SAN FERNