CALIFORNIA DIVISION OF MINES AND GEOLOGY

Supplement #1 to FER-174

THE SAN CAYETANO FAULT NEAR FILLMORE, THE LION FAULT IN UPPER OJAI VALLEY, AND THE ARROYO PARIDA-SANTA ANA FAULT NEAR MIRA MONTE, VENTURA COUNTY, CALIFORNIA

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INTRODUCTION

Preliminary review maps showing recommended special studies zones for the Matilija, Ojai, Santa Paula Peak, and the Fillmore quadrangles, in Ventura County, were released on January 1, 1986. Written comments from the County of Ventura by Joe Hanna (personal communication, March 1986), and from Tom Rockwell (personal communication, March 1986) of San Diego State University, recommended certain changes in the proposed zoning. The purpose of this supplement to the original fault evaluation report (FER-174) is to address these concerns.

Both Joe Hanna and Tom Rockwell suggested that the Arroyo Parida-Santa Ana fault should be zoned east of the Ventura River, near Mira Monte. This had not originally been recommended for zoning because the fault in this area is not marked by a well-defined surface trace. Trench logs, not available to the author at the time the fault evaluation was done, made it necessary to reevaluate this stretch of the fault.

The Lion fault, in Upper Ojai Valley was also suggested as an additional zoning candidate by Joe Hanna. This fault was not originally recommended for zoning because it lacked a well-defined surface trace and data on most recent activity.

The San Cayetano fault, in the town of Fillmore, was suggested by Tom Rockwell as another trace to be zoned. Rockwell (1983, Plate 1d) showed the fault in Fillmore as inferred or approximately located and other authors were even less definite which formed the basis for not zoning this trace originally.

All the above areas are reevaluated in this report.

SUMMARY OF AVAILABLE DATA

The data available at the time FER-174 was done are reviewed in that report. Only the newer data will be summarized here unless the information previously summarized is repeated for emphasis.

Arroyo-Parida-Santa Ana Fault

Consultants reports submitted with the review comments on the Preliminary Review Map of the Matilija Quadrangle (Buena Engineers, 1981, 1982a, 1982b) contain trench logs which show offset late Quaternary units and faulted soil layers. The trenches were dug near, but not exactly on, the trace shown by Rockwell (1983, Plate 1a) or in FER-174 (Plate 1). The exploratory trenches were required by the County of Ventura as part of the development of Tract 3720. The tract and trench locations are shown on Figure 1 (this report). Only two of the trench logs show soil being offset. The sketch of trench 2 (Buena Engineers, 1981) shows late Pleistocene terrace gravel, designated Qt_{5b} (25,000-30,000 YBP) by Rockwell (1983), being offset approximately 1.7 feet, south side up, and shows the mantle (soil?) being cut by the fault. The sketch of trench 3 (Buena Engineers, 1982a) shows a similar relationship with the Qt_{5b} offset approximately 1.5 feet. The other trench logs do not clearly indicate the fault breaking the soil but do show some discontinuity of units. The amount of offset of Qt_{5b} averages about 1.6 feet (488 mm) or less. The average of these offsets would yield a rough slip rate of 0.02 mm/yr, an order of magnitude less than Rockwell's estimate of 0.37 mm/yr for this fault (1983, p. 68).

Another report by Buena Engineers (1983) on an area east of the Ventura River, contains a trench log which is difficult to interpret. It shows a unit labeled Cl, which would be interpreted as soil, cut by the fault but also shows the Cl unit possibly interbedded with Sespe Formation and overlain by alluvium. This trench was apparently located by projecting the trace of the fault as mapped by Clark (1982). Neither Clark nor Rockwell show a fault where the trench was dug (see Figure 1, this report).

Tom Rockwell also suggested that the Santa Ana fault, southeast of Ojai, is "well defined in the subsurface." The location of the trace, along the north side of Black Mountain, is not clear. Rockwell (1983) shows it at the base of the slope and Clark (1982) shows it 800-1,000 feet farther north and buried, basing his location on a study of ground water done by J.M. Turner in 1971 in Ojai Valley (see Plate 2, FER-174).

Lion Fault

Joe Hanna suggested that we should zone the Lion fault (Lion Canyon fault in some reports) along the south boundary of Upper Ojai Valley. He mentions the Gorian and Associates report (1983) which he interprets as showing "Pleistocene, and possibly Holocene, materials...offset." The Lion fault was not adequately discussed in FER-174 but the trench locations are shown on Figure 2 of that report and the fault was discussed by Smith (1977b) in FER-29. He recognized the fault as probably active in the late Quaternary. No evidence of Holocene activity has been presented by any workers.

