister Redevelopment Agency
Attn: Mr. Barry Johnson, Program Manager
375 Fifth Street
Hollister, CA 95023

SUBJECT: **Proposal for a Geologic Fault Summary Report and Additional Fault Trenching**

Dear Mr. Johnson:

Earth Systems Consultants Northern California is pleased to submit this proposal to provide engineering geology services for the City of Hollister. We understand that the City of Hollister wishes to further define the trace of the East Branch of the Calaveras Fault with respect to the areas slated for future redevelopment. We are proposing a two-fold approach for this project. The first phase will be to consolidate the existing reports prepared by this firm for the properties extending from Fremont Way to South Street. This will aid in achieving the City's objective of having one reference document that addresses existing information regarding the fault's impact upon the redevelopment area. The second phase will be to perform additional investigative work to determine if the fault is present within distances that would affect the remaining redevelopment areas.

The proposed project team will be the same as that assigned to the earlier phases of the work. As they are already familiar with the area, the geologic features, and the background of the project, we feel that we can provide efficient and cost-effective services for these phases of the project.

Thank you for your consideration of our firm for this project. We trust that this proposal adequately presents our capabilities, proposed approach, and our interest in the project. Please feel free to contact the undersigned if you have any questions or if we can be of service in any way.

Sincerely,

EARTH SYSTEMS CONSULTANTS
NORTHERN CALIFORNIA

C. S. Hill, V.P.

Craig S. Hill, Vice President

Doc No.: 9406-007.PRP

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SECTION 3 FIRM HISTORY AND QUALIFICATIONS

SECTION 4 THE PROJECT TEAM

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SECTION 1

BACKGROUND AND PROJECT APPROACH

Phase I will consist of a geologic fault summary report, Phase II will consist of performing a fault investigation.

The Calaveras Fault is an active fault that extends through the City of Hollister, California. As part of the State fault evaluation program, the California Division of Mines and Geology (CDMG) defined the East Branch of the Calaveras Fault as sufficiently active and well-defined to be included within an Earthquake Fault Zone (formerly known as an Alquist-Priolo Special Studies Zone). State law prohibits construction of habitable buildings within 50 feet of an active fault. To determine if the fault crosses within 50 feet of a proposed building site, exploratory trenches are generally excavated within the proposed building site (and extending 50 feet beyond the building footprint) under the supervision of an engineering geologist experienced in fault investigation. Our firm, Earth Systems Consultants (formerly Applied Soil Mechanics), has conducted several such investigations for the Hollister Redevelopment Agency. These included properties extending from Fremont Way to South Street. In the areas investigated for the City, no traces of the fault were found.

Based upon our meeting with the City of May 20, 1994, we understand that the City wishes to further define the trace of the fault with respect to the areas slated for redevelopment. As separate reports were issued for each of the properties previously investigated by this firm, the first phase of our work would involve compiling the information into a single report that specifically addresses the impact of the fault's presence (or absence) on the proposed redevelopment areas. This compilation of existing information will be augmented by probablistic analysis of significant faults located within a 100-mile radius of the City of Hollister. The second phase would be to conduct further physical exploration of the remaining redevelopment areas to determine if the presence of the fault will affect redevelopment plans.

The same project team that performed the earlier investigations will be assigned to this project. The team will be led by Richard Gorman, chief geologist, and Craig Hill, project engineer. Field support will be provided by staff geologists Brian Papurello and Craig Harwood.

SECTION 2

PROPOSED SCOPE OF WORK

Phase I: Geologic Fault Summary Report

The previous fault study reports will be reviewed and the information will be summarized into a single report. The report will include discussions of regional geology, local geology, and seismicity. The significant faults located within a 100-mile radius of the City of Hollister will be listed, included with their activity levels and their significant structural characteristics. The faults will be analyzed using a computer program to estimate their maximum probable ground accelerations. A probabilistic earthquake analysis will also be performed. Based upon the results of the analysis and the information contained in the earlier reports, conclusions will be developed with respect to the impact of seismic activity upon the City of Hollister's redevelopment area. If possible, zones within the redevelopment that should be considered as excluded from the Earthquake Fault Hazard Zone will be established. Figure 1 presents the areas where the presence of faulting has been cleared. These areas are based on the previous fault investigations.

Phase II: Geologic Fault Investigation

As only a portion of the City's redevelopment area located within the Earthquake Hazard Zone has been investigated, additional subsurface exploration will be necessary to assess the fault's impact upon the remaining areas. We estimate that four fault trenches totaling approximately 1,000 lineal feet will be required. The depths of the trenches will be about 15 feet below street elevation. The proposed trench locations are shown on Figure 1.

The trenching will be conducted under the supervision of a registered engineering geologist, who will log the materials and structural elements encountered in the trench and evaluate the trench for evidence of the faulting. It will be the resposibility of the City of Hollister to provide a dump truck and driver to haul away and dispose of the trench spoils during trench excavation operations. This proposal also assumes that the City of Hollister will also provided an additional laboror/trench spotter to aid in the trenching operations and general site safety. Following completion of the evaluation, the trenches will be backfilled with slurry (a two-sack grout mix), or a controlled density backfill, to finish subgrade elevation. Placement of aggregate base and repaving of the street will be the responsibility of the City of Hollister. Backfill material will be supplied by San Benito Supply, and this proposal assumes that the backfill supplier will invoice the City of Hollister directly for backfill material costs.

PROPOSED SCOPE OF WORK
(Continued)

A report will be prepared that discusses the findings of the fault investigation. Based upon the results of the investigation, conclusions will be developed with respect to the presence or absence of the fault in the redevelopment area. If possible, zones within this portion of the redevelopment that should be considered as excluded from the Earthquake Fault Hazard Zone will be established.

SECTION 3

FIRM HISTORY AND QUALIFICATIONS

Earth Systems Consultants has a geographic distribution that spans the State of California.

Earth Systems Consultants has been operating since 1969 and has a geographic distribution that spans the State of California. This structure allows us to integrate the advantages of local knowledge of geotechnical and geologic conditions, with the broad base of professional and technical personnel available through a large consulting organization. As Earth Systems Consultants includes affiliated divisions of similar structure and expertise, the needs of a particular project can be fully addressed from project inception through completion of construction, regardless of its location. Each investigation is conducted under the direct supervision of a registered engineer or geologist. This degree of involvement allows us to thoroughly address the aspects of a project at the early critical stages. Assessment of the potential for hazardous substances can be combined with evaluations of geotechnical and geologic aspects, thus providing a complete evaluation of the site.

The State of California selected us as their geotechnical consultant.

We were selected by the State of California Department of Transportation as their District 5 (San Luis Obispo, San Benito, Santa Barbara, Monterey, and Kern Counties) geotechnical and materials testing consultant. The California Office of Project Development and Management also selected us as their geotechnical consultant for the Central Coast region. Both of these contracts were recently renewed due to these agencies' high level of satisfaction with our services. We were also selected by the State of California to perform geologic studies and preliminary environmental site assessments for the State Water Project. Both GTE Mobilnet and MCI Communications selected us to perform geotechnical engineering investigations for sites across the State of California.

Our laboratories have been certified by the Army Corps of Engineers, OSA and CCRL.

Our laboratories have the capacity to perform hundreds of tests upon soils, concrete, asphalt, steel, masonry, and other building materials. Tests are conducted by trained technicians in strict accordance with ASTM, Caltrans, and other appropriate laboratory standards. We have mobile laboratory equipment for fill control services and for concrete sampling, curing (tank and fog room), compression testing, and asphalt concrete testing. Our laboratories have been certified by the Army Corps of Engineers (Sacramento District), Office of the State Architect (OSA) and Concrete and Cement Reference Laboratory (CCRL). Our laboratories are inspected annually, and the calibrations are traceable to the National Bureau of Standards.

FIRM HISTORY AND QUALIFICATIONS
(Continued)

Earth Systems Consultants has consistently provided quality geotechnical, geological and environmental services for projects such as dams, highways, bridges, airports, military installations, hospitals, educational facilities, and single and multi-family residential developments throughout California.

SECTION 4

THE PROJECT TEAM

Mr. Richard T. Gorman, chief geologist

Richard T. Gorman is the chief geologist with the firm and is a registered geologist and a certified engineering geologist. He is experienced in all phases of engineering geology from project inception, field investigation, data analysis, to final compilation and issuance of the completed report, as well as post-study consultation. He has conducted numerous large scale geologic investigations both with Earth Systems and in his previous position with Irvine/Highland Soil Engineering of Riverside and Irvine, California. These investigations have involved major site specific studies of seismicity, geologic hazard, landslides, faults, and coastal bluff retreat. Mr. Gorman is responsible for developing and conducting field investigations, document research, and report preparation. His education consists of a Bachelor of Science degree in Geology obtained from California Polytechnic State University, Pomona, California and he is presently a member of the Association of Engineering Geologists and the Geologic Society of America. He also was the senior geologist for the previous fault investigation for the City of Hollister.

Mr. Craig S. Hill, project engineer

Craig S. Hill Craig Hill is a registered civil engineer and manager of Earth Systems Consultants Hollister office. Mr. Hill specializes in pre-construction geotechnical investigations and site assessments. He obtained his B.S. degree in Civil Engineering from California Polytechnic State University in San Luis Obispo, California. His project experience in the Hollister area includes a geotechnical engineering study for the Downtown Parking Structure, a four-story parking garage located within an Earthquake Studies Zone; a geotechnical engineering study for the Hollister Areawide Sewer Project; and a geotechnical engineering study for the Cienega Road Realignment. This last project involved evaluation of slope stability, pavement design, and drainage facilities. Mr. Hill is a member of the American Society of Civil Engineers and the Post Tensioning Institute.

THE PROJECT TEAM
(Continued)

Mr. Brian Papurello, staff geologist

Brian Papurello Mr. Papurello's assignment for this project will be staff geologist. Mr. Papurello has been a staff geologist with Earth Systems Consultants since 1990. His work includes assisting in geologic and geotechnical engineering investigations, including logging of soils during trenching and drilling operations; fault investigations; evaluation of slope stability; field inspection during construction operations; observation and testing during grading projects; and inspection of rip-rap placement for creek realignment and seawall projects. He obtained a Bachelor of Science degree in geology from San Diego State University. He also assisted in the previous fault investigations for the City of Hollister as a staff geologist and project coordinator.

Mr. Craig S. Harwood, staff geologist

Craig S. Harwood will also be a staff geologist for this project. Mr. Harwood has served as a staff geologist on a number of projects since joining Earth Systems Consultants in 1989. His projects have involved geologic hazard assessment, landslide and fault evaluation, and distressed residence evaluation. Most recently, he worked on several earthquake distressed sites in Santa Cruz County. Mr. Harwood obtained his Bachelor of Science degree in geological sciences from the University of California, Santa Cruz. He participated in geologic field mapping in Oregon and Nevada for the U.S. Geological Survey, and has co-authored several geologic maps as a result. He also assisted in the previous fault investigations for the City of Hollister as a staff geologist.

SECTION 5

FEES AND INSURANCE

FEES

Phase I - Geologic Fault Summary Report	**$5,100.00**
Phase II - Fault (Trenching) Investigation	**$143,000.00**

INSURANCE

Earth Systems Consultants maintains general liability insurance and professional liability insurance in the amount of $1,000,000. The City of Hollister will be named as an additional insured on our general liability policy.

APPENDIX A

RESUMES OF THE PROJECT TEAM

Please see attached.

Resumes of Hollister Redevelopment Agency Project Team

Mr. Richard T. Gorman
Mr. Craig S. Hill
Mr. Brian Papurello
Mr. Craig S. Harwood

RICHARD T. GORMAN, Vice President

EXPERIENCE

March 1989 to Present
Vice President, Geology Department
Earth Systems Consultants, Pacific Geoscience Division, San Luis Obispo, California
Responsibilities: Manages the geology department and conducts studies involving engineering geology, seismicity, and hydrology. Areas of expertise include groundwater, fault hazard investigations, landslide analysis (including computer-generated slope stability analysis), seismic refraction analysis, and mass grading geologic inspection.

August 1987 to March 1989
Senior Engineering Geologist
Buena Engineers, Inc., San Luis Obispo, California
Responsibilities: Managed geology department and conducted studies involving engineering geology, seismicity, and hydrology.

September 1978 to August 1987
Project Geologist
Irvine Soils Engineering, Irvine, California
Responsibilities: Seismic refraction analysis, percolation testing, managed geology department and coordinated geologic projects. Worked on projects regarding groundwater, fault hazard investigations, landslide investigations, geotechnical preliminary investigations and mass grading geologic inspections.

July 1976 to September 1978
Soils Technician
Le Roy Crandall and Associates, Los Angeles, California
Responsibilities: In charge of grading control and inspection.

EDUCATION

B.S., Geology, California Polytechnic State University, Pomona, California, 1974

Graduate courses in Geology, California State University, Los Angeles, California

REGISTRATION AND CERTIFICATION

Certified Engineering Geologist, State of California, 1986 (No. 1325)
Registered Geologist, State of California, 1985 (No. 4065)

PROFESSIONAL AFFILIATIONS

Member, Inland Geologic Society
Member, Association of Engineering Geologists
Member, Geologic Society of America

PROJECT EXPERIENCE
(as head geologist)

- City of Hollister, fault investigation
- City of Pismo Beach, bluff erosion study
- Atascadero State Hospital, fault investigation
- Valley Community Hospital, Phase 1 expansion, Santa Maria
- General Hospital Replacement Facility, San Luis Obispo
- Cuesta College Student Center, San Luis Obispo
- Paso Robles Public School District, various schools
- San Luis Coastal Unified School District, various schools
- California Highway Patrol, Arroyo Grande
- Unocal Pipeline, Cuesta Ridge, slope stability and monitoring

CRAIG HILL, Vice President

EXPERIENCE

September 1991 to Present
Manager and Chief Engineer
Earth Systems Consultants Northern California, Hollister, California
Responsibilities: Manages the Hollister office. As such, supervises laborator construction materials and supervises field inspectors and technicians. Authors soil reports, develops foundation design criteria and performs foundation evaluatio foundation excavations and reinforced concrete. Prepares estimates, proposals, and c

1987 to 1991
Testing and Inspection Engineer
Earth Systems Consultants Northern California, San Luis Obispo, California
Responsibilities: Coordinated and supervised field and laboratory operations, supervi and soils technicians and inspectors. Prepared cost estimates and tracked proj Ensured timely completion of construction reports.

1983 to 1987
Project Engineer
Buena Engineers, Inc. (prior to their merger with Earth Systems Northern California)
Responsibilities: Provided geotechnical engineering services for a wide range of re commercial developments. Authored soils engineering reports which included foun criteria, retaining wall design criteria, liquefaction analysis, slope stability analy capacity analysis. Designed effluent disposal systems.

1981 to 1983
Staff Engineer
Buena Engineers, Inc. (prior to their merger with Earth Systems Northern California)
Responsibilities: Authored soils engineering reports and project plan revie supervision of the project engineer. Produced cost estimates for soils engineering i and testing and inspection services. Performed drilling operations and logged soil pr

1979 to 1981
Field Technician
Buena Engineers, Inc. (prior to their merger with Earth Systems Northern California)
Responsibilities: Field construction inspection testing of construction materials, p construction reports.

CRAIG HILL, Vice President

EXPERIENCE

September 1991 to Present
Manager and Chief Engineer
Earth Systems Consultants Northern California, Hollister, California
Responsibilities: Manages the Hollister office. As such, supervises laboratory testing of construction materials and supervises field inspectors and technicians. Authors soils engineering reports, develops foundation design criteria and performs foundation evaluations. Inspects foundation excavations and reinforced concrete. Prepares estimates, proposals, and contracts.

1987 to 1991
Testing and Inspection Engineer
Earth Systems Consultants Northern California, San Luis Obispo, California
Responsibilities: Coordinated and supervised field and laboratory operations, supervised materials and soils technicians and inspectors. Prepared cost estimates and tracked project budgets. Ensured timely completion of construction reports.

1983 to 1987
Project Engineer
Buena Engineers, Inc. (prior to their merger with Earth Systems Northern California)
Responsibilities: Provided geotechnical engineering services for a wide range of residential and commercial developments. Authored soils engineering reports which included foundation design criteria, retaining wall design criteria, liquefaction analysis, slope stability analysis, and pile capacity analysis. Designed effluent disposal systems.

1981 to 1983
Staff Engineer
Buena Engineers, Inc. (prior to their merger with Earth Systems Northern California)
Responsibilities: Authored soils engineering reports and project plan reviews under the supervision of the project engineer. Produced cost estimates for soils engineering investigations and testing and inspection services. Performed drilling operations and logged soil profiles.

1979 to 1981
Field Technician
Buena Engineers, Inc. (prior to their merger with Earth Systems Northern California)
Responsibilities: Field construction inspection testing of construction materials, preparation of construction reports.

EDUCATION

B.S. Civil Engineering, California Polytechnic State University,
San Luis Obispo, California, 1981

REGISTRATIONS AND CERTIFICATIONS

Registered Professional Engineer (Civil), State of California, 1983, (No. 38234)

ICBO Certified Special Inspector: Reinforced Concrete, 1985 (No. 58644)

PROFESSIONAL AFFILIATIONS

American Society of Civil Engineers
Post Tensioning Institute
Society of American Military Engineers

SELECTED MAJOR PROJECT EXPERIENCE
(as lead professional engineer)

- Hollister Sewer Main Project
- Hollister Parking Garage
- Atascadero State Hospital Warehouse Additions
- River Road Widening, Salinas
- Cienaga Road Realignment, Hollister
- Carmel Valley Ranch, Carmel Valley
- Chappell Road Subdivision, Hollister
- American Cooling, Inc., Castroville, California
- Pismo Beach Post Office, Pismo Beach
- San Luis County Operational Center, Main Jail Expansion, San Luis Obispo
- San Luis Obispo Wastewater Treatment Plant, San Luis Obispo
- San Benito School, Atascadero
- Smart SMR of California, Inc., Basalt Hill, Stevinson, Kettleman Hills, and Joaquin Ridge cell sites

BRIAN PAPURELLO, Staff Geologist

EXPERIENCE

1988 to Present
Staff Geologist and Field Technician
Earth Systems Consultants Northern California, Hollister, California
Responsibilities: Authors geologic studies involving landslides, slope stability, distressed foundations, and mass grading projects. Drills borings and logs soil profiles. Performs field and laboratory testing and inspection of construction materials. Performs special inspection of reinforced concrete.

EDUCATION

B.S. Geological Sciences, California Polytechnic State University, San Diego, Ca., 1987

REGISTRATIONS AND CERTIFICATIONS

ICBO Certified Special Inspector, Reinforced Concrete, 1989 (No. 62573)
NICET Level II, Associate Engineering Technician (No. 081495)
Licensed Nuclear Gauge Operator (No. 1266)

SELECTED MAJOR PROJECT EXPERIENCE
(as geologist and/or technician)

- Hollister Sewer Main Project, Hollister, CA
- Cienaga Road Realignment, Hollister, CA
- Sally Street Renovation, Hollister, CA
- Hollister Earthquake Fault Study, Hollister, CA
- Sunnyslope Villages, Hollister, CA
- American Cooling, Inc., Castroville, CA
- Christopher Estates, Hollister, CA
- Smart SMR of California, Inc., Basalt Hill, Stevinson, Kettleman Hills, and Joaquin Ridge cell sites

APPENDIX B

CLIENT REFERENCES

Please see attached.

CLIENT REFERENCES

- City of Hollister, Engineering Department, Jim Perrine/Clint Quilter375 5th Street, Hollister, California, 95023, (408) 636-4340.
- County of San Benito, Public Works Department, Max Bridges, 3220 Southside Road, Hollister, California, 95023, (408) 637-3725.
- MH Engineering Company, Brian Curtis, 225 6th Street, Suite B, Hollister, California, 95023, (408) 637-2133.
- San Benito Engineering and Surveying, Inc., Dan Weatherly, 502 Monterey Street, Hollister, California, 95023, (408) 637-2763.

  City of Hayward, Building Inspection Division, Robert Bauman, 25151 Calwilter Road, Hayward, California, 94545-2731, (510) 293-8675.
- County of San Mateo, Planning and Building Division, William R. Rozar, 590 Hamilton Street, County Government Center, Redwood City, CA 94063, (415) 363-4016.
- City of San Bruno, Mary Jo Dutra, 567 El Camino Real, San Bruno, CA 94066, (415) 877-8874.
- Daily City, Carlos DeMelo, 333 - 90th Street, Daily City, CA 94015, (415) 991-8033.
- City of Loas Gatos, Ronald S. Gruenwald, P.E., One North San Antonio Road, Los Altos, CA 94022; (415) 948-1491.
- City of Fremont, Public Works Department, Richard Asimus, City Engineer, 39550 Liberty Street, Fremont, CA 94537-5006, (510) 494-4670.
- County of Santa Clara Housing Authority, Kathy Elright Robinson, 505 W. Julian Street, San Jose, CA 95110, (408) 275-8770.
- South County Housing, Cynthia Bokura, 7477 Carmel Street, Gilroy, CA 95020, (408) 842-9181.

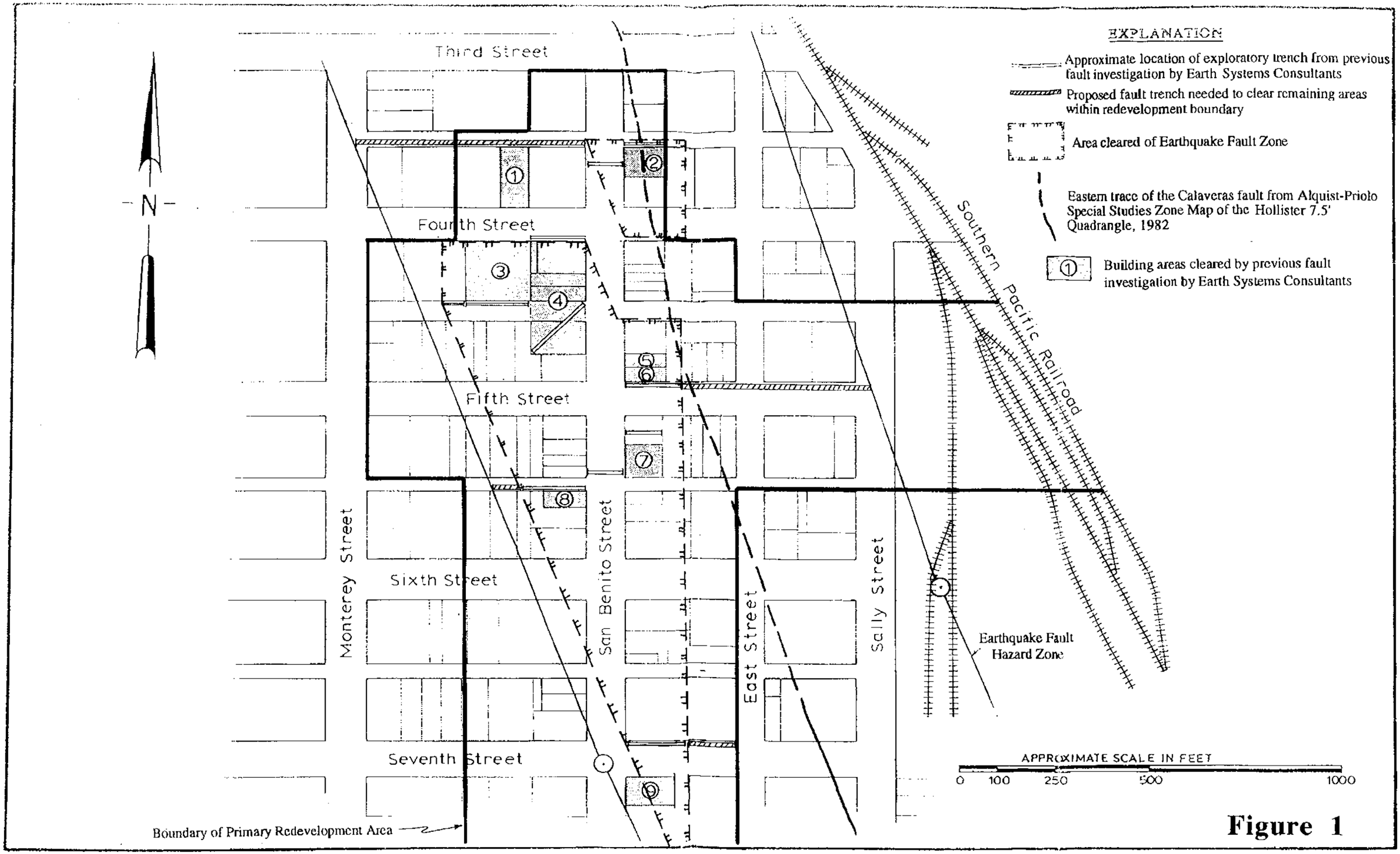
EXPLANATION
Approximate location of exploratory trench from previous fault investigation by Earth Systems Consultants
Proposed fault trench needed to clear remaining areas within redevelopment boundary
Area cleared of Earthquake Fault Zone
Eastern trace of the Calaveras fault from Alquist-Priolo Special Studies Zone Map of the Hollister 7.5' Quadrangle, 1982
Building areas cleared by previous fault investigation by Earth Systems Consultants
N
Third Street
Fourth Street
Fifth Street
Sixth Street
Seventh Street
Monterey Street
San Benito Street
East Street
Sally Street
Southern Pacific Railroad
Earthquake Fault Hazard Zone
Boundary of Primary Redevelopment Area
APPROXIMATE SCALE IN FEET
0 100 250 500 1000

Figure 1

City of Hollister
Development Services

375 Fifth Street, Hollister, CA 95023

November 6, 2014

Mr. Bill Bryant
Office of the State Geologist
California Geological Survey
801 K Street, MS 12-30
Sacramento, California 95814

Mr. Jerry Tremain
Senior Engineering Geologist
California Geological Survey
888 S. Figueroa Street, Suite 475
Los Angeles, California 90017

Subject: Submittal of 1991 Surface Fault Hazard Investigations in Downtown Hollister

Dear Mr. Bryant and Mr. Tremain,

The City of Hollister requested written confirmation that the five 1991 surface fault hazard investigations listed below were filed with the California Geological Survey in compliance with Section 3603 of Article 3 Policies and Criteria of the State Mining and Geology Board with reference to the Alquist-Priolo Earthquake Fault Zoning Act in the attached December 20, 2012 letter:

1. Applied Soil Mechanics Incorporated, Fault Study, 335 Poletti Property, City of Hollister, File Number AO-2279-S1, June 1991 [San Benito County Assessor Parcel Number 054-014-004]
2. Applied Soil Mechanics Incorporated, Fault Study Sites 1, 3-6 and 10, City of Hollister, File Number AO-2280-S1, June 1991 [San Benito County Assessor Parcel Numbers 054-011-016, 054-011-029, 054-011-030, 054-011-035 and 054-011-036]
3. Applied Soil Mechanics Incorporated, Fault Study Building Sites 7 and 8, Bruhn and Peterson Properties 515, 525 and 530 San Benito Street, City of Hollister, File Number AO-2281-S1, July 1991 [San Benito County Assessor Parcels 054-008-019; 054-009-012; 054-120-008 and 054-120-009]
4. Applied Soil Mechanics Incorporated, Fault Study Building Site 9, Showcase Theatre, City of Hollister, File Number AO-2282-S1, July 1991 [San Benito County Assessor Parcel 054-002-001]
5. Applied Soil Mechanics Incorporated, Fault Study "600-block" Properties SE Corner of Sixth & San Benito Street, File Number AO-2323-S1, July 1991 [San Benito County Assessor Parcels 054-006-002, 054-006-003, 054-006-011, 054-006-012 and portion of parking lot 054-005-010]

The City of Hollister is still awaiting written confirmation that the State Geologist has placed the five submitted surface fault hazard investigations "on open file' pursuant to §3603 (f) of the Policies and Criteria of the State Mining and Geology Board with Reference to the Alquist-Priolo Earthquake Fault Zoning Act. We have prepared the attached form for your convenience that confirms that the five surface fault investigations have been filed by the state along with an envelope. If you choose not to complete the form, could you please advise us when and how the City of Hollister can confirm that the investigations are "on open file"?

Sincerely,

Mary M. Paxton
Program Manager
City of Hollister

Cc: William B. Avera, City Manager
Mary Paxton, City of Hollister
John Feltman, Pacific Geotechnical Engineering

From: Mary Paxton [mailto:mary.paxton@hollister.ca.gov]
Sent: Wednesday, November 19, 2014 4:18 PM
To: John Feltman (jfeltman@geo-logic.com)
Subject: File of reports

I sent a letter to Bill Bryant and Jerry Tremain on November 5, 2014 asking for written confirmation that the 1991 fault studies had been filed with the state. I then left a voice mail with Jerry today. He called me back and explained that two of the 1991 reports were published in 2003 (for the 400 block and Poletti Building). He said the other three reports were logged in when we sent the attached 2012 letter to the state.

Mary M. Paxton
City of Hollister Development Services
375 Fifth Street
Hollister, California 95023
(831) 636-4316 x16
(831) 634-4913 fax

APPENDIX A.24