STOPS 1 & 2

ACTIVE FAULTS IN NORTH HARRIS COUNTY AND SOUTH CENTRAL MONTGOMERY COUNTY, TEXAS

Carl E. Norman
Department of Geosciences, University of Houston

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Bill R. Elsbury
Fugro-McClelland (Southwest), Inc., Houston, Texas

Introduction

Over 450 active surface faults are known in the Texas Coastal Zone between Corpus Christi and the Beaumont-Orange-Port Arthur area. Many others likely remain undiscovered due to lack of a concerted effort to find them. About 90 percent of the known active faults are in the Houston Metropolitan Area where hundreds of residential, commercial and industrial structures have been built across them, for the most part unknowingly. Due to the low rates of differential ground movement across the faults, normally less than 0.5 inches per year, these structures rarely show evidence of damage during their first 5 to 10 years of existence. However, experience shows that the ultimate fate of the structures is abandonment long before their intended life span has been reached.

Recent investigations have also revealed that some waste disposal sites in the Texas Coastal Zone, including at least 4 Superfund sites, are crossed by active faults. The listric (concave upward) shape of the faults, combined with their normal-slip movement pattern, results in extensional strain in the near-surface sediments which may allow the faults to become conduits for the movement of subsurface fluids. However, at depths of a few thousand feet and more, the faults frequently are barriers to movement of fluids. A large percentage of the coastal oil and gas accumulations, both onshore and offshore, are trapped by listric normal faults.

With no known exceptions, the active surface faults are strictly normal-slip faults. Those monitored for their movement show no strike-slip or net reverse-slip movement. Sparker profiles indicate that the same pattern of faults extends out across the continental shelf. Small, linear topographic scarps on the sea floor indicate that there are many active faults offshore as well.

Maps of Surface Faults

Figures 1, 2, and 7-10 show the location, orientation, and sense of movement of several active faults, 6 of which we will cross during this trip. The lengths of the fault traces are shown conservatively: to date no real effort has been made to trace these faults to their terminations, with the exception of the Long Point and Woodgate faults.

As with all geologic maps, those presented here should be considered no more than progress reports. They show only the faults that are well documented. No attempt was made to show "probable" or "possible " faults. One of the best tools for locating active faults in the Coastal Zone is an aerial photograph. However, surface faults do not show up clearly in wooded or developed areas, or in ares of significant topographic relief. For this reason much of north-central and northeastern Harris County and most of Montgomery County will have to be surveyed painstakingly by on-site investigations in order to identify and map unknown surface faults. Petroleum industry maps of faults deep in the subsurface can provide important clues to the location, orientation, and sense of movement of surface faults.

Rates of Fault Movement

During the period of June 1985 through September 1987 the present author and John Mastroianni, a graduate student in geosciences at the University of Houston, embarked on a personally funded study of the movement patterns of 29 faults in and around the Houston Metropolitan Area. Table 1 lists the current movement rates of 11 faults in the field trip area. The measurements are of only the vertical component of motion. The horizontal component is about 1/3 as great because the near-surface dip of most of the faults is about 70 degrees.

During the 1985-1987 study, lines of bench marks across the faults were measured for elevation changes at intervals of about 3 to 5 months. The rates of movement were fairly uniform, except at the Conroe and Big Barn faults where essentially no movement occurred until May through September 1987. The rates were then 2 to 3 times as great as that recorded for the other faults. At this time we offer no explanation for the anomalous behavior.

Faults Along the Field Trip Route

Our field trip route crosses 6 of the active faults, the Long Point, Brittmoore, Woodgate, Navarro, Big Barn, and Conroe faults. The first 3 are regional contemporaneous (growth) faults. The Navarro and Big Barn are located on the west flank of the Conroe Dome, a large oil-producing structure measuring 8 miles north-south by 5.5 miles east-west and centered about 7

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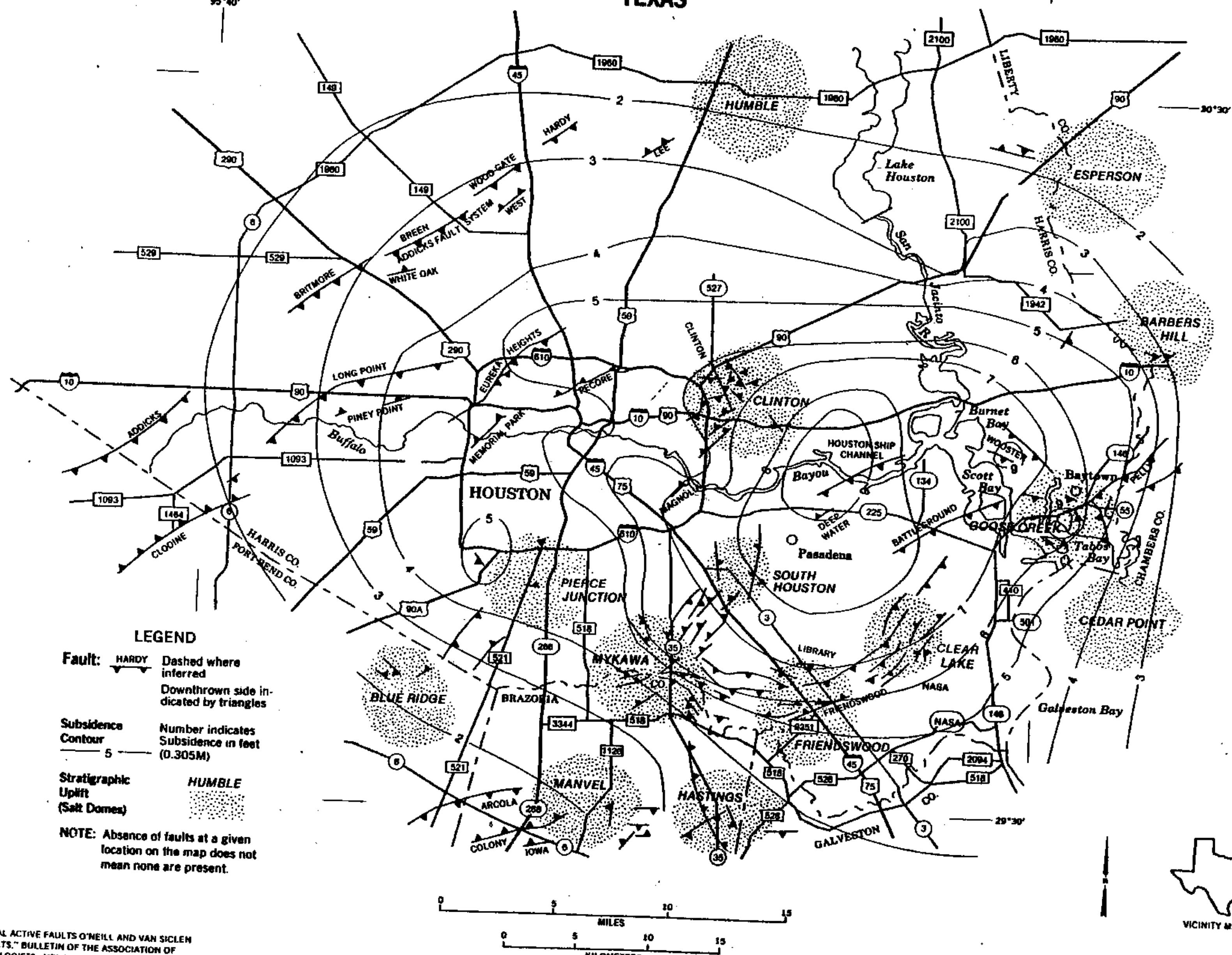
PRINCIPAL ACTIVE FAULTS
HOUSTON AREA
TEXAS



LEGEND

Fault: HARDY — Dashed where inferred. Downthrown side indicated by triangles

Subsidence Contour —— 5 —— Number indicates Subsidence in feet (0.305M)

Stratigraphic Uplift (Salt Domes) HUMBLE

NOTE: Absence of faults at a given location on the map does not mean none are present.

SOURCE PRINCIPAL ACTIVE FAULTS O'NEILL AND VAN SICLEN "GULF COAST FAULTS," BULLETIN OF THE ASSOCIATION OF ENGINEERING GEOLOGISTS. VOL XXI, NO 1, 1984 PP 73-87.

USDA SCS NATIONAL MAPPING DIVISION, FT WORTH, TX 1986

FIGURE 2

MAY 1984 4-R-38750

TABLE 1

FAULT ORIENTATION AND MOVEMENT DATA

FAULT NUMBER[1]	FAULT NAME	STRIKE	DOWNTHROWN SIDE	RATE OF MOVEMENT (in/yr)[2]
1	Long Point	N45-75E	SE	0.50
2	Brittmoore	N55-60E	SE	0.47
3	Woodgate	N52E	SE	0.35
4	Hardy	N45E	SE	0.24
5	Lee	N53E	NW	0.27
6	Jetero	N72E	NW	0.25
7	Cantertrot	N75W (at U.S. 59)	NE	0.22
8	Navarro	N52E	SE	0.43
9	Big Barn	N40E	SE	0.00 (8/85-9/86) 0.64 (2/87-9/87)
10	Conroe	N55E	SE	0.00 (8/85-2/87) 0.74 (2/87-9/87)
11	Grangerland	N83W	NE	(Not monitored)

1. Numbers refer to location on map figures

2. Movement rate includes only the vertical component of motion during the period of 6/85-9/87.

miles southeast of Conroe. The location, orientation and sense of movement of these 2 faults corresponds well with faults identified in borings completed to depths of 4000 to 5000 feet during development of the field. We won't stop to inspect these down-to-coast faults, but we will point them out to you just before we cross them on our way up to Conroe.

