PHASE I FAULT RUPTURE HAZARD ASSESSMENT
CITY OF HOLLISTER
DOWNTOWN AREA

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SUBMITTED TO:

City of Hollister
375 Fifth Street
Hollister, CA 95023

PREPARED BY:

Geo-Logic Associates
16055 Caputo Drive, Suite D
Morgan Hill, California 95037
(408) 778-2818

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1.0 GENERAL

As requested, we are pleased to present our Phase I Fault Rupture Hazard Assessment of the downtown area of the City of Hollister. The work product presented here addresses earthquake fault rupture hazard potential for a select portion of downtown Hollister. This letter report is primarily an assessment of the relevance of previously prepared surface fault investigations conducted for individual properties/parcels, and provides rationale for using those reports in aggregate to address fault rupture hazard potential for a larger area of interest (Designated Assessment Area).

A brief discussion of the potential to clear additional property of fault rupture hazard is included in this report.

2.0 INTRODUCTION

The revitalization of the downtown area of the City of Hollister is one of the goals of the City's Planning Department. The downtown area is characterized by many older structures, many of which are multi-story buildings. Rehabilitating these buildings for residential or commercial use on the upper stories is viewed by the City as a desirable milestone in paving the way for infill sustainable growth that is consistent with the Association of Monterey Bay Area Governments Sustainable Communities Strategy Plan. Reuse of the upper floors also supports goals for revitalization of the downtown area. In addition, many current property owners in the downtown area have plans to redevelop, repair, or replace structures on their properties.

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 Calaveras fault (Figure 1). Areas of potential earthquake fault rupture hazard in the State of California are shown on EFZ maps published by CGS, one of which (the Hollister 7.5-minute quadrangle) covers the downtown section of Hollister currently being considered in this report. The CGS EFZ 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 or commercial 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 EFZ requires establishing an acceptably low level of surface fault rupture hazard for the planned development. This is typically accomplished in a fault investigation performed by a State-certified engineering geologist who inspects soil stratigraphy exposed in 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 needs to be 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).

During the 1989 Loma Prieta Earthquake, many unreinforced masonry structures in Hollister were damaged due to ground shaking. Some other structures were destroyed by unrelated fires in 1990 and 1991. Most were demolished, and new structures were proposed. In 1991, the City of Hollister Redevelopment Agency hired an independent geologic consultant to prepare fault investigation reports for many of the damaged properties in compliance with the AP Act. Applied Soil Mechanics was hired to complete the studies, which were completed during 1991. Many of those reports were reviewed as part of this study (see below).

Due to the mutually close proximity of the trenches excavated for those studies, the City recognized the potential to use them in aggregate to clear larger portions of the downtown area. On July 30, 1991, following completion of the Applied Soil Mechanics studies across downtown Hollister, the reviewing geologist for the City, Mr. John Kingsley, addressed a letter to the City suggesting that additional geologic work be completed with the objective of redefining the Alquist-Priolo Earthquake Fault Zone in the downtown area. This concept was later the subject of a letter from the City of Hollister Building Official, Tom Barry, to the City of Hollister Redevelopment Agency, dated April 29, 1994. Earth Systems Consultants (formerly Applied Soil Mechanics) prepared a proposal, dated July 15, 1994, to conduct such a study. However, there was a change in staff and no such study was completed. It is our understanding the City wishes to carry on with this concept, using both the 1991 investigations and other nearby relevant reports to address portions of downtown with respect to fault rupture hazard.

In 2012, Pacific Geotechnical Engineering (now Geo-Logic Associates) prepared a report which compiled available previous fault investigation reports in the downtown area into a GIS database for the City. The report also outlined a conceptual approach to property clearance based on previous work, and provided recommendations for further study.

3.0 PURPOSE AND SCOPE

This letter report is intended to be the first phase in the City's goal to address fault rupture hazard in downtown. It is primarily a desktop study to assess the relevance of previous reports and provide rationale for using those reports in aggregate to clear a larger area of downtown. Areas not cleared by existing/previous reports will likely require additional subsurface investigations (fault investigation reports) in the future. Preliminary recommendations regarding the scope and possible locations of such future investigations are provided at the end of this report.

For this report we completed the following tasks:

- Meeting with the City of Hollister Planning Department and the City Geologist to discuss project goals and define the "Designated Assessment Area" boundary.
- Review geologic literature pertinent to study area.
- Review seven (7) previous fault investigation reports relevant to the Designated Assessment Area, provided to us by the City.
- Summarize the findings of the individual fault investigations reviewed
- Preparation of this Letter Report, which presents our findings, conclusions, and recommendations.

4.0 GEOLOGIC SETTING

The Calaveras fault, which passes through the City of Hollister, is one of the primary faults of the San Andreas fault system, which forms the tectonic plate boundary between the Pacific Plate on the west, and the North American Plate on the east. Right-lateral strike-slip plate motion between the two plates is distributed across multiple faults of the San Andreas fault system.

The San Andreas fault has been recognized in this area for more than a hundred years, but its significance was not apparent until the great San Francisco earthquake of 1906 and the subsequent study by the California State Earthquake Investigation Commission (Lawson, 1908).

The San Andreas fault trends through western California from the Gulf of California to Eureka, passing through the western part of the San Francisco Bay Area. In central California the fault lies within the Gabilan Range along the entire southwestern side of San Benito County.

The Calaveras fault runs along the eastern side of the San Francisco Bay Area, and is generally considered to have four segments. The northern segment extends from the Danville-San Ramon area to Calaveras Reservoir; the central segment from Calaveras Reservoir to San Felipe Lake; the southern segment from San Felipe Lake to just south of Hollister; and the Paicines segment from south of Hollister to the San Andreas fault south of Paicines in San Benito County. The latter segment is generally referred to as the Paicines fault (www.earthquake.usgs.gov/hazards/qfaults/).

The northern and central segments of the fault run through mountainous terrain of the Diablo Range. East of Gilroy, at San Felipe Lake, the southern segment of the fault leaves the mountains and traverses the Hollister Valley southward, where it passes through the City of Hollister. Several fault-controlled pressure ridges have formed anomalous topographic highs in the otherwise flat valley terrain. At one of these pressure ridges in the City of Hollister, Park Hill, the fault splits southward into the West Branch and East Branch.

The West Branch Calaveras fault is widely recognized as a historically active fault, with readily observable offsets of cultural features, including city streets, curbs, and sidewalks within the City of Hollister. The southern segment of the Calaveras fault, which includes the West Branch, is characterized by fault creep, where the fault has been measured in many locations to be actively moving at a very slow but constant rate just below the ground surface. Historic surface fault creep rates of 4-12 mm/year have been reported for the Hollister area. While slip rates of 15mm/year have been reported for the central segment of the Calaveras fault (north of the Hollister Valley), no slip rates have been reported for the southern segment of the Calaveras fault. This is likely because the strain is released by fault creep, rather than by sudden, discrete seismic events, which are typically used to determine slip rates and earthquake recurrence intervals.

The East Branch Calaveras fault, the driving fault for this study, is mapped southward from Park Hill through the eastern part of Hollister and rejoins the West Branch in the San Benito River drainage. The East Branch Calaveras fault is considered to be active by the State, and is regulated by a State fault rupture hazard zone (EFZ). While the East Branch does not exhibit active fault creep like the West Branch, fault investigations completed in compliance with the Alquist-Priolo Earthquake Fault Zoning Act have shown that the East Branch is Holocene-active (Terratech, 1987; Earth Systems Consultants, 1998; Earth Systems Pacific, 2008).

The East Branch Calaveras fault in the low-lying areas of downtown south of Park Hill was originally identified and mapped based on “offset” of a blue clay layer in water well logs (Ellis, 1952), an abrupt change in groundwater elevations, and most notably, the geomorphic expression of the fault along a subtle west-facing scarp. The fault scarp can be seen on LiDAR hillshade imagery (GeoEarthScope, 2007), even though grading of the urban environment has modified the ground surface. Active faulting has been clearly identified coincident with the fault scarp (Terratech, 1987; Earth Systems Consultants, 1998). However, as shown on the LiDAR hillshade imagery, no geomorphic expression of the fault is present between approximately 7th Street and Park Hill. No evidence of faulting has been identified during fault investigations conducted across that interval in downtown Hollister. Terratech (1978) concluded that faulting was present on the east side of Park Hill at First Street. However, subsequent

investigation of that property (Pacific Rim Geologic, 2000) concluded otherwise, stating that faults identified by Terratech (1978) are flexural slip features, rather than tectonically generated ground ruptures. These conflicting interpretations have yet to be reconciled for that property.

5.0 DESIGNATED ASSESSMENT AREA

Based on our discussions with the City of Hollister Planning Department, the Designated Assessment Area boundary for this project is defined as follows, and shown on Figure 2: an area bounded by 4th Street and Hawkins Alley on the north, the western boundary of the CGS EFZ on the west, and South Street on the south. The eastern boundary of the Designated Assessment Area is defined roughly by the eastern limit of trenches completed within the western half of the CGS EFZ, and includes portions of city blocks west of East Street. This area was delineated based on the high density of exploratory trenches completed in this this part of downtown Hollister. A list of properties that lie within the Designated Assessment Area is included in Table 1.

6.0 SUMMARY OF FAULT INVESTIGATION REPORTS REVIEWED

We reviewed seven (7) fault investigation reports completed between 1985 and 1998. Some of the reports address multiple parcels. 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 trenches, quality of the report, and applicability of the exploration methods used to assess fault ground rupture.

The following includes a summary of each report we reviewed. As requested, individual parcels are referenced as originally described by the City and/or the investigating consultant (ie. Site 1, Site 2, Poletti Property, etc) to maintain continuity with previous work. Individual sites and/or properties are labeled in this manner on Figure 2. Scanned copies of these reports and additional supporting documentation are included on an attached CD as Appendix A :

- ***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***

  This report addresses a cluster of parcels in the central downtown area. Site 1 is located on the north side of 4th Street, west of San Benito Street. Sites 3, 4, and 10 are located between 4th and 5th Streets, west of San Benito Street. Sites 5 and 6 are located on the northeast corner of San Benito Street and 5th Street.

  Ten (10) exploratory trenches were excavated in 5th Street, Briggs Alley, and on subject parcels. Trenches depths ranged from 14 ½ feet to 17 ½ feet below ground surface. Trenches ET-7 and ET-8 were abandoned due to "locally created saturated conditions", which resulted in unsafe conditions. However, these trenches appear to be adequately shadowed by trenches ET-1 and ET-5. Trench ET-10, located in Briggs Alley, caved in before it could be logged. However, the majority of this trench was located outside of the western boundary of the EFZ.

  In general, these trenches encountered a remarkably continuous and consistent flat-lying stratigraphy across the trenches. Geologic units encountered include a massive heavily bioturbated unit of lacustrine silty clay with thin sand layers. This unit overlies a well-stratified

fluvial deposit of thinly bedded silty sands, clayey silts, and silty clays. Individual beds in the fluvial unit were easily traced over many tens of feet. The top of the fluvial unit was consistently located between 8 and 12 feet below ground surface across the ten trenches, providing a local stratigraphic marker. This stratigraphy was also encountered in trenches completed by Applied Soil Mechanics for other properties in the downtown area during their 1991 study.

A sample collected from the upper lacustrine unit at a depth of 12 feet below ground surface in trench ET-1 was dated using ^{14}C radiometric analysis at 3,720 ± 90 years before present (YBP).

No faulting was identified during this investigation. The report states that the trenches were reviewed by the City Geologist, Mr. John Kingsley. Mr. Kingsley summarized his review of the trenches in a letter to the City dated July 12, 1991, in which he certified that no evidence of faulting was observed in the trenches for this study. In his letter, Mr. Kinsgley asked for clarification as to why an exploratory trench was not excavated for Site 1. Applied Soil Mechanics prepared a response letter dated July 10, 1991 in which they explained that any fault passing through Site 1 would have been intercepted in exploratory trenches excavated for adjacent and nearby properties in which no faulting was observed. Hence, no trench was excavated for Site 1.

- ***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***

  This report addresses sites 7 and 8, which are located in the central downtown area. Site 7 is located on the northeast corner of San Benito Street and Wentz Alley. Site 8 is located on the southwest corner of San Benito Street and Wentz Alley.

  Seven (7) exploratory trenches were excavated in San Benito Street, Wentz Alley, and on the subject parcels. Trench depths ranged from 13 feet to 19 ½ feet below ground surface. Trench ET-4 caved before it could be logged, and was abandoned. We note that Trench ET-3 was excavated immediately adjacent to Trench ET-4 and covers the same footprint.

  In general, these trenches encountered the same flat-lying stratigraphy and geologic units encountered in trenches excavated for nearby Sites 1, 3-6, and 10, discussed above. The top of fluvial unit was encountered at between 7½ and 11 feet below ground surface.

  A sample collected from the upper lacustrine unit at a depth of 17 feet below ground surface in trench ET-2 was dated using ^{14}C radiometric analysis at 18,110 ± 190 years before present (YBP).

  No faulting was identified during this investigation. The report states that the trenches were reviewed by the City Geologist, Mr. John Kingsley, and that Trench ET-2, on Site 7, was reviewed by Mr. Chris Wills of CDMG (now CGS).

- ***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***

This report addresses two parcels located on the western half of the city block bounded by Sixth Street, San Benito Street, Brown Alley, and East Street. The site includes 609, 611, 615, and 623 San Benito Street, and 243 and 257 Sixth Street.

Three (3) exploratory trenches were excavated in Brown Alley, a public parking lot on the north side of Brown Alley, and the subject parcel. Trenches depths ranged from 14 feet to 15 feet below ground surface. Trenches ET-1 and ET-2 caved before they could be logged due to "locally created saturated conditions".

In general, these trenches encountered the same flat-lying stratigraphy and geologic units encountered in trenches excavated in the reports discussed above. The top of fluvial unit was encountered at approximately 10 feet below ground surface in Trench ET-3. Although not logged directly, the top of the lacustrine unit in Trench ET-1 was observed to be 12 feet deep and was not offset. Likewise, no offset of the lacustrine/fluvial contact was observed in Trench ET-2.

No faulting was identified during this investigation. The report states that the trenches were reviewed by the City Geologist, Mr. John Kingsley.

- ***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.***

  This report addresses a single parcel located on the southeast corner of Seventh Street and San Benito Street. The site is the former location of the Showcase Theater, which was damaged in the 1989 Loma Prieta Earthquake, and later demolished. The theater had a 12-foot-deep basement, which was backfilled during demolition.

  A single exploratory trench was excavated north of the site in Seventh Street to a depth of 15½ below ground surface.

  In general, the trench encountered the same flat-lying stratigraphy and geologic units encountered in trenches excavated in the reports discussed above. The top of the fluvial unit was encountered at approximately 8 to 10 feet below ground surface in the trench.

  No faulting was identified during this investigation. The report states that the trenches were reviewed by the City Geologist, Mr. John Kingsley.

- ***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***

  This report addresses a single parcel located on the southeast corner of San Benito Street and Hawkins Alley. The original structure was damaged during the 1989 Loma Prieta Earthquake, and was later demolished.

Four (4) exploratory trenches were excavated in San Benito Street, Hawkins Alley, and on subject parcel. Trench depths ranged from 12 ½ feet to 20 feet below ground surface. Trench ET-1 caved before it could be logged.

In general, the trenches encountered the same flat-lying stratigraphy and geologic units encountered in trenches excavated in the reports discussed above. The top of the fluvial unit was encountered at approximately 9 to 11 feet below ground surface in the trench, consistent with the findings of nearby reports.

No faulting was identified during this investigation. Trench ET-3 was excavated directly over the mapped trace of the fault, and yet no faulting or warping of sediments was encountered. The report states that the trenches were reviewed by the City Geologist, Mr. John Kingsley.

- ***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***

  This report addresses a the entire city block bounded by 7th Street, San Benito Street, South Street, and East Street. The investigation was prepared for a warehouse building.

  Two exploratory trenches were excavated at the site. Trench T-1 traversed the site from northeast to southwest, and was excavated to a maximum depth of 18 feet below ground surface. Trench T-2 was relatively short and was excavated close to the eastern property line. Trench T-2 was "briefly observed, but was not logged due to unstable conditions".

  In general, the trenches encountered the fluvial stratigraphy consisting of lean clays with interbeds of well-sorted sand and clay. Stratigraphy is generally flat-lying.

  A fault was encountered in Trench T-1 approximately 44 feet from the northeast end of the trench, in the northeast portion of the property, and close to the mapped trace of the fault (CGS, 1982). The fault was found in the bottom of the trench at 18 feet below ground surface, and was found to die upward at approximately 13 feet below ground surface. Relatively thin beds of clay and sand are warped downward as they approach the fault from the northeast, and are ultimately truncated by the fault. A younger topsoil unit was observed to thicken dramatically at the fault and is laterally extensive to the southwest across the majority of the property. This topsoil layer is not present northeast of the fault. The fault, warped bedding, and abrupt thickening of topsoil are coincident with the degraded scarp that is evident in South Street adjacent to the property. These findings suggest a down-to-the-west normal component of slip across the fault. Fills associated with older structures at the site (demolished prior to this investigation) were built up over the majority of the site southwest of the fault to accommodate the topographic relief associated with the scarp and provide a flat surface.

  A sample collected from fluvial deposits at a depth of 8 feet below ground surface in trench T-1 near the northeast end of the trench was dated using ^{14}C radiometric analysis at 2570 ± 50 years before present (YBP). A sample collected at a depth of 15.5 feet below ground surface, southwest of the fault and immediately adjacent to it, was dated using ^{14}C radiometric analysis at 2650 ± 80 years before present (YBP). Similar ages at different depths can be explained by

normal offset across the fault. These findings conclude a Holocene age for faulting on the East Branch Calaveras fault.

Stratigraphy southwest of the fault is generally similar to that found in the nearby study for Building Site 9 (Showcase Theater), as well as the other studies performed by Applied Soil Mechanics in 1991 (reviewed above). Laterally extensive and flat-lying sand beds at a depth of approximately 10 feet below ground surface in Trench T-1 at South Street are a likely corollary to the top of the fluvial unit identified in the those studies.

- ***Terratech, Inc., 1985, Fault Investigation, J.C. Penney Building, Hollister, California: unpublished report prepared for Mr. Mike Fitzpatrick. Project 7737/1***

  This report addresses a single parcel occupying the northwest corner of 4th Street and San Benito Street. The investigation was prepared for a warehouse building. The original structure at the site was destroyed by fire. The fault investigation was prepared prior to redevelopment of the site.

  Two exploratory trenches were excavated at the site. Trench T-1 traversed the northwest corner of the site from southwest to northeast. Trench T-2 was was excavated in Hawkins Alley along the north side of the parcel. Both trenches were excavated to depths between 11 and 13 feet below ground surface.

  In general, the trenches encountered the same flat-lying stratigraphy and geologic units encountered in trenches excavated in the reports discussed above. These include an upper unit of massive clay, and a lower unit of well stratified clay, silt, and sand beds beginning at 8 to 10 feet below ground surface. Stratigraphy is generally flat-lying.

  No faulting was identified during this investigation.

On December 20, 2012 the City of Hollister submitted the five (5) 1991 fault investigations prepared by Applied Soil Mechanics (and summarized above) to CGS in accordance with the Alquist-Priolo Earthquake Fault Zoning Act. The City requested confirmation that those reports were filed with CGS. In a letter dated November 5, 2014, the City requested confirmation of receipt and file of those reports. Mr. Jerry Tremain of CGS replied to Ms. Mary Paxton of the City of Hollister by phone confirming that the reports for Building Sites 1, 3-6, and 10, and the Poletti Building , were filed with CGS in 2003. The other three reports were filed in 2012 following the December 20, 2012 submittal of those reports by the City.

As summarized in the City's December 2012 letter, City Geologist Mr. John Kingsley formally reviewed and accepted the Applied Soil Mechanics report for Building Sites 1, 3-6, and 10. The City does not have evidence of formal review for the remaining four 1991 Applied Soil Mechanics reports. However, Mr. Kingsley's letter to the City of July 30, 1991, in which he proposed follow-on work to the Applied Soil Mechanics studies, closely follows submittal of all five of the Applied Soil Mechanics reports during the months of June and July 1991. It therefore appears reasonable and likely that Mr. Kinglsey reviewed all of those reports prior to issuing his letter proposing additional work.

The City could not find evidence of formal peer review for the Terratech 1985 report for the J.C. Penney building, or the Earth Systems Consultants 1998 report for the San Benito Foods Warehouse. However, structures were built on both parcels following preparation of the respective reports, suggesting that City approval was granted.

7.0 FINDINGS

Geologic Age of Materials

In the reports we reviewed above, four soil samples taken from relevant horizons in the subsurface soils of Hollister were dated using ^{14}C radiometric analysis. The results of these analyses are stated above in our summary of the respective reports, and their map locations are noted on Figure 2.

Two of the samples are from reports prepared by Applied Soil Mechanics during their extensive investigation of the downtown area in 1991. The lacustrine deposit identified in these studies was dated at 3720 ± 90 years before present (YBP) at approximately 12 feet below ground surface on Building Site 4. The underlying fluvial unit was dated at 18110 ± 190 YBP at a depth of 17 feet below ground surface at Building Site 7.

The other two samples were collected in the Earth Systems Consultants (1998) trench for the San Benito Foods Storage Building. One sample was dated at 2570 ± 50 YBP at a depth of 8 feet below ground surface, and east of the fault encountered in that trench. The other was dated at 2650 ± 80 YBP at a depth of 15.5 feet below ground surface, adjacent to and west of the fault.

Applied Soil Mechanics relied heavily on the two geologic ages determined from samples taken from their trenches on Building Sites 4 and 7 to make a case for the sediments exposed in their 1991 investigations across downtown being of latest Pliestocene to Holocene in age. This interpretation was made based on the uniform and flat-lying stratigraphy correlated between trenches and between sites. The two geologic ages from the San Benito Foods Storage Building trench (Earth Systems Consultants, 1998) are similar to the Holocene age for the lacustrine deposit at Building Site 4. The late Pliestocene age (18110 ± 190 YBP) at Building Site 7 appears somewhat anomalous. However, soil there was sampled in the fluvial unit encountered beneath the Holocene lacustrine deposits in the 1991 studies, and could be explained by an unconformity between the lacustrine and fluvial units.

Relevance of Previous Reports

In general, the investigations we reviewed appear to adequately address fault rupture hazard for the intended properties.

Several trenches caved and/or were abandoned during the investigations due to “locally created saturated conditions” and/or the loose/unconsolidated consistency of the geologic materials encountered. However, our review of these investigations suggests that these caved trenches were adequately shadowed either by additional trenches excavated as part of the same study, or by the trenches excavated nearby, as follows:

- Trenches ET-7, ET-8, and ET-10 (Building Sites 1, 3-6, and 10) caved, but are adequately shadowed by Trenches ET-1 and ET-5 of the same study, and by Trenches ET-3, ET-5, and ET-6

at Building Site 8 to the south. We note that the majority of Trench ET-10 is located outside of the CGS EFZ to begin with.

- Trench ET-4 (Building Site 8) is adequately shadowed by adjacent Trench ET-3 of the same study.
- Trenches ET-1 and ET-2 ("600-Block" Properties) caved in, but were observed prior to being abandoned. The prominent lacustrine-fluvial contact was observed to be intact and not offset. These trenches are also adequately shadowed by the trench for Site 9 to the south, and by the unfaulted portion of Trench T-1 of the San Benito Food Storage Building site to the southeast.
- Portions of Trench T-1 for the San Benito Food Storage Building site caved in. However, geologic contacts were found to be relatively flat-lying and continuous across caved intervals.

As discussed above, geologic materials were found to be of latest Pliestocene to early Holocene age. As the unfaulted fluvial unit identified in the majority of the Applied Soil Mechanics 1991 reports was interpreted to be Pleistocene based on ^{14}C radiometric analysis, these investigations encountered geologic materials of sufficient age to preclude active faulting as defined in the AP Act (greater than 11,000 years old). A well-defined fault was found to offset Holocene age sediments in the San Benito Foods Storage Building study. Soils older than 11,000 years were not conclusively encountered in that study. However, Earth Systems Consultants (1998) noted that site was suitable for its intended use as a storage facility, but not for a structure for human occupancy in accordance with the AP Act. Earth Systems Consultants stated that a maximum of 17 inches horizontal displacement and 5 inches of vertical displacement could occur during an earthquake on the East Branch Calaveras fault, based on work by Wells and Coppersmith (1994).

8.0 CONCLUSIONS AND RECOMMENDATIONS

Based on our review of previous work discussed above, we judge that the probability of a through-going fault passing through the Designated Assessment Area is low (Figure 1 and Figure 2). We base this conclusion on the following supporting evidence:

- No active faulting was encountered within the Designated Assessment Area.
- The City of Hollister has accepted the reports within the Designated Assessment Area (reviewed above), and has filed the reports with CGS.
- The investigations we reviewed document a remarkably continuous and consistent flat-lying stratigraphy across the trenches and between sites. No offsets or warping of bedding were recorded.
- Very clear examples of active faulting of geologically young sediments (Holocene) have been documented along the East Branch Calaveras fault east and southeast of the Designated Assessment Area (Terratech, Inc., 1987; Earth Systems Consultants, 1998). In each of these examples, down to the west warping and faulting of sedimentary beds was observed in exploratory trenches. These exposures provide context for the style, expression, and geometry of faulting that can be expected in the relatively young sediments of the downtown Hollister area. None of these fault-related features was observed in the Designated Assessment Area.
- No geomorphic expression of a fault is present within the Designated Assessment Area. South of approximately 7th Street, a subtle degraded scarp is present along the mapped trace of the Calaveras fault. No such scarp is present north of 7th Street or within the Designated Assessment Area.
- The large number of trenches and their distribution within the Designated Assessment Area mutually shadows a much larger area when considering the mapped trend of the fault. In our

previous report for the City (Pacific Geotechnical Engineering, 2012), we considered the local mapped variation in fault trend to establish potential "cleared" polygons, as presented on the map that accompanies that report (and reproduced here on Figure 2). We considered that same variation in fault trend in this report, and find that the aggregate map distribution of trenches makes the possibility of a through-going fault in the Designated Assessment Area unlikely. In other words, an assumed fault that passes by the end of one exploratory trench is "blocked" by an adjacent or nearby trench along strike.

Based on the findings of our investigation, we conclude that the Designated Assessment Area has not experienced surface faulting in the recent geologic past, and that the potential for future ground rupture in said area is low. However, active faulting was identified on the adjacent San Benito Foods Warehouse parcel to the southeast (Earth Systems Consultants, 1998). Based on this finding, we recommend that habitable structures be set back from the fault identified in that study. We have incorporated a setback from that fault in our delineation of the southeastern boundary of the Designated Assessment Area, which takes into account a 50 foot seback from the fault where located in Trench T-1 of that study. The Designated Assessment Area boundary diverges westward away from the fault at Trench T-1 to reflect decreasing confidence in the location of the fault to the northwest and southeast, and incorporates variation in fault trend as recommended in our previous report for the City (Pacific Geotechnical Engineering, 2012).