The Gorian and Associates report (1983) was examined previously and reexamined for this report. The log for trench 1 (Gorian and Associates,

1983, sheet 4; Figure 2, this report) shows rocks of the Monterey Formation over old alluvium, possibly late Pleistocene or older in age. No surface expression or indication of offset soil or offset Holocene unit is shown and the fault dips only a few degrees to the southeast. The log for trench 2 (1983, sheet 5; Figure 3, this report) is much more complicated but shows the same basic relationship with the fault dipping about 18° southeast. Neither trench log shows the soil or a known Holocene unit offset. Both trench logs exhibit some characteristics that strongly resemble landslide debris. The fault trace mapped by both Gorian and Associates (1983) and Rockwell (1983) is shown as a straight line which crosses the topography without deflection, and lies along the mountain front south of Upper Ojai Valley. Farther west, in Lion Canyon, both Clark (1982) and Rockwell (1983) show the trace intersecting the topographic contours so as to indicate a south dipping high angle reverse or thrust fault.

San Cayetano Fault

Tom Rockwell also said he thought the San Cayetano fault should be zoned where he mapped it in Fillmore. He (1983) shows the fault as inferred or approximately located (Figure 4) and by implication shows the Qf_3 unit offset, although the unit north of the trace is unlabeled. In his review he says "...the scarps are in alluvial fan material (Holocene)." No soil description localities are shown in this area but surfaces elsewhere, with which he correlates this fan, are estimated to be about 10,000 years old.

Morton (in Weber and others, 1973, Plate 5) shows a large composite landslide to the north of Fillmore, north of the trace of the San Cayetano fault. Weber and others (1975) show this same area, but slightly larger, as a "bedrock" landslide area. The toe of this slide coincides with the fault trace shown by Rockwell.

Weber and others (1973; 1975) and Cemen (1977) show the San Cayetano fault in Fillmore generally to lie south of Rockwell's trace (1983) and to be concealed (Figure 4). Neither Weber nor Cemen connect the Fillmore trace to the main trace of the San Cayetano fault where it crosses Sespe Creek. They show it connecting to a fault, branching from the main fault, which is only inferred in Tertiary rocks and concealed by the younger units. They also identify other branches of the San Cayetano fault to the north in bedrock east of Sespe Creek. Rockwell (1983) is the only one to connect the Fillmore trace with the main San Cayetano fault. The faults were assessed previously by Smith (1977a) as not meeting the current zoning criteria. Thus, there remains a question as to which if any traces of the San Cayetano fault east of Sespe Creek are active. Moreover, the location and activity of the Fillmore trace remains uncertain.

FIELD AND AIR PHOTO OBSERVATIONS

The Arroyo Parida-Santa Ana fault near the Ventura River has no persistent, well-defined surface expression. East of the river a portion of an older terrace surface (Qt_{6a}), estimated to be 38,000 years old, is higher south of the trace shown by Rockwell (1983). This surface appears

to be considerably eroded on both sides of the fault but no discrete scarp can be seen on air photos or on the ground. The younger Qt_{5b} surface (> 10,000 years old) immediately east of the Qt_{6a} surface, also has no visible fault trace. The portion of this fault west of the Ventura River has already been discussed in FER-174.

The Lion fault, as mapped by Rockwell (1983) in Upper Ojai Valley (see Plate 2, FER-174) crosses contours in a nearly straight line. The noses of several ridges appear to be north of the trace. Features visible on air photos which may be a fault trace appear to be more sinuous and more discontinuous than mapped by Rockwell. Indeed, upon closer inspection, there are only a few anomalous areas between the alluvial fans being deposited from Sulphur Mountain. These interfan depressions bounded on the south by semi-linear, but as yet unburied bedrock could be interpreted as faults but they are very eroded and ambiguous. No trace or other anomaly is visible on the fans. If the interfan features represent a fault, they are not as fresh appearing as other faults in the area. These interfan "scarps" could easily be partially buried ridges given some linearity by the prevailing attitude of bedding in the area or could be old landslides.