Our first stop will be at the Long Point Fault where it crosses the Sam Houston Tollway just north of Interstate Highway 10. This northeast-trending, down-to-coast fault can be traced downward to depths of at least 7000 feet and horizontally about 10.5 miles from Westella Road, 0.7 miles west of Dairy Ashford Road, northeastward to a point near the intersection of Hempstead Road and Dacoma Street. The I-10 crossing is approximately at the mid-point of the fault trace. We will drive through a residential subdivision south of I-10 to view the effect of the fault on a few houses and a strip shopping center and then stop to view it just north and east of the Sam Houston Tollway and I-10 interchange. A 1986 count showed that 243 structures, mostly homes, rest directly in the zone of ground disturbance along this single fault.

Movement of the fault in the immediate area has been monitored continuously since 1966 from surveys of the pavement of Old Katy Road, by McClelland Engineers in 1966, 1979 and 1984; from monitoring stations along the north side of I-10 (bench marks installed by the USGS in 1978, and by Norman and Mastroianni in 1985) and along the east side of Gessner Road 0.4 miles north of I-10 (tilt beam and extensometer installed by the University of Texas in 1971). In addition, Norman has repeatedly measured vertical displacements of floors in the Igloo Company plant across the tollway from Stop 1. The data show that fault displacement here has accumulated at an average rate of 0.5 inches per year since 1966. Although the movement is intermittent throughout any given year, the average rate from year to year is nearly constant.

Figures 3 and 4 are maps of the fault prepared by McClelland Engineers for the Harris County Toll Road Authority. They were completed before construction of the interchange and its approaches in 1988. All 4 bridges that cross the fault are designed to account for the exact location and orientation of the fault, as well as its sense and rate of motion. Figure 5a is a topographic profile along the east side of West Belt Drive (Now the Sam Houston Tollway). The 1 percent slope over the 900-foot length of the profile steepens to a 2 percent slope at the modern fault scarp. Figure 5b is a similar profile along Old Katy Road. The location of the profiles are shown on figure 3.

Figure 5a is a profile of a trench dug to view the fault in advance of construction of the I-10 tollway interchange, and figure 6 is a structural-stratigraphic cross-section constructed from borehole logs run at the location shown in Figure 3. At a depth of about 250 feet, the fault has displaced horizon F vertically about 40 feet. At a depth of about 100 feet, Horizon C is displaced only about 10 feet. The difference in displacement with depth clearly demonstrates that the Long Point Fault is a "growth fault" that has been active, at least intermittently, for the 1.5 million or so years since horizon F in the lower Lissie Formation was deposited. Assuming that date is approximately correct, the average Pleistocene-Holocene rate of movement is about 0.0003 inches per year, 3 orders of magnitude less than the current rate.

Stop 2 will be at the northeast-trending Conroe Fault, also downthrown to the south. It appears to tie to an extensive deep regional fault which has trapped oil and gas in the Grand Lake-Risher field west of Conroe. You will see that the fault is easily recognizable on State Highway 105 by an abrupt change in the elevation of the pavement and by a series of en-echelon cracks across it. It also disturbs pavement on I-45 and its service roads about 0.2 miles north of S. H. 105. Although the fault shows a surface scarp only a few inches high here, it has displaced the top of the Yegua Formation 400 to 500 feet at a depth of 5000 feet.

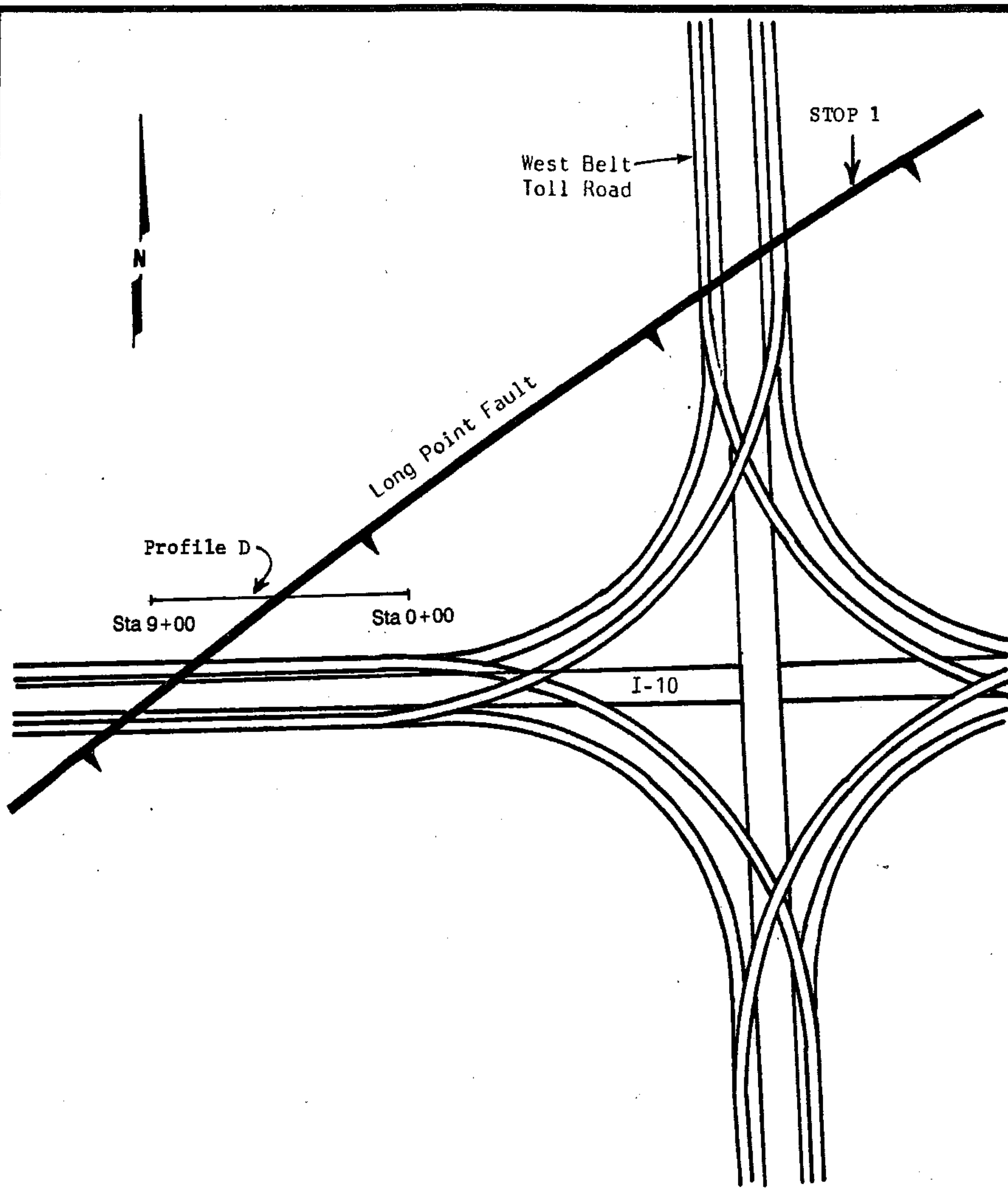
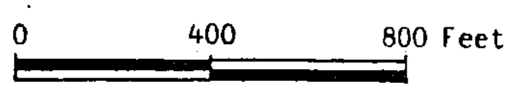


FIGURE 3

APPROXIMATE LOCATION OF LONG POINT FAULT



McClelland Engineers

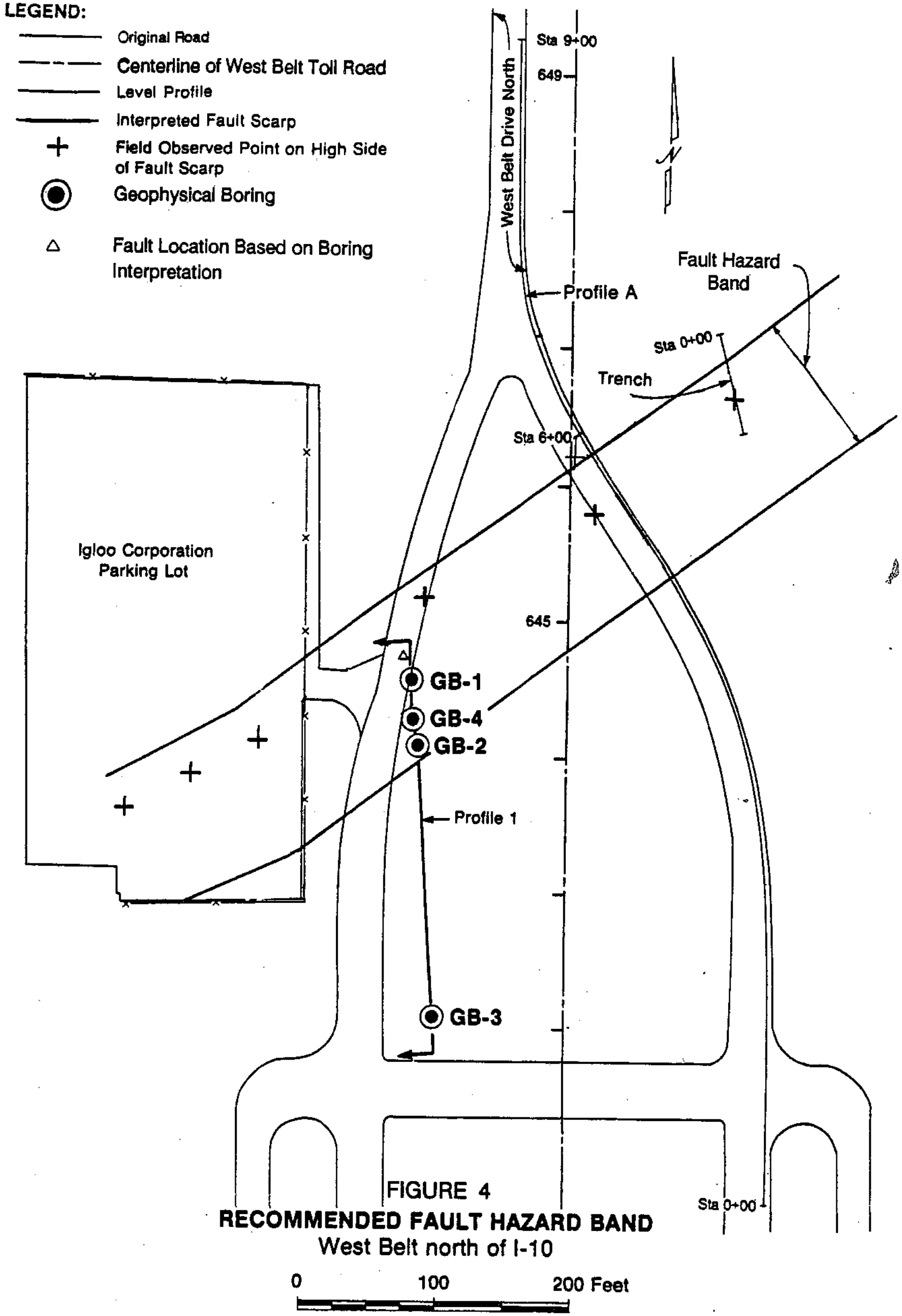


FIGURE 4
RECOMMENDED FAULT HAZARD BAND
West Belt north of I-10

Profile A

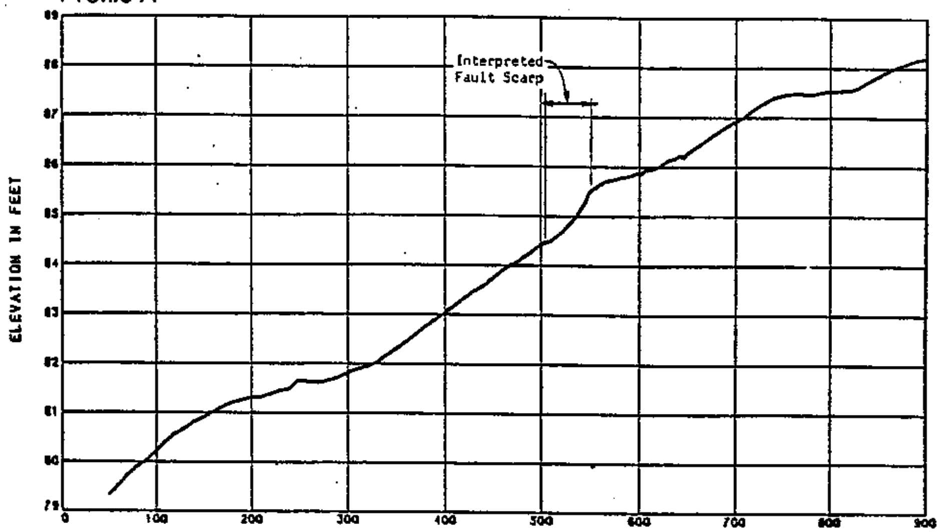


Figure 5a. Topography along east side of Sam Houston Tollway.

Profile D

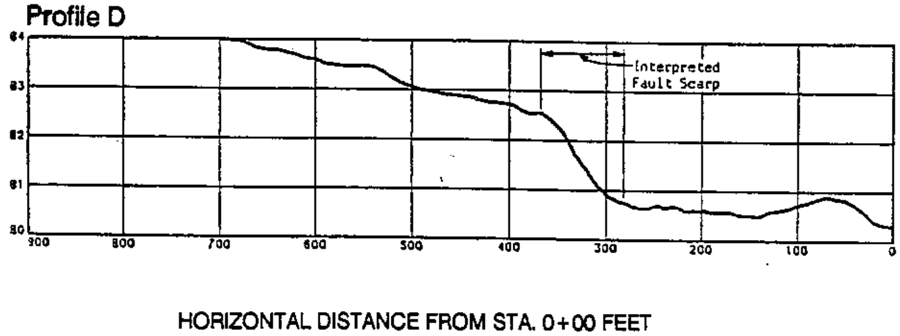


Figure 5b. Topography along Old Katy Road.

FIGURE 5. Topographic Profiles.

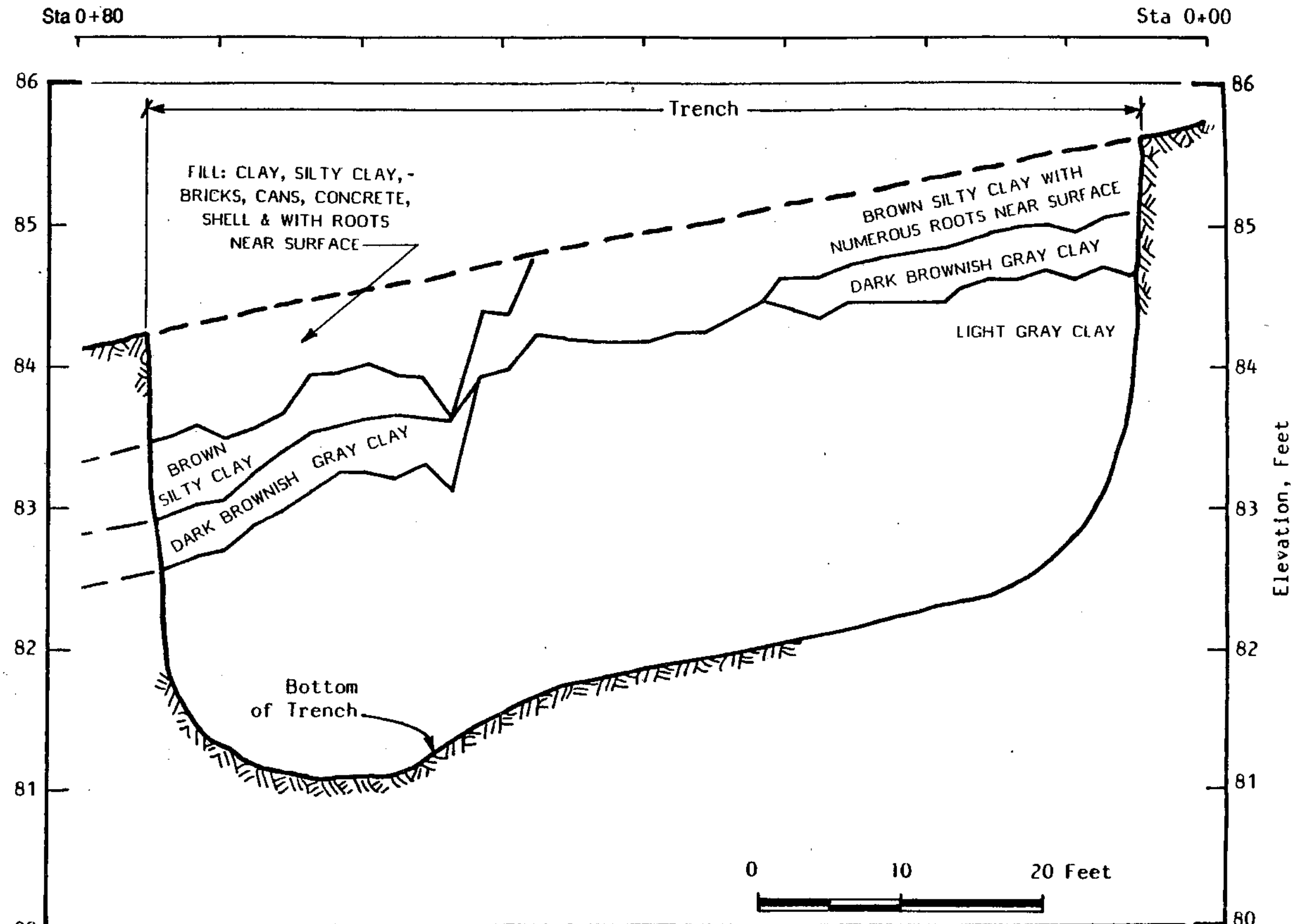


FIGURE 5c
PROFILE OF TRENCH WALL

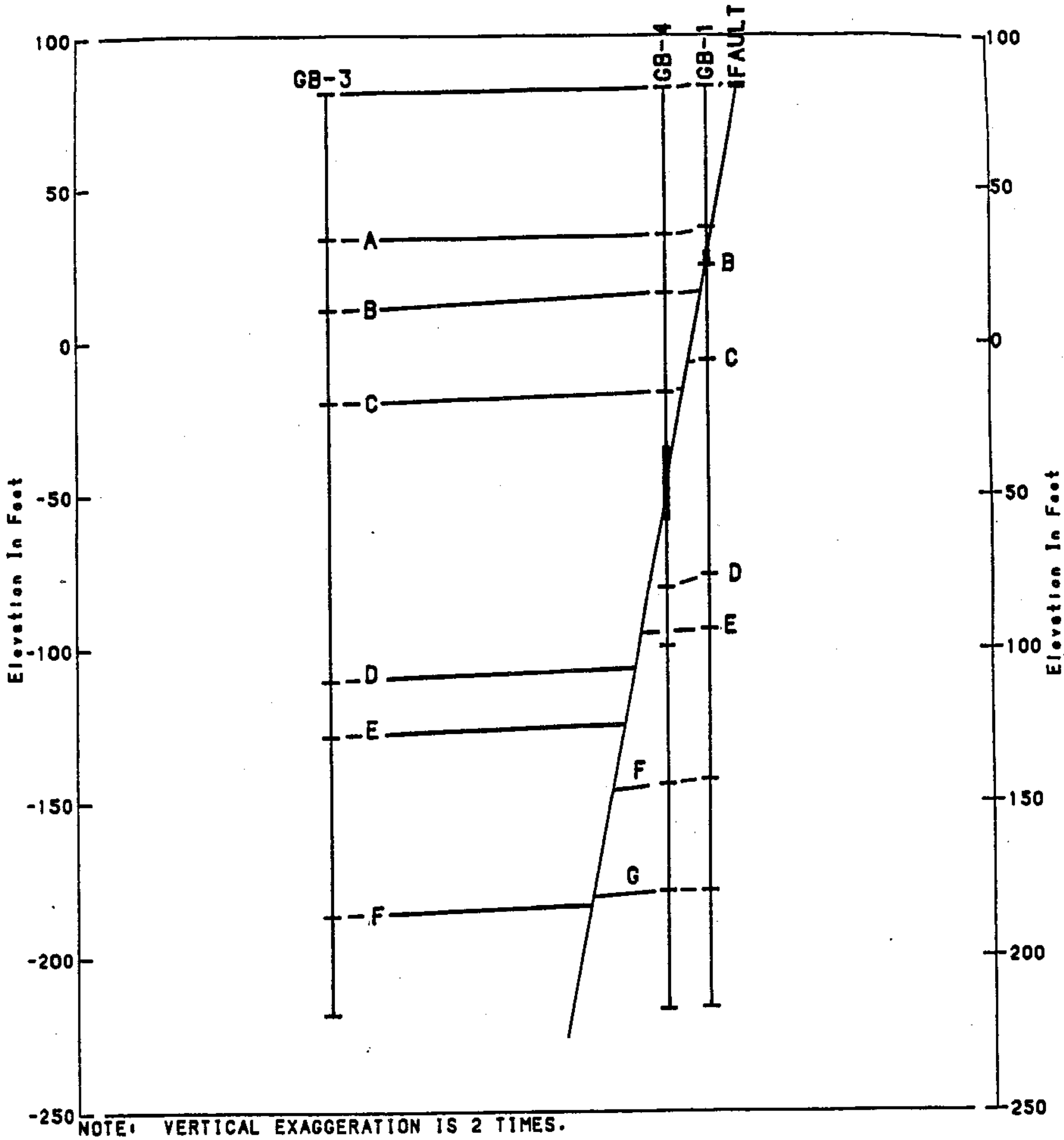


FIGURE 6

SOIL MARKER PROFILE

Profile 1

0 50 100 Feet

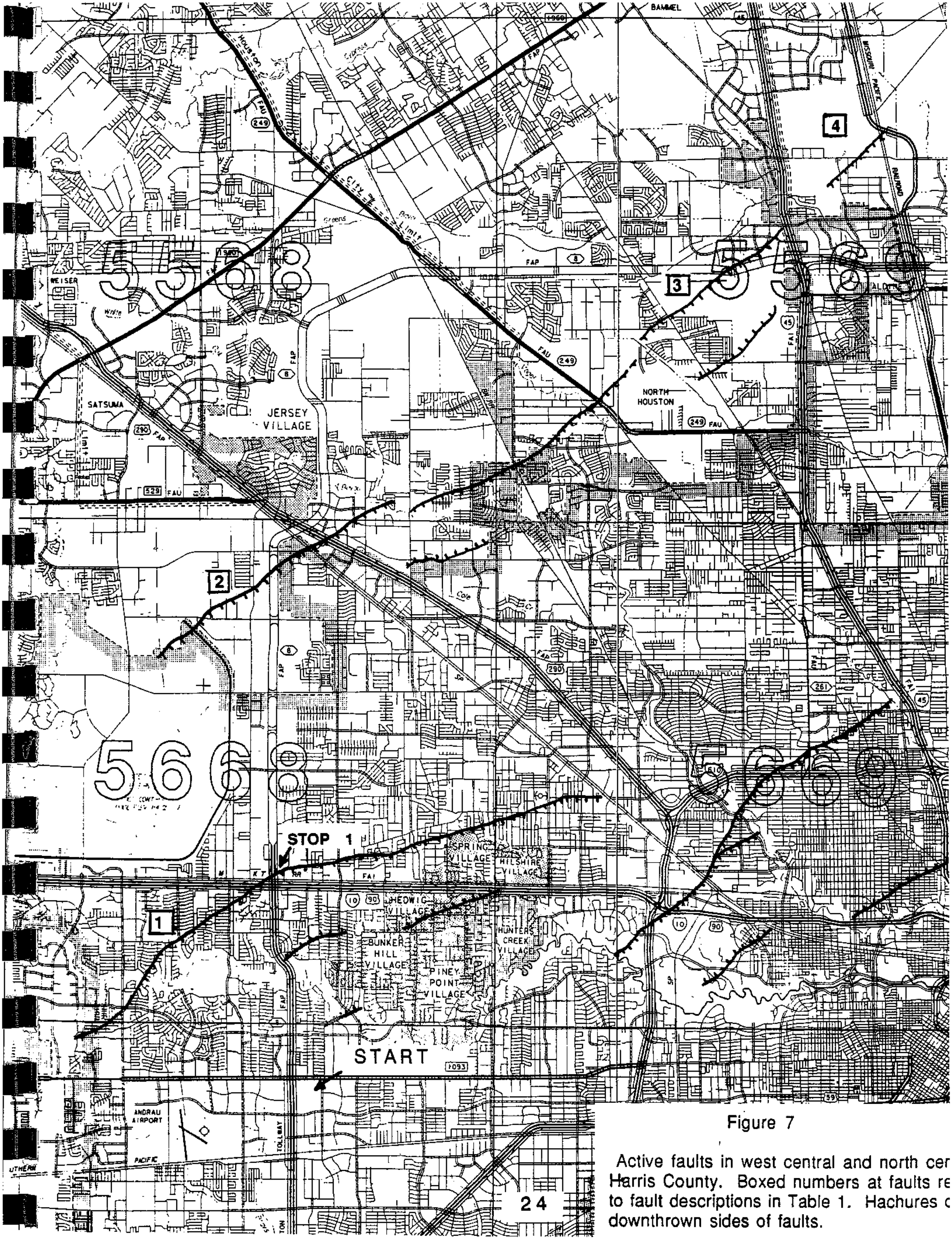


Figure 7

