

**LOS ANGELES INTERNATIONAL AIRPORT-PALMDALE REGIONAL AIRPORT
SPECIALIZED RAIL TRANSIT SYSTEM DEMONSTRATION PROJECT**

TASK 3:

GEOTECHNICAL, GROUNDWATER, AND CONTAMINATED SOILS INFORMATION

Prepared for:

**LOS ANGELES COUNTY TRANSPORTATION COMMISSION
818 West Seventh Street, 11th Floor
Los Angeles, California 90017**

Prepared by:

**CORDOBA CORPORATION
617 South Olive Street, 5th Floor
Los Angeles, California 90014**

December 9, 1991

TABLE OF CONTENTS

	<u>Section</u>	<u>Page</u>
I.	Introduction	1
II.	LAX to Marina Freeway	4
III.	Marina Freeway to Venice	6
IV.	Venice to Pico	7
V.	Pico to Wilshire	8
VI.	Wilshire to Ventura	8
VII.	Ventura to Victory	14
VIII.	Victory to Roscoe	15
IX.	Roscoe to Chatsworth	16
X.	Chatsworth to Roxford	17
XI.	Roxford to San Fernando	20
XII.	San Fernando to Holt Canyon	25
XIII.	Holt Canyon to Avenue "S"	27
XIV.	Avenue "S" to Palmdale Airport	40
XV.	Bibliography	41

INTRODUCTION

The following is a technical memorandum which presents Task 3 - Review of available Caltrans geotechnical, groundwater and contaminated soils information for the Los Angeles International Airport to Palmdale Specialized Rail Transit System (LAX-Palmdale). The LAX-Palmdale Rail Project is proposed to follow the alignment of Interstate 405 (I-405, San Diego Freeway), Interstate 5 (I-5, Golden State Freeway) and State Route 14 (SR-14, Antelope Valley Freeway), and is generally proposed as an aerial transitway within the freeway median. This section discusses geologic conditions along the route, with an emphasis on the engineering qualities of soils and rock formations encountered.

Southern California is situated in a geologically highly active region at the contact between the Pacific and North American Continental Plates. Relative movement between the Plates (approximately 2" per year) has produced folding, twisting, crushing, and lifting of rock formations many miles from the contact zone. Not only does the proposed route encounter these secondary phenomena, it traverses three distinct geomorphic provinces (the Los Angeles Coastal Basin, the Transverse Ranges, and the Mojave Desert Provinces), and must cross the contact zone itself, evidenced in the form of the San Andreas Fault rift zone near Palmdale.

While the geologic conditions encountered are diverse and complex, the route generally follows the roadbed of existing freeways. Within the limits of the traveled way, the first 2.0 to 2.5 feet of soil encountered is highly engineered foundation and likely to be relatively uniform along the entire route. In addition, virtually the entire length of the I-405/I-5/SR-14 corridor under study is within either embankment, fill, or cut areas. It is only within cut areas that native soils are likely to be encountered during footing excavation. Embankments and fill areas will exhibit highly engineered and uniform conditions. Table 1 presents the specifications for imported material which were uniformly applied during the period of construction for the freeway projects.

Organization of this Document

The route study area is divided into segments between proposed stations. This report describes the regional and local geologic conditions for the segment between each station. Included in the discussion are 1) rock formations and soils encountered, 2) earthquake faulting, 3) groundwater conditions, 4) hazardous materials identified by Caltrans, and 5) bearing capacities of local soils. To aid the reader, each is treated under an individual sub-heading within each segment.

Table 1	
Standards for Roadway Foundation Materials	
<u>Imported Subbase Material (ISM)</u>	
Pass 2½ Sieve	100 %
Pass No. 4 Sieve	30 - 100 %
Pass No. 200 Sieve	1 - 20 %
Sand Equivalent	25 min.
R-Value	65 min.
<u>Imported Base Material (IBM)</u>	
Pass 1½ Sieve	100%
Pass No. 4 Sieve	30 - 100%
Pass No. 200 Sieve	1 - 15%
Sand Equivalent	30 min.
R-Value	72 min.

Methodology

The construction segments for which this report is prepared are considerably different from the stationing in use for the present project, thus the segment between Transit stations (e.g., Roxford to San Fernando) may be covered in several project reports. Further, stationing in these 30 to 45-year old reports was found to be frequently inaccurate, with marginal notations and changes by later readers. The stationing of the original reports has been converted as accurately as possible to the present system.

This summary report is largely based on geologic information contained in 17 "Materials Reports" (see Bibliography) prepared by the State Department of Transportation, Division of Highways (now Caltrans) for the original construction of the subject freeways and nearby roadways, and on reports prepared to address certain problems encountered during or after construction (such as improperly protected expansive soils). The original Materials Reports are

Task 3: Geotechnical/Groundwater/Soils

housed in the Caltrans District VII Materials Lab Archive (120 South Spring Street, Room 211, Los Angeles, California 90012, Mr. Jim Nakamura, 213-897-0452). In this report, the superscript numbers (¹, ², etc.) refer to bibliographic entries rather than endnotes.

Soil bearing capacities from Caltrans' over- and under-crossing structural data were examined. The source of bearing capacity data was as-built drawings (microfiche) and actual maintenance logs for the individual crossing structures. These are maintained at Caltrans Structure Maintenance Division (849 South Broadway Street, 7th Floor, Los Angeles, California 90014, Mr. Paul Askelson, 213-620-3760).

All data presented in this report is based on existing generalized geological and structural reports. No field investigations were conducted. The reader is cautioned to conduct a complete geologic investigation to verify field conditions.

Crossing structures rest either on piles or spread footings, or a combination of both. In general, all structures south of station 1400 are on piles, while those north are almost exclusively on spread footings. An exception to this is the area between stations 671+00 and 902+80 (crest of the Santa Monica Mountains), where spread footings are used. Piles carry a design weight of 45 tons each and are driven to varying depths to attain refusal at the design profile. Spread footing loads are highly variable, carrying 1.5 to 5 tons per square foot.

Depth of footings to attain design loads is also highly variable, even within individual crossing structures. Because of the highly variable nature of the geologic strata, even within relatively uniform portions of the route, bore offsets of even a few feet are likely to reveal significantly different conditions. Thus, reporting here of detailed footing data for each crossing structure is not worthwhile. Rather, the user is referred to the Structure Maintenance Division (above) or the original geologic reports for each structure, located at the Caltrans Division of New Technology (Transportation Materials and Research, 5900 Folsom Boulevard, Sacramento, California 95819 Mr. Adlai Goldschmidt, 916-739-2336).

**LAX TO MARINA FREEWAY
(Station 1 to Station 2)**

Local Geology

The southern end of the route, beginning near the Los Angeles International Airport, is situated on the recent Quaternary alluvium and upper pleistocene terrace deposits of the Torrance Plain. The Torrance Plain parallels the Newport-Inglewood belt of hills from the Ballona Gap southwest to Dominguez Gap. It is a broad, geologically featureless area only slightly dissected by local streams north of Centinela Creek. The Plain is immediately underlain by up to 1,000 feet of fine-grained materials of marine and nonmarine origin. The presence of both marine and nonmarine fossils and the remains of extinct land mammals, commonly found 10 to 30 feet below the surface, suggests repeated cycles of complete or nearly complete inundation by shallow sea waters.

The El Segundo Sand Hills extend from the Ballona Gap south to Torrance and the Palos Verdes Hills, approximately three to four miles inland from the ocean. The sand hills consist of a narrow strip of active or recent dunes along the coast and older stabilized sand dunes inland. The active dunes are up to one-half mile wide, with a maximum elevation of 185 feet above sea level. These active dunes have undergone at least two stages of development, as shown by excavations for the Scattergood Steam Plant. An earlier phase of the recent unweathered sand dunes had a surface which was inhabited by man and subsequently covered with over 30 feet of sand to form the present dunes.

The active dunes are underlain by older sand dunes of probable late Pleistocene age. These older dunes are probably beach deposits which have been altered by wind action and deeply weathered. The form of the older dunes was modified by wind action so that the surface now has closed depressions formed by the action of removing and depositing sand. Weathering and associated stabilizing processes have removed all but the gross features of dune topography in the older dune area.

This geologic structure indicates that coarse to fine sands and silty sands can be expected throughout the segment. Paleontological (common) and archaeological (rare) artifacts can be expected.

Faulting

No earthquake faults were reported crossing the route within this segment.

Groundwater

Table 2 indicates the location and depth of groundwater encountered within this segment. At Centinela, an historic natural drainage contained a perennial surface stream and groundwater.¹

Table 2 Groundwater Location and Depth LAX to Centinela		
Location	Encounter	Depth
147+50±	Free Water	17 feet
150+50±	Free Water	24 feet
172±	Historic Drainage Channel Seepage Free Water	7 feet 25 feet
200+00±	Slight Seepage	23 feet
207+50±	2½' Rise in Bore	24 feet

Hazardous Materials

Substantial end dumping occurred prior to construction of the freeway. Dumped material (excavated from local street and storm drain work) contained concrete and organic materials, but generally was cleaned and reused in embankment areas. There is a notation that the "top three feet of the cultivated fields located west of Sepulveda and south of Jefferson contains material excavated during the construction of the Ballona Channel."¹ The nature of this material is not indicated, but is thought to be very silty.

Bearing Capacity

All crossing structures within this segment are carried on 45-ton piles.

**MARINA FREEWAY TO VENICE
(Station 2 to Station 3)**

Local Geology

In this segment, the freeway route traverses the Ballona Gap. The Ballona Gap is probably the (geologically) historic channel of the Los Angeles River. Prior to 1825 and again during the flood of 1867-68, it flowed westerly from the Los Angeles Narrows through the Ballona Gap rather than southerly through the Dominguez Gap. This river-cut channel has repeatedly been inundated by rising sea waters and river flows have been slowed and blocked by baymouth bars, depositing coarse to fine grained sediments within the Gap area. This stream aggradation was accompanied by wave erosion of the marine terrace deposits on exposed beaches and by marine deposition offshore. Geologic conditions within this segment are similar to those described above.¹ From the vicinity of Venice Boulevard (and north), there is a marine deposit consisting of coarse to fine sand.

Jefferson Boulevard formed the limit of the southward construction for a period of approximately two years. In the area north of Jefferson, ISM and IBM were taken from freeway-related excavation in the Santa Monica Mountains and contain significant amounts of slate and shale material. This source was exhausted prior to construction of the later segment south of Jefferson, thus necessary import is likely from commercial sources in the San Gabriel or San Fernando Valleys.

Culver City records indicate the presence of a filled-in storm channel approximately 370 feet south of the centerline of Venice Boulevard. The width and depth of the channel are given as 20 and 10 feet respectively. The construction of this channel is unknown. A boring at this location indicates that the fill material was adequately consolidated.²

Faulting

No earthquake faults were reported crossing the route within this segment.

Groundwater

No groundwater was reported in borings within this segment.

Hazardous Materials

No hazardous materials or rubbish were reported within this segment.

Bearing Capacity

All crossing structures within this segment are carried on 45-ton piles.

**VENICE TO PICO
(Station 3 to Station 4)**

Local Geology

Geologic conditions within this segment are similar to those described for the previous segment.² Embankment materials will include substantial quantities of slate and shale imported from freeway-related excavations in the Santa Monica Mountains.

Faulting

No earthquake faults were reported crossing the route within this segment.

Groundwater

No groundwater was encountered in any borings within this segment.

Hazardous Materials

In the vicinity of Ocean Park Boulevard, approximately 20,000 cubic yards (cy) of fill (concrete, organic material, silty sand) was removed. This material was used in embankment areas within this segment. No other refuse or hazardous materials were identified within this segment.

Bearing Capacity

All crossing structures within this segment except structure 53-242 (Palms Boulevard, station 370+00) are carried on piles. The bents for the Palms Boulevard overcrossing are carried on spread footings.

**PICO TO WILSHIRE
(Station 4 to Station 5)**

Local Geology

Geologic conditions within this segment are similar to those in the previous segment.^{2, 3} Embankment materials will include substantial quantities of slate and shale imported from freeway-related excavations in the Santa Monica Mountains.

Faulting

No earthquake faults were reported crossing the route within this segment.

Groundwater

No groundwater was encountered in any borings within this segment.

Hazardous Materials

No refuse or hazardous materials were identified within this segment.

Bearing Capacity

All crossing structures within this segment are carried on 45-ton piles.

**WILSHIRE TO VENTURA
(Station 5 to Station 6)**

Local Geology

The Santa Monica Mountains, through which the route now passes, form the central portion of the Transverse Ranges, running about 275 miles eastward from Point Arguello into the Mojave Desert. Consisting of several large areas of uplifted basement rocks, the blocks which form the Santa Monica's are seismically active and are transected by a northwest trending branch of the Santa Monica fault and numerous small faults. The route passes near the juncture of the Santa Monica Fault which trends east-west, and the Newport-Inglewood Fault, which has a north-south trace.

The Santa Monica Mountains are a major east-west trending anticlinal structure composed primarily of an uplifted basement complex characterized by the Santa Monica Slate. The metasedimentary Santa Monica Slate (metamorphosed by intrusions of granitic magma) is thought to be of Triassic or late Jurassic age and is an intensely jointed dark grey to black slate containing minor amounts of sheared metasilstone and metasandstone.^{7,9} Numerous small faults and at least one important fault (the Benedict Canyon Fault, station 637±) have caused considerable local distortion and jointing within the formation. Frequently, the ruptures do not extend to the adjoining sandstone beds. Large portions of this formation have been altered by contact with metamorphism to mica schist, phyllite, and spotted cordierite slate.

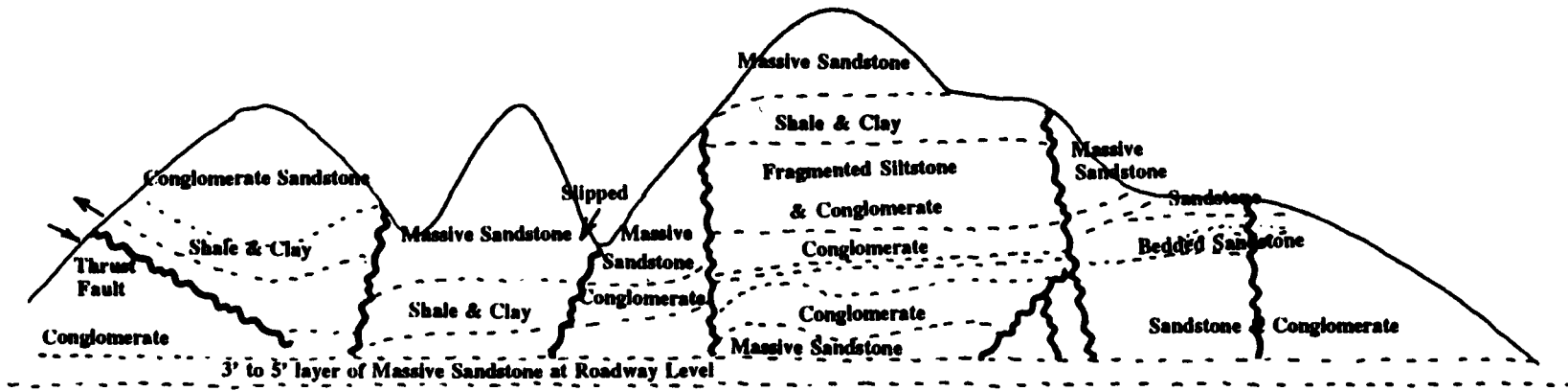
Sediments deposited over the slate have been eroded and are present only on the flanks of the segment. Steeper gradients of streams flowing south have caused greater headwater erosion on the south flank of the mountains, moving the topographic summit some two miles north of the anticlinal crest.⁷ Subsurface soils consist of alluvial gravels (the fractured slate noted above) in the lower elevations, and sandstone and conglomeratic sandstone of the Topanga and Modelo formations interspersed with layers of shale.⁴

The Modelo formation, predominating the north slope, is the youngest marine deposit on the leeward side of the Santa Monica's.⁶ The oldest member of this formation (95% of the soils encountered) consists of alternating sandstone and shale beds of considerably varying thickness. The sandstone member is a medium to fine grained sandstone cemented by calcium carbonate. The shale is described as hard platy beds north of Sepulveda and soft-earthy and siliceous south of the right-of-way. In this southern area, the shale could be classed as sand or silty sand. The upper Modelo member is a soft punky diatomaceous shale interbedded with occasional thin beds of siliceous shale. This member has a minimal exposure east of the freeway route in the area immediately south of Ventura Boulevard and is well bedded with distinct lamination.

Faulting

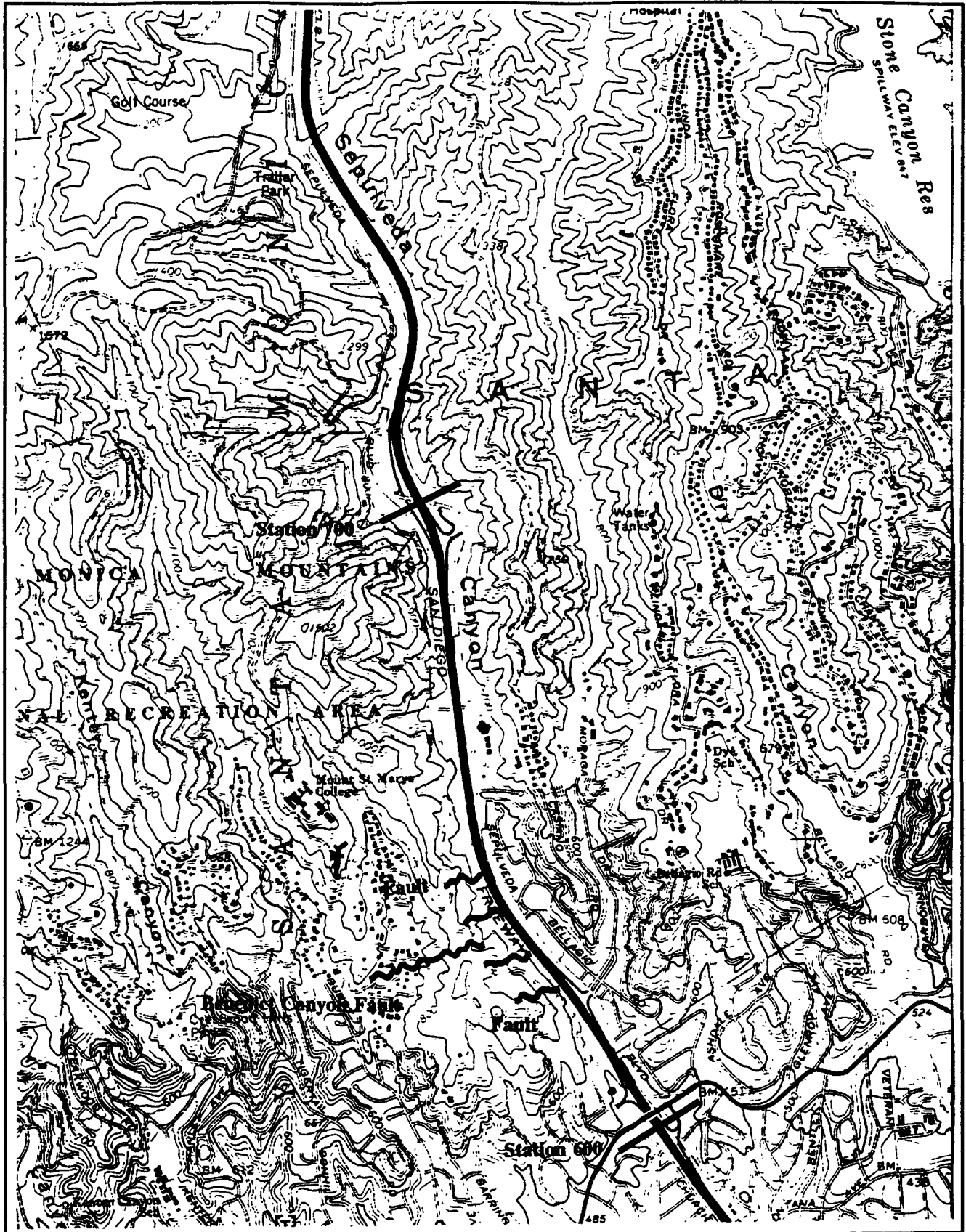
Four fault traces were noted in the existing cut slopes. These all occurred between stations 625 and 650. (See Figure 1 and Maps 1 and 2.)

Figure 1
Faults and Bedding Planes in Roadside Cutslope
Stations 625± to 650±

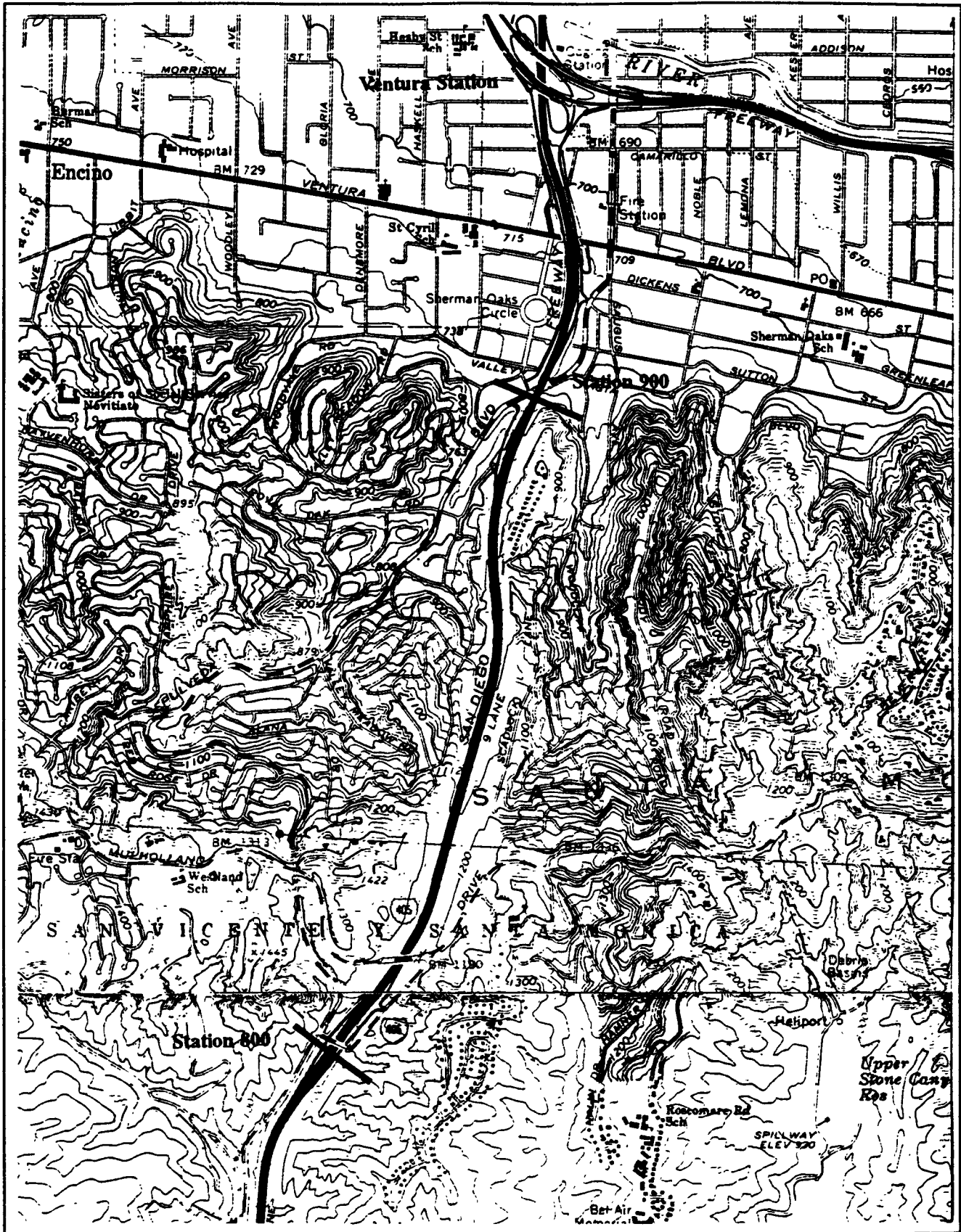


Source: Caltrans

Map 1
Stations 585 to 775



Map 2
Stations 775 to 950



Task 3: Geotechnical/Groundwater/Soils

Groundwater

No groundwater was encountered in any borings within this segment.

Hazardous Materials

In 1929, an 84" R.C.P. storm drain was placed within the Sepulveda Canyon gorge by the City of Los Angeles. City records describing this project were destroyed before 1940, thus there are no records indicating the exact location of this structure. Based on a 1954 inspection,⁴ the storm drain consisted of six foot lengths of cast concrete pipe with 7/16" reinforcing hoops at 2¼" to 4" on center. This storm drain was abandoned and filled between Bronwood Avenue and Montana Avenue. The recommended action indicates that "the portion within the outside shoulder limits of the freeway (should) be excavated, top broken in and backfilled with granular material and compacted." A 12-foot wide by 100-foot long by 8-foot high junction box was observed "near Ovada Place."

Bearing Capacity

Crossing structures within this segment are generally carried on 45-ton pile footings. Exceptions to this are Getty Center Drive undercrossing (station 671+00), Rimerton Road overcrossing (station 803+00), Mulholland Drive overcrossing (station 818+80), and Sepulveda Boulevard undercrossing (station 902+80). Spread footings encountering the Modelo formation at Mulholland Drive (bents only) have a six ton per square foot design capacity. At Sepulveda Boulevard (station 902+80), the design capacity ranges from three to four and one-half tons per foot.

**VENTURA TO VICTORY
(Station 6 to Station 7)**

Local Geology

At Ventura Boulevard, the route leaves the Santa Monica Mountains and enters the alluvial fans of the San Fernando Valley. The San Fernando Valley is a large east-west synclinal structure resting on mid-Tertiary marine sedimentary beds and volcanics. Soils through the Valley generally consist of 15 to 50 feet of sandy silt above a clean coarse sand.¹⁰ This poorly consolidated alluvium extends over most of the Valley at total depths of up to 1,500 feet and averaging about 200 feet.

From this point north to the junction with I-5, virtually the entire right-of-way is constructed on a 20-foot embankment. Between Valley Vista and Burbank Boulevards, the source of import materials appears to have been freeway excavation north of Mulholland Drive. These consist of shale and sandstone. In addition, a 500,000 cy stockpile of silty sandy clay and clayey sandy silt from the Sepulveda Dam outfall area was used in the base. Embankment materials for the segment between Burbank and Victory Boulevards were taken from a stockpile along the centerline of the freeway route.

Faulting

No faults were reported within this segment.

Groundwater

No groundwater was encountered in any borings within this segment.

Hazardous Materials

No refuse or hazardous materials were identified within this segment.

Bearing Capacity

All crossing structures within this segment are carried on 45-ton piles.

**VICTORY TO ROSCOE
(Station 7 to Station 8)**

Local Geology

Geologic conditions within this segment are similar to those described for the previous segment.¹⁰

Faulting

No faults were reported within this segment.

Groundwater

No groundwater was encountered in any borings within this segment.

Hazardous Materials

No refuse or hazardous materials were identified within this segment.

Bearing Capacity

All crossing structures within this segment are carried on 45-ton piles.

**ROSCOE TO CHATSWORTH
(Station 8 to Station 9)**

Local Geology

Geologic conditions within this segment are similar to those described for the previous segment.¹⁰

Faulting

No faults were reported within this segment.

Groundwater

No groundwater was encountered in any borings within this segment.

Hazardous Materials

No refuse or hazardous materials were identified within this segment.

Bearing Capacity

All crossing structures within this segment are carried on 45-ton piles.

**CHATSWORTH TO ROXFORD
(Station 9 to Station 10)**

Local Geology

In this segment, the route passes through the Mission Hills, gently rolling hills which are an extension of the Santa Susana Mountains to the west. These hills were evolved from the Mission Hills thrust fault. Listed in Table 3 are the seven distinct geological formations which the freeway cut traverses from south to north¹¹. (See Map 3.)

Table 3		
Geologic Formations of the Mission Hills		
Station	Formation	Composition
Below 1392	Pacoima Formation	Dark brown breccia and fanglomerate
1392 to 1398	Modelo Formation	Silicious and diatomaceous shale, <i>expansive</i>
1398 to 1406 and 1413 to 1415	Terrace Deposits	Boulders and cobbles of various igneous and metamorphic rocks in a clayey sandy matrix (hilltops only, not encountered at pavement grade)
1406 to 1413	Repetto Formation	Marine siltstone, fine sandstone and conglomerate
1415 to 1417	Pico Formation (lower)	Predominantly siltstone with a minor amount of sandstone
1417 to 1420 and 1421 to 1430	Sunshine Ranch Formation	Continental sandstone conglomerate siltstone and thin nodular limestone beds
1420 to 1421	Recent Alluvium	Sand, gravel, and clayey silt derived from the weathering of adjacent hills

The expansive diatomaceous and silicious shales between stations 1392 and 1406 were recommended for removal to a depth of two feet below the structural section, but may be encountered in footing excavations extending below that depth. The Modelo formation is known to be difficult to compact to 90% R.C. and requires special treatment for adequate compaction.

Faulting

Three major high-angle faults cross the freeway within this area. These occur at approximately stations 1407+50, 1412+50, and 1416. Just west of where fault 1416 crosses the southbound truck lane, it intersects with another fault trace which, in turn, intersects fault 1412+50 approximately 875 feet to the west.

Groundwater

Groundwater was encountered in borings along Sepulveda Boulevard within this segment. Locally, aquifers along the bedding planes of permeable strata feed this area from the Los Angeles Reservoir to the north. In addition, low velocity and quantity uniform groundwater flows through the relatively massive beds may be encountered between stations 1416 and 1422. Historically, a seasonal pond existed just west of the freeway alignment beginning at station 1420. In wet years, perched groundwater may be present in the recent alluvium formation which forms the substrata of the freeway west embankment.

Hazardous Materials

No refuse or hazardous materials were identified within this segment.

Bearing Capacity

All crossing structures within this segment are carried on 45-ton piles with the exception of the structures at the I-5/I-405 interchange. At this location, spread footings carry three tons per square foot.

**ROXFORD TO SAN FERNANDO
(Station 10 Station 11)**

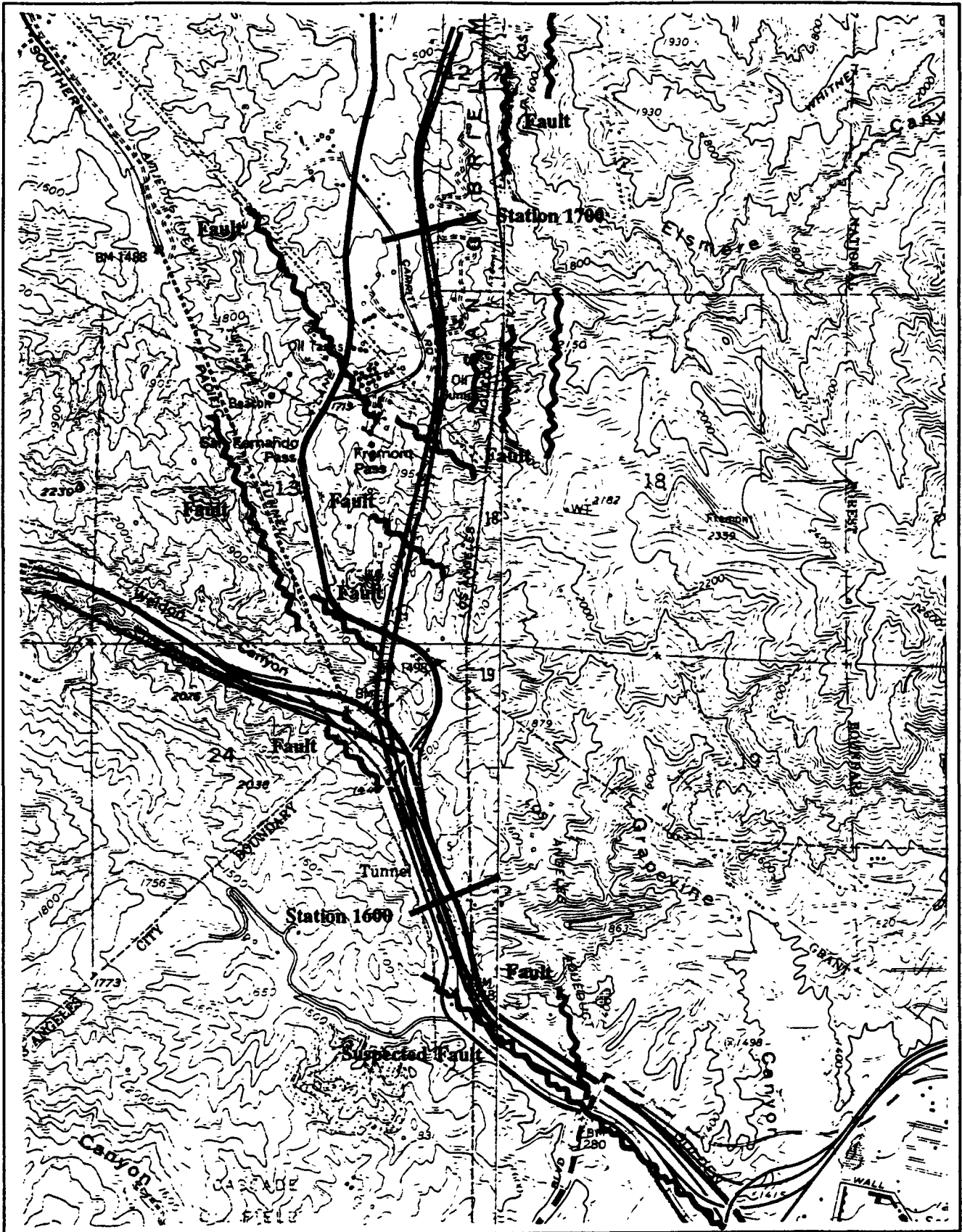
Local Geology

North of Roxford, the route traverses the northernmost portion of the San Fernando Valley and enters the San Gabriel Mountains. (see Maps 3, 4 and 5.) Between the I-5 and SR-14 interchanges, the underlying formations consist entirely of sedimentary rocks of both marine and continental origin. They are pebbly conglomerates, sandstones, siltstones, mudstones, and shale. In the cuts for the northbound truck lanes, an isolated zone of expansive and highly erosive blackish shale is encountered. It is local, but may extend beneath the travelway.^{12, 13}

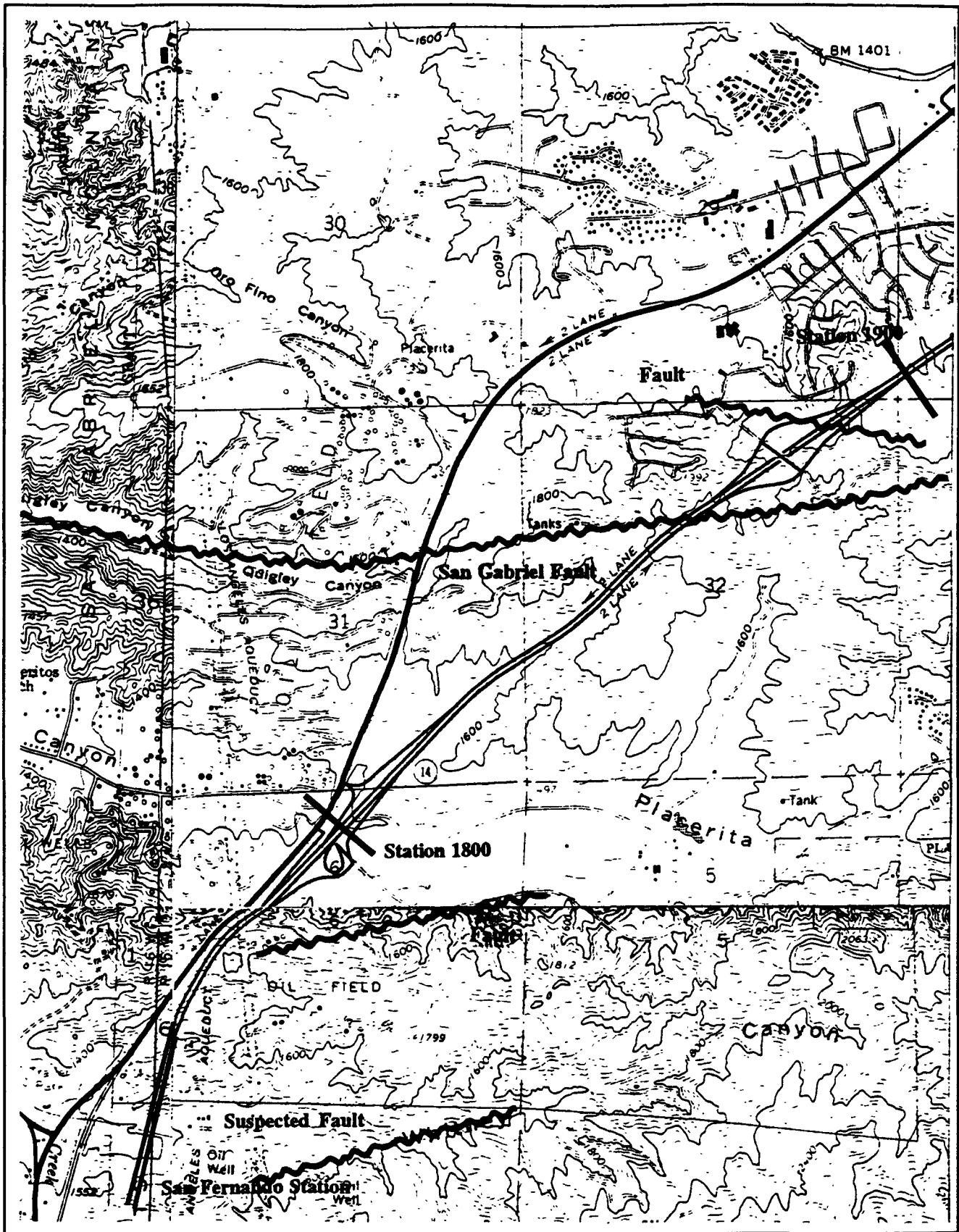
The San Gabriel Mountains are the second major element of the Transverse Ranges. The geology of the San Gabriel's is quite complex and here the proposed route passes through a sequence of marine and continental sediments involving the Mint Canyon, Townsley, Pico, and Saugus formations¹⁴. (See Table 4.) In general, the Saugus formation and recent alluvial terrace deposits unconformably overlay the other formations. The Saugus formation consists of clean loosely cemented cross bedded conglomerates. In addition to these formations, terrace deposits, landslides, recent alluvial deposits, and minor and major faults are encountered.

Station	Formation	Composition
Location not mapped	Mint Canyon formation	Loosely cemented, cross bedded conglomerate beds unconformably overlying the Townsley formation.
Loc. not mapped.	Townsley formation	Sandstone, shale, and conglomerate beds.
Loc. not mapped.	Pico formation	Sandstone, shale, and conglomerate beds.
Loc. not mapped.	Saugus formation	Sandstone, shale, and conglomerate beds.

Map 4
Stations 1550 to 1735



Map 5
Stations 1735 to 1905



Faulting

This narrow valley is a region of significant seismic activity, being situated at the juncture of the Santa Susana, San Gabriel, and Sierra Madre Fault systems.¹² It is not possible to tell whether the Sierra Madre Fault truncates the Santa Susana, or vice versa, or whether one fault grades into the other. The thrust zone lies at the base of the cliffs north of the freeway, just west of the penstock. The situation is further complicated by cross-trending faults throughout the area. A major fault is indicated as diagonally crossing the route (to the northwest) at approximately station 1568 (Balboa Boulevard). Additional minor faulting is present west of the route north of station 1525. Additional northwest trending faults are identified at stations 1616 and 1632. Some formations show considerable horizontal movement, including both vertical and horizontal local displacements of up to six feet during the 1971 Sylmar earthquake.

In the vicinity of the I-5 and SR-14 interchange (roughly station 1625±), a fault crosses the route, paralleling on the west the SPRR tunnel west of Sierra Highway. The southward extension of this fault is not mapped in available reports. At station 1650+, a west-to-east thrust fault crosses the route. North of this fault, sandstone bedding with occasional interbedded silt, shale, and conglomerate beds are highly warped and skewed. At station 1660±, a thick highly erodible shale bed is exposed in cuts south of the route. At approximately station 1655+, the toe of a landslide approaches the centerline.

At station 1666±, a fault crosses the route at right angles. This fault is thought to be the start of a very large thrust fault which trends northwest from this area through the Tunnel Oil Field. The hill south of station 1680 is shattered by at least three faults which roughly parallel the north-south line of the route. The material which makes up this hill is blocky massive sandstone and conglomerate with some clay seams.

Between stations 1700 and 1790, an extensive fault system occurs east of the route. This system includes at least four north-south trending faults intersected by at least two east-west trending faults which cut across the Elsmere Oil Field. The freeway route has been moved as far west (away) from this fault system as possible without interfering with Sierra Highway. However, there is still a possibility of sliding near station 1790 due to low bedding angles and a small spring paralleling the bedding.

Groundwater

Within the area between the I-5/I-405 interchange and the I-5/SR-14 interchange, considerable groundwater has been encountered at elevations both above and below the present freeway grade. Groundwater should be expected throughout this area.

Hazardous Materials

Also discovered in this area during freeway construction were numerous rubbish and dirt dumps. All of those reported were minor and could be cleared by normal clearing and grubbing

Task 3: Geotechnical/Groundwater/Soils

operations. One unconsolidated fill which may have been left in place was encountered at the toe of the slope to the left of the southbound truck lane.¹²

Within this area are a number of oil fields dating from as early as 1889. Some conglomerate and sandstone beds in the vicinity of the oil fields are contaminated with naturally occurring oil seepage.

Prior to freeway construction, in the vicinity of station 1681+, an oil sump related to the now abandoned refinery site existed within the south boundary of the right-of-way. This location was used as the disposal site for drilling mud and viscous oil. Either off-site placement or spreading and covering of sump material were the recommended disposal measures at the time of construction. It is not known which method the contractor employed. There is also evidence, in the vicinity of station 1700, of contaminated runoff from oil drilling and refining operations.

West of the freeway travelway, approximately at the centerline of San Fernando Road (station 1760±), a "dump" is noted on geological maps. There is no discussion of this site or its disposition in the report¹⁴, but it is noted here since it is adjacent to the San Fernando station area.

Bearing Capacity

Most structures within this segment are carried on spread footings. The design capacity of the footings at Balboa Boulevard (station 1566+50) is five tons per square foot.

**SAN FERNANDO TO HOLT CANYON
(Station 11 to Station 12)**

Local Geology

The geologic formations encountered in this segment are generally the same as those described above. (See Maps 5 and 6.¹⁴)

Substantial areas of expansive soil are present in the segment, generally between Golden Valley Road and Sand Canyon Road (Route 126). Vertical offsets of eight to 12-inches and 18-inch bulges in cut facts were not uncommon. From 1972 to 1978, this segment underwent remedial mudjacking to restore level. In 1978, a report was prepared recommending excavation to a depth of four feet below top of pavement and disposal of expansive materials in certain portions of this segment.¹⁵ These materials were generally disposed of along the shoulders of the travelway. Currently, there continues to be a significant problem with expansion of soils underlying the roadbed.

Faulting

The primary fault in this segment is the San Gabriel Fault, a right lateral fault with many miles of displacement. (Also in the vicinity is the Pole Valley Fault, the site of the 1971 Sylmar earthquake.) The San Gabriel Fault is marked by near vertical beds and a large crushed zone between stations 1863+50 and 1867. "Considerable amounts of loose fill" apparently attributed to oil drilling operations were noted at the southerly end of the fault deformation zone.

From stations 1896 to 1906+50±, the route traverses an area described in geological reports as a landslide. This slide is immense, covering an area 2,600 feet long (east-west) and 1,100 feet wide (north-south). The east-west trend of the slide area may indicate the concealed presence of a major fault, mapped as possibly crossing the route at station 1891+75. The depth of this slide is indicated as in excess of 80 feet. Borings in this area indicate free water "in many of the holes" along the route. In addition, a large seepage is present in bedded shale near station 1910. An additional fault is indicated by folding of the beds and groundwater seepage in the vicinity of station 1928.

Groundwater

Just north of San Fernando Road at station 1753±, a spring is noted in the embankments east of the route. Additional seepage was found on the route centerline at station 1773±. At station 1800 (Placerita Canyon) the seasonally significant surface water flows have been channelled by placement of a substantial fill. The effect of this fill on underlying water bearing strata is unknown, but some percolation of groundwater may be observed in borings for deep footings.

Task 3: Geotechnical/Groundwater/Soils

Hazardous Materials

Approximately between stations 1650 and 1750, the Placerita oil field west of the route may be the source of locally contaminated soils. The shallow field was rapidly and improperly prospected in the late 1940's, with the result that only a part of the full potential was realized.

Two small dumps are identified on geologic maps, near stations 1812 and 1821. These are not discussed in the report itself and are thought to have been excavated and removed during construction. Runoff from oil refining was noted at station 1700.

Bearing Capacity

All crossing structures within this segment are carried on spread footings with the exception of the San Fernando Road undercrossing (station 1745+00), the Cedar Valley Way overcrossing (station 1942+00) and the Holt Canyon Road undercrossing (station 1973+00).

Task 3: Geotechnical/Groundwater/Soils

operations. One unconsolidated fill which may have been left in place was encountered at the toe of the slope to the left of the southbound truck lane.¹²

Within this area are a number of oil fields dating from as early as 1889. Some conglomerate and sandstone beds in the vicinity of the oil fields are contaminated with naturally occurring oil seepage.

Prior to freeway construction, in the vicinity of station 1681+, an oil sump related to the now abandoned refinery site existed within the south boundary of the right-of-way. This location was used as the disposal site for drilling mud and viscous oil. Either off-site placement or spreading and covering of sump material were the recommended disposal measures at the time of construction. It is not known which method the contractor employed. There is also evidence, in the vicinity of station 1700, of contaminated runoff from oil drilling and refining operations.

West of the freeway travelway, approximately at the centerline of San Fernando Road (station 1760±), a "dump" is noted on geological maps. There is no discussion of this site or its disposition in the report¹⁴, but it is noted here since it is adjacent to the San Fernando station area.

Bearing Capacity

Most structures within this segment are carried on spread footings. The design capacity of the footings at Balboa Boulevard (station 1566+50) is five tons per square foot.

**SAN FERNANDO TO HOLT CANYON
(Station 11 to Station 12)**

Local Geology

The geologic formations encountered in this segment are generally the same as those described above. (See Maps 5 and 6.¹⁴)

Substantial areas of expansive soil are present in the segment, generally between Golden Valley Road and Sand Canyon Road (Route 126). Vertical offsets of eight to 12-inches and 18-inch bulges in cut facts were not uncommon. From 1972 to 1978, this segment underwent remedial mudjacking to restore level. In 1978, a report was prepared recommending excavation to a depth of four feet below top of pavement and disposal of expansive materials in certain portions of this segment.¹⁵ These materials were generally disposed of along the shoulders of the travelway. Currently, there continues to be a significant problem with expansion of soils underlying the roadbed.

Faulting

The primary fault in this segment is the San Gabriel Fault, a right lateral fault with many miles of displacement. (Also in the vicinity is the Pole Valley Fault, the site of the 1971 Sylmar earthquake.) The San Gabriel Fault is marked by near vertical beds and a large crushed zone between stations 1863+50 and 1867. "Considerable amounts of loose fill" apparently attributed to oil drilling operations were noted at the southerly end of the fault deformation zone.

From stations 1896 to 1906+50±, the route traverses an area described in geological reports as a landslide. This slide is immense, covering an area 2,600 feet long (east-west) and 1,100 feet wide (north-south). The east-west trend of the slide area may indicate the concealed presence of a major fault, mapped as possibly crossing the route at station 1891+75. The depth of this slide is indicated as in excess of 80 feet. Borings in this area indicate free water "in many of the holes" along the route. In addition, a large seepage is present in bedded shale near station 1910. An additional fault is indicated by folding of the beds and groundwater seepage in the vicinity of station 1928.

Groundwater

Just north of San Fernando Road at station 1753±, a spring is noted in the embankments east of the route. Additional seepage was found on the route centerline at station 1773±. At station 1800 (Placerita Canyon) the seasonally significant surface water flows have been channelled by placement of a substantial fill. The effect of this fill on underlying water bearing strata is unknown, but some percolation of groundwater may be observed in borings for deep footings.

Hazardous Materials

Approximately between stations 1650 and 1750, the Placerita oil field west of the route may be the source of locally contaminated soils. The shallow field was rapidly and improperly prospected in the late 1940's, with the result that only a part of the full potential was realized.

Two small dumps are identified on geologic maps, near stations 1812 and 1821. These are not discussed in the report itself and are thought to have been excavated and removed during construction. Runoff from oil refining was noted at station 1700.

Bearing Capacity

All crossing structures within this segment are carried on spread footings with the exception of the San Fernando Road undercrossing (station 1745+00), the Cedar Valley Way overcrossing (station 1942+00) and the Holt Canyon Road undercrossing (station 1973+00).

**HOLT CANYON TO AVENUE "S"
(Station 12 to Station 13)**

Local Geology

This segment is located primarily in the Soledad Basin which lies north of the western San Gabriel Mountains in the Transverse Range Province. (See Maps 6 through 15.) The Soledad Basin is characterized by some 25,000 feet of Tertiary land-laid deposits, primarily consisting of the Mint Canyon formation. With minor exceptions, all of the rocks north of Sand Canyon Road for a distance of about 6½ miles are of the Mint Canyon formation. Just north of the Agua Dulce Road interchange, the grayish-brown, very coarse, bouldery fanglomerate layers of the Mint Canyon formation contact the pink fine silt stone and sandstone layers of the Vasquez formation. The lower Vasquez member, a basalt lava is exposed in cuts beginning approximately 2½ miles north of Agua Dulce Road.

The ridge at Escondido Summit (station 2700) forms a divide between north and southwest flowing watersheds. The exposed rocks range in age from Jurassic to Recent and are composed of seven different formations. (See Table 4.) While more recent formations are exclusively sedimentary, early geologic formations in this area show substantial evidence of volcanic land forming activity.

This 26.5 mile segment is covered by three Materials Reports.^{14, 16, 17} The first of these¹⁴ includes only the area from the Holt Station to the Santa Clara River. The primary study¹⁶ covers a 23.4 mile stretch north to 1.12 miles east (north) of Angeles Forest Highway near Vincent.

Faulting

As a result of ancient volcanic activity, folded and fractured rock formations and a number of large and small faults are seen in this area. Beginning at station 2275, the route parallels the trace of the Agua Dulce Fault and passes near the junction of the Agua Dulce and Soledad Faults at station 2293. An area of faulting occurs in the vicinity of station 2473 and another large fault is suspected at station 2593. At station 3276, faulting has uplifted the basement rocks to the surface, where they and their alluvium are exposed for several hundred feet along the route. At the north end of the segment, the route encounters the deformation zone of the San Andreas Fault, here approximately one mile wide. The proposed location of the Avenue "S" station is almost exactly on the surface trace of the Fault near the 20-foot displacement zone of the 1857 Tejon earthquake.

Groundwater

No groundwater was reported in this segment although it is anticipated that significant groundwater flows at relatively shallow depths would be encountered in the vicinity of the Santa Clara River. Additional welling of groundwater could be encountered in the vicinity of the San Andreas Fault.

Task 3: Geotechnical/Groundwater/Soils

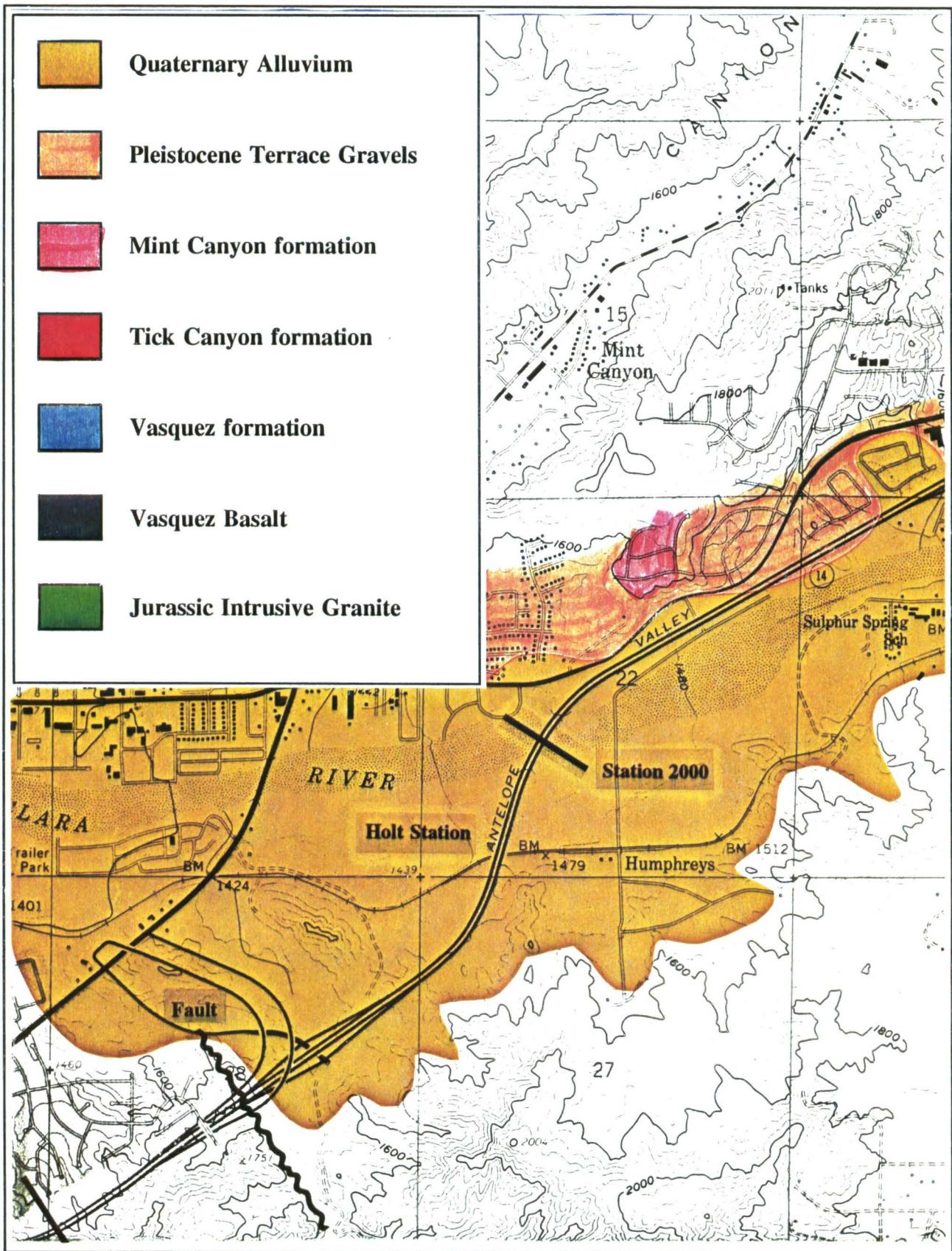
Hazardous Materials

No rubbish dumps or other hazardous materials were noted. High sulfate concentrations near Tick Canyon and Escondido Canyon require use of Type V cement.

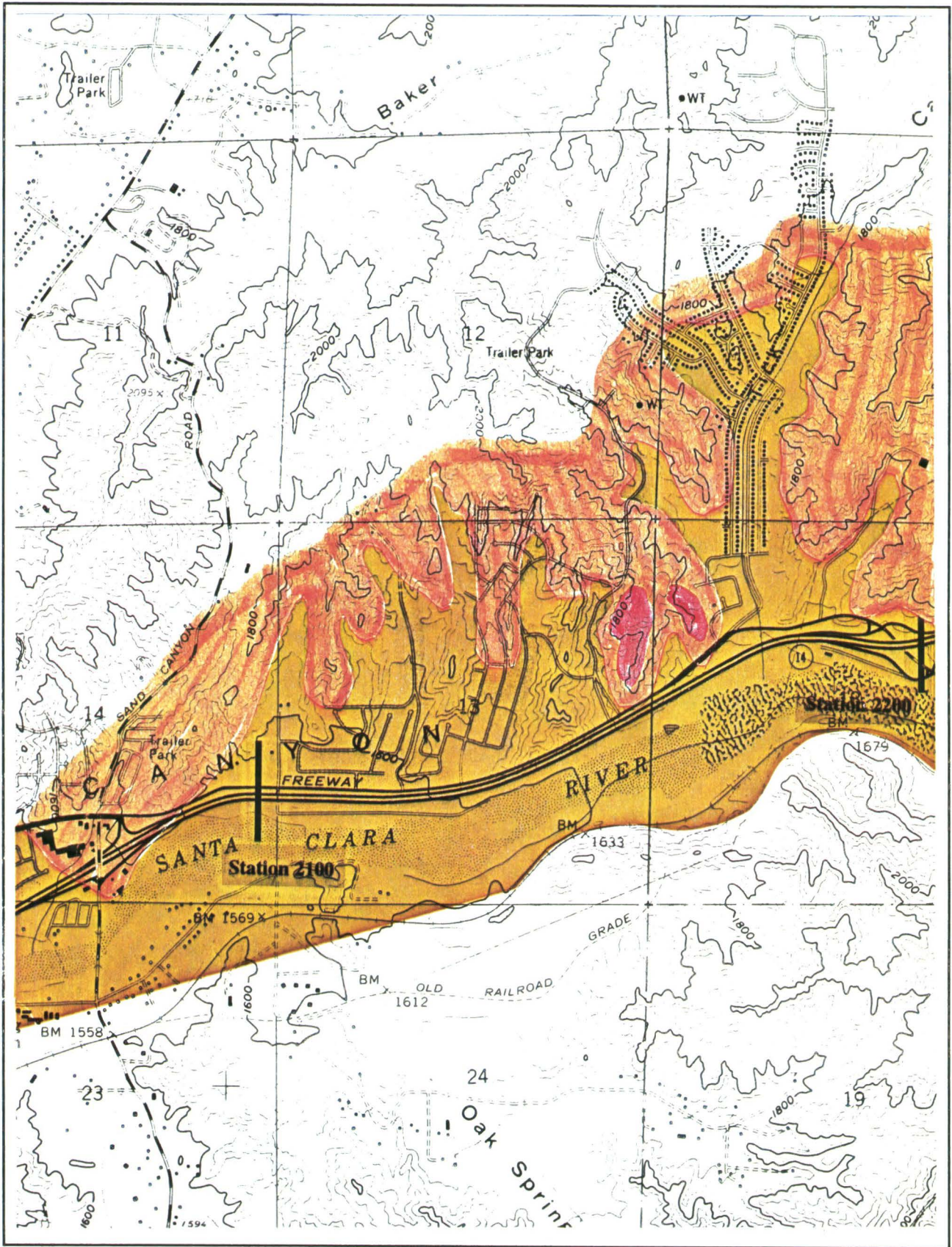
Bearing Capacity

All crossing structures within this segment are carried on spread footings with the exception of the Santa Clara River undercrossing (station 2002+50) and the Avenue "S" undercrossing (station 3382+00). The footings for the Sand Canyon Road overcrossing (station 2067+00) carry three tons per foot at the bents and two tons per foot at the abutments. At Agua Dulce Canyon Road (station 2416+00), design loads are generally five tons per square foot, but drop as low as two tons per foot at the west side abutment. At Ward Road (station 2780+00), the footings carry five tons per square foot. At the California Aqueduct undercrossing, the allowable load is five tons per foot in general, but only one and one-half tons per square foot along the left side.

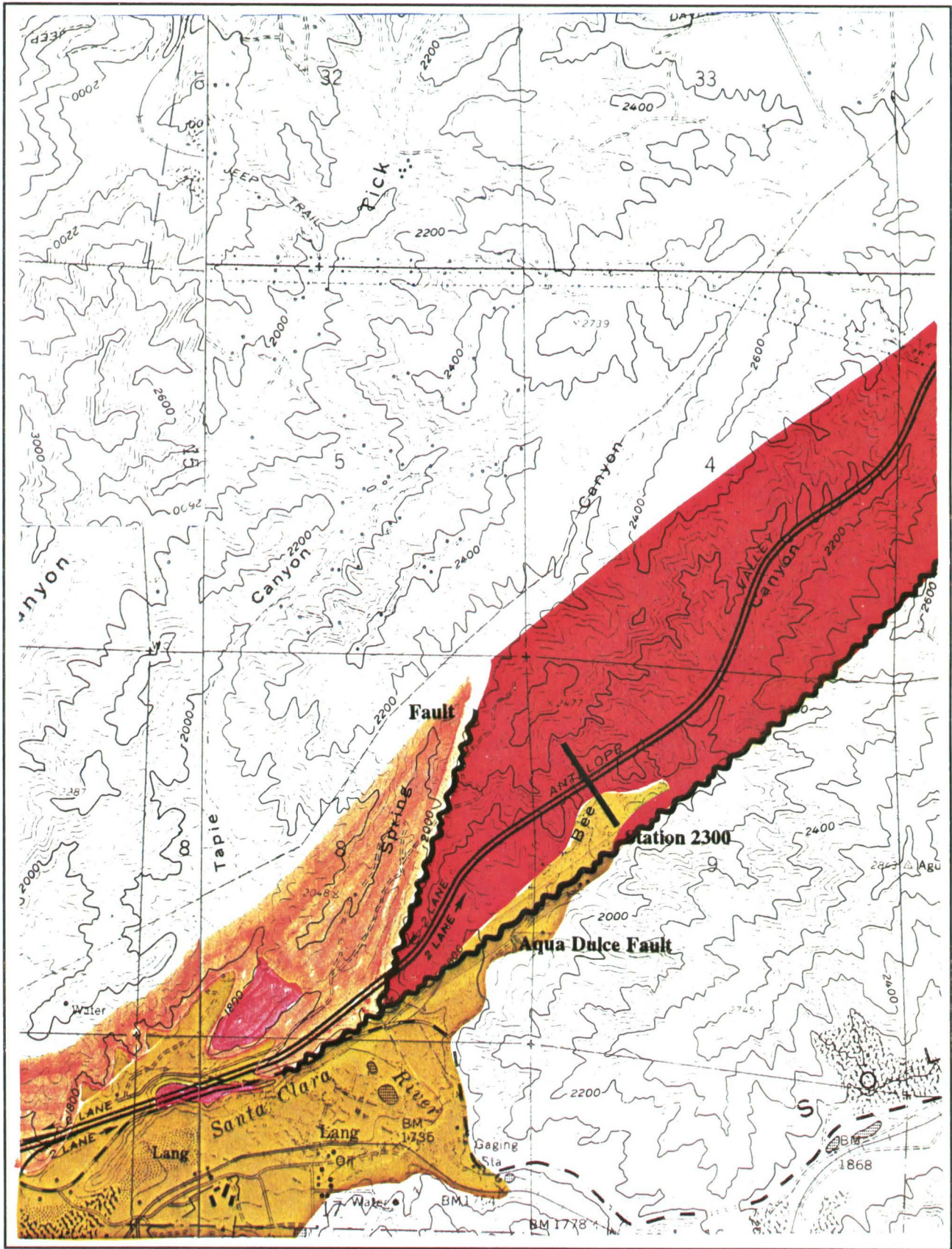
Map 6
Stations 1900 to 2065



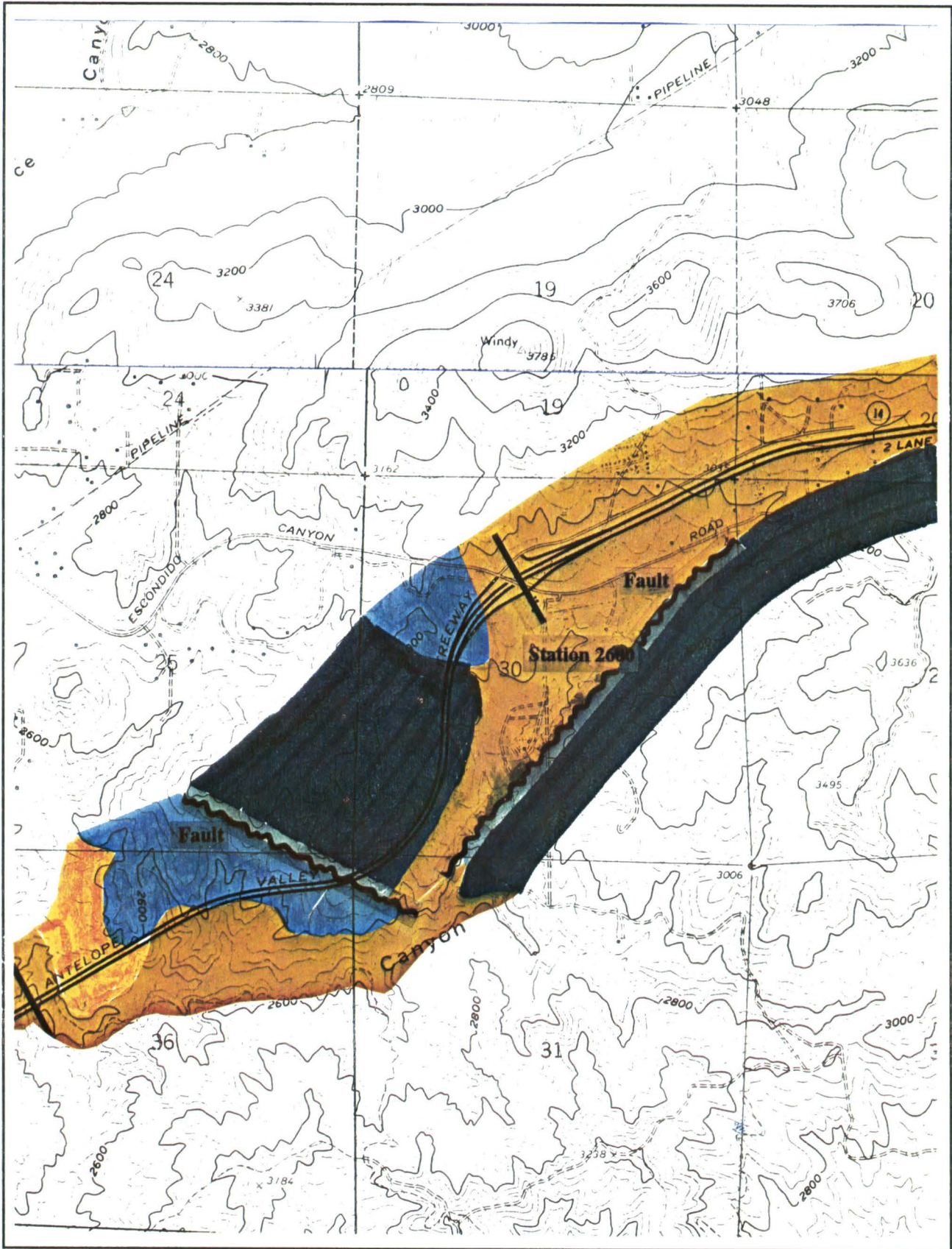
Map 7
Stations 2065 to 2205



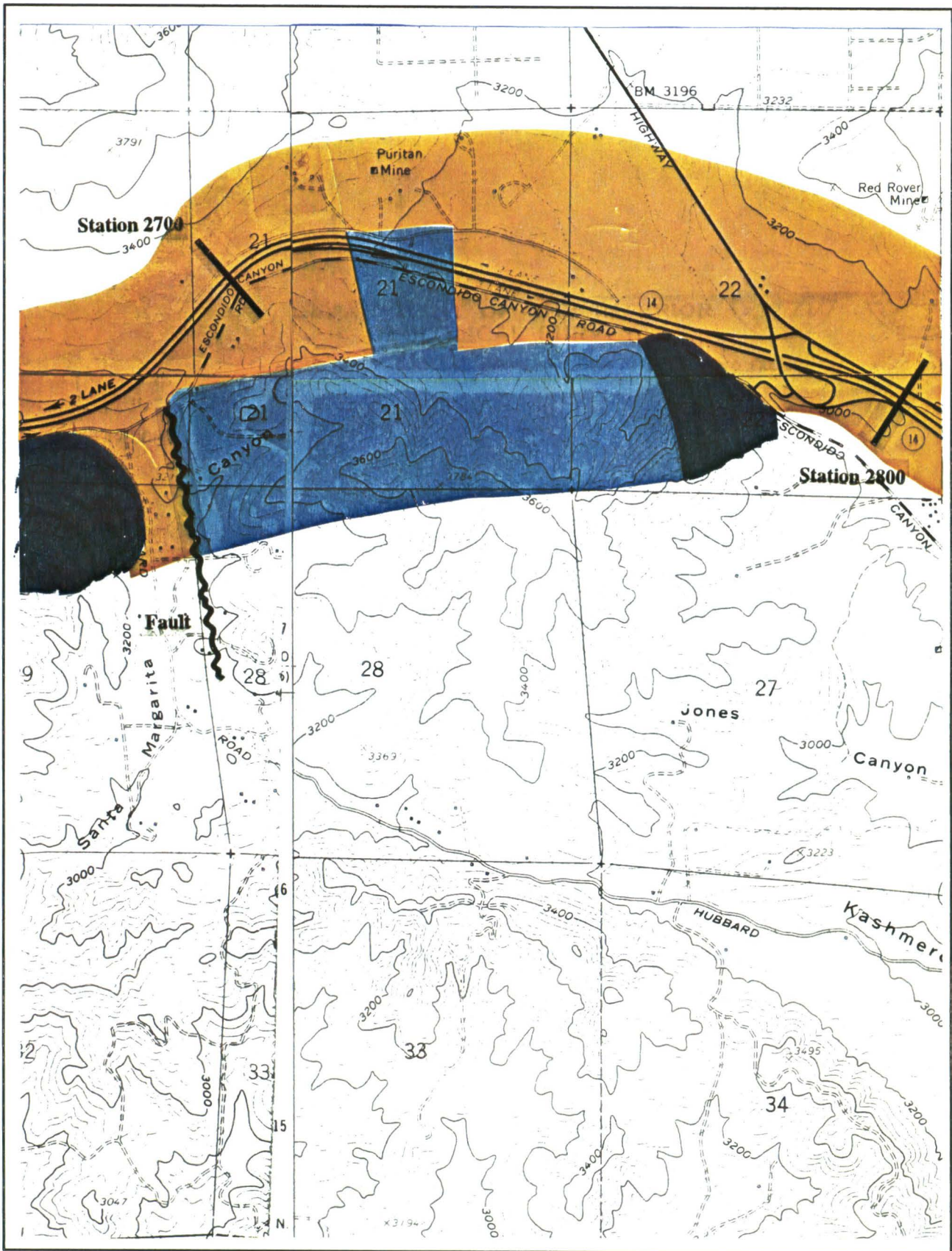
Map 8
Stations 2205 to 2380



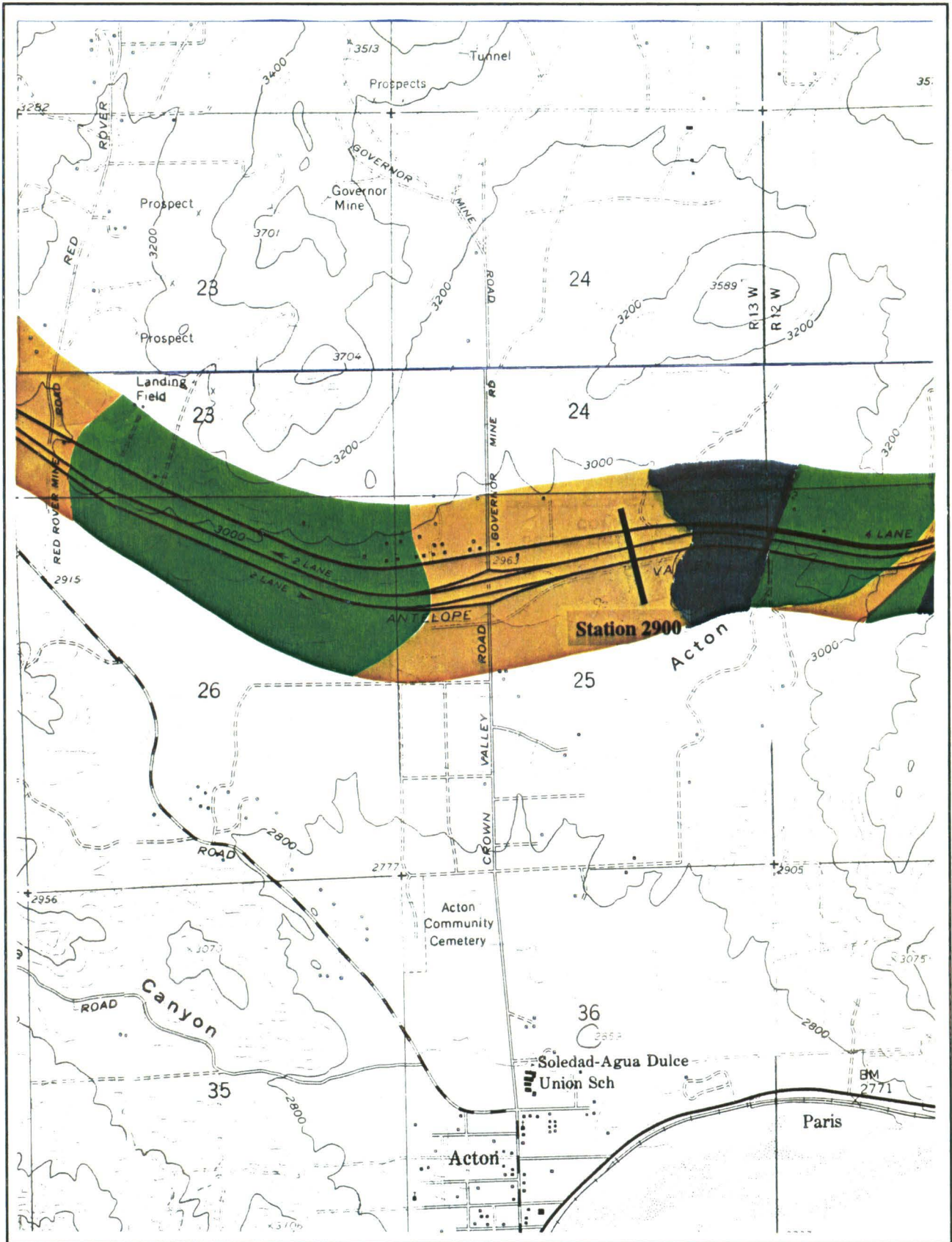
Map 10
Stations 2500 to 2660



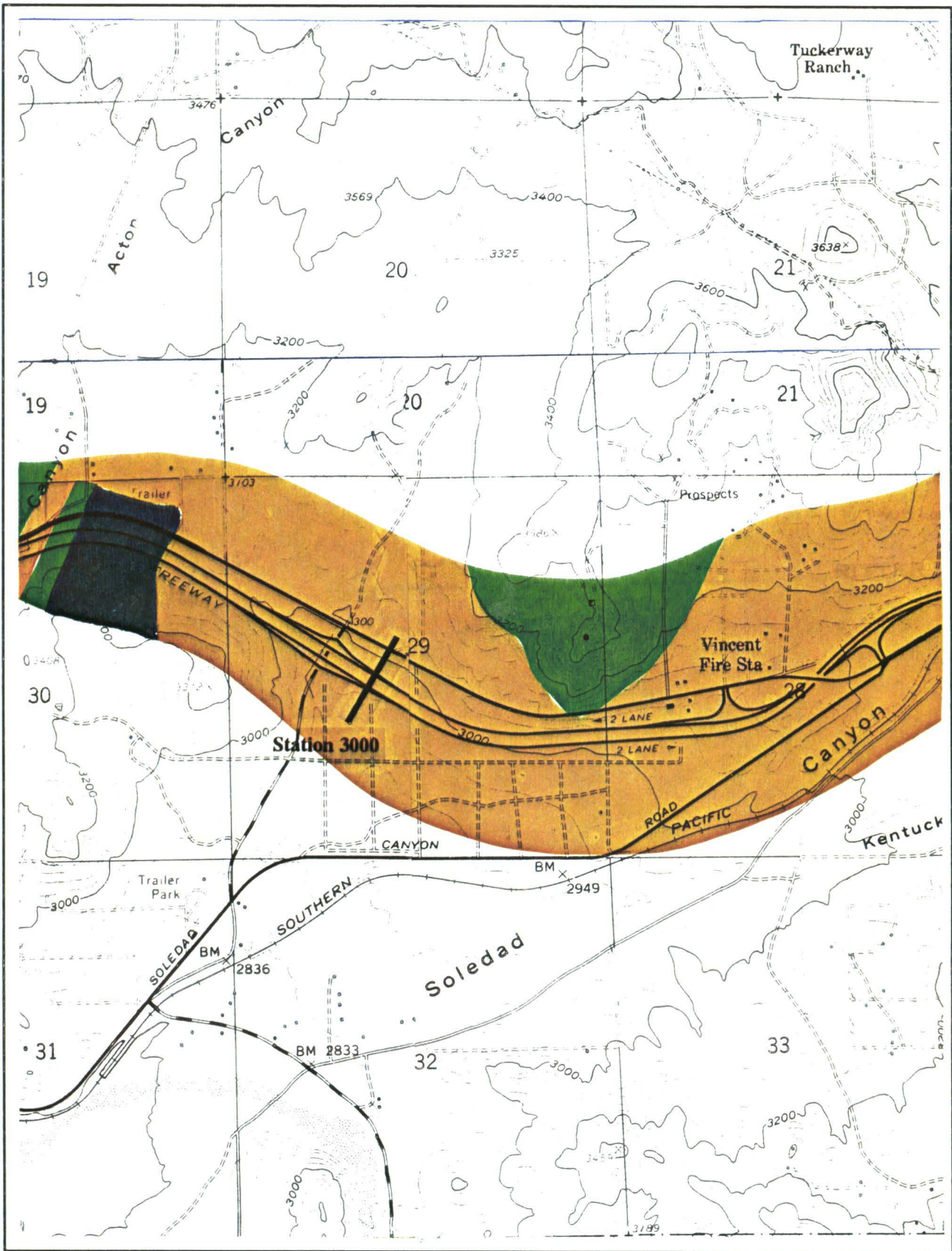
Map 11
Stations 2660 to 2810



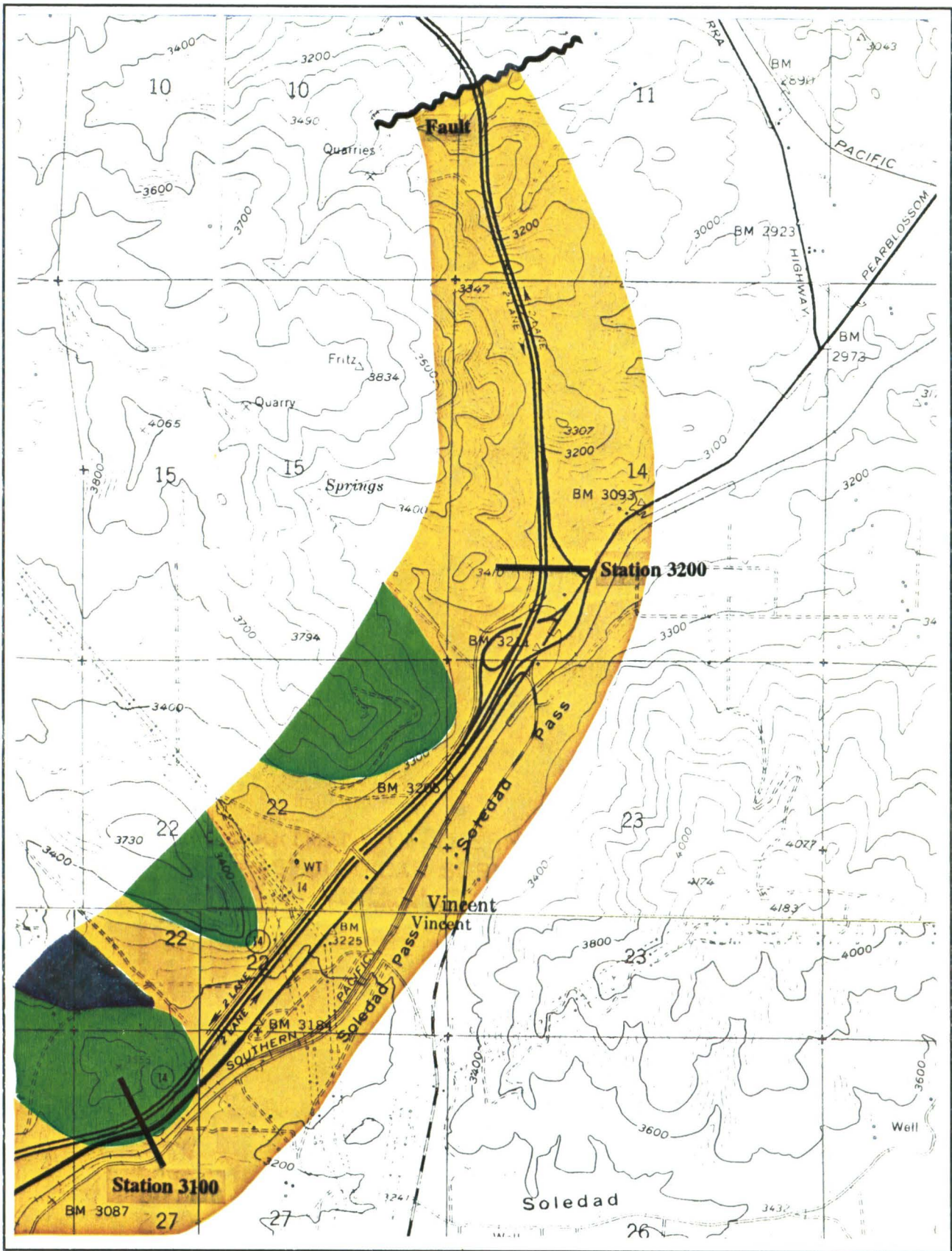
Map 12
Stations 2810 to 2940



Map 13
Stations 2940 to 3080



Map 14
Stations 3080 to 3275



Map 15
Stations 3275 to 3465

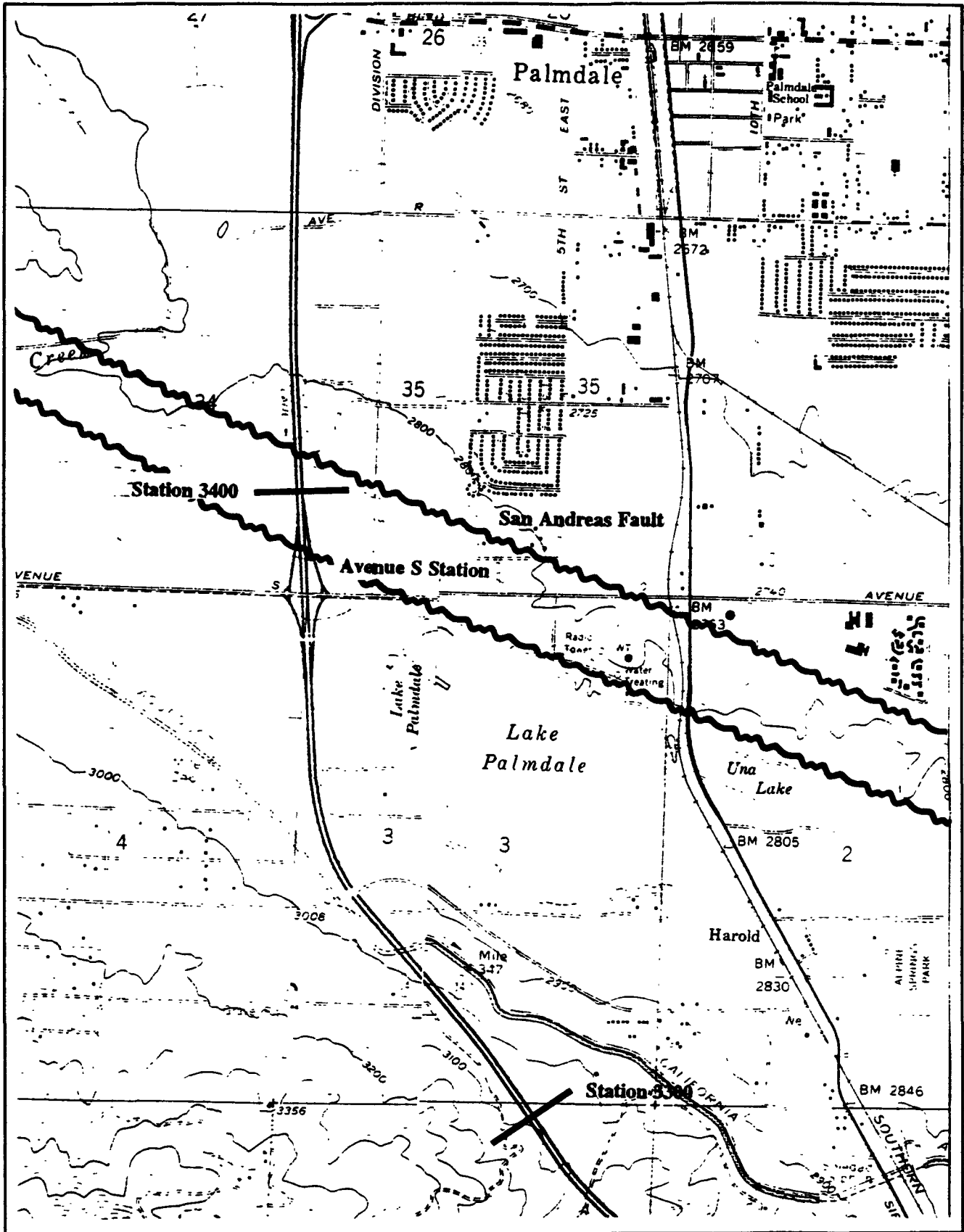


Table 4		
Geologic Formations of the Soledad Basin		
Station	Formation	Composition
1988 to 2040 and 2093 to 2131 and 2195 to 2216 and 2235 to 2239 and 2593 to 2718 and 2732 to 2820 and 2870 to 2906 and 2964 to 3025 and 3033 to 3082 and 3089 to 3138 and 3163 to 3203 and 3227 to 3276 and 3392 to 3384	Recent Alluvium	Variable depending on upstream washdown. Historical torrential rains have enabled deposition of angular boulders up to 5 feet in diameter. Variably cemented with angles of repose ranging up to ½:1. Unconsolidated sand and gravel to depth within the Santa Clara River floodplain. Also found elsewhere in small amounts below deep fills.
2040 to 2093 and 2131 to 2195 and 2195 to 2213 and 2239 to 2273	Mint Canyon Formation	Unconformably overlies the Tick Canyon Formation and consists of medium to coarse grained fluvatile sandstones with occasional conglomerate stringers.
2216 to 2235 and 2405 to 2408 and 2461 to 2477	Pleistocene Terrace Gravels	Similar to recent alluvium, but including more extensive representation clasts of volcanic origin.
2273 to 2405	Tick Canyon Formation	Unconformably overlies the Vasquez formation and consists of green, buff, and reddish brown siltstones, sandstones, and conglomerate. Also includes a coarse basal conglomerate near station 2400.
2408 to 2461 and 2477 to 2593 and 2718 to 2732 and 2906 to 2922 and 2951 to 2964	Vasquez Formation	This formation is composed of continental redgeds, sandstone, and conglomerate with intercalated volcanic flows. Some conglomerate beds show a torrential type deposition with boulders up to six feet in diameter. It is the most weather resistant of the local formations.
2820 to 2870 and 2922 to 2951 and 3025 to 3033 and 3082 to 3089 and 3138 to 3163 and 3203 to 3227	Intrusive Granitic rocks of Lower Cretaceous to pre-Jurassic age	The oldest geologic units traversed by the route consist of weathered gneiss, quartz, diorite, and quartz bearing synite which have been locally intruded by andesite and basalt.
3276 to 3292	San Gabriel formation	Fine to coarse grained granitics.

**AVENUE "S" TO PALMDALE AIRPORT
(Station 13 to Station 14)**

Local Geology

This segment crosses the San Andreas Fault and traverses the alluvial floor of the Antelope Valley. Within the low hills which mark the deformation zone, the basin sediments composed of sandstone, silt, and gypsum have been folded and even overturned by the action of the Fault.¹⁷ The rocks which make up this exposed deformation zone are the Anaverde formation, mid-Pliocene shale and siltstone beds.

The Antelope Valley itself is primarily alluvial, an unconsolidated 1,000 to 2,000 (occasionally 5,000) foot deep fill here derived primarily from the Sierra Pelona Mountains to the south.

Faulting

Between stations 3390 and 3410, the route crosses the deformation zone of the San Andreas Fault. Since there is an extensive body of literature on the San Andreas, it is not covered in detail here. However, it should be noted that the *average annual movement along the fault trace is two inches*. Also of note is differential settlement of macerated rocks within the fault zone, characterized by bumps in the freeway within the notch.

In addition, virtually every cut in the southern portion of this segment encounters one or more small faults. These are described as "minor" in the reporting and are frequently filled with chalcedony.

Groundwater

No groundwater was encountered in any of the borings taken in this segment. The report notes that "minimal" seepage can be expected along fault traces and bedding planes.

Hazardous Materials

Several small rubbish dumps (no location given) were removed during the original construction.

Bearing Capacity

The Avenue P-8 undercrossing is carried on 45-ton piles. All other structures are carried on spread footings. Loads at Palmdale Boulevard can reach four and one-half tons per square foot. At Avenue "Q", allowable loads are five tons for the bents and two tons for the abutments.

BIBLIOGRAPHY

<u>Approx. Segment</u>	<u>Report</u>
1 110-214	Himmelhoch, A. L., District Engineer, <u>Materials Report for the Proposed Construction of the San Diego Freeway from Manchester to Jefferson</u> , March 24, 1958.
2 214-511	Gillis, Lyman R., District Engineer, <u>Materials Report for the Proposed Construction of the San Diego Freeway from Jefferson Blvd. to Ohio Avenue</u> , May 3, 1956.
3 533-570	Fahey, W. L., District Engineer, <u>Materials Report for the Proposed Construction of the San Diego Freeway from 1500' So. of Wilshire Blvd. to Waterford St. and the Proposed Realignment of Wilshire Blvd. Bonsall Grade Separation and the Resurfacing and Widening of Federal Ave.</u> , April 29, 1955.
4 570-628	Fahey, W. L., District Engineer, <u>Materials Report for the Proposed Construction of the Sepulveda Freeway from Waterford Street to Casiano Road</u> , October 25, 1954.
5 627-850±	G. R. Harlton, Acting District Materials Engineer, <u>Materials Report, Sepulveda Parkway from Moraga Drive to Hairpin Turn</u> , March 12, 1946.
6 850±-925	G. R. Harlton, Acting District Materials Engineer, <u>Preliminary Geological Report of Portions of Proposed Sepulveda Parkway, Hairpin Turn to Ventura Blvd.</u> , March 16, 1945.
7 850±-875±	G. R. Harlton, Acting District Materials Engineer, <u>Preliminary Geological Report of Proposed Sepulveda Parkway, Hairpin Turn to Del Gado Drive</u> , August 5, 1946.
8 606-925	M. E. Cessna, District Engineer, <u>Materials Report for the Proposed Widening and Repair of an Existing Highway on Route 158 From Sunset Boulevard to Ventura Boulevard</u> , December 12, 1949.
9 905-978	Fahey, W. L., District Engineer, <u>Materials Report for the Proposed Construction of the Sepulveda Freeway from Valley Vista Blvd. to Burbank Boulevard</u> , October 11, 1955.

Task 3: Geotechnical/Groundwater/Soils

- 10 978-1198 Himelhoch, A. L., District Engineer, Materials Report for the Proposed Construction of the San Diego Freeway from Burbank Boulevard to Nordoff Street, May 13, 1959.
- 11 1198-1430 Himelhoch, A. L., District Engineer, Materials Report for the Proposed Construction of the San Diego Freeway from Nordoff Street to Route 4 Interchange, February 16, 1960.
- 12 A. W. Hoy, Deputy District Engineer, Materials Report for the Proposed Construction of the Golden State Freeway from 0.7 Mile South of San Fernando Road to 0.8 Mile North of Los Angeles City Limits, Including Interchanges with Antelope Valley and Route 210 Freeways, date unknown. (This report references the "Materials Report for Ridge Route from Yarnell Street to Tunnel Station, October 7, 1952.)
- 13 1430-1560 Unknown Author, Materials Report for the Proposed Construction of Truck Ramps at Junction of Golden State Freeway and San Diego Freeway, September, 1968.
- 14 1650-2040 Trombatore, Leo J., Assistant District Engineer, Complete Materials Report for the Proposed Construction of the Antelope Valley Freeway from Route 5 to 0.8 Mile West of Sand Canyon Rd., December 9, 1966.
- 15 1673-1859 Unknown Author, Materials Report for the Proposed Reconstruction of the Antelope Valley Freeway Between Golden Valley Road and Route 126, January, 1978.
- 16 2000-3155 Himelhoch, A. L., District Engineer, Materials Report for the Proposed Construction of the Antelope Valley Freeway from 0.5 Miles East of Sierra Highway at Soledad Canyon Road to 1.12 Miles East of Angeles Forest Highway, February 2, 1960.
- 17 3155-3500+ Hoy, A. W., District Engineer, Materials Report for the Proposed Construction of the Antelope Valley Freeway from 0.4 Mile North of Angeles Forest Highway to Avenue P-8 in Palmdale, April 24, 1963.

