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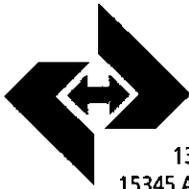
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**SUBSURFACE INVESTIGATION OF FAULTING
PARADISE HILLS PROJECT
BADGER CANYON AREA
CITY OF SAN BERNARDINO, CALIFORNIA
PREPARED FOR
INLAND COMMUNITIES CORPORATION
JOB NO. 05894-8**

JANUARY 31, 2006



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January 31, 2006

Inland Communities Corporation
1801 Avenue of the Stars, Suite 1205
Los Angeles, California 90067
Attention: Mr. Jim Ahmad

Job No. 05894-8

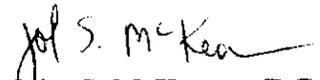
Dear Mr. Ahmad:

Attached herewith is the Subsurface Investigation of Faulting report prepared for the Paradise Hills Project in the Badger Canyon area of the City of San Bernardino, California.

This report was based upon a scope of services generally outlined in our proposal, dated September 21, 2005, and other written and verbal communications.

We appreciate this opportunity to provide engineering geologic services for this project. If you have questions or comments concerning this report, please contact this firm at your convenience.

Respectfully submitted,
C.H.J., INCORPORATED


John S. McKeown, E.G.
Project Geologist

JSM/dmg

Distribution: Inland Communities Corporation (4)
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INTRODUCTION

During October through December of 2005, a subsurface investigation of faulting was performed by this firm for an approximate 410-acre project site, located in the Badger Canyon area of the City of San Bernardino, California. The purpose of this investigation was to explore and evaluate the potential hazard of ground rupture due to surface faulting at the subject site and provide appropriate engineering geologic recommendations for design of the proposed development. The location of the site is shown on the attached Index Map (Enclosure "A-1").

Most of the site is included within an Alquist-Priolo Earthquake Fault Zone (APZ) designated by the State of California to include traces of suspected active faulting associated with the San Andreas fault system. The approximate boundaries of the site and the location of the APZ are shown on the attached Earthquake Fault Zone Map (Enclosure "A-2"). In addition, suspected fault traces mapped by Miller et al. (2001) are present within the site boundaries. The locations of these features are shown on the attached Geologic Index Map (Enclosure "A-3").

To orient our investigation, we were provided with black-and-white aerial photographs of the site at a scale of 1 inch equal to 320 feet, and a topographic survey with a 1-foot contour interval overlain on the aerial photographic base.

The results of our current investigation, together with our conclusions and recommendations, are presented in this report.

SCOPE OF SERVICES

The scope of services provided during this subsurface investigation of faulting included the following:

- Review of published and unpublished literature and maps, including previous investigations conducted by this firm and others
- Review and analysis of stereoscopic aerial photographs flown in 1938, 1953, 1963, 1964, 1965, 1971, 2001, 2004, and 2005



- A geologic field reconnaissance of the site and surrounding area
- Geologic mapping of the site at a scale of 1 inch equals 100 feet
- Continuous geologic trenching across identified faults and lineaments to provide subsurface coverage for the proposed building areas with respect to ground rupture hazards due to faulting
- Evaluation of the geologic data to develop site-specific recommendations for mitigation of geologic hazards and concerns to the site.

PROJECT CONSIDERATIONS

It is proposed to develop the approximate 410-acre site for residential use, including open space. This is expected to entail construction of one- to two-story wood frame buildings and associated infrastructure. The area of this investigation includes all of the proposed development area located within the APZ. Based on the findings of this investigation, the originally planned development area located north of the South Branch San Andreas Fault Zone (SAFZ) and west of Badger Creek is included within a Recommended Restricted Use Zone (RRUZ).

The final project grading plan was not available at the time of our investigation. Based on the slope of the existing land surface at the site, we anticipate that grading for the proposed building pads may require the use of cut and fill slopes up to 20 feet in height. The final project grading plan should be reviewed by the geotechnical engineer.

SITE DESCRIPTION

The site is located on the southern flank and bordering alluvial fans of the western San Bernardino Mountains in the City of San Bernardino, California. The San Andreas Fault Zone (SAFZ) trends through the central portion of the site along the base of the mountains. Badger Creek flows southward through the central portion of the site and divides the site into two areas designated for this study - the West Parcels and East Parcels, respectively. Flood control/debris basins and access roads form the southern boundaries of the site. The northern portion of the site is bounded by lands of the San Bernardino National Forest.

The West Parcels include the site area west of Badger Creek extending to the western site boundary. The Andy Jackson Airpark (a large fill pad) and a private residence and associated acreage are located



along the western site boundary. The West Parcels area encompasses steep and rugged terrain north of the SAFZ with a more moderately-sloping alluvial fan surface south of the SAFZ. The alluvial fans slope from a low topographic divide near the mouth of Badger Creek toward the south-southwest at gradients of approximately 8 1/2 (h) to 1 vertical (v) and are dissected by several south-southwest trending gullies and shallow ravines. A 78-inch-diameter water pipeline operated by the San Bernardino Valley Municipal Water District and associated 50-foot-wide easement trend east-southeast through the West Parcels area. Several dirt roads and various dirt tracks cross the area. The West Parcels area includes a narrow strip of land along the western edge of Badger Creek that is bordered to the west by rugged granitic terrain. Numerous trees, including native sycamore, are located within this area.

The East Parcels area includes the site area east of Badger Creek extending to the eastern site boundary located near the mouth of Sycamore Canyon. This site area is divided by a north-south trending strip of land included within a flood-control easement. The easement of the 78-inch-diameter water line trends along the southern boundary of the East Parcels area. In addition, a power pole alignment trends eastward across the East Parcels area from a debris basin near Badger Creek to beyond the eastern site limit. Several infiltration basins are located southwest of the East Parcels area.

At the time of our investigation, the site was covered by annual grasses, weeds, and native shrubs. Stands of sycamore and other tree species are located along the SAFZ at numerous locations. Eucalyptus trees border a topographic bench area located in the western portion of the site. Indications of past irrigation activity in this bench area include several sections of steel pipe and a small building foundation located north of the SAFZ. A building ruin and associated foundation structures were observed west of the mouth of Badger Creek within the SAFZ. A sediment settling box associated with a water supply system for the former building was observed approximately 450 feet north-northeast of the building ruin adjacent to Badger Creek. A second, larger settlement area with associated foundations and ruins is located northeast of the proposed development area in Badger Canyon. A sediment settling box near a spring, remains of a shallow swimming pool, seepage pits, several fill pads, and several concrete slab foundations are located in this area.

GENERAL GEOLOGIC AND STRUCTURAL SETTING

The site is located at the boundary of the Transverse Ranges and Peninsular Ranges geomorphic provinces. The Transverse Ranges province is characterized by east-west trending geologic structure forming steep, fault-bounded mountains and foothills trending from the San Bernardino Mountains to



the offshore area of California. The SAFZ (located within the site) forms the boundary between the Transverse Ranges and Peninsular Ranges provinces in the area of the site. The Peninsular Ranges are characterized by northwest-trending mountains and basins bounded by northwest-trending faults. The Peninsular Ranges province includes numerous distinctive landforms consisting of elevated erosional surfaces (geomorphic surfaces). The geomorphic surfaces are relatively planar, stable, highland areas that have been uplifted and are now being incised by modern drainages.

The site is located on upland bedrock and alluvial fans of various ages formed at the base of the San Bernardino Mountains. Bedrock materials in the upland area of the site include intrusive granitic, sedimentary sandstone, and metamorphic schist, gneiss, and marble. The alluvial fans contain materials derived from the upland bedrock areas transported by Badger Creek and adjacent smaller streams. As mapped by Miller et al. (2001), the alluvial fans increase in age with increasing distance to the west from Badger Creek. Alluvial fans within the site are generally younger east of Badger Creek (the location of most recent fan activity) with the exception of an area of very old fan deposits mapped along the SAFZ. Several geomorphic surfaces visible as reddish-brown soils in color aerial photographs (also mapped by Miller et al., 2001) are formed on the upland areas of the site and adjacent highlands. A similar geomorphic surface also mantled by reddish-brown soil is formed on the "bench" area west of Badger Creek. A Geologic Index Map is included as Enclosure "A-3" (Miller et al., 2001).

Geologic structure in the area of the site is dominated by the South Branch SAFZ, several older segments of the SAFZ, and associated landslide deposits. The South Branch strand of the SAFZ (mapped by Miller et al. [2001] as the Southern Branch and Mission Creek Strand) is located along and controls landforms at the base of the modern mountain front. Fault-related landforms associated with the South Branch SAFZ include many "classic" features of right-lateral, strike-slip fault displacement such as offset stream courses, shutter ridges, springs, seeps, beheaded drainages, sag features, and linear troughs and ridges. The South Branch trace of the SAFZ trends approximately N65W through the site.

A second major fault strand is located sub-parallel to and approximately 600 feet north of the South Branch SAFZ trace. This fault, mapped by Miller et al. (2001) as the Mill Creek strand of the SAFZ, trends slightly more westerly than the South Branch SAFZ and merges with the South Branch strand near the western boundary of the site. The Mill Creek strand separates granitic bedrock on the north from sandstone bedrock on the south. Bedrock landslide deposits conceal the trace of the Mill Creek strand west of Badger Creek.



A third major fault splay is located approximately 1,600 feet north-northeast of the South Branch SAFZ, as measured along Badger Creek, and separates metamorphic carbonate terrain on the north from granitic bedrock on the south. This fault (referred to herein as the North Branch SAFZ) appears as a major contact on aerial photographs, trends approximately N70W, and merges with the South Branch SAFZ west of Devil Canyon. This fault has also been referred to as the Arrowhead Springs fault.

As observed during geologic mapping of the site, the granitic materials located west of Badger Creek and bounded by the Mill Creek fault and North Branch SAFZ are part of a landslide complex. This landslide complex includes several landslides of various relative ages formed in bedrock materials. An undeformed "source" area for these deposits was not observed during our investigation, suggesting the possible long-distance transport of these materials westward along the ancestral SAFZ. A smaller area of granitic landslide material may be present along the east side of Badger Creek.

The faults mapped by Miller et al. (2001) are shown on Enclosure "A-3". Note that the landslide complex identified during this investigation is not depicted on the map by Miller et al. Enclosure "A-4", Geologic Map and Site Plan, shows details of the faults and related features within the area of the site.

AERIAL PHOTOGRAPH REVIEW AND SITE GEOMORPHOLOGY

The geomorphology (landforms) of the site was assessed for indications of faulting and other geologic hazards by review of geologic maps, topographic maps, and historic aerial photographs of the site and surrounding area. The geomorphology of the site area is dominated by the west-northwest trending South Branch SAFZ that separates a rugged upland terrain of steep slopes and ravines north of the fault from more moderately-sloping alluvial fans south of the fault. Badger Creek crosses the South Branch SAFZ and associated older fault splays located to the north, and bisects the site. Several landslides exhibiting geomorphic expression are located west and east of Badger Creek and are identified based on scarp and bench topography, arcuate bedrock contacts and lineaments, and hummocky topography.

Several types of features visible on aerial photographs identify the major traces of the SAFZ in the site area. These include vegetational lineaments, linear troughs, offset drainages, shutter ridges, linear ridges, scarps, and beheaded drainages. The surface expression of the South Branch SAFZ appears to be obscured by recent (in the geologic sense) stream activity and grading at the mouth of Badger Creek. The aerial photographs reveal several lineaments within bedrock terrain north of the South Branch SAFZ. Some of these are associated with landslide features.



With the exception of the former residence located near the mouth of Badger Creek and the historic settlement area in Badger Canyon, little modification of the site is apparent since the time of the earliest aerial photographs reviewed. The earliest photographs (1938) show several fire breaks along ridge tops within the upland terrain of the site and trending parallel to the toe of the mountain front just south of the South Branch SAFZ. These modified surfaces extend to approximately the southern limit of the topographic scarp of the South Branch SAFZ across the western and eastern portions of the site. Plowing or discing is evident on the earliest photographs at the following locations:

- topographic bench area located north of the South Branch SAFZ in the West Parcels area,
- between the branches of Badger Creek north of the settlement area,
- in level terrain located in the upland area east of Badger Creek and north of the North Branch SAFZ, and
- on a bench located west of Badger Creek.

A road or narrow disced area extends along the linear trough of the South Branch SAFZ in the East Parcels area.

Later photographs show the presence of various dirt roads within the site, the presence of the flood-control levees and settling basins (1963, 1964, 1965, 1971, 2001, 2005), and disturbed ground associated with construction of the high-pressure water line (1971, 2005). The mouth of Badger Creek appears to be unmodified until the time of the 1963 photographs that show a small detention basin formed in the fan deposits. In addition, the 1963-era photographs show a large borrow area at the mouth of Sycamore Canyon near the eastern edge of the site, the presence of the existing levee in this area, and the residence located within the South Branch SAFZ just east of Sycamore Canyon. A denuded area is visible on the 1971-era photographs on the ridge top located east of Badger Creek and may indicate a prior burn area.

The 2004- and 2005-era color photographs reveal the locations of older reddish-brown soils mantling bedrock (forming pedogenic surfaces) in the upland areas north of the South Branch SAFZ. These reddish-brown soils represent areas where stable surfaces existed during the past. The Mill Creek strand of the SAFZ is revealed as traversing the area of these pedogenic surfaces. Field relations suggest that these soils, overlying the Mill Creek strand, are unruptured by faulting.



PREVIOUS INVESTIGATIONS

Prior investigations at the site include a geotechnical feasibility investigation with several trench explorations (CHJ, Inc., 1989) and a preliminary engineering geology investigation with geologic mapping by Gary S. Rasmussen and Associates (1990). Copies of these reports were reviewed for pertinent information with regard to the currently proposed project. Hillenbrand (1990) mapped the major rock types, including subunits of the Potato Sandstone in the eastern portion of the site, at a scale of 1:16,000.

Several prior studies of the SAFZ in the vicinity of the site were reviewed for information regarding the location and character of faulting associated with the fault zone. These include several reports prepared by G.A. Clopine (1977 and 1978) and C. Price (1977) for parcels located within the South Branch SAFZ east of the site. Several trenches revealed surface faulting in relatively young sedimentary (alluvial) and sandstone bedrock materials at these sites associated with the active South Branch SAFZ. Prior fault studies were not available for sites adjacent to the western limit of the project site.

CRITERIA FOR FAULT ACTIVITY DESIGNATIONS

In general, the activity of a fault is determined by establishing the age of the youngest materials displaced by the fault. If datable material is present, an absolute age can sometimes be established using radio-carbon dating methods. If no datable material exists, then only a relative age can be assigned to movement on the fault.

The APZ that includes portions of the site (CDMG, 1979) was established based on the criteria for zoning faults that included consideration of "potentially active" fault traces for the San Andreas Fault Zone. The fault traces mapped during our study, faults depicted on the APZ map, several lineaments identified in aerial photographs, and escarpments of the South Branch SAFZ located within the subject site were investigated during this study. The faults of the SAFZ (including the North Branch, Mill Creek fault, and South Branch) are considered active for planning purposes.

SUBSURFACE AND FIELD INVESTIGATION

Our field program included excavation of 18 trench alignments to investigate the areas of identified potential fault strands. These trench alignments were designated with the prefix "WT" (west trench) and



"ET" (east trench) for the West Parcels and East Parcels areas, respectively. A total of approximately 6,445 lineal feet (approximately 1.2 miles) and 2,065 lineal feet (approximately 0.4 mile) of trench were excavated for the West Parcels and East Parcels, respectively. The trenches ranged in maximum depth from 5 to 22 feet, were oriented roughly north-south to reveal the northwest-striking fault trend of the SAFZ, and were excavated with a Caterpillar 235 excavator utilizing a 48-inch wide bucket. Trench sidewall stability considerations necessitated the inclusion of benches in the excavations. The trench walls were cleaned to expose relatively undisturbed soil/rock substrate and examined for geologic features, including lithology, soil horizons, and indications of possible fault-related features. A reference datum and lateral stationing were established along the trench exposures by use of a water level manometer and measuring tape. The trench margins and center lines were surveyed by PBS&J to further establish horizontal and vertical control, following logging. The trenches were logged at a scale of 1 inch equals 5 feet. We also mapped surficial geologic units at a scale of 1 inch equals 100 feet. The nomenclature for the logged geologic units is adapted from Miller et al. (2001) and is described in the section titled GEOLOGIC MATERIALS. Individual trench logs reference trench-specific geologic unit descriptions. The locations of the trenches and general site features are shown on the attached Geologic Map and Site Plan (Enclosure "A-4"). The trench logs are included in Appendix "B". The trenches were spaced in general conformance with County of San Bernardino guidelines, which require exposures at approximately 600-foot intervals along the fault strike.

Dr. Floyd Williams, consulting geologist to the City of San Bernardino, visited the site on November 23, 2005 and December 1, 2, and 9, 2005 to observe the trench exposures, accompanied by representatives of this firm. In addition, Dr. Douglas Morton of the U. S. Geological Survey examined selected trench exposures on December 21, 2005.

Upon completion of the City's review of this report, the trenches are to be backfilled and track rolled with a bulldozer. No other compactive effort is planned. The trench backfill should be considered as undocumented fill. Structures should not be placed on or immediately adjacent to any undocumented fill. The trench locations, associated fault features, and southern limit of surface deformation (faulting), where encountered, were surveyed by PBS&J on December 15, 2005 to facilitate accuracy of their location and recovery of the trench margins during future site work when the trench backfill is removed and replaced as engineered fill, if necessary.



GEOLOGIC MATERIALS

As observed during geologic mapping of the site and in our current explorations, the geologic materials at the site include a variety of bedrock and surficial geologic units. The geologic units mapped at the site as part of this investigation (Enclosure "A-4") are discussed below. We have adapted the nomenclature of Miller et al. (2001) for the geologic units.

FILL (f):

Fill material derived from local alluvial fans and composed of silty sand with gravel and cobbles was observed in and adjacent to roadways, adjacent to the pipeline easement in the West Parcels and East Parcels areas, and as shotcrete-covered embankments in gullies crossing the pipeline access road. Minor amounts of fill were encountered locally in our exploratory trenches near roadways and utility crossings. The area of the former residence near Badger Creek and detention basin areas also include areas of fill placement. The locations of the larger fill areas are shown on Enclosure "A-4". Minor amounts of fill may be present in other modified areas of the site.

VERY YOUNG WASH, ALLUVIAL-FAN, AND COLLUVIAL DEPOSITS (Qw, Qf, Qc):

Very young deposits of late Holocene age (as designated by Miller et al., 2001) occur in active drainages, on alluvial-fan surfaces, and on slopes within the site. The very young materials are composed primarily of gray to brown clean sand and silty sand with gravel and cobbles. The colluvial materials tend to be finer-grained and lack cobble-sized clasts relative to the wash deposits that are transported in the higher energy stream beds. Due to rapid emplacement, these materials are typically unconsolidated and may have a potential for settlement.