Active faults in west central and north cer Harris County. Boxed numbers at faults re to fault descriptions in Table 1. Hachures c downthrown sides of faults.

Active faults in north central Harris Cour
and south central Montgomery County. Bo
numbers at faults refer to fault descriptic
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faults.

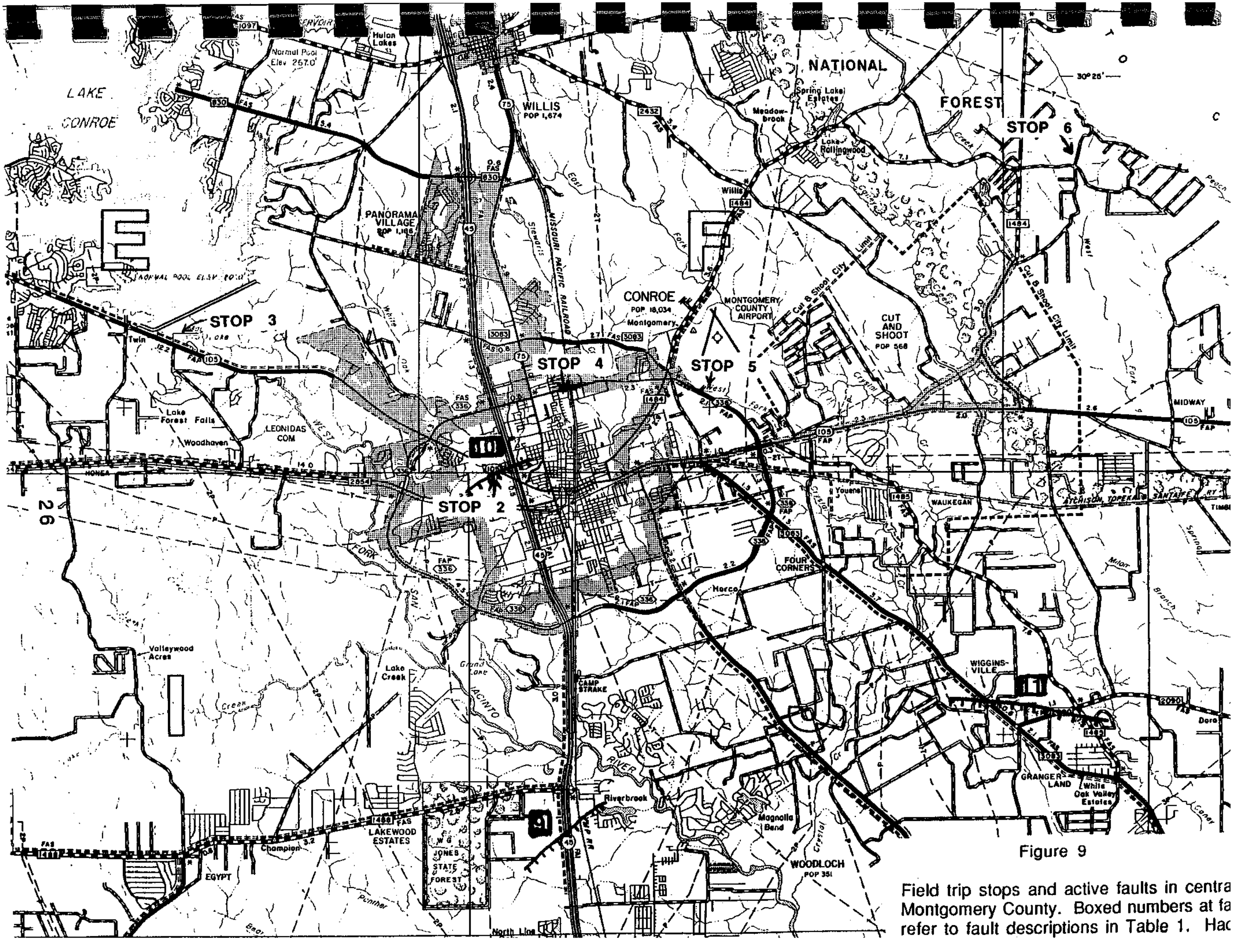

Figure 9

Field trip stops and active faults in centra
Montgomery County. Boxed numbers at fa
refer to fault descriptions in Table 1. Ha