We note that the actively creeping West Branch of the Calaveras fault lies west of the Designated Assessment Area. Paleoseismic literature abundantly documents that the site of the most recent *past* surface faulting event has the highest probability of being the site of the *next* surface faulting event (McCalpin, 2009). Given the continual and incremental release of strain along the actively creeping trace nearby, it is judged unlikely for surface fault rupture to occur within the Designated Assessment Area in the near future.

Suggestions for Future Work

The Designated Assessment Area considered in this report covers a limited portion of the downtown area in roughly the western half of the CGS EFZ. It is our understanding that the City wishes to clear additional areas to the east and north of the Designated Assessment Area.

As outlined in our 2012 report, 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 downtown Hollister. Between San Benito Street and East Street, nearly half of the block along Fifth Street has been trenched, with no fault found, as summarized in this study. 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) 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. This could be done with one continuous trench.

A subsurface exploration program of Cone Penetrometer Testing (CPT) could be used to assess areas east of the Designated Assessment Area of this report. A grid of CPT borings placed along east-west streets across the eastern remainder of the CGS EFZ could be used to compare subsurface conditions with existing reports reviewed in this study. Specifically, the CPT borings would be used to explore for the base of the Holocene, which is thought to be the top of the San Benito Formation (San Benito Gravels). If the top of the San Benito Formation is found to be laterally continuous, with no offset or

warping of that stratum, such findings may support a conclusion that active faulting is not present north of Seventh Street. If the top of the San Benito Formation is found to be deformed, such findings may indicate the presence and location of the fault buried within younger sediments in the downtown area.

Additional trenching and/or CPT exploration could be used to assess areas north of the Designated Assessment Area of this report, with likely locations in the lots north of Hawkins Alley and along 3rd Street.

9.0 LIMITATIONS

In preparing the findings and professional opinions presented in this report, we have endeavored to follow generally accepted principles and practices of the engineering geologic profession. This warranty is in lieu of all other warranties, express or implied. The conclusions contained in this report are based, in large part, on information that has been provided to us. This information includes previous fault investigation reports for which Geo-Logic Associates staff was not present, involved, or responsible. As such, we rely heavily on the prior acceptance of those reports by the City of Hollister, and knowledge that the City considers the subject properties of those investigations to be free of active faulting.

Should persons concerned with this project observe features or conditions at the site or surrounding area that are different from those described in this report, those observations should be reported immediately to Geo-Logic Associates for evaluation.

If you have any questions, please contact us.

Sincerely,

Geo-Logic Associates, Inc.

John A Feltman

John Feltman

CEG #2530

PROFESSIONAL GEOLOGIST
JOHN A. FELTMAN
No. 2530
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Exp. 8-31-17

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Reviewed Reports

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

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

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

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

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.

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

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Additional References:

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Earth Systems Consultants Northern California, 1994, Proposal for Engineering Geology Services and Geologic Fault Trenching for the City of Hollister Redevelopment Agency, Hollister, California;, dated July 15, 1994.

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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*

A preliminary working compilation of fault investigation reports through November 2008 in Kmz format (W.A. Bryant, personal communication, 2009)

TABLES

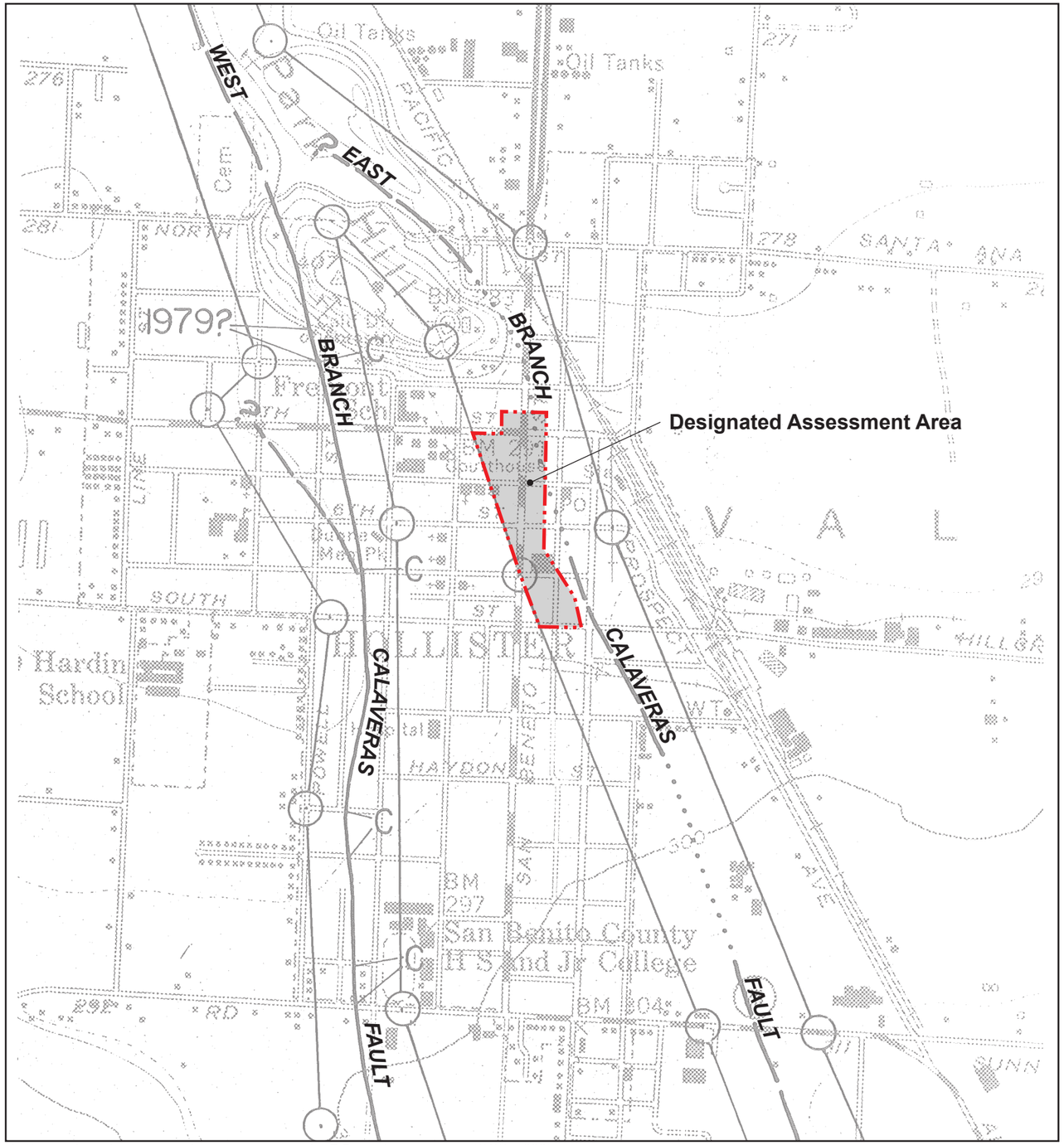
Table 1 – Parcels Included in the Designated Assessment Area

APN	Clearance Status	Parcel Description
54020001000	Cleared 1991	701 & 705 SAN BENITO ST
54020002000	Cleared 2015	713 SAN BENITO ST
54020003000	Cleared 2015	717-719-721 SAN BENITO ST
54020004000	Cleared 2015	727-729-731 SAN BENITO ST
54020005000	Cleared 2015	737 SAN BENITO ST
54020008000	Cleared 2015	217 SEVENTH ST
54020009000	Cleared 2015	759 San Benito Street
54032004000	Fault Found and remainder of site cleared 1998	EAST-SOUTH-SALLY & 7TH STS
54050006000	Cleared 2015	610-616-618-620-628 SAN BENITO ST
54060002000	Cleared 1991	615 SAN BENITO ST
54060003000	Cleared 1991	625 SAN BENITO ST
54060005000	Partial Clearance 2015	649 SAN BENITO ST
54060010000	Partial Clearance 1991	East Street
54060011000	Cleared 1991	601 A & B SAN BENITO ST & 243 6TH ST
54060012000	Cleared 1991	225 SIXTH ST
54080006000	Cleared 2015	339 Fifth St
54080007000	Cleared 2015	327 FIFTH ST
54080008000	Cleared 2015	321 FIFTH ST
54080009000	Cleared 2015	500 SAN BENITO ST
54080010000	Cleared 2015	510 & 512 SAN BENITO ST
54080011000	Cleared 2015	520 SAN BENITO ST
54080012000	Cleared 2015	522 & 526 SAN BENITO ST
54080018000	Cleared 2015	0 SIXTH ST
54080019000	Cleared 1991	530 & 534 SAN BENITO ST
54080020000	Cleared 2015	542 SAN BENITO ST
54080024000	Cleared 2015	544 SAN BENITO ST
54090001000	Cleared 2015	501 & 511 SAN BENITO ST
54090004000	Cleared 2015	221 FIFTH ST
54090008000	Cleared 2015	535 SAN BENITO ST
54090009000	Cleared 2015	549 SAN BENITO ST
54090010000	Cleared 2015	575 SAN BENITO ST
54090012000	Cleared 1991	515 SAN BENITO ST (BRUHN'S) #100, 102 & 102
54110002000	Cleared 2015	334-336-338 FOURTH ST
54110015000	Cleared 2015	334 336 FIFTH STREEET

APN	Clearance Status	Parcel Description
54110016000	Cleared 1991	430 San Benito Street
54110023000	Cleared 2015	446-452 SAN BENITO ST
54110029000	Cleared 1991	FIFTH ST TO BRIGGS ALLEY
54110030000	Cleared 1991	434, 452 San Benito ST
54110033000	Cleared 2015	350 FIFTH ST
54110034000	Cleared 2015	342 & 344 5TH ST
54110035000	Cleared 1991	FOURTH STREET
54110036000	Cleared 1991	430 434 SAN BENITO
54120007000	Cleared 2015	435-437-439-441-443 S.B. ST
54120008000	Cleared 1991	445 SAN BENITO ST
54120009000	Cleared 1991	240 5TH ST & 459 SAN BENITO ST
54120017000	Cleared 2015	230 FIFTH ST
54120018000	Cleared 2015	401 San Benito St
54120021000	Cleared 2015	222 5TH ST
54120022000	Cleared 2015	411 San Benito Street
54120024000	Cleared 2015	417 San Benito Street
54120030000	Cleared 2015	427 San Benito Street
54120032000	Cleared 2015	419 San Benito Street
54120034000	Cleared 2015	None - Parking lot
54120035000	Partially Cleared 2015	None - Parking lot
54130012000	Cleared 1991	328 & 330 FOURTH ST
54130013000	Cleared 1986	310-314-334-336 FOURTH ST
54140004000	Cleared 1991	335 SAN BENITO ST
54140005000	Cleared 2015	355 SAN BENITO ST
54140006000	Partially Cleared 2015	220 FOURTH ST
54140008000	Partial	321 S.B. ST & 321 & 211 3RD ST

Note: Information in Table 1 provided by the City of Hollister

FIGURES



BASE MAP: Earthquake Fault Zone Maps, Hollister 7.5 minute 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 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.