YOUNG ALLUVIAL-FAN DEPOSITS (Qyf5, Qyf3, Qyf2, Qyf1):

Young alluvial-fan deposits of late Holocene to late Pleistocene age (as designated by Miller et al., 2001) occur south of the South Branch SAFZ across the site. These fan materials are derived and transported from the upland areas of the site along the major canyons (Devil Canyon, Badger Canyon, and Sycamore Canyon) and smaller drainages in the site area. Alluvial-fan materials vary from fine-grained sand to cobble and boulder-size clasts, are typically rounded, and form interbedded coarse and fine-grained units of variable lateral extent. Miller et al. (2001) base the relative ages of these units on the degree of consolidation, landscape position, degree of dissection, and grain size (Miller et al., 2001).



YOUNG LANDSLIDE DEPOSITS (Qyls):

Young landslide deposits of Holocene to late Pleistocene age were mapped in the mountainous terrain north of the site by Miller et al (2001). These occur outside of the site area and are interpreted to be inactive under current climatic and seismic conditions.

OLD ALLUVIAL-FAN DEPOSITS (Qof3, Qof2):

Old alluvial-fan deposits of late Pleistocene age were mapped by Miller et al. (2001) along the base of the mountain front in the western and eastern parcels areas. As observed in our exploratory trenches, these materials consist of consolidated, interbedded gravel and cobble conglomerate with silty sand matrix locally with boulder-sized clasts. Imbricated fluvial and debris flow fabrics occur locally within the fan deposits. Brown to dark brown color hues are typical.

VERY OLD ALLUVIAL-FAN DEPOSITS (Qvof1):

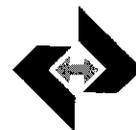
Very old alluvial-fan deposits of early Pleistocene age (as designated by Matti et al., 2003) occur locally as remnants on the uplifted bedrock surface north of the South Branch SAFZ, as a "sliver" of material along the SAFZ in the eastern parcels area, and south of the South Branch SAFZ at the western boundary of the site. Elevation differences between outcrops of Qvof suggest landslide or fault offset east of Badger Creek in the upland area. These are well consolidated, moderately to well dissected, and have reddish-brown surface horizons.

VERY OLD LANDSLIDE DEPOSITS (Qvols):

Very old landslide deposits of middle to early Pleistocene age, lacking geomorphic expression, are located in the western portion of the site north of the North Branch SAFZ and locally in the Sycamore Canyon area.

CONGLOMERATE AND ARKOSE (Tc):

Reddish- to purplish-brown arkosic sandstone of variable grain size occurs as an elongated "wedge" of bedrock material between the South Branch and Mill Creek strands of the SAFZ. These materials were studied previously by Hillenbrand (1990). This wedge narrows toward the west and "tapers out" west of Badger Creek; however, slivers of sandstone were encountered locally within the South Branch SAFZ in the trench exposures near the western site boundary. As encountered in our trenches, the sandstone is locally highly sheared and crushed within the SAFZ. Bedding was measured in cross-bedded and conglomeratic units observed in the eastern portion of the site in road cut and waterfall exposures.



Locally, the sandstone forms resistant, steep topography. West of Badger Creek, Trench WT-4 exposed sandstone materials as landslide deposits in contact with granitic landslide materials. This sandstone is texturally and visually similar to exposures of the Potato Sandstone mapped to the east of the site and locally include the characteristic rounded pebbles and cobbles of the Potato Sandstone in the type area.

BIOTITE MONZOGRANITE (Kmg):

Monzogranite (herein referred to as granitic) bedrock of Cretaceous age (as designated by Miller et al., 2001) crops out between the Mill Creek and North Branch segments of the SAFZ in the area of the site. These materials are variously sheared and crushed as landslide deposits with pervasive fracture and shear fabric or consist of fresh, intact-appearing rock separated by diffuse shear and fracture surfaces. Straight-trending, slope-normal erosion rills and gullies characterize the drainage patterns formed in these materials. Weathering is intense within the upper few feet of this unit, especially where topography is subdued. Preservation of igneous contacts within the landslide deposits is suggested, in some trench exposures, by the presence of foliation in a medium-grained, homogeneous-appearing granitic unit near a contact with very fine-grained (possibly hydrothermally altered?), pervasively crushed unit with dark mineral coatings and staining. This contact trends roughly east-west and occurs near the trend of the Mill Creek strand of the SAFZ. It appears that all of the near-surface granitic materials located between the North Branch and Mill Creek strands of the SAFZ are landslide deposits.

AGE OF THE GEOLOGIC UNITS

We utilized relative pedogenic (soil) development and the geologic mapping by Miller et al. (2001) and Hillenbrand (1990) as an indicator of age for the surficial geologic materials encountered during this investigation.

In general, the degree of soil development reflects the time a particular geomorphic surface has been exposed to the physical, chemical, and biological effects of weathering. Assuming similar soil-forming conditions, numerical age estimates can also be established by comparison with a sequence of radiometrically dated soils. Such sequences have been prepared for Cajon Pass (McFadden and Weldon, 1987), Anza (Rockwell and others, 1990), and for Yucaipa (Harden and Matti, 1989) and the San Timoteo Badlands (Kendrick, 1999).



FAULT RUPTURE HAZARD

The majority of the site is located within an APZ designated by the State of California to include traces of suspected active faulting within the San Andreas fault zone. The boundaries of the APZ are shown on Enclosure "A-2".

The San Andreas Fault Zone is a major system of faults approximately 800 miles long that forms the tectonic plate boundary between the North American and Pacific tectonic plates. The strands of the SAFZ that traverse the site are considered portions of the "master" fault of this zone that displaces rocks north of the fault northwestward relative to rocks south of the fault at a maximum rate of approximately 2 inches per year. This displacement occurs in an uneven fashion along the various segments of the fault zone producing earthquake events (on average approximately every 140 years for the southern portions) and an accumulated horizontal offset of approximately 350 miles since the inception of faulting along the fault zone. The SAFZ produced an earthquake of magnitude 8.3 and maximum lateral offset of approximately 21 feet along the Peninsular segment of the fault during the San Francisco earthquake of April 18, 1906. Closer to the site, the Fort Tejon earthquake of January 9, 1857 ruptured a segment of the SAFZ extending from at least Cholame to Cajon Pass (approximately 190 miles) generating an earthquake of magnitude 7.8 with lateral movement up to 29 feet along the fault.

Based on the current understanding of the mechanics and earthquake history of the SAFZ, there is a potential for fault rupture to occur along the SAFZ at the site during the design life of the proposed project. Prudent application of the APZ requirements and guidelines outlined in California Geologic Survey (CGS) Note 49 were utilized to address this potential hazard for the project. To this end, we utilized geomorphic indications of surface disturbance, together with the more obvious methods of locating surface rupturing faults or lithologic discontinuities in the trench exposures, to delineate areas of the site where a potential for ground rupture/deformation exists. The bounding limits of the zone of deformation associated with the individual SAFZ strands as determined in this study are designated on Enclosure "A-4". A discussion of the trench exposures and data relating to the limits of surface deformation follows.



TRENCH EXPOSURES - WEST PARCELS

TRENCH ALIGNMENT WT-1:

Trench alignment WT-1 (includes WT-1A, -1B, and -1C) begins on a bench (abandoned stream terrace) extending down the west side of Badger Canyon from the vicinity of the North Branch SAFZ, extends down the scarp of the active SAFZ, and onto the alluvial fan located west of Badger Creek. This trench alignment forms an exposure approximately 2,030 feet long and extends approximately 30 feet south of the boundary of the APZ. A gap approximately 75 feet long in the trench alignment occurs at the location of a roadway and a high-pressure water line easement.

Trench WT-1A in the bench area north of the South Branch SAFZ exposes a sequence of alluvial deposits that include stream and debris flow sediments. These materials consist of sand and gravel lenses interbedded with cobble conglomerate beds with a silty sand matrix. Near the north end of the trench alignment, carbonate-clast-rich debris flow deposits are interbedded with sandy alluvial materials. A reddish-brown pedogenic horizon is formed at the surface of the bench area extending from approximately Station 180 southward to the scarp of the South Branch SAFZ at Station 1425. This pedogenic horizon is locally stripped away by erosion and backfill in younger stream channels that cross the trench alignment; however, the character of the underlying materials demonstrates continuity of the geologic units across these intervals.

Landslide deposits consisting of pervasively crushed and fractured granitic rock (unit Kmg) were exposed between Stations 830 and 1065 where they are thrust over a reddish-brown alluvial unit. A gouge zone approximately 6 inches thick is formed between these units indicating a basal shear plane. The basal shear plane is exposed along strike in a road cut just west of WT-1A and in the southern end of WT-4. South of the basal landslide surface, the alluvial materials are older than those exposed north of the landslide materials (Qof vs. Qyf as mapped by Miller et al., 2001) and have a similar texture and composition as residual materials formed on reddish-colored arkosic sandstone exposed in trenches within the East Parcels area. Between Stations 940 and 980 of WT-1A, the trench was excavated to a depth of 13 feet to expose the bedrock landslide materials where incision and backfill in a young alluvial channel has removed the pedogenic horizon at the surface and increased the thickness of overlying younger materials. Near Station 965, steep contacts were observed in the landslide materials separating lighter and darker colored materials and cutting through the shear fabric of the rock, suggesting the presence of a fault. These features are located along the inferred/concealed trend of the Mill Creek



strand of the SAFZ as revealed in aerial photographs. Therefore, we excavated WT-1C just east of WT-1A to expose the fault and reveal an unbroken interval of the pedogenic surface horizon adjacent to the stream-incised interval of WT-1A.

Trench WT-1C exposed a steeply-dipping fault separating dissimilar landslide deposit materials. The orientation (strike N73W, dip 87NE) and location of the fault indicate a trend consistent with that of the westward projection of the Mill Creek strand from east of Badger Creek. Based on the presence of a pedogenic (argillic) horizon formed on the modern surface of apparently unfaulted alluvial materials that scour and truncate the upward projection of the fault, it appears that the Mill Creek strand is inactive in terms of Holocene-age faulting. This interpretation is consistent with observations at other locations along the Mill Creek strand, including a ravine exposure located in the upland bench north of the East Parcels area. However, given the proximity of the Mill Creek strand to the demonstrably active South Branch SAFZ, as well as the potential for the SAFZ to generate large intensity seismic events resulting in possible sympathetic movement of the Mill Creek strand, a prudent treatment of the Mill Creek branch should include a restricted use zone for structures according to APZ guidelines.

South of Station 1425, the reddish-brown pedogenic surface of unit Qof3 is truncated at the 30-foot-high scarp of the active SAFZ. As exposed in WT-1A, surface rupture and deformation on the South Branch SAFZ is expressed as a zone of faults and warping of beds approximately 120 feet wide. Fault zone features include:

- a colluvium-filled, fault-bounded graben coinciding with a linear trough located near Station 1490,
- landslide deposits with a faulted scour surface north of the graben,
- warped bedding in alluvial materials overlying the landslide deposits in the scarp face,
- a progression of closely-spaced, north-dipping faults of apparent thrust offset with southward shallowing dips, separating materials of the fault zone from alluvial-fan deposits to the south, and
- alluvial-fan deposits (Qyf1) locally faulted and warped in the southern reach of the fault zone along low-angle thrust faults.

The northern limit of surface deformation associated with the South Branch SAFZ at the location of WT-1A is indicated by the truncation of the pedogenic horizon at the major scarp face (Station 1425).



The southern limit of surface deformation is indicated by the location of the toe of a smaller topographic scarp and presence of continuous, flat-lying units of the alluvial-fan materials near Station 1550. These locations define a zone of deformation approximately 120 feet wide.

The reach of WT-1A, located south of Station 96 and WT-1B, exposed flat-lying, laterally continuous, and unfaulted alluvial-fan deposits that consist of fluvial channel deposits (sand and gravel units) interbedded with debris flow units expressed as cobble beds with a silty sand matrix. Between WT-1A Stations 1495 and 1715, a reddish pink, clayey sand unit was exposed along the base of the trench. This unit was observed to contain steeply-dipping, carbonate-lined fractures and locally contains very intensely weathered cobble-sized clasts. The upper surface was scoured and overlain by the base of the alluvial-fan sediments. Faults and/or fault-related features were not observed in this unit.

TRENCH ALIGNMENT WT-2:

Trench alignment WT-2 consists of a single trench approximately 175 feet long located approximately 350 feet west of WT-1A. Located on the scarp of the South Branch SAFZ, the trench exposes a fault zone with strikes that vary from approximately N55W to N71W, which includes the following features:

- granitic landslide materials at the base of the trench exposure in the scarp face in fault contact with massive, sheared, fault zone sediments,
- a colluvium-filled graben, coinciding with a linear topographic trough, bounded to the north by a zone of very-closely spaced, south-dipping shears and fractures, and to the south by north-dipping faults,
- a progression of north-dipping faults of apparent thrust offset with southward shallowing dips, separating materials of the fault zone from alluvial-fan deposits to the south, and
- alluvial-fan deposits (Qyfl) locally faulted and warped in the southern reach of the fault zone along low-angle thrust faults.

The northern limit of surface deformation associated with the South Branch SAFZ at the location of WT-2 was not observed as this trench did not extend north of the topographic scarp. The southern limit of surface deformation is indicated by the location of the toe of a topographic scarp and the presence of continuous, flat-lying units of the alluvial-fan materials near Station 96. The zone of deformation is inferred to be at least 100 feet wide at this location, as the northern limit was not observed, but is implied by the presence of bedrock in the scarp face as observed in WT-1A.



The reach of WT-2 located south of the South Branch SAFZ exposed flat-lying, laterally continuous, and unfaulted alluvial-fan deposits that consist primarily of interbedded debris flow units expressed as cobble beds with a silty sand matrix and an overlying matrix-dominated debris flow unit.

TRENCH ALIGNMENT WT-3:

Trench alignment WT-3 includes three trenches (WT-3A, -3B, and -3C) totaling approximately 1,040 feet in length. These are located between 350 and 650 feet west of WT-2.

WT-3A extends southeastward down a narrow bedrock ridge (exposing pervasively fractured granitic landslide deposits) and into an alluviated bench, and terminates north of the South Branch SAFZ. The alluvium consists of massive, fine- to medium-grained, silty sand deposited onto the southward-dipping landslide deposit surface and was saturated at a depth of approximately 10 feet below ground surface (bgs). Caving and raveling of the trench walls south of Station 420 occurred subsequent to logging of the exposure. Abundant fractures and shear surfaces were observed within the landside materials that locally included deformed mafic and aplitic dikes; however, through-going, tectonic-fault-related features were not observed. A 24-inch-wide zone of cemented, fractured rock bounded by residuum derived from granitic material was observed at Station 390. This feature was surveyed and noted as a possible continuation of the Mill Creek fault based on its location along the trend of this fault.

WT-3B was excavated to provide continuity of exposure between the south end of WT-3A and WT-3C. The presence of shallow groundwater in deep, younger soils north of the end of WT-3C prevented a northward extension of WT-3C. Located across a scarp of the South Branch SAFZ, the trench exposes a fault zone with strikes that vary from N47W to N80W, which includes the following features:

- a thick accumulation of massive, fine-grained sediments located north of the topographic high formed by the scarp of the South Branch SAFZ that are locally faulted and bounded to the south by a north-dipping fault,
- a progression of north-dipping faults of apparent thrust offset with southward shallowing dips, separating fine-grained alluvial materials from coarse-grained alluvial-fan deposits to the south, and
- alluvial-fan deposits (Qyfl) faulted and warped in the southern reach of the fault zone along low-angle thrust faults that locally place older materials above relatively younger dark gray soils of the upper ground surface.



The northern limit of surface deformation associated with the South Branch SAFZ at the location of WT-3B is suggested to be located at Station 35 based on lack of observed faults north of this location. However, the massive fabric and young age of the materials exposed north of this location prevents a conclusive determination of lack of surface rupture. The southern limit of surface deformation is indicated by the location of the toe of a topographic scarp and presence of continuous, flat-lying units of the alluvial-fan materials overlain by a reddish-brown pedogenic (argillic) surface horizon near Station 200. The width of the zone of deformation is at least 150 feet wide at the location of WT-3B.

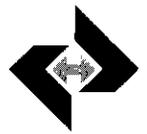
The reach of WT-3B located south of Station 200 exposed flat-lying, laterally continuous, and unfaulted alluvial-fan deposits that consist primarily of interbedded debris flow units expressed as cobble beds with a silty sand matrix.

WT-3C is located approximately 150 feet west of WT-3B and exposed alluvial-fan deposits that are correlative with the materials exposed at the south end of WT-3B. Subtle indications of faulting within the alluvial-fan deposits are indicated by the following:

- the presence of subdued topographic and buried scarps above the projections of low-angle, south-dipping faults,
- the presence of a south-dipping silt bed truncated by a fault near the bottom of the trench at Station 25,
- an accumulation of larger cobble- and boulder-size clasts near the surface at Station 50 above the projection of a fault, suggesting a colluvial-wedge feature, and
- the absence of the pedogenic horizon that is present north of Station 45 south of the colluvial-wedge feature, suggesting uplift north of the fault, resulting in stripping of the soil to the south.

The northern limit of surface deformation associated with the South Branch SAFZ at the location of WT-3C was not observed, as this trench exposes the southern limit of the fault zone. The southern limit of surface deformation at the location of WT-3C is indicated by the location of the toe of the topographic scarp at Station 54 and the presence of continuous, flat-lying units of the alluvial-fan materials south of Station 54.

The reach of WT-3C located south of Station 54 exposed relatively flat-lying, laterally continuous, and unfaulted alluvial-fan deposits that consist primarily of interbedded debris flow units expressed as cobble beds with a silty sand matrix interbedded with fluvial channel deposits of sand and gravel.



TRENCH ALIGNMENT WT-4:

Trench alignment WT-4 is located approximately 300 feet west of WT-1A and extends across a topographic bench and scarp formed by a bedrock landslide deposit. WT-4 was excavated to evaluate several roughly east-west trending lineaments indicated by topographic steps and tonal contacts visible on aerial photographs. The materials exposed in WT-4 consist of pervasively fractured and sheared granitic rocks varying from relatively large, intact blocks of monzogranite (unit Kmg) to several feet in diameter to very fine-grained, blocky material of indeterminate original composition (hydrothermally-altered intrusive?) with dark mineral coatings on closely-spaced fracture surfaces. Locally, mafic and aplitic dikes are preserved within the rock mass.

Geologic contacts separating materials of contrasting fabric and color (possibly original intrusive contacts) were observed near Stations 110 and 180 and approximately correspond to the trend of lineaments (possible faults) identified in aerial photographs along the trend of the Mill Creek fault. Based on a lack of through-going, tectonic-fault-related features observed in trench exposures at these locations, this correspondence of contact location to the Mill Creek fault appears to be coincidental. The presence of Pleistocene-age soils (an estimated minimum age) overlying the Mill Creek fault strand just east of WT-4 implies that the area of WT-4 would have been overlain by sufficient overburden (since removed by erosion) to confine the landslide materials and generate a distinct, through-going fault plane if fault activity occurred along the Mill Creek fault subsequent to formation of the landslide deposits. We interpret that subsequent erosion of this overburden would expose a well-defined fault zone within the landslide deposits. We did not observe this postulated fault zone in WT-4, suggesting that the landslide formed subsequent to major activity along the Mill Creek fault. Because of the uncertainty related to interpretations of these contacts, these features are depicted as a postulated continuation of the Mill Creek fault in the area of the landslide deposits.

South of Station 210, the trench alignment descends a south-facing slope to its termination. Materials forming the slope include granitic materials described above in contact with a fine-grained, arkosic sandstone unit (Tc - landslide deposits) near the toe of the slope. These units are separated by a shear plane striking EW and dipping 33 degrees to the north. The trend of this shear plane projects eastward to the basal shear plane exposed at Station 1065 in WT-1A and likely represents the same feature. The presence of fine-grained, reddish-brown alluvium (a residuum formed from the arkosic sandstone as observed in the east parcels area?) in the foot wall of the shear plane in WT-1A and orientation of the shear plane in WT-4 suggest that the basal shear plane of the landslide forms a major lithologic contact between the granitic and sandstone bedrock units. East of Badger Creek this contact is formed by the



Mill Creek fault. It appears that this lithologic boundary (fault) is translated southward by the landslide deposit. The sandstone exposed in WT-4 is faulted along several north-dipping structures that juxtapose color contrasts within the sandstone. A single, near-vertical fault (N45W, 88SW) is located near Station 331. This fault is truncated by a low-angle feature and does not extend to the modern ground surface.

TRENCH ALIGNMENT WT-5:

Trench alignment WT-5 is located approximately 250 feet west of WT-4 and extends across the topographic bench formed by the bedrock landslide deposit described previously in the discussion of WT-4. WT-5 was excavated to evaluate two roughly east-west trending lineaments indicated by topographic steps and tonal contacts visible on aerial photographs. The geologic units exposed in WT-5 are correlative with the materials observed in WT-4. A lithologic contact similar to that observed near Station 110 of WT-4 was observed near the south end of the trench near Station 340. A steeply-dipping fault (N87W, 86NE) was observed at Station 115 and corresponds with a topographic bench feature and the trend of a curvilinear tonal contact identified in aerial photographs. This fault appears to be a feature internal to the landslide mass based on its curvilinear trend (southward deflection during landslide emplacement) and lack of expression in the alluvial deposits east of the landslide body. This feature is more moderately expressed as a fault (N64W, 86NE) in WT-6 located along the tonal trend indicated on the aerial photographs. WT-5 did not expose the arkosic sandstone unit (Tc).

TRENCH ALIGNMENT WT-6:

Trench alignment WT-6 is located approximately 320 feet west of WT-5 and exposes materials of the bedrock landslide deposit described previously. WT-6 was excavated to evaluate the westward continuation of the lineaments investigated by WT-5. The geologic units exposed in WT-6 are correlative with the materials observed in WT-4 and WT-5. A fault (N64W, 86NE) located near Station 90 (described previously in the discussion of Trench WT-5) is located along a tonal trend indicated on the aerial photographs. This fault is internal to a single geologic unit. A contact similar to that near Station 110 of WT-4 and Station 340 of WT-5 was observed in the trench near Station 115.

A steeply-dipping fault (N59W, 82NE) was observed at Station 188 to be truncated by the basal shear plane of a (now) shallow landslide deposit that is exposed in the trench from Station 175 to Station 225. This fault may represent a westward continuation of the Mill Creek fault and is depicted as such on the Geologic Map and Site Plan (Enclosure "A-4"). The basal shear plane is formed in well-cemented, tight bedrock material. Upper plate materials in this landslide deposit are similar to the geologic unit exposed on the north side of the truncated fault. WT-6 did not expose the arkosic sandstone unit (Tc).



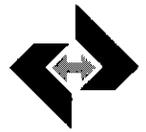
TRENCH ALIGNMENT WT-7:

Trench alignment WT-7 includes two segments (WT-7A and -7B) totaling approximately 300 feet in length and is located approximately 300 feet west of WT-3A. WT-7A trends down a steep, south-sloping ridge and bends to the southwest near its midpoint. The trench exposed granitic landslide materials correlative to the landslide units exposed in trenches WT-3A, -4, -5, and -6 in the northern reach of the trench that are overlain by alluvium in the more moderately-sloping southern reach. The alluvium consists of massive, fine- to medium-grained sand and sandy silt derived from slopewash and ponding of materials north of the South Branch SAFZ. These materials are correlative to materials exposed along the southern reach of trench WT-3A and were saturated at shallow depths. Caving and raveling of the trench walls south of Station 150 occurred subsequent to logging of the exposure and prevented excavation of a continuous trench to the location of WT-7B. Trench WT-7A did not expose obvious indications of through-going faults or fault-related features. The presence of youthful sediments and saturated soil conditions appear to preclude well-defined expression of faulting within the trench reach and depth.

Based on the well-defined geomorphic expression of the linear trough of the South Branch SAFZ south of the caving trench section of WT-7A, we located the north end of WT-7B to avoid caving conditions and expose the South Branch SAFZ. WT-7B is approximately 100 feet long and trends southward from the South Branch SAFZ down a scarp face and into alluvial-fan deposits mapped by Miller et al. (2001) as Qof3. The trench exposed a fault zone with strikes that vary from approximately N58W to N80W, which includes the following features:

- granitic landslide materials at the base of the exposure in the scarp face faulted against massive, sheared, fault-zone sediments,
- a colluvium-filled graben, coinciding with a linear topographic trough, bounded to the north by bedrock landslide deposits and to the south by a sharp color contact at north-dipping faults,
- a progression of north-dipping faults of apparent thrust offset with southward-shallowing dips, separating materials of the fault zone from alluvial-fan deposits to the south, and
- alluvial-fan deposits (Qyf1) locally faulted and warped in the southern reach of the fault zone along low-angle thrust faults.

The northern limit of surface deformation associated with the South Branch SAFZ was not observed in the WT-7 alignment, as these trenches did not expose bedded sediments that could preclude the presence of such features. The southern limit of surface deformation is indicated by the location of the toe of a topographic scarp and the presence of continuous, flat-lying units of alluvial-fan materials near WT-7B,



Station 57. The width of the zone of deformation is at least 100 feet wide and likely extends northward beyond the "gap" between WT-7A and -7B, as suggested by potential fault features in WT-7A, and the interpretation of a westward projection of the Mill Creek fault.

The reach of WT-7B located south of Station 57 exposed flat-lying, laterally continuous, and unfaulted alluvial-fan deposits that consist primarily of interbedded debris flow units expressed as cobble beds with a silty sand matrix.

TRENCH ALIGNMENT WT-8:

Trench alignment WT-8 consists of a single trench totaling approximately 180 feet in length located approximately 300 feet west of WT-7A. WT-8 trends down a steep, south-facing slope located north of the South Branch SAFZ in landslide terrain. The trench exposed granitic landslide materials correlative to units exposed in prior trenches overlain in depositional contact by massive, fine-grained sandy and silty alluvium.

A topographic scarp corresponding to the surface projection of a south-dipping fault (slide plane?) was observed near Station 40. The base of an alluvial unit offset by a fault (N56W, 90) was exposed near Station 67. A "wrinkled" sequence of beds was observed near Station 100, suggesting a landslide process. Additional faults within the alluvial units were observed near Stations 120 and 140 and include infilled fissures and fractures with gleyed coatings. Heavy water seepage was encountered at the alluvium/bedrock contact resulting in caving and raveling of the trench walls south of Station 130 subsequent to logging. We interpret the materials exposed in WT-8 as landslide deposits based on the presence of south-dipping, low-angle shear planes and surface morphology of the trench area. Liquefaction of the alluvial sediments is suggested by sandy infill within a fissure exposed at Station 137. The presence of modern scarps at the ground surface indicate either primary or sympathetic recent landslide movement (Holocene age) caused by shaking generated by the SAFZ or other nearby active faults.

TRENCH ALIGNMENT WT-9:

Trench alignment WT-9 includes two trenches (WT-9A, -9B) totaling approximately 650 feet in length. WT-9A is located approximately 500 feet west of WT-7B and assumes a southwesterly trend near the base of the South Branch SAFZ scarp to avoid a drainage feature. The trench alignment includes a gap where it crosses the trend of the high-pressure water line easement and extends approximately 80 feet south of the APZ boundary. The western property boundary is approximately 400 feet west of the south end of the WT-9 alignment as measured along the trend of the APZ boundary.



The northern reach of WT-9A exposed the South Branch SAFZ and includes the following fault features:

- the southern portion of a colluvium-filled graben, coinciding with a linear topographic trough located just north of the trench end, and bounded to the south by a sharp color contact at north-dipping faults,
- a progression of north-dipping faults of apparent thrust offset with southward-shallowing dips, separating materials of the fault zone that include granitic landslide deposits from alluvial-fan deposits to the south, and
- alluvial-fan deposits (Qof2) locally faulted and warped in the southern reach of the fault zone along low-angle thrust faults.

The northern limit of surface deformation associated with the South Branch SAFZ was not observed in WT-9A as this trench did not extend north of the linear trough feature. The southern limit of surface deformation is indicated by the location of the toe of a topographic scarp and presence of continuous, flat-lying units of the alluvial-fan materials near Station 80. The zone of deformation is inferred to be at least 150 feet wide at this location as the northern limit was not observed, but is implied by topographic features including scarps north of the South Branch scarp face and an inferred westward projection of the Mill Creek fault.

The reach of WT-9A located south of Station 80 and WT-9B exposed relatively flat-lying, laterally continuous, and unfaulted alluvial-fan deposits that consist of fluvial channel deposits (sand and gravel units) interbedded with debris flow units expressed as cobble beds with a silty sand matrix. A reddish-brown soil horizon is developed near the fan surface.

TRENCH ALIGNMENT WT-10:

Trench alignment WT-10 consists of one trench approximately 280 feet in length and was limited in depth north of the fault due to the presence of water seepage and potential trench wall collapse. WT-10 is located approximately 300 feet west of WT-9A and trends down the south-facing scarp of the South Branch SAFZ. Trench WT-10 exposed the South Branch SAFZ and includes the following fault features:

- a thick accumulation of fine-grained alluvial deposits "ponded" behind a low topographic rise (shutter ridge) formed by the fault zone,
- a small graben structure infilled by young colluvium coinciding with a linear trough, and bounded to the south by a sharp color contact at north-dipping faults,



- a progression of north-dipping faults of apparent thrust offset with southward shallowing dips, separating materials of the fault zone, including granitic landslide deposits and consolidated carbonate-cemented alluvium, from alluvial-fan deposits (Qof2) to the south,
- alluvial-fan deposits (Qof2) locally faulted and warped in the southern reach of the fault zone along low-angle thrust faults, and
- a fold formed in older alluvial-fan deposits defined by a north-dipping fault and south-dipping gravel beds.

The northern limit of surface deformation associated with the South Branch SAFZ was not observed in WT-10 as this trench did not extend north of the linear trough feature. It is inferred that faults associated with the westward extension of the Mill Creek fault may be present beneath the alluvial cover north of the trench, as this area is located near the inferred junction of the Mill Creek fault and South Branch SAFZ. The southern limit of surface deformation is indicated by the location of the toe of a prominent topographic scarp and presence of continuous, flat-lying units of the alluvial-fan materials near Station 176. The width of deformation defined in this exposure indicates a zone at least 150 feet wide. The northern limit of deformation was not directly observed, but is implied by the width of directly-observed faulting in WT-11 and inferred westward projection of the Mill Creek fault to be north of the trench termination.

The reach of WT-10 located south of Station 176 exposed laterally continuous and unfaulted alluvial-fan deposits that consist of fluvial channel deposits (sand and gravel units) interbedded with debris flow units expressed as cobble beds with a silty sand matrix. A reddish-brown soil horizon developed at the fan surface also suggests a lack of surface deformation.

TRENCH ALIGNMENT WT-11:

Trench alignment WT-11 consists of a single trench approximately 510 feet in length located approximately 300 feet west of WT-10. Trench WT-11 follows a south-trending bedrock ridge, crosses an area of ponded alluvium, traverses a linear trough, and descends the scarp of the South Branch SAFZ. Trench WT-11 exposed granitic landslide deposits in its northern reach and the South Branch SAFZ (a zone of deformation approximately 240 feet wide at this location). The following fault features were observed:

- a thick accumulation of fine-grained alluvial deposits "ponded" behind a low topographic rise (shutter ridge) formed by the fault zone,



- a large graben structure (approximately 20 feet wide) infilled by young colluvium coinciding with a linear trough, and bounded to the north by granitic landslide deposits and to the south by a sharp color contact at north-dipping faults,
- a progression of north-dipping faults of apparent thrust offset with southward-shallowing dips, separating materials of the fault zone, including granitic landslide deposits and consolidated carbonate-cemented alluvium, from alluvial-fan deposits (Qof2) to the south, and
- alluvial-fan deposits (Qof2) locally faulted and warped in the southern reach of the fault zone along low-angle thrust faults.

The northern limit of surface deformation associated with the South Branch SAFZ may be defined by a fault in the granitic landslide deposits at Station 205; however, a smaller potential fault feature was observed at Station 173 and may indicate a more northerly limit of deformation. The southern limit of surface deformation is indicated by the northern limit of continuous, flat-lying units of the alluvial-fan materials near Station 445. The width of deformation defined in this exposure indicates a zone approximately 275 feet wide. We interpret the apparent westward increase of the width of deformation along the South Branch SAFZ, defined by trench exposures and geomorphic relations, as an indication that faults associated with the westward extension of the Mill Creek fault merge into the South Branch SAFZ near the western portion of the site forming a wider zone of deformation.

The reach of WT-11 located south of Station 445 exposed laterally continuous, unfaulted alluvial-fan deposits (Qof2) that consist of fluvial channel deposits (sand and gravel units) interbedded with debris flow units expressed as cobble beds with a silty sand matrix. A reddish-brown soil horizon is developed at the fan surface.

TRENCH EXPOSURES - EAST PARCELS

TRENCH ALIGNMENT ET-1:

Trench alignment ET-1 consists of a single trench approximately 140 feet in length located adjacent to the eastern project boundary. Trench ET-1 descends the steep scarp of the South Branch SAFZ and exposed sandstone bedrock (Tc), colluvium, and alluvial-fan deposits (Qvof). The following fault features were observed:

- a portion of a graben structure infilled by younger colluvium coinciding with a linear topographic trough, and bounded to the south by north-dipping faults,



- a progression of north-dipping faults of apparent thrust offset with southward shallowing dips, separating materials of the fault zone, including reddish arkosic sandstone (Tc), from alluvial-fan deposits (Qvof) to the south,
- fault-ruptured and tilted scour contacts between reddish-brown sandstone (Tc) and an overlying yellowish-brown alluvial-fan unit,
- alluvial-fan deposits (Qvof) locally faulted and warped in the southern reach of the fault zone along low-angle thrust faults, and
- an accumulation of colluvium (colluvial wedge?) overlying alluvial-fan deposits along a flat-lying contact.

Faults were measured to strike between N58W and N68W and dip between 11 and 73 degrees to the northeast.

The northern limit of surface deformation associated with the South Branch SAFZ at the location of ET-1 falls outside of the northern project boundary and was not observed in ET-1. The southern limit of surface deformation at the location of ET-1 is indicated by the location of the toe of a topographic scarp, the presence of continuous, flat-lying units of the alluvial-fan materials near Station 85, and a reddish-brown soil horizon developed near the ground surface.

The reach of ET-1 located south of Station 85 exposed relatively flat-lying, laterally continuous, and unfaulted alluvial-fan deposits that consist of fluvial channel deposits (sand and gravel units) interbedded with debris flow units expressed as cobble beds with a silty sand matrix. A reddish-brown soil horizon is developed near the fan surface.

TRENCH ALIGNMENT ET-2:

Trench alignment ET-2 consists of two trenches (ET-2A and -2B) approximately 210 feet and 325 feet in length, respectively. The alignment is located approximately 550 feet west of ET-1 and extends to the southern property limit. The APZ boundary is located approximately 130 feet south of ET-2B. Alignment ET-2 descends the steep scarp of the South Branch SAFZ and exposed sandstone bedrock (Tc), colluvium, and alluvial-fan deposits (Qvof). The following fault features were observed:

- a small graben structure infilled by younger colluvium coinciding with a linear trough, and bounded to the south by north-dipping faults,



- a progression of north-dipping faults of apparent thrust offset with southward shallowing dips, separating materials of the fault zone, including reddish arkosic sandstone (Tc), from alluvial-fan deposits (Qvof) to the south,
- fault-ruptured and tilted scour contacts between reddish-brown sandstone (Tc) and an overlying yellowish-brown alluvial-fan unit,
- bedding (defined by the orientation of elongate clasts) tilted steeply southward in an alluvial-fan unit,
- alluvial-fan deposits (Qvof) locally faulted and warped in the southern reach of the fault zone along low-angle thrust faults, and
- an accumulation of colluvium (colluvial wedge?) overlying alluvial-fan deposits including a pedogenic horizon along a flat-lying contact.

Faults were measured to strike between N38W and N60W and dip between 10 and 83 degrees to the northeast. A fault bounding the graben near the northern reach of ET-2A was observed to be oriented N55W, 86SW.

The northern limit of surface deformation associated with the South Branch SAFZ falls outside the northern project boundary at the location of ET-2A and was not observed. The southern limit of surface deformation is indicated by the location of the toe of a topographic scarp and presence of continuous, flat-lying units of alluvial-fan materials near ET-2A, Station 130.

The reach of ET-2A located south of ET-2A Station 130 and ET-2B exposed relatively flat-lying, laterally continuous, and unfaulted alluvial-fan deposits that consist of fluvial channel deposits (sand and gravel units) interbedded with debris flow units expressed as cobble beds with a silty sand matrix. A reddish-brown soil horizon is developed near the fan surface.

TRENCH ALIGNMENT ET-3:

Trench alignment ET-3 consists of a single trench approximately 155 feet in length located approximately 640 feet west of alignment ET-2 and 350 feet east of a parcel boundary. Alignment ET-3 descends the steep scarp of the South Branch SAFZ and exposed alluvial-fan deposits (Qvof) in fault contact with narrow slivers of sandstone (Tc). The alignment is located south of the South Branch SAFZ as indicated by the location of a linear trough north of the trench. The following fault features were observed:

- a progression of north-dipping faults of apparent thrust offset with southward shallowing dips, in alluvial-fan deposits (Qvof),



- a large wedge of fine-grained, reddish residuum (derived from unit Tc) bounded by shallowly north-dipping faults overlying alluvial-fan (Qvof) materials, and
- alluvial-fan deposits (Qvof) locally faulted and warped in the southern reach of the fault zone along low-angle thrust faults.

Faults were measured to strike between N50W and N60W and dip between 7 and 11 degrees to the northeast.

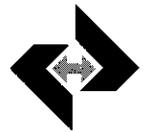
The northern limit of surface deformation associated with the South Branch SAFZ falls outside of the northern project boundary at this location. The southern limit of surface deformation is indicated by the location of the toe of the topographic scarp and presence of continuous, flat-lying units of alluvial-fan materials (Qvof) near ET-3 Station 105.

The reach of ET-3 located south of Station 105 exposed relatively flat-lying, laterally continuous, and unfaulted alluvial-fan deposits that consist of fluvial channel deposits (sand and gravel units) interbedded with debris flow units expressed as cobble beds with a silty sand matrix. A continuous, reddish-brown soil horizon is developed on the fan surface.

TRENCH ALIGNMENT ET-4:

Trench alignment ET-4 consists of a single trench approximately 650 feet in length located approximately 600 feet west of alignment ET-3 and 80 feet west of a parcel boundary. The southern end of the alignment coincides with the parcel boundary and APZ boundary. The presence of an active drainage channel located west of the trench prevented exploration beyond the APZ boundary at this location. Alignment ET-4 descends a more subdued, eroded scarp of the South Branch SAFZ and exposed alluvial-fan deposits (Qof3 and Qvof). The alignment is located south of the South Branch SAFZ as indicated by the location of a linear trough north of the trench. The following fault features were observed:

- subtle but recognizable fractures defined by subvertical gley streaks in-massive alluvial units near the north end of the trench exposure, and
- apparent discontinuity of alluvial beds defined by subtle truncations (possibly channel scour and backfill activity) suggesting the location of potential faults.



Well-defined faults were not observed in the exposure.

The northern limit of surface deformation associated with the South Branch SAFZ is located north of the northern project boundary at this location. The southern limit of surface deformation is suggested by the location of the toe of a topographic scarp and presence of continuous, flat-lying units of alluvial-fan materials (Qvof) near ET-4 Station 120.

The reach of ET-4 located south of Station 120 exposed relatively flat-lying, laterally continuous, and unfaulted alluvial-fan deposits that consist of fluvial channel deposits (sand and gravel units) interbedded with debris flow units expressed as cobble beds with a silty sand matrix.

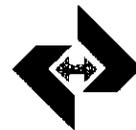
TRENCH ALIGNMENT ET-5:

Trench alignment ET-5 consists of a single trench approximately 110 feet in length located approximately 600 feet west of ET-4. Alignment ET-5 is located south of the steep scarp of the South Branch SAFZ in a small beheaded drainage on level ground. The trench exposed massive, fine-grained, young alluvial/colluvial deposits (Qyfl) containing localized cobble beds. The alignment is located south of the South Branch SAFZ as indicated by the location of a linear trough north of the trench. Faults were not observed within the depth of the trench.

TRENCH ALIGNMENT ET-6:

Trench alignment ET-6 consists of a single trench approximately 170 feet in length located approximately 70 feet west of the south end of ET-5, 20 feet west of a parcel corner, and 350 feet east of a parcel boundary. Alignment ET-6 traverses a portion of the South Branch SAFZ, follows a south-trending ridge, and terminates at the top of a steep, stream-modified scarp. The trench exposed arkosic sandstone (Tc) in fault contact with alluvial-fan deposits (Qvof). The alignment is located south of the South Branch SAFZ as indicated by the presence of a linear trough located slightly north of the trench. The following fault features were observed:

- a progression of north-dipping faults internal to a sandstone unit and as a fault contact between the sandstone and alluvial-fan deposits,
- fault scarps in the sandstone surface mantled by younger colluvium,
- alluvial-fan deposits (Qvof) locally faulted and warped in the southern reach of the trench based on bedding orientations inferred from elongate clasts and scour contacts.



Faults were measured to strike between EW and N75W and dip between 40 and 60 degrees to the northeast.

The northern limit of surface deformation associated with the South Branch SAFZ is located north of the trench alignment in a hillside area outside of the project boundary. We infer the southern limit of deformation to be approximately 60 feet south of the end of ET-6 based on the interpretation that the topographic scarp of the South Branch SAFZ has been modified by recent, ongoing stream erosion, and with consideration of fault trends visible in aerial photographs.

TRENCH ALIGNMENT ET-7:

Trench alignment ET-7 consists of a single trench approximately 285 feet in length located approximately 400 feet west of ET-6 and 40 feet east of the parcel boundary. The southern end of alignment ET-7 terminates in fill associated with a high-pressure water line easement approximately 60 feet north of the property boundary. Trench ET-7 terminates approximately 230 feet north of the APZ boundary. Limitations on explorations outside of the property boundary and the presence of the easement of the high-pressure water line prevented exploration to the southern parcel boundary and APZ boundary. The presence of a heavily-trafficked roadway prevented extension of the alignment to the north to intercept the South Branch SAFZ. Alignment ET-7 is located approximately 80 feet south of a gouge zone exposed in a stream cut (inferred to be the South Branch SAFZ based on geomorphic and aerial photographic evidence) and exposed a thick sequence of alluvial-fan deposits of early Holocene to late Pleistocene age (Qyfl).

The entire reach of ET-7 exposed relatively flat-lying, laterally continuous, and unfaulted alluvial-fan deposits (early Holocene to late Pleistocene age - Qyfl) that consist of fluvial channel deposits (sand and gravel units) interbedded with debris flow units expressed as cobble beds with a silty sand matrix. Based on the geomorphic expression of the South Branch SAFZ to the north of the trench, it appears that the sediments exposed in ET-7 represent an unfaulted interval with low potential for primary fault surface rupture. However, based on a westward, along-strike projection of the limit of deformation of the South Branch SAFZ through Trench ET-4 and ET-6 toward ET-7, we interpret a possible concealed fault located approximately 50 feet south of the north end of Trench ET-7. Recent stream activity near the mouth of Badger Creek and the presence of recent sediments apparently obscure a youthful expression of the South Branch SAFZ as a scarp feature at the location of alignment ET-7. This postulated fault location is depicted on Enclosure "A-4". This feature should be considered active for planning purposes.



ACTIVITY OF FAULTS:

We base the age of latest activity of the faults observed within the site based on the evidence observed in our trench exposures, geomorphic evidence, and historic seismicity. The trench exposures reveal evidence of surface-rupturing faults including young colluvial materials overlain by bedrock materials. Geomorphic evidence of recent faulting consists of abundant fault-related topographic features and offset of Holocene-age geologic materials. Historic, large-magnitude earthquake events on segments of the SAFZ located north and south of the site attest to the potential for future surface-rupturing events on the SAFZ within the site boundaries. The faults associated with the South Branch SAFZ are demonstrably active features capable of generating large lateral (10s of feet) and significant vertical shifting and offset of the ground surface along the South Branch SAFZ within the extent of the site.

It appears that the Mill Creek strand is inactive in terms of Holocene-age faulting based on the exposure in WT-1A and geomorphic relations east of Badger Creek. However, given the proximity of the Mill Creek strand to the demonstrably active South Branch SAFZ and potential for the SAFZ to generate large- intensity seismic events possibly resulting in sympathetic movement along the Mill Creek fault strand, a prudent treatment of the Mill Creek fault within the site should include a restricted use zone for placement of structures according to APZ guidelines. A similar treatment of the North Branch SAFZ is recommended.

RECOMMENDED RESTRICTED USE ZONES (RRUZ):

For the portions of the site north of a line located 50 feet south of and parallel to the defined and surveyed zone of deformation for the South Branch SAFZ, we recommend a RRUZ to preclude placement of structures for human occupancy according to the requirements of the Alquist-Priolo Earthquake Fault Zoning Act and the requirements of the City of San Bernardino. This zone should extend along the mapped projection of the South Branch SAFZ within the property boundaries.

Lazarte et al. (1994) discuss observations of the width of surface rupture zones measured along the system of faults that ruptured during the M_w 7.3 Landers earthquake. This system of faults had a nearly pure strike-slip focal mechanism and exhibited primarily right-lateral surface displacement, similar to the type of movement anticipated along the South Branch SAFZ within the site. In addition, a typical amount of strike-slip offset was measured as 2 to 3 meters (6.6 to 9.8 feet) with a maximum offset of 6 meters (19.5 feet). These values of right-lateral offset are within the range expected for the South Branch SAFZ within the site (approximately 3.3 meters) based on an average slip rate of 24mm/year (Cao and others, 2003) and an average recurrence interval of approximately 140 years. The rupture zones created



during slippage of faults along the Landers rupture zone were observed to become wider and more diffuse within unconsolidated materials (such as young alluvium). Based on the observations of ground deformation formed during the Landers earthquake, the presence of unconsolidated, younger alluvial fan deposits derived from Badger Creek near the area of Trench ET-7 indicates a potential for diffuse ground deformation to occur near the South Branch SAFZ in the northwest portion of the East Parcels area. Accordingly, we recommend that the RRUZ for the East Parcels include the northern reach of ET-7. This recommendation is consistent with the width of the zone of deformation in the remainder of the East Parcels area (approximately 200 feet south of the "main" trace of the South Branch SAFZ as defined by a linear topographic trough feature).

For the Mill Creek and North Branch SAFZ faults west of Badger Creek, the RRUZ should consist of a zone extending 50 feet north and south of and parallel to the mapped fault traces. The inclusion of the remainder of the area located north of the South Branch SAFZ is a result of the presence of bedrock landslide deposits and deep, young alluvium that does not allow accurate determination of fault presence/absence near the surface and/or activity in exposed bedrock faults. The limits of the RRUZ are depicted on Enclosure "A-4". The control points for faults defining the RRUZ were set in the field by this firm and were surveyed by PBS&J. The surveyed points and limits of the RRUZ are shown on Enclosure "A-4".

As stated previously, the entire site area located northeast of the South Branch SAFZ is located within the RRUZ designated in this report. Should additional investigation of landsliding in the area of the RRUZ provide recommendation for mitigation of the landslide hazard, certain areas currently within the RRUZ may be removed from that classification.

OFF-FAULT DEFORMATION:

The potential for off-fault deformation associated with movement along the faults identified within the site is addressed by establishment of the RRUZ within the site. We utilized a conservative approach in defining the zone of deformation of the South Branch SAFZ within the site that includes a consideration of surface warping based on topographic evidence, the presence or absence of colluvial accumulations near the surface projection of low-angle faults, and pedogenic evidence of surface stability. A consideration of along-strike projection of the zone of deformation was utilized for the area of the site near the mouth of Badger Creek where recent stream activity apparently obscures the expression of faulting. Deformation outside of a zone extending more than 50 feet laterally and south of the identified zone of deformation for the South Branch SAFZ is not anticipated.



REGIONAL TECTONIC SETTING

The tectonics of the Southern California area are dominated by the interaction of the North American Plate and the Pacific Plate, which are sliding past each other in an apparently translational manner. Although some of the motion may be accommodated by rotation of crustal blocks such as the Western Transverse Ranges (Dickinson, 1996), the SAFZ is thought to represent the major surface expression of this tectonic boundary and to be accommodating most of the translational motion between the Pacific Plate and the North American Plate. However, some of the plate motion is accommodated along other northwest-trending strike-slip faults that are thought to be related to the San Andreas system, such as the San Jacinto fault and the Elsinore fault. Local compressional or extensional strain resulting from the translational motion along this boundary is accommodated by left-lateral, reverse, and normal faults, such as the Cucamonga fault, the Crafton Hills fault zone, and the blind thrust faults of the Los Angeles Basin (Matti and others, 1992; Morton and Matti, 1993).

SAN ANDREAS FAULT ZONE:

As discussed previously, the SAFZ is located along the southwest margin of the San Bernardino Mountains and is a prominent feature of the site. The toe of the mountain front from the southern Cajon Pass area to San Geronio Pass roughly demarcates the presently active trace of the South Branch SAFZ, which is characterized by youthful fault scarps, vegetational lineaments, springs, and offset drainages. The South Branch SAFZ (also known as the San Bernardino segment, or Mission Creek segment to the southeast) traverses the site and was exposed in most of the trench excavations at the site during this study. The Working Group on California Earthquake Probabilities (1995) tentatively assigned a 28 percent (± 13 percent) probability to a major earthquake occurring on the South Branch SAFZ between 1994 and 2024. The State of California has designated an Alquist-Priolo Earthquake Fault Zone to include traces of potentially active (Quaternary) faulting associated with the South Branch SAFZ. Several other strands of the SAFZ of various ages of activity pass through or near the site and are described below.

Mill Creek Branch:

The Mill Creek branch of the San Andreas fault is a major structural boundary with respect to the basement rock type in the San Bernardino Valley. Within the site, the Mill Creek branch forms the contact between granitic rocks on the north and sandstone on the south as it traverses the upland portion of the site approximately 600 feet north of the South Branch SAFZ. In Mill Creek, located southeast of the site, the fault juxtaposes predominantly granitic rocks along the north side against predominantly gneissic



rocks and Tertiary-age sediments against the south side. East of Badger Creek, the fault is clearly visible on aerial photographs as a linear tonal contact in bedrock terrain. West of Badger Creek, this trace is obscured by landslide deposits and younger alluvium. The State of California has designated an Alquist-Priolo Earthquake Fault Zone to include traces of potentially active (Quaternary) faulting associated with the Mill Creek branch. The state of activity of the Mill Creek fault is not known with certainty; however, the presence of (apparently) Pleistocene-age pedogenic surfaces (soils) overlying the trace of the fault west and east of Badger Canyon suggest that the fault is not active according to APZ guidelines. As discussed previously in the section on Recommended Restricted Use Zones, we treat the Mill Creek fault within the site as an active feature capable of movement during future seismic events on the nearby South Branch SAFZ.

North Branch:

The North branch of the San Andreas fault is a major structural boundary with respect to the basement rock type in the upland area north of the site. The North branch fault forms the contact between metamorphic terrain on the north and granitic rocks on the south, and is clearly visible on aerial photographs as a tonal contact and topographic feature. The fault is well exposed in a road cut approximately 100 feet north of Trench WT-1A.

OTHER FAULTS:

The Crafton Hills are formed by a system of normal dip-slip faults that trend from the Live Oak Canyon area to the San Andreas fault to the northeast (Matti and others, 1992). The Reservoir Canyon (Crafton) fault, which forms the northwest boundary, is located approximately 14 miles southeast of the site as mapped by Matti and others (1992). The Western Heights fault forms the southeast boundary and is located approximately 18 miles east-southeast of the site as mapped by Matti and others (1992). The Western Heights fault is included within a designated Alquist-Priolo Zone to include traces of suspected active faulting.

The "main" trace of the San Jacinto fault is located approximately 4 miles southwest of the site. The San Jacinto fault zone is a system of northwest-trending, right-lateral, strike-slip faults. More large historic earthquakes have occurred on the San Jacinto fault than any other fault in Southern California (Working Group on California Earthquake Probabilities, 1988). Based on the data of Matti and others (1992), the San Bernardino Valley segment of the San Jacinto fault may be accommodating much of the motion between the Pacific Plate and the North American Plate in this area. Matti and others (1992) suggest this motion is transferred to the San Andreas fault in the Cajon Pass region by "stepping over" to parallel



fault strands which include the Glen Helen fault. The Working Group on California Earthquake Probabilities (1995) tentatively assigned a 37 percent (± 17 percent) probability of a major earthquake on the San Bernardino Valley segment of the San Jacinto fault for the 30-year interval from 1994 to 2024.

The Cleghorn fault (also known locally as the Silverwood Lake fault), a steeply-dipping, left-lateral strike slip fault within the San Bernardino Mountains, is located approximately 6 miles north of the site. The age of activity of the Cleghorn fault is estimated as Quaternary.

HISTORICAL SEISMICITY

A map of recorded earthquake epicenters archived in a computer database that includes events from 1977 to 2005 for earthquakes of magnitude 4 or greater within a radius of 100 kilometers/miles of the site is included as Enclosure "A-5" (Epi Software, 2000).

No large earthquakes have occurred on the South Branch (San Bernardino segment) of the San Andreas fault within the regional historical time frame. Using dendrochronological evidence, Jacoby and others (1987) inferred that a great earthquake ruptured the northern reaches of this segment on December 8, 1812. Trenching studies have revealed evidence that rupture on the San Andreas fault at Wrightwood occurred within this time frame (Fumal and others, 1993). Comparison of rupture events at the Wrightwood and Pallett Creek sites and analysis of reported intensities at the coastal missions led Fumal and others (1993) to conclude that the December 8, 1812 event ruptured the San Bernardino Mountains segment of the San Andreas fault largely to the southeast of Wrightwood, possibly extending into the San Bernardino Valley.

Surface rupture occurred on the Mojave segment of the San Andreas fault in the great 1857 Fort Tejon earthquake. The Coachella Valley segment of the San Andreas fault was responsible for the 1948 **M** 6.5 earthquake in the Desert Hot Springs area and for the 1986 **M** 5.6 earthquake in the North Palm Springs area. The 1986 quake ruptured the ground surface along the Banning fault at the northwest end of the Coachella Valley.

The Working Group on California Earthquake Probabilities (1988) lists seven **M** 6.0 or greater earthquakes that have occurred on the San Jacinto fault since 1899, although they acknowledge that several of these earlier episodes may have occurred on other nearby faults. Two of these earthquakes took place



in the San Bernardino Valley. A **M** 6.5 event in 1899 near Lytle Creek and a **M** 6.2 event in 1923 near Loma Linda may have occurred on the San Jacinto fault. However, Fife and others (1976) and Matti and Carson (1991) suggest that the 1923 event took place on an unnamed fault parallel to and east of the San Jacinto fault.

SEISMIC ANALYSIS

The precise relationship between magnitude and recurrence interval of large earthquakes for a given fault is not known due to the relatively short time span of recorded seismic activity. As a result, a number of assumptions must be made to quantify the ground shaking hazard at a particular site. Seismic hazard evaluations can be conducted from both a probabilistic and a deterministic standpoint. The probabilistic method was utilized to estimate the seismic hazard for the site during this investigation as prescribed by current codes.

The probabilistic analysis of seismic hazard is a statistical analysis of seismicity of all known regional faults and seismic sources attenuated to a particular geographic location. The results of a probabilistic seismic hazard analysis (PSHA) are presented as the annual probability of exceedance of a given strong motion parameter for a particular exposure time (Johnson and others, 1992).

For this report, the seismic hazard analysis computer program EZFRISK, version 7.14 (Risk Engineering, 2005) was used to analyze the location of the site under the criteria for "soil" and "rock" site types with an average shear wave velocity of 270 m/s and 760 m/s in the upper 30 meters (100 feet), respectively. The estimated value for the peak ground acceleration (PGA) was calculated as the average of the accelerations computed using the attenuation relations of Boore et al. (1997), Sadigh et al. (1997), and Abrahamson and Silva (1997) in relation to seismogenic faults within a 93-mile (150-km) radius of the site. The EZFRISK program considers seismicity from mapped seismogenic faults and background sources (those earthquakes not associated with a mapped fault source) and assumes that the occurrence rate of earthquakes on a fault is proportional to the estimated slip rate of that fault. Potential earthquake magnitudes are correlated to expected seismic sources and the resultant maximum ground acceleration at the site is computed.

Based on the site-specific PSHA performed for the site, the estimated peak horizontal ground acceleration with a 10 percent probability of exceedance in 50 years (statistical return period of 475 years) for the "soil" and "rock" site classes are 0.80g and 0.72g, respectively. This corresponds to the Design Basis Earthquake as defined in the 2001 California Building Code (CBC).



SEISMIC ZONE:

The site is included within Seismic Zone 4. Table 16-I of the 2001 CBC assigns a Seismic Zone Factor "Z" of 0.4 to Seismic Zone 4.