The San Cayetano fault in Fillmore is marked by a man-modified south to southwest facing scarp (Figure 4). Toward the northwestern part of the trace, shown on Figure 4 by short dashes with bar and ball symbols, shale type bedrock and shaley slope wash debris is exposed north of a break in slope without any obviously stream deposited debris evident except in the immediate areas of the active drainages. Terrace deposits occur south of the trace but no matchable offset units, which I would classify as Holocene, could be found. Farther east the scarp is well-defined and coincides with Rockwell's trace but is severely man-modified by housing development. Near Pole Creek and south along the east side of Pole Creek no scarp-like feature could be seen although the linear ridge could possibly be fault controlled. No evidence of major faulting is present in bedrock exposed along Pole Creek.

The hills to the north have several anomalous closed depressions in some terrane that appears to be possibly a large landslide. The scarp here could also be interpreted as the toe of a landslide along the northwest part of the inferred fault. Where the fault crosses the younger fan material coming from Pole Creek no evidence for faulting could be found.

CONCLUSIONS

The Arroyo Parida-Santa Ana fault, in the stretch between its juncture with the Villanova fault and the well-defined portion west of the Ventura River, does not meet the criteria of being well-defined. Additionally, it does not appear to be sufficiently active, as summarized in FER-174, to warrant zoning. However, because of the evidence revealed in trench logs submitted by Buena Engineers (1981, 1982a, 1982b) it must now be considered sufficiently active, because they show it cutting the soil, presumed to be Holocene in age, in trenches 2 and 3. The fault alignment

revealed by these and other trenches is sufficiently close to the alignment shown by Rockwell to indicate that this is the location of the fault in question.

The Santa Ana fault east of San Antonio Creek is characterized by Rockwell (personal communication, March 1986) as being "...well defined in the subsurface." The subsurface information (Clark, 1982) places the location about 800-1,000 feet north of the location shown by Rockwell (1983). No data on the recency of movement is evident along this stretch and subsurface definition is not sufficient to accurately locate or to date the activity on this fault.

The Lion fault as indicated in the Gorian and Associates trenches (Figures 2 and 3) is not what I would consider well-defined. A fault with a dip less than 30 degrees would have a very sinuous trace sub-parallel to the topographic contours and would not show a straight trend crossing topography. It is much more likely that these trench logs represent landslides although the slide planes could indeed be the fault deformed by sliding. No unambiguous evidence of Holocene movement is revealed here, although late Pleistocene activity could be inferred.

The fault trace in Lion Canyon (Plate 2, FER-174) is properly sinuous for a thrust fault but here the fault is obscured by landslides, possibly related to faulting. I suspect the fault in Upper Ojai Valley may have a similar relationship but is buried under the alluvium filling the valley. At present there seems no way to resolve this dilemma with the time or resources available.

The San Cayetano fault north of Fillmore, as mapped by Rockwell (1983), does not exactly coincide with the break in slope (Figure 4) but I believe it was his intent to place it there. Implied evidence for offset terrace surfaces is not convincing. The possibility that this may be a large landslide toe cannot be ruled out. Without further evidence from trenching, soil comparison profiles, and particularly some further substantiation of estimated ages of units, this fault must be questioned as being active in Holocene time. Even though the northern part of this fault appears fairly well-defined the rest is poorly-defined to undefined. Whether it is sufficiently active is not clear at this time but is questionable.

RECOMMENDATIONS

The Arrroyo Parida-Santa Ana fault should be zoned as shown on figure 5 and the trace of the fault should be delineated as shown to match the trench locations. The zone should be extended to join with the existing zone (FER-174) west of the Ventura River. Although the trench by Buena Engineers (1983) is near the zone it is not on the trace and should be ignored for zoning purposes. The zone should be extended slightly west of the zone recommended in FER-174.

The Santa Ana fault east of San Antonio Creek should not be zoned at this time. Additional data are needed to define this stretch of the fault and to estimate the age of latest movement.

The Lion fault should not be zoned in Upper Ojai Valley as the fault is not well-defined and may be complicated or buried by landslide debris. Additional data may be developed in the future to warrant zoning of this fault. Where the Lion fault is mapped in Lion Canyon it should not be zoned unless its trace can be more accurately delineated and separated from the landslides and unless some further data on recency of faulting is developed.

The San Cayetano fault north and east of Fillmore should not be zoned at this time. If subsequent work to estimate the age of alluvial surfaces in the area is done and shows these surfaces to be offset the fault should be reevaluated at that time. Further work to identify the exact location of the presumed fault is also needed. The influence of possible landsliding also needs to be evaluated.

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Reviewed - the conclusion and recommendation appear reasonable.
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6/13/86

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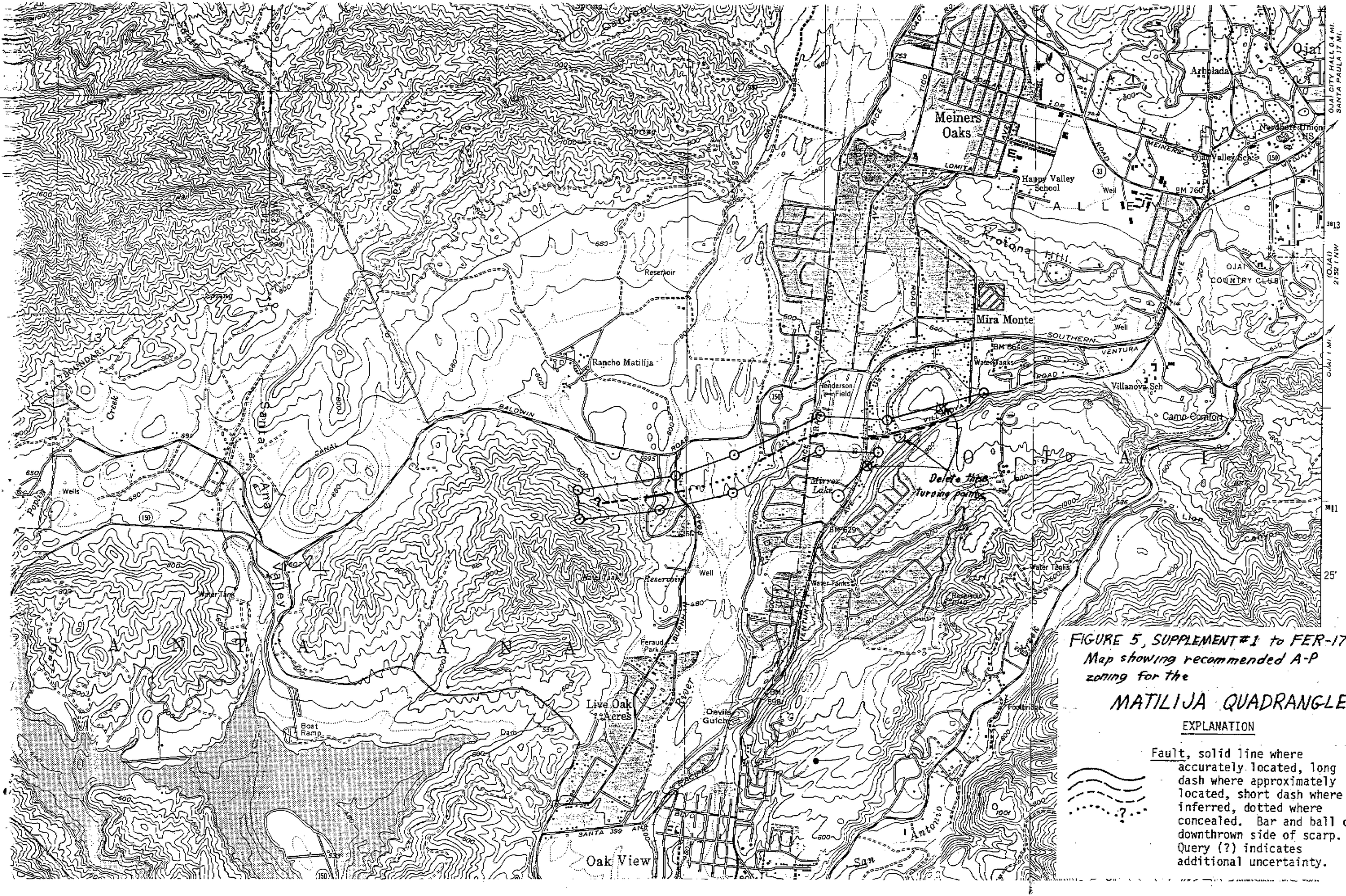

FIGURE 5, SUPPLEMENT #1 to FER-174: Map showing recommended A-P zoning for the

MATILIJA QUADRANGLE

EXPLANATION

Fault, solid line where accurately located, long dash where approximately located, short dash where inferred, dotted where concealed. Bar and ball on downthrown side of scarp. Query (?) indicates additional uncertainty.