Earthquake Fault Zone Boundaries

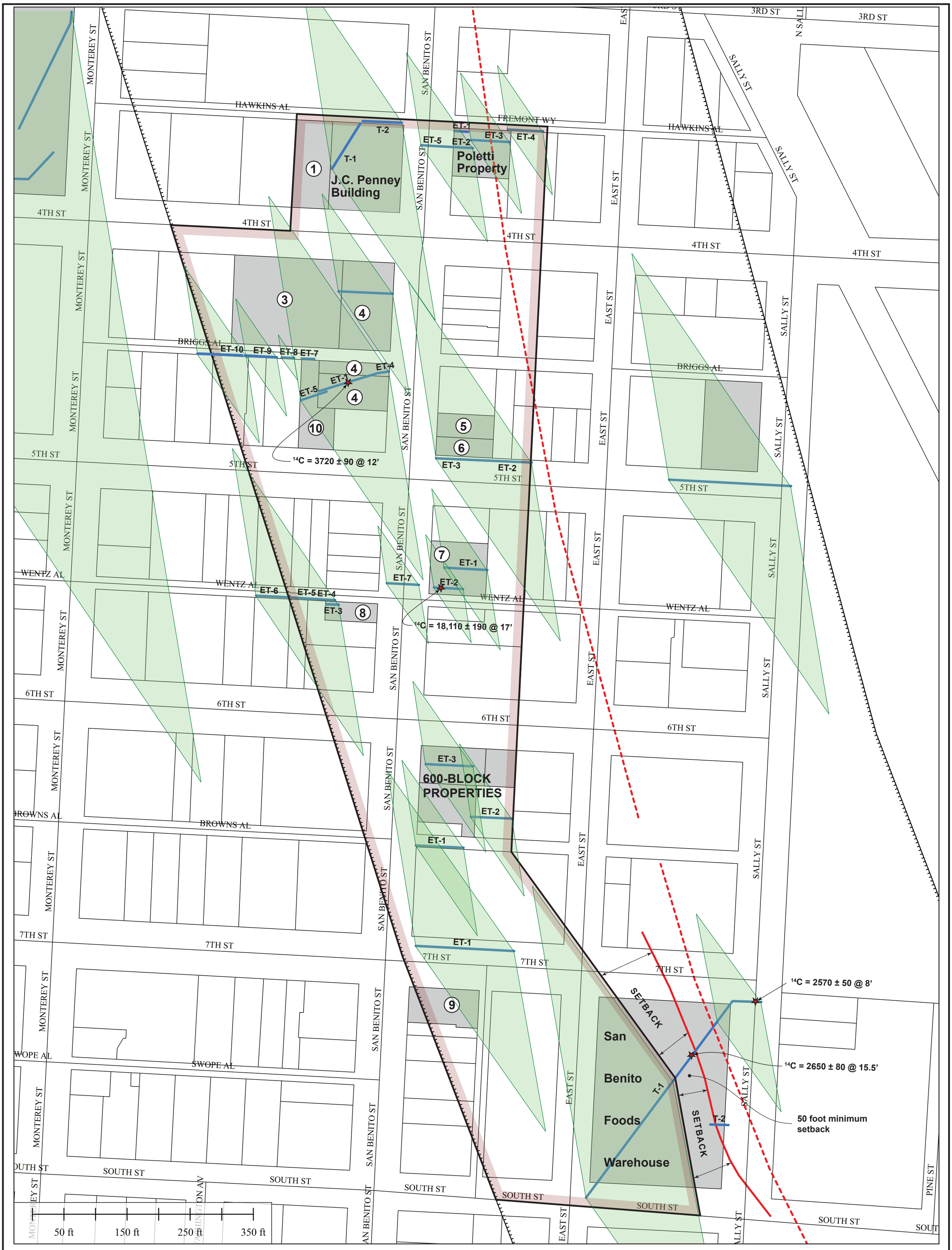
These are delineated as straight-line segments that connect consecutively numbered turning points so as to define one or more special studies zone segments.

N

0 1,000 ft.

Geo-Logic ASSOCIATES

Drafted By: GDG	**FAULT ZONE MAP** **HOLLISTER 7.5 MINUTE QUADRANGLE**	**FIGURE** 1
Date: August 2015	**PHASE I FAULT RUPTURE HAZARD ASSESSMENT**	
Checked By: JF		**PROJECT** 2015.0062
Revision:	**HOLLISTER, CALIFORNIA**	



EXPLANATION

- CGS-mapped fault (dashed)
- Documented fault (solid)
- CGS Earthquake Fault Zone boundary
- Exploratory trench
- ^{14}C = radiometric age date (years before present) location and depth of sample in trench
- Designated assessment area boundary
- (10) Parcel with investigation; number references "Building Site" in 1991 Applied Soil Mechanics investigations for City
- Cleared area (Pacific Geotechnical Engineering, 2012)

N

0 100 200 ft

Geo-Logic ASSOCIATES

DATE	FAULT HAZARD ASSESSMENT AREA MAP	FIGURE
AUGUST 2015	PHASE I FAULT RUPTURE HAZARD ASSESSMENT HOLLISTER, CALIFORNIA	2
		PROJECT 2015.0062

APPENDIX A

SUPPORTING DOCUMENTATION

(see attached CD)

APPENDIX A

(See Attached CD)

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