NEAR-SOURCE EFFECTS:

The seismic hazard to this site is dominated by the South Branch (San Bernardino segment) of the San Andreas fault. The South Branch of the San Andreas fault is classified as a Type "A" fault by the State of California (Cao and others, 2003). The applicable near-source acceleration factor N_A , is 1.5, and the near-source velocity factor N_V is 2.0.

SOIL PROFILE TYPE:

The preliminary soil profile types for the site as defined by the 2001 CBC are estimated to be S_D , stiff soil, and S_c , very dense soil and soft rock, to account for variability in the materials at the site. The soil profile classifications should be verified during the recommended geotechnical investigation.

SLOPE STABILITY

The term "deep-seated landslide" as used in this report refers to slope failures with a thickness (in the zone of origination) greater than approximately 10 feet in depth. Deep-seated landslides extend through upper surficial soils into the underlying bedrock material. They are typically related to the underlying geologic structures such as bedding planes, foliation, jointing, or faulting. In contrast, surficial failures (debris flows) occur within the upper soil horizon and are typically unrelated to the underlying geologic structure. Both types of failures are common in steep mountainous terrain such as that located in the northern half of the site. The proximity of active faults capable of generating strong seismic shaking contributes to the potential for seismically-induced landslides.

The topography of the site is variable and locally includes relatively level areas adjacent to steep hillsides and ravines north of the SAFZ, and sloping alluvial fans south of the SAFZ. The materials at the site consist of moderately- to gently-sloping alluvial deposits south of the South Branch SAFZ and weathered bedrock landslide deposits and young alluvium north of the fault. Miller et al. (2001) did not map landslides on or adjacent to the site (within 1/4 mile). Based on our review of aerial photographs, field mapping, and trench exposures, we identified a large landslide complex, including individual landslides of various relative ages and areal extent formed in granitic rock, that constitutes the geologic materials of the northern portion of the site west of Badger Creek. Rasmussen and Associates (1990) previously

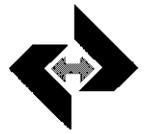


mapped several small landslides in the area of the landslide complex identified during our investigation but did not recognize the larger landslide body in their reconnaissance-level study. We infer a possible continuation of landslide deposits east of Badger Creek (off site) based on aerial photographs and geomorphic evidence. The limits of the landslide complex and outlines of individual landslides are shown on Enclosure "A-4". Individual landslide masses were identified based on geomorphic expression, aerial photograph review, and evidence (including slide planes) observed in the trench exposures.

The materials of the landslide complex are comprised of pervasively sheared granitic rock with relatively larger "intact" blocks of granite. The landslide materials contain an abundance of randomly-oriented, closely-spaced discontinuities (shear planes) that constitute potential planes of weakness. As observed in Trenches WT-1A, -2, -7B, -9A, -10, and -11, the landslide complex is bounded on the south by the South Branch SAFZ and extends north to the contact formed by the North Branch SAFZ. In the southern reach of WT-4, we observed granitic materials in contact with sandstone along a north-dipping, low-angle shear plane. This contact relationship and a similar contact exposed in a road cut located just east of WT-4 suggest the presence of a younger landslide deposit formed on/within the previously-emplaced (relatively older) landslide complex.

Based on the potential for exposing adversely-oriented discontinuities in graded slopes formed in the materials of the landslide complex and the seismic potential at the site, as a primary mitigative measure with regard to potential slope instability, we recommend avoidance of the area north of the South Branch SAFZ. As a second and equally valid measure, individual landslides or proposed building areas could be further investigated on an individual basis to assess the potential for static and dynamic slope stability using appropriate investigative techniques. The thickness of individual landslides and/or the landslide complex may preclude a conclusive result from such an investigation. In such a case, the primary mitigative measure would apply.

Debris flow scars were noted in slopes located in the upland area of the site and in adjacent off-site areas. Abundant evidence of past debris flow activity was observed within the western portion of the site in the form of transported surficial soils, grus, and soot-laden alluvial deposits mantling alluviated portions of the site. Recent debris flow activity is evidenced by deposits containing abundant cobbles and small boulders noted in several drainages emanating from the upland area of the site. Incision and down-cutting of older debris flow deposits was noted in historic (glass and metal debris containing) sediments in the western portion of the site. A comparison of topography based on aerial surveys flown prior and



subsequent to January 2005 shows a marked widening and deepening of the channel of Badger Creek. Mitigation methods for both temporary and long-term debris flow hazard should be applied in site planning due to the presence of steep, potentially fire-denuded hillsides in the upland areas near and within the site.

GROUNDWATER AND LIQUEFACTION

With the exception of surface water flowing in a small creek located in the East Parcels area, no evidence of springs or perched groundwater conditions was observed south of the South Branch SAFZ on the site during the geologic field reconnaissance, the geologic mapping, or on the aerial photographs reviewed. In contrast, abundant evidence of a significant groundwater barrier formed by the South Branch SAFZ was observed in the form of heavy water seepage in trench exposures that crossed the fault zone. In several cases, trenches were relocated, reconfigured, or abandoned to mitigate the hazard of trench collapse in saturated alluvial materials north of the South Branch SAFZ.

According to our review of available groundwater data, water wells representative of the groundwater conditions in the alluvium south of the South Branch SAFZ are not present within the site. Wells located south of the Devil Canyon levee and Badger Hill showed groundwater depths of greater than 80 feet for the time period from 1993 to present. These wells are situated at a lower elevation than the site. With the exception of the very young alluvium near the mouth of Badger Creek, the depth to groundwater within the alluvial fan sediments at the site is anticipated to be greater than 50 feet bgs. Based upon the anticipated depth to groundwater and the poorly-sorted, granular character of the Pleistocene-age materials that underlie the alluvial fans of the site, the hazard posed by liquefaction is expected to be low in the site area located south of the South Branch SAFZ. For the area located near the mouth of Badger Creek, a site-specific liquefaction investigation is recommended to more accurately characterize the potential for liquefaction in the alluvial-fan sediments located south of the SAFZ.

For the area of the site located north of the South Branch SAFZ, a site-specific investigation is recommended to more accurately characterize the potential for liquefaction of the saturated, fine-grained, sandy geologic materials encountered. For the site in general, the geotechnical investigation (pending) should address the potential for groundwater-related hazards such as hydrocollapse throughout the site.



At exposed interfaces, such as the alluvium/bedrock contact and fill over cut slopes, a potential exists for springs or seeps to develop, especially when considering future landscape irrigation. The seeps may result in minor nuisances or, in extreme cases, may lead to slope failure. Such contacts will need to be evaluated on a case-by-case basis as part of the geologic in-grading observation, and remedial measures may be necessary. Potential mitigation methods include construction of a stabilization fill with a back-drain system. Such stabilization fills could also provide cosmetic improvement of slopes.

Subdrains are expected to be recommended where drainages/canyons are filled. Final subdrain locations and design should be determined by the engineering geologist and geotechnical engineer during grading.

FLOODING AND EROSION

Evidence of recent localized flooding of portions of the site was observed during our field reconnaissance and geologic field mapping, and on the aerial photographs used for this investigation. Badger Creek drains a significant watershed located within the upland area of the San Bernardino Mountains. Recent incision of the banks of the creek forming steep slopes and bluffs adjacent to the creek channel was noted. Denudation of vegetation from the hillside areas occurred within the past two years and likely exacerbated the erosion process; however, the storms of January 2005 are an example of the potential for large volumes of water runoff to be directed into Badger Canyon and the adjoining smaller watersheds that drain into the site. Site planning should include appropriate measures to address the potential for flooding within the site. An evaluation of the flood potential of the site and the design of adequate drainage falls under the purview of others.

The on-site soils are moderately to highly susceptible to erosion by running water. Water should not be allowed to flow over graded areas or slope faces so as to cause erosion.

CONCLUSIONS

On the basis of our investigation, it is the opinion of this firm that the proposed development is feasible from an engineering geologic standpoint, provided the recommendations contained in this report and in the recommended subsurface investigation are implemented during design, grading, and construction.



A larger portion of the site is included in an Alquist-Priolo Earthquake Fault Zone designated by the State of California to include traces of suspected faulting associated with the northwest-trending San Andreas fault zone. We encountered the South Branch San Andreas Fault Zone and an older strand, the Mill Creek fault, within the site. Other faults encountered included faults within the landslide deposits west of Badger Creek that appear to be primarily associated with landslide movement; however, some of these features have trends similar to that of the Mill Creek fault. Based on the data from our subsurface investigation, faults of the SAFZ, including the Mill Creek fault and North Branch fault, are considered to be active for planning purposes. Therefore, an RRUZ is recommended to mitigate the potential for the hazard of surface rupture during movement on the identified faults. The location of the RRUZ is shown on Enclosure "A-4".

Severe seismic shaking of the site can be expected during the lifetime of the proposed development and should be considered in site development.

Landslides are present on the site and should be considered a potential hazard to the proposed development unless further investigation precludes this hazard. These landslides are all located within the RRUZ designated by this report. Should further investigation of the landslide hazard provide mitigation measures for slope stability hazards, certain areas within the RRUZ may be removed from that classification.

The depth to groundwater is expected to be greater than 50 feet in the majority of the site located south of the South Branch SAFZ for which the hazard posed by liquefaction is considered to be low. Shallow groundwater and fine-grained alluvial soils in portions of the site located near the mouth of Badger Creek and north of the SAFZ may have a potential for liquefaction. The liquefaction susceptibility should be evaluated for these areas, and the hydrocollapse potential should be evaluated for the site during the recommended geotechnical investigation when exploratory borings will provide additional groundwater and soils data.

Some potential for future shallow, perched groundwater exists at the site, particularly associated with landscape irrigation. The potential for perched groundwater is considered to be highest at native/fill contacts in fill over cut slopes and in filled drainages.



Evidence of recent significant erosion/flooding of portions the site was observed during our field reconnaissance and geologic mapping, and on the aerial photographs used for this investigation. An evaluation of the flood potential of the site and the design of adequate drainage is recommended; however, this falls under the purview of others.

RECOMMENDATIONS

RECOMMENDED RESTRICTED USE ZONES:

Evidence of active faulting was found associated with several laterally continuous faults within the site. The faults of the SAFZ at the site, including the Mill Creek fault and the North Branch fault, are considered to be active for planning purposes. An RRUZ is recommended to mitigate the potential for surface rupture along these fault zones. Human occupancy structures should not be placed within the RRUZ. The location of the RRUZ is shown on Enclosure "A-4".

GEOTECHNICAL INVESTIGATION:

A geotechnical investigation of the site should be conducted. Geotechnical issues pertinent to this site and the proposed development include the presence of potentially compressible/collapsible soils throughout the site, liquefaction hazards, stability of fill and cut slopes, and the presence of landslide deposits with a potential to form unstable fill and cut slopes.

SEISMIC DESIGN CONSIDERATIONS:

Severe seismic shaking of the site can be expected during the lifetime of the proposed structures. Therefore, the proposed structures should be designed accordingly.

The site is subject to near-source effects of strong motion. The applicable near-source acceleration factor N_a , as defined in the 2001 CBC, is 1.5, and the near-source velocity factor N_v is 2.0.

The preliminary soil profile types as defined by the 2001 CBC are S_D , stiff soil and S_C , very dense soil and soft rock, for the materials at the site. The soil profile classifications should be verified during the recommended geotechnical investigation.



The 2001 CBC places the site within Seismic Zone 4. A Seismic Zone Factor "Z" of 0.40 is assigned to Seismic Zone 4.

CUT SLOPE CONSTRUCTION:

Provided that no adverse structures are exposed during grading, such as the faults of the SAFZ or landslide deposits that exist within the site, cut slopes in the older alluvial-fan deposits should be grossly and surficially stable at inclinations of 2(h) to 1(v) to a maximum height of 30 feet. Cut slopes should be provided with terraces and interceptor drains in accordance with the 2001 CBC.

SUBSURFACE DRAINAGE:

At exposed interfaces, such as fill over cut slopes, a potential exists for springs or seeps to develop, especially when considering landscape irrigation. The seeps may result in minor nuisances or, in extreme cases, may lead to slope failure. Such contacts will need to be evaluated on a case-by-case basis as part of the geologic in-grading observation, and remedial measures may be necessary. Potential mitigation methods include construction of a stabilization fill with a back-drain system. Such stabilization fills could also provide cosmetic improvement of slopes.

Subdrains may be recommended where drainages are filled. Subdrain locations and design should be determined by the engineering geologist and geotechnical engineer during grading plan review and grading.

TRENCH BACKFILL:

Upon completion of the City's review of this report, the trenches are to be backfilled and track rolled with a bulldozer. No other compactive effort is planned. The trench backfill should be considered as undocumented fill. Structures should not be placed on or immediately adjacent to any undocumented fill. Should structures be placed on or supported by the trench backfill, the trench backfill should be removed and replaced as engineered compacted fill.

SLOPE PROTECTION:

Inasmuch as the native materials are susceptible to erosion by running water, it is our recommendation that the slopes at the project be planted as soon as possible after completion. The use of succulent



ground covers, such as iceplant or sedum, is not recommended. If watering is necessary to sustain plant growth on slopes, then the watering operation should be monitored to assure proper operation of the water system and to prevent over-watering.

Measures should be provided to prevent surface water from flowing over slope faces.

GRADING PLAN REVIEW:

The final project grading plan should be reviewed by the engineering geologist.

LIMITATIONS

C.H.J., Incorporated has striven to perform our services within the limits prescribed by our client, and in a manner consistent with the usual thoroughness and competence of reputable engineering geologists practicing under similar circumstances. No other representation, express or implied, and no warranty or guarantee is included or intended by virtue of the services performed or reports, opinion, documents, or otherwise supplied.

This report reflects the conditions of the site as the site existed during the investigation which is the subject of this report. However, changes in the conditions of a property can occur with the passage of time due to natural processes or the works of man on this or adjacent properties. Changes in applicable or appropriate standards may also occur whether as a result of legislation, application, or the broadening of knowledge. Therefore, this report is indicative of only those conditions tested at the time of the subject investigation, and the findings of this report may be invalidated fully or partially by changes outside of the control of C.H.J., Incorporated. This report is therefore subject to review and should not be relied upon after a period of one year.

The conclusions and recommendations in this report are based upon observations performed and data collected at separate locations, and interpolation between these locations, carried out for the project and the scope of services described. It is assumed and expected that the conditions between locations observed and/or sampled are similar to those encountered at the individual locations where observation and sampling was performed. However, conditions between these locations may vary significantly.



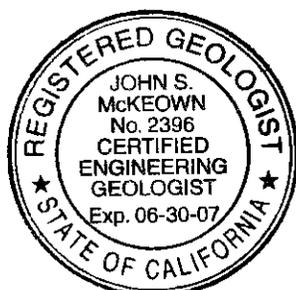
Should conditions be encountered in the field, by the client or any firm performing services for the client or the client's assign, that appear different from those described herein, this firm should be contacted immediately in order that we might evaluate their effect.

If this report or portions thereof are provided to contractors or included in specifications, it should be understood by all parties that they are provided for information only and should be used as such.

The report and its contents resulting from this investigation are not intended or represented to be suitable for reuse on extensions or modifications of the project, or for use on any other project.

CLOSURE

We appreciate this opportunity to be of service and trust this report provides the information desired at this time. Should questions arise, please do not hesitate to contact this office.



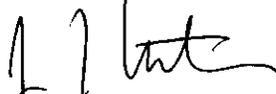
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Respectfully submitted,
C.H.J., INCORPORATED

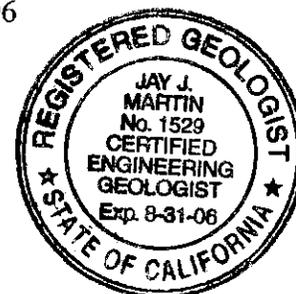

John S. McKeown, E.G. 2396
Project Geologist



2-2-06


Jay J. Martin, E.G. 1529
Vice President


Allen D. Evans, G.E. 2060
Vice President



2-2-06



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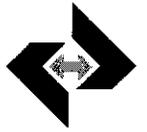
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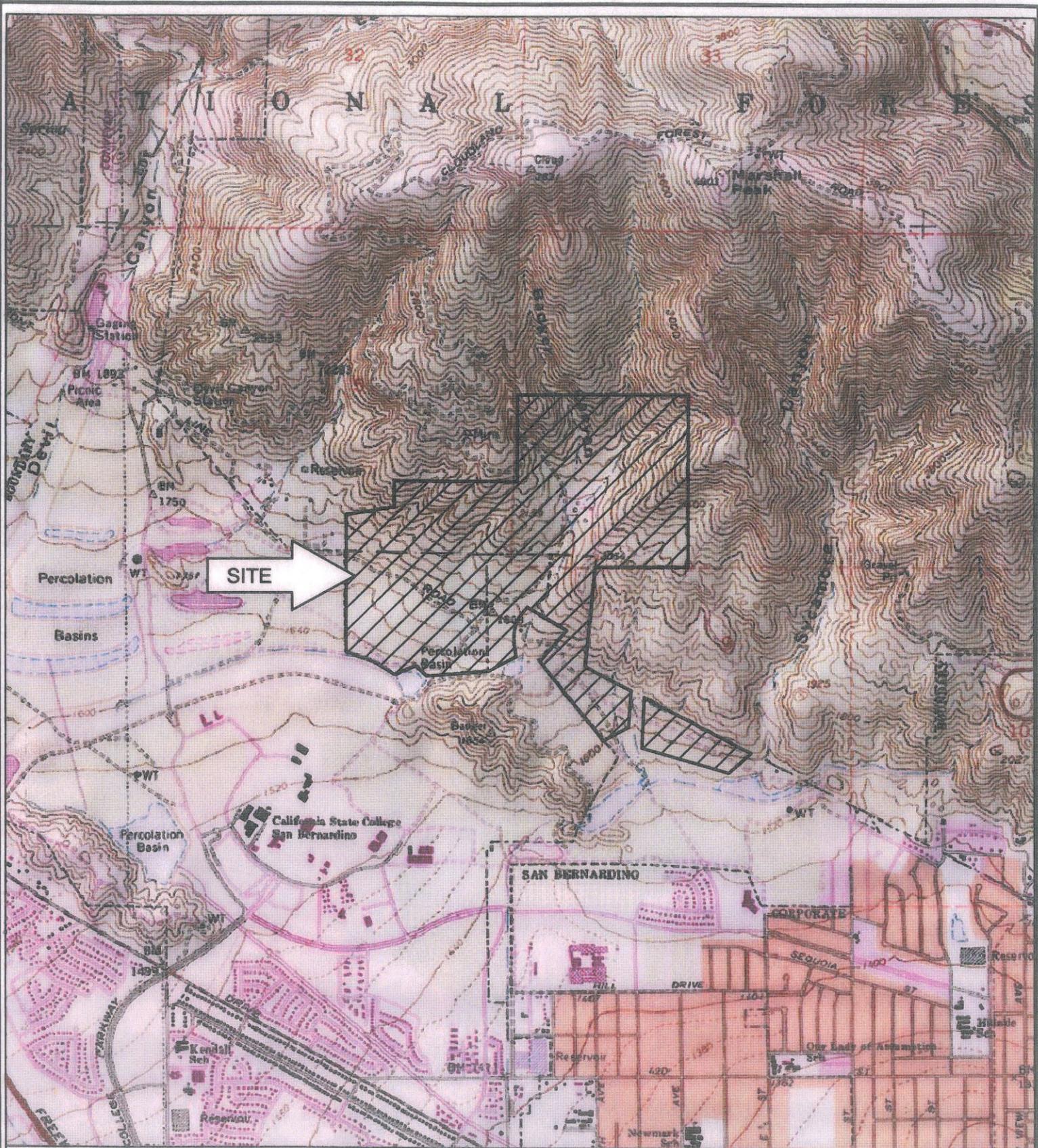
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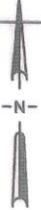
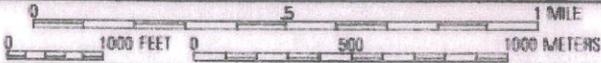
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APPENDIX "A"
GEOLOGIC MAPS

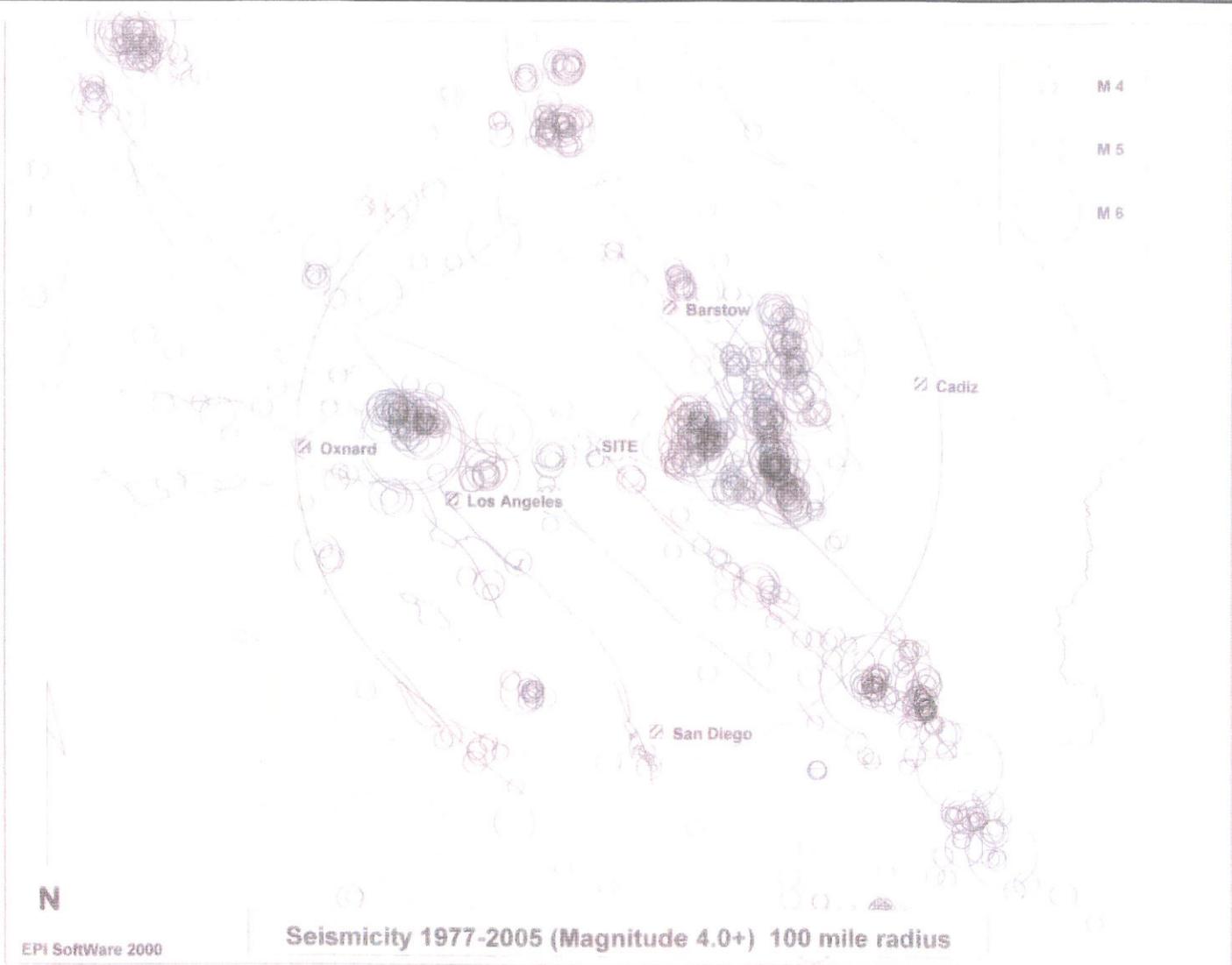


SITE →



SCALE: 1"= 2,000'

INDEX MAP		
FOR: INLAND COMMUNITIES CORPORATION	PARADISE HILLS PROJECT BADGER CANYON AREA	ENCLOSURE "A-1"
DATE: JANUARY 2006	SAN BERNARDINO, CALIFORNIA	JOB NUMBER 05894-8
		C.H.J. Incorporated



EPI SoftWare 2000

Seismicity 1977-2005 (Magnitude 4.0+) 100 mile radius

SITE LOCATION: 34.1933 LAT. -117.3103 LONG.

MINIMUM LOCATION QUALITY: C

TOTAL # OF EVENTS ON PLOT: 830

TOTAL # OF EVENTS WITHIN SEARCH RADIUS: 501

MAGNITUDE DISTRIBUTION OF SEARCH RADIUS EVENTS:

4.0- 4.9 : 442
 5.0- 5.9 : 53
 6.0- 6.9 : 4
 7.0- 7.9 : 2
 8.0- 8.9 : 0

CLOSEST EVENT: 4.2 ON SATURDAY, JUNE 28, 1997 LOCATED APPROX. 2 MILES SOUTHWEST OF THE SITE

LARGEST 5 EVENTS:

7.3 ON SUNDAY, JUNE 28, 1992 LOCATED APPROX. 49 MILES EAST OF THE SITE
 7.1 ON SATURDAY, OCTOBER 16, 1999 LOCATED APPROX. 65 MILES NORTHEAST OF THE SITE
 6.7 ON MONDAY, JANUARY 17, 1994 LOCATED APPROX. 70 MILES WEST OF THE SITE
 6.6 ON MONDAY, JANUARY 17, 1994 LOCATED APPROX. 70 MILES WEST OF THE SITE
 6.4 ON SUNDAY, JUNE 28, 1992 LOCATED APPROX. 27 MILES EAST OF THE SITE



EARTHQUAKE EPICENTER MAP

FOR: INLAND COMMUNITIES CORPORATION

PARADISE HILLS PROJECT
 BADGER CANYON AREA
 SAN BERNARDINO, CALIFORNIA

ENCLOSURE "A-5"

DATE: JANUARY 2006

JOB NUMBER 05894-8

APPENDIX "B"

TRENCH LOGS

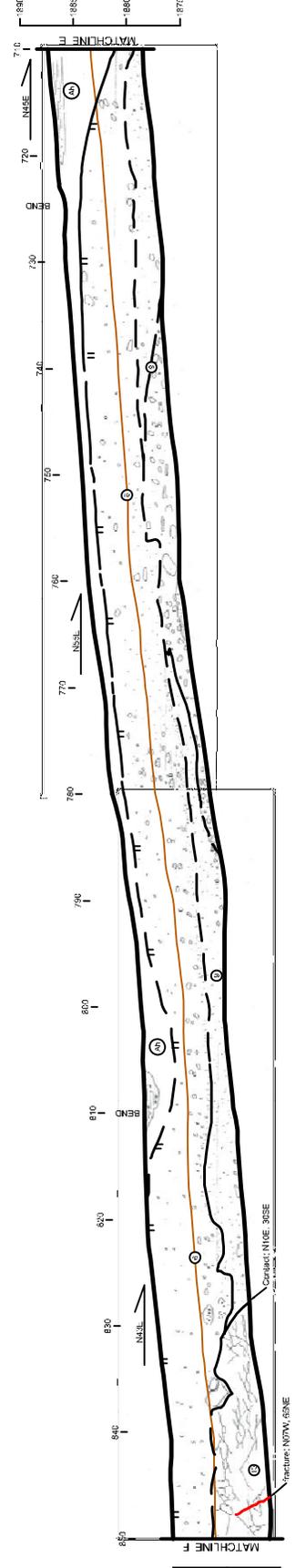
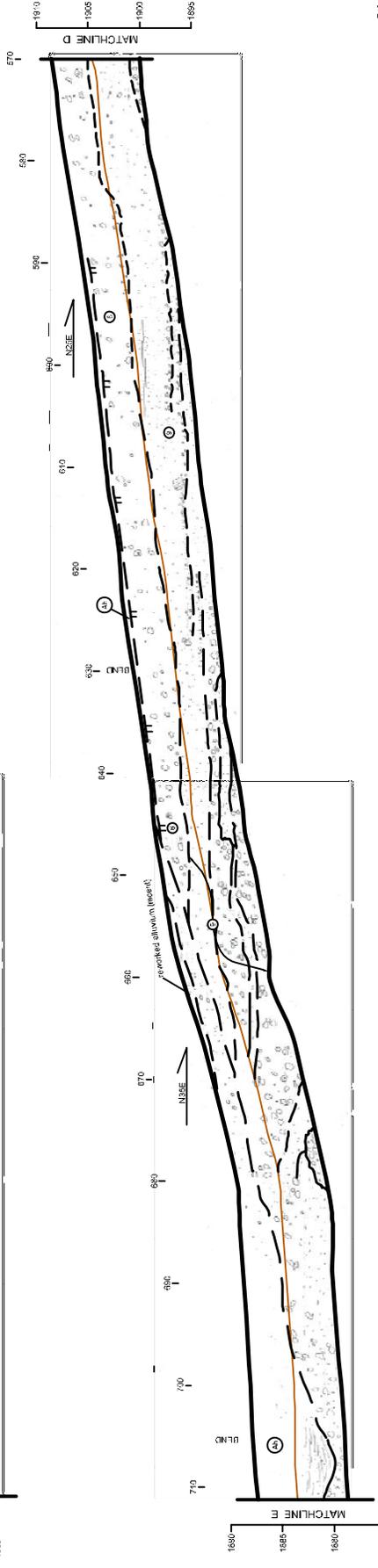


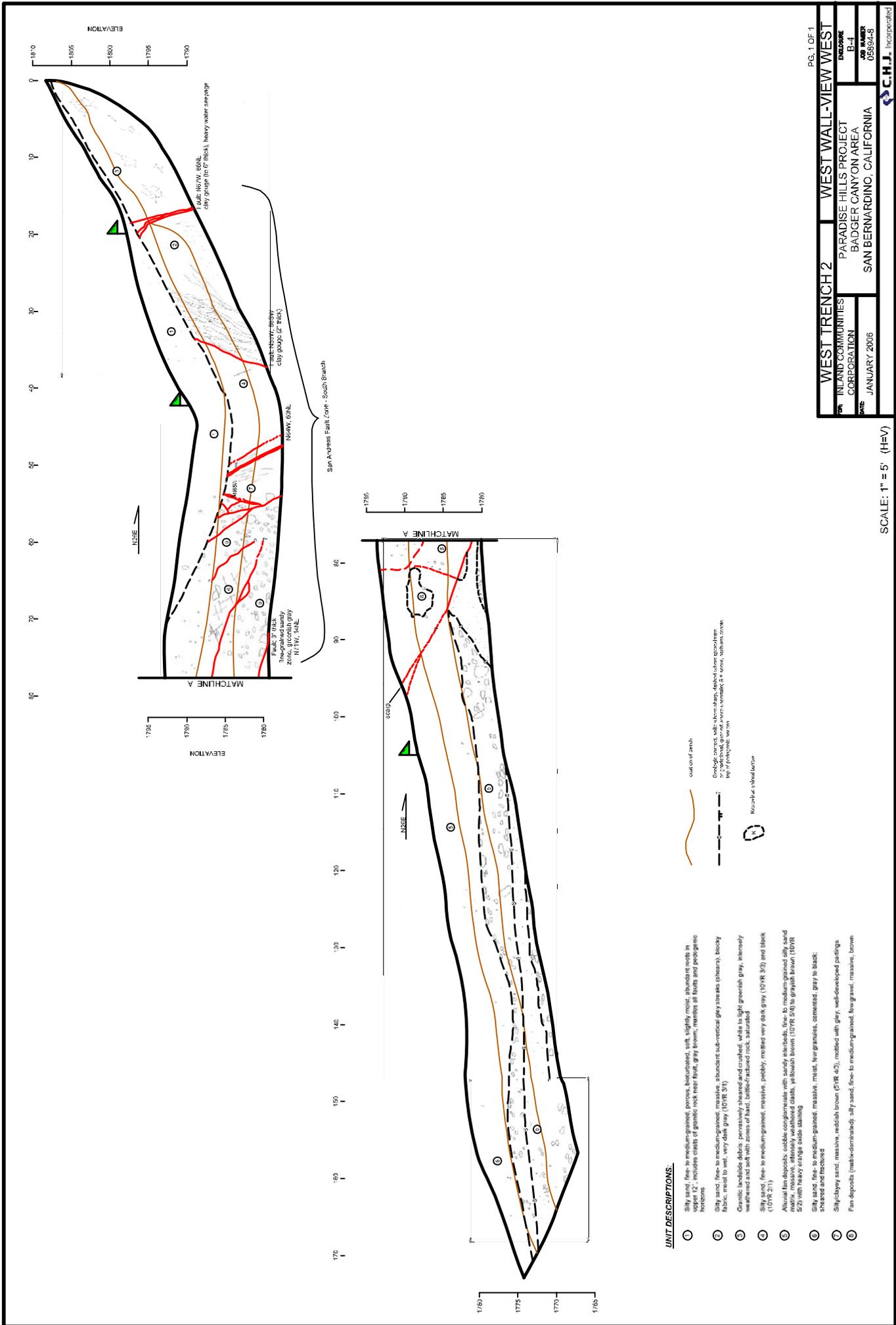
FIG. 2 OF 5

WEST TRENCH 1A - WEST WALL-VIEW WEST	
FOR INLAND COMMUNITIES CORPORATION	PARADISE HILLS PROJECT BADGER CANYON AREA
DATE: JANUARY 2006	PROJECT NUMBER: 055345-S
SAN BERNARDINO, CALIFORNIA	

SCALE: 1" = 5' (H=V)

NOTE: SEE SHEET B-1.1 FOR UNIT DESCRIPTIONS



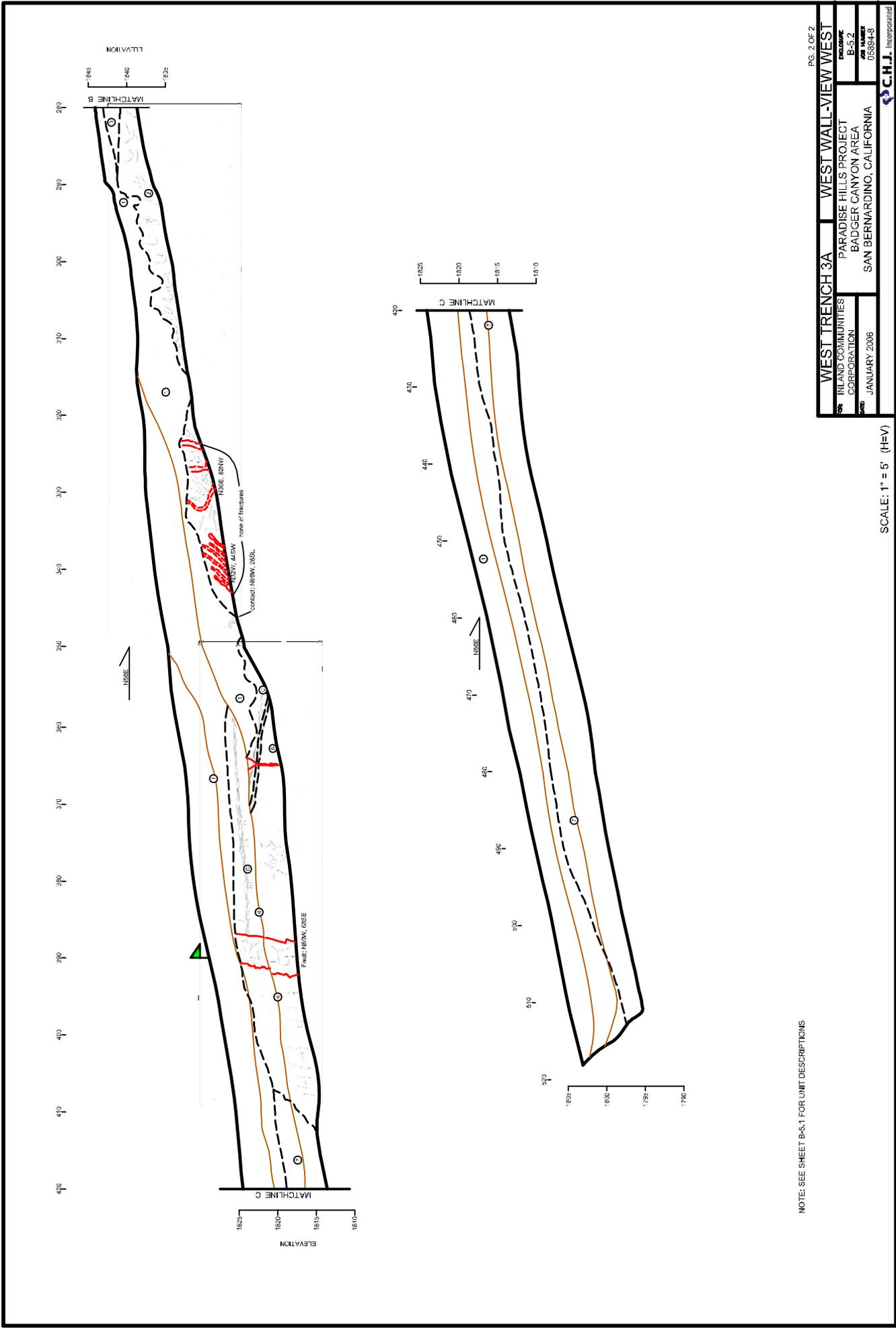


UNIT DESCRIPTIONS:

- ① Silty sand, fine- to medium-grained, porous, noncrusted, soft, slightly moist, abundant roots in upper 12", includes clasts of granitic rock near fault, gray brown, mantles all faults and pedogenic horizons
- ② Silty sand, fine- to medium-grained, massive, abundant sub-vertical clay streaks (shaly), blocky fabric, moist to wet, very dark gray (10YR 3/1)
- ③ Granitic landslide debris, pervasively sheared and crushed, white to light greenish gray, intensely weathered and soft with zones of hard, brittle fractured rock, saturated
- ④ Silty sand, fine- to medium-grained, massive, pebbly, moist to very dark gray (10YR 3/3) and black (10YR 2/1)
- ⑤ Alluvial fan deposits, cobble conglomerate with sandy matrix, fine- to medium-grained silty sand matrix, massive, intensely weathered clasts, yellowish brown (10YR 5/4) to grayish brown (10YR 5/2) with heavy orange oxide staining
- ⑥ Silty sand, fine- to medium-grained, massive, moist, low granules, cemented, gray to black, sheared and fractured
- ⑦ Silty clayey sand, massive, reddish brown (5YR 4/3), mottled with gray, well-developed partings
- ⑧ Fan deposits (matrix-dominated), silty sand, fine- to medium-grained, few gravel, massive, brown

WEST TRENCH 2		WEST WALL-VIEW WEST	
INLAND COMMUNITIES CORPORATION		PARADISE HILLS PROJECT BADGER CANYON AREA SAN BERNARDINO, CALIFORNIA	
DATE	JANUARY 2006	PROJECT NUMBER	058394-S
PG. 1 OF 1		C.H.J. Incorporated	

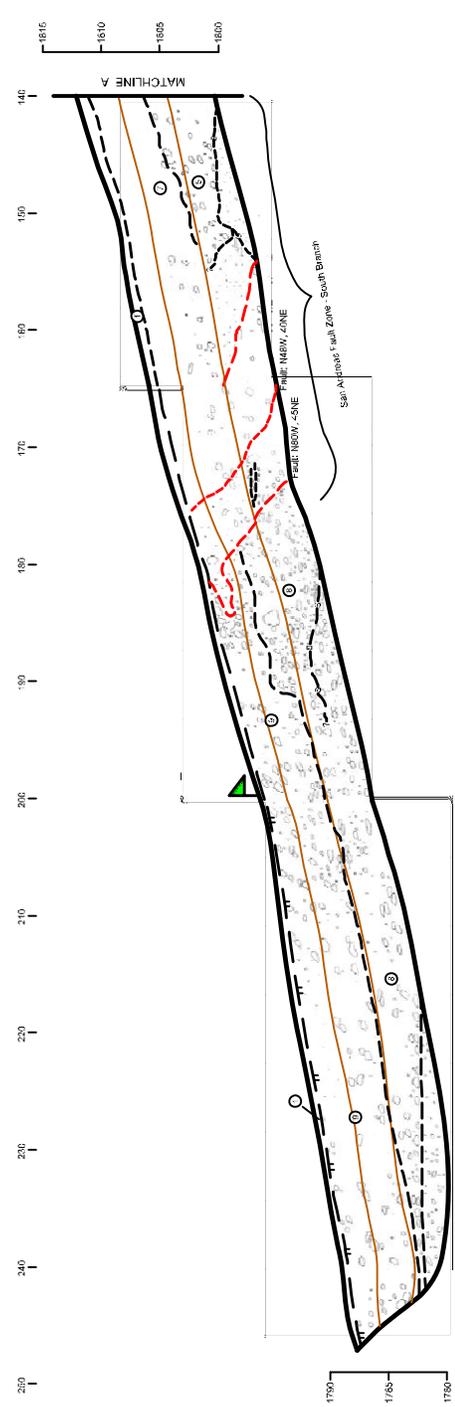
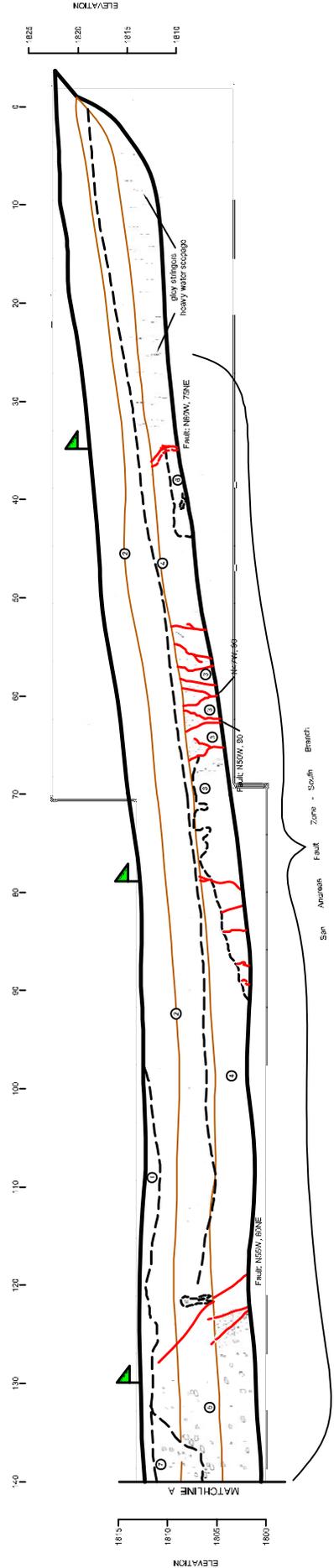
SCALE: 1" = 5' (H-V)



NOTE: SEE SHEET B-5.1 FOR UNIT DESCRIPTIONS

WEST TRENCH 3A		WEST WALL-VIEW WEST	
FOR: INLAND COMMUNITIES CORPORATION	DATE: JANUARY 2006	PROJECT: PARADISE HILLS PROJECT	PROJECT NUMBER: B-5.2
		LOCATION: BADGER CANYON AREA	JOB NO: 03684-S
		LOCATION: SAN BERNARDINO, CALIFORNIA	DESIGNED BY: CH.J.

SCALE: 1" = 5' (H=V)



- UNIT DESCRIPTIONS:**
- Columnar jointed silty sand, fine grained, massive, porous, abundant roots, highly indurated, very silty clay
 - Silty sand, fine to medium grained, massive, porous, brown (10YR 5/2)
 - Silty sand, fine to medium grained, massive, root, porous, very clayey lower (10YR 5/2)
 - Silty sand, fine to medium grained, massive, root, porous, abundant clay streaks, brown (10YR 5/2)
 - Alluvial fine deposits, calcareous, massive to poorly bedded, silty sand matrix, fine to medium grained, fine to coarse (2.5Y 5/2), primarily intertidal, weathered grains and root clasts
 - Clayey sand, fine to medium grained, well, silty, greenish gray (10Y 5/1)
 - Alluvial fine deposits, calcareous, massive to poorly bedded, silty sand matrix, fine to medium grained, brown (10Y 5/4)
 - Alluvial fine deposits, calcareous, massive to poorly bedded, silty sand matrix, fine to medium grained, slightly cemented, brown (10Y 5/4)
 - Alluvial fine deposits, calcareous, massive to poorly bedded, silty sand matrix, fine to medium grained, intertidal, brown (10Y 5/4)

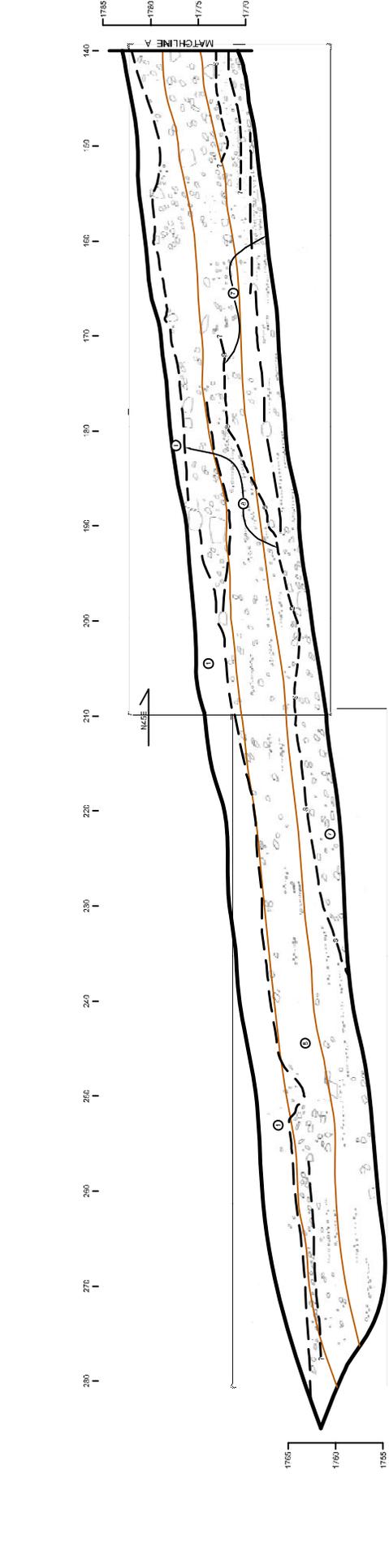
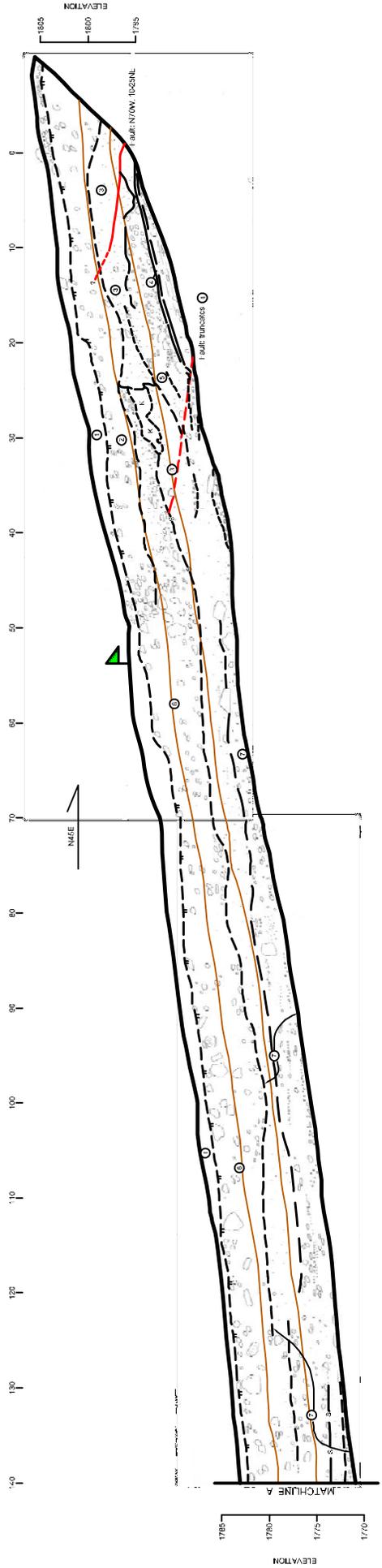
- boundary of fault
- boundary of fault
- boundary of fault

PG. 1 OF 1

WEST TRENCH 3B	WEST WALL-VIEW WEST
INLAND COMMUNITIES CORPORATION	PARADISE HILLS PROJECT BADGER CANYON AREA
JANUARY 2006	SAN BERNARDINO, CALIFORNIA
	PROJECT NUMBER: 056394-S

SCALE: 1" = 5' (H=V)





UNIT DESCRIPTIONS:

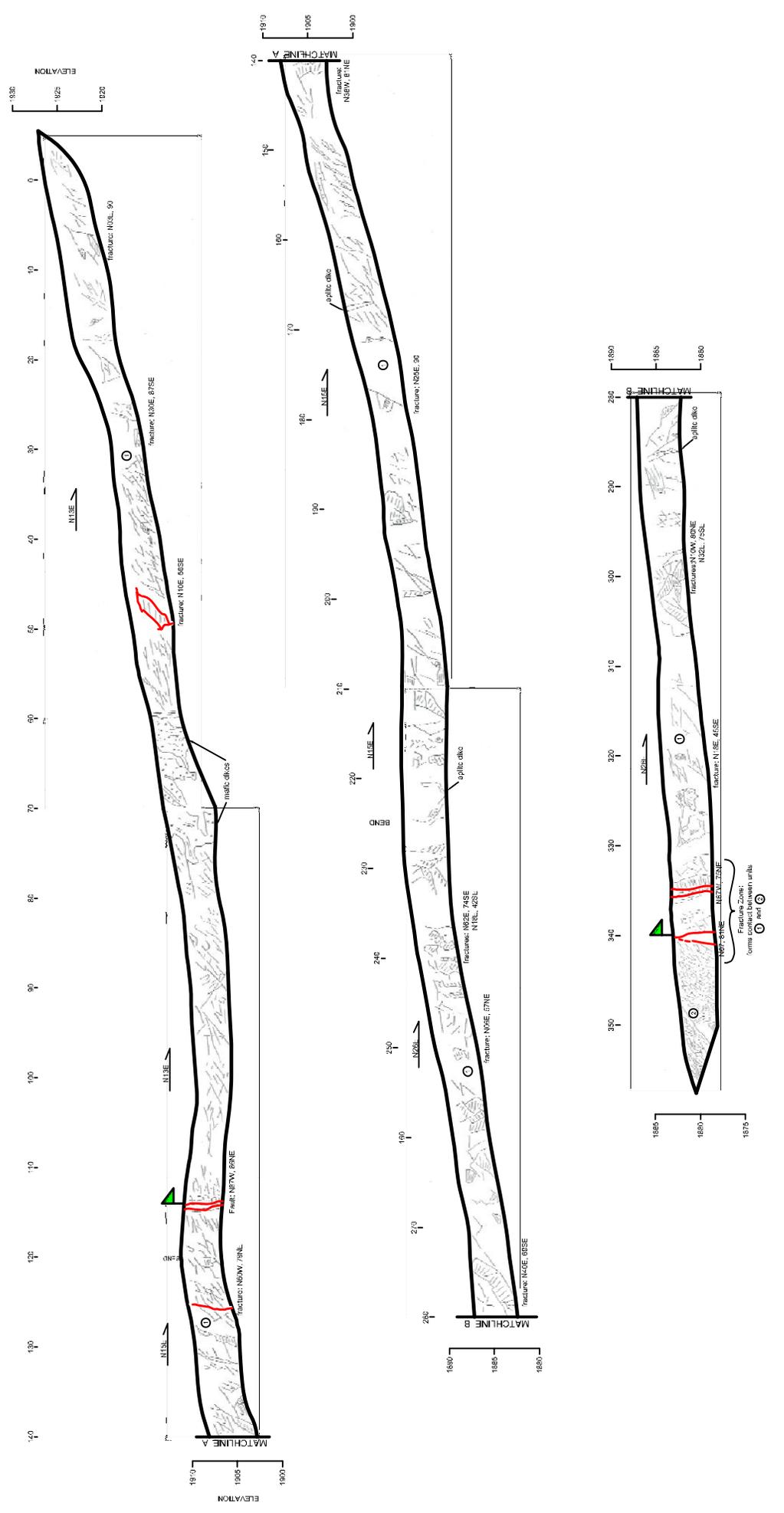
- Colluvium with sand, fine to medium-grained, massive, indurated, reddish zone, locally with
- Alluvial fan deposits with sand, fine to medium-grained with coarse gravel, massive, indurated
- and small boulders, pebbles (up to 12" to 24" in diam) (MVE 5A) to (MVE 6)
- (MVE 7) (MVE 8)
- Alluvial fan deposits with sand, fine to medium-grained, massive to poorly bedded, silty sand
- (MVE 5A) to (MVE 6)
- (MVE 7) (MVE 8)
- Alluvial fan deposits with sand, fine to medium-grained, massive to poorly bedded, silty sand
- (MVE 5A) to (MVE 6)
- (MVE 7) (MVE 8)
- Alluvial fan deposits with sand, fine to medium-grained, massive to poorly bedded, silty sand
- (MVE 5A) to (MVE 6)
- (MVE 7) (MVE 8)
- Alluvial fan deposits with sand, fine to medium-grained, massive to poorly bedded, silty sand
- (MVE 5A) to (MVE 6)
- (MVE 7) (MVE 8)

- Boundary of level
- Geological contact, with above clearly defined above and below
- Fault: N/O/W, U/C/S/N/L
- (MVE 5A) to (MVE 6)
- (MVE 7) (MVE 8)
- (MVE 9) (MVE 10)

PG. 1 OF 1

WEST TRENCH 3C	WEST WALL-VIEW WEST
INLAND COMMUNITIES CORPORATION JANUARY 2006	PARADISE HILLS PROJECT BADGER CANYON AREA SAN BERNARDINO, CALIFORNIA 056394-8

SCALE: 1" = 5' (H=V)



UNIT DESCRIPTIONS:

- Granitic landslide debris, medium-grained quartz monzonite, extensively fractured and cemented, weathered and well-sorted, light brown to tan, brittle to friable rock, blocky to shaly, 10-15 ft thick.
- Light greenish gray, fine to medium grained, silty to sandy, silty claystone to siltstone, locally with vertical, irregularly spaced, thin, clay-rich, silty, clayey, silty claystone, locally with vertical, irregularly spaced, thin, clay-rich, silty, clayey, silty claystone, locally with vertical, irregularly spaced, thin, clay-rich, silty, clayey, silty claystone.

Location of fault

Geologic contact, soft, very sharp, dashed, unless proven to be a fault zone contact

Fault zone, normal contact between units

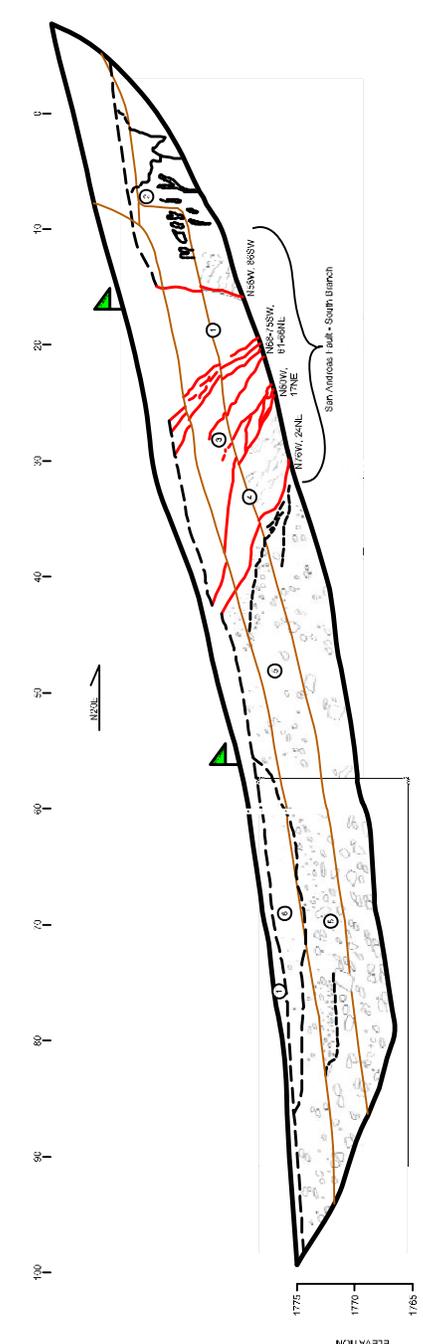
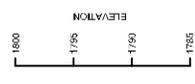
Microfingering

WEST TRENCH 5		WEST WALL-VIEW WEST	
INLAND COMMUNITIES CORPORATION		PARADISE HILLS PROJECT BADGER CANYON AREA SAN BERNARDINO, CALIFORNIA	
DATE: JANUARY 2006		PROJECT NUMBER: 058394-S	

SCALE: 1" = 5' (H-V)

PG. 1 OF 1

C.H.J. Incorporated



San Antonio I Fair - South Blanch

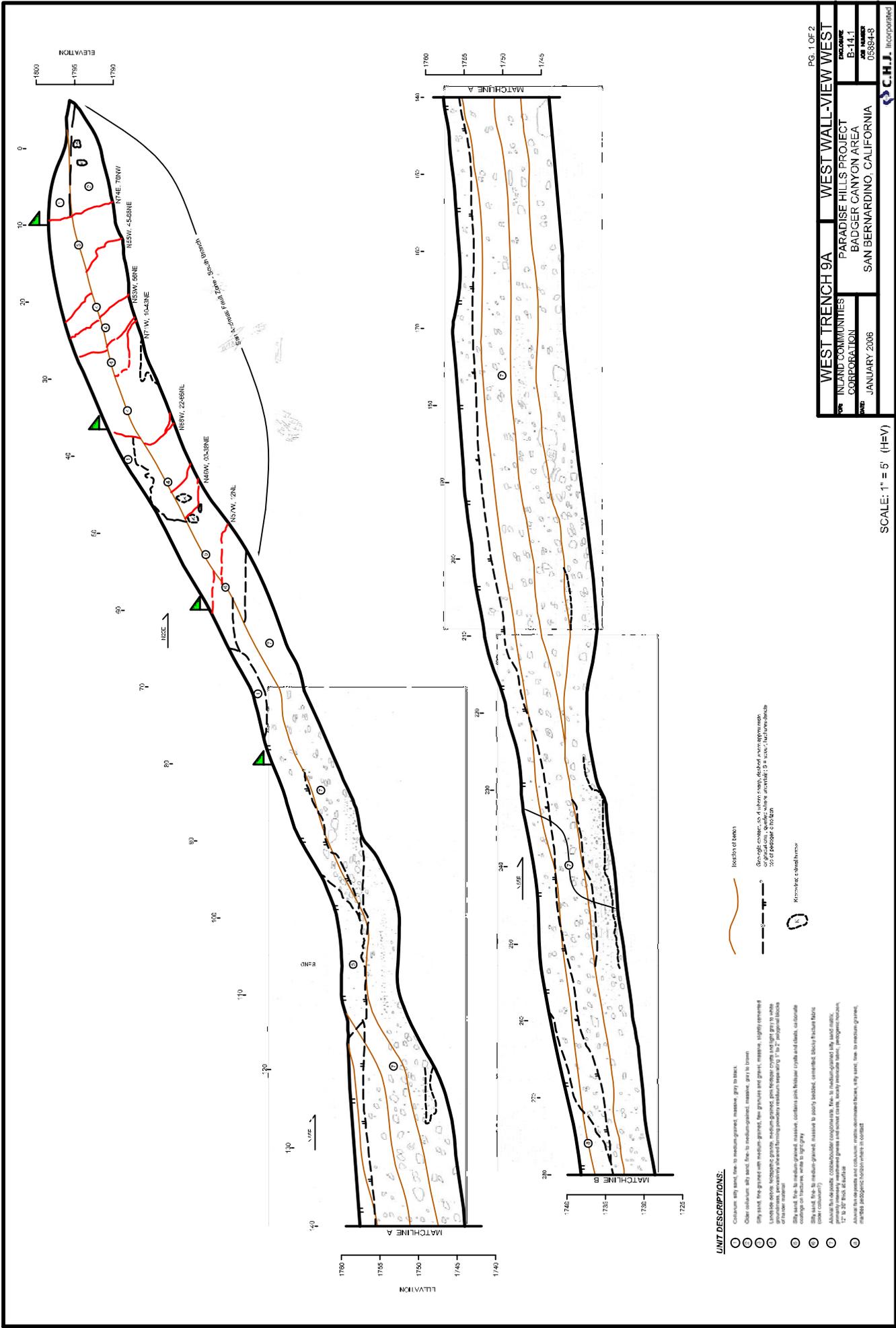
UNIT DESCRIPTIONS:

- Collection site backfill from medium-grained, massive, grayish brown (10YR 5/2), moderate to high
- Concrete (include above fine-grained heterogeneous, pervasively fractured and cracked, heavily weathered and stiff with joints of soil, light-buffish red, silty and silty clay shale, pink massive (10YR 5/6))
- Fine-grained silty and silty clay shale, with light gray to buff color of lower clay shale massive (10YR 5/6)
- Silty sand from medium-grained, fine-grained to 1" in size, massive, reddish yellowish brown (10YR 4/4) to clay loam (10YR 3/2)
- Aluvial deposits (colluvial) conglomerate, sand-supported, fine to medium-grained silty sand matrix, brown (10YR 4/3)
- Concrete (include above) from medium-grained silty sand, fine to medium-grained silty sand, fine-grained sand

- outline of trench
- Quality control soil sample location or grid location, 2' x 2' x 2' in size trench device top of respective trench
- Known not testing zones

WEST TRENCH 7B		WEST WALL-VIEW WEST	
FOR	INLAND COMMUNITIES CORPORATION	PROJECT	PARADISE HILLS PROJECT
DATE	JANUARY 2006	AREA	BADGER CANYON AREA
		LOCATION	SAN BERNARDINO, CALIFORNIA
		JOB NUMBER	05884-3
			C.H.J. Incorporated

SCALE: 1" = 5' (HEV)



SCALE: 1" = 5' (H=V)



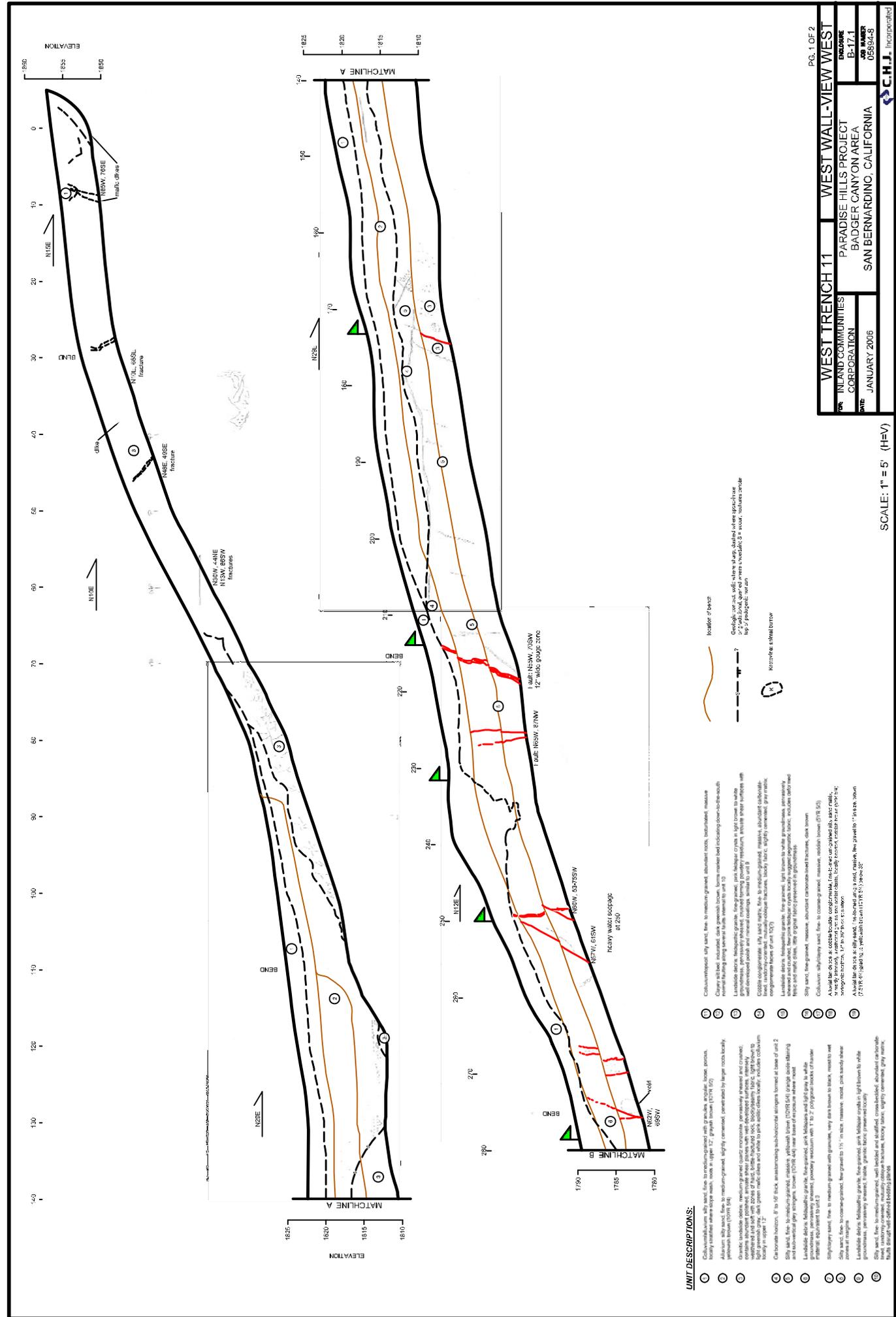
NOTE: SEE SHEET B-14.1 FOR UNIT DESCRIPTIONS

PG. 2 OF 2

WEST TRENCH 9A		WEST WALL-VIEW WEST	
FOR	INLAND COMMUNITIES CORPORATION	PROJECT	PARADISE HILLS PROJECT BADGER CANYON AREA
DATE	JANUARY 2006	DRAWN BY	B-14.2 05694-S
		LOCATION	SAN BERNARDINO, CALIFORNIA

C.H.J. Incorporated

SCALE: 1" = 5' (H=V)

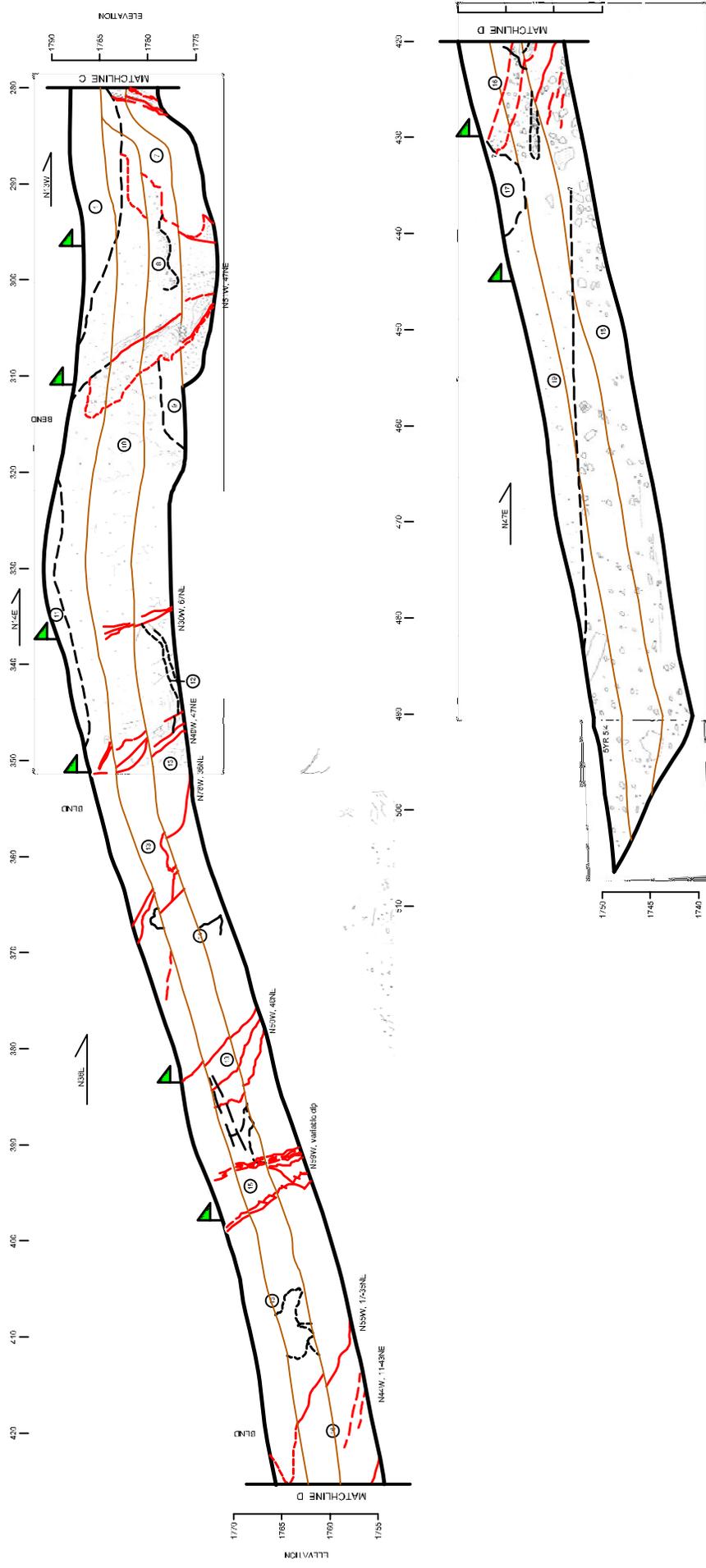


PG. 1 OF 2
 SCALE: 1" = 5' (H-V)

UNIT DESCRIPTIONS:

1	Colluvium: silty sand, fine to medium grained; abundant roots, bedded; massive to blocky; silty sand, fine to medium grained; abundant roots, bedded; massive to blocky; silty sand, fine to medium grained; abundant roots, bedded; massive to blocky; silty sand, fine to medium grained; abundant roots, bedded; massive to blocky.
2	Altamira: silty sand, fine to medium grained; light to medium grained; abundant roots, bedded; massive to blocky; silty sand, fine to medium grained; abundant roots, bedded; massive to blocky.
3	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
4	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
5	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
6	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
7	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
8	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
9	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
10	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
11	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
12	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
13	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
14	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
15	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
16	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
17	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
18	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
19	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.
20	Granite: medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic; medium to coarse grained; massive; pink to light gray; crystalline; granitic.

- 1. Location of borehole
- 2. Fault
- 3. Fault
- 4. Fault
- 5. Fault
- 6. Fault
- 7. Fault
- 8. Fault
- 9. Fault
- 10. Fault
- 11. Fault
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- 18. Fault
- 19. Fault
- 20. Fault



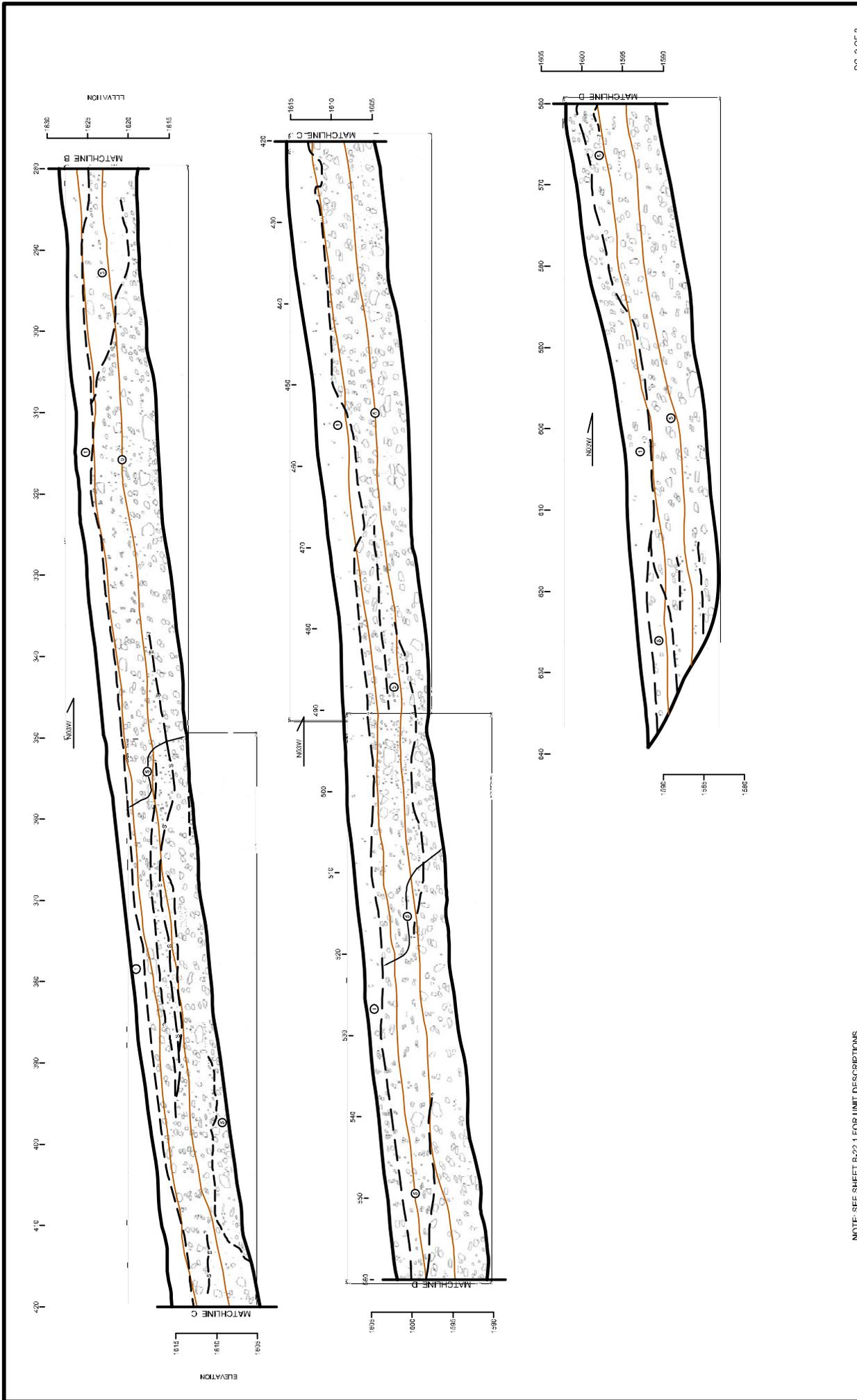
NOTE: SEE SHEET B-17.1 FOR UNIT DESCRIPTIONS

PG. 2 OF 2

WEST TRENCH 11 WEST WALL-VIEW WEST	
INLAND COMMUNITIES	PARADISE HILLS PROJECT
CORPORATION	BADGER CANYON AREA
JANUARY 2006	SAN BERNARDINO, CALIFORNIA
DATE	PROJECT NO. 055344-S

SCALE: 1" = 5' (H=V)

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NOTE: SEE SHEET B-22.1 FOR UNIT DESCRIPTIONS

PG. 2 OF 2

EAST TRENCH 4		WEST WALL-VIEW WEST	
FOR	INLAND COMMUNITIES CORPORATION	PROJECT	PARADISE HILLS PROJECT BADGER CANYON AREA
DATE	JANUARY 2006	DRAWN BY	056394-S
		LOCATION	SAN BERNARDINO, CALIFORNIA

SCALE: 1" = 5' (H=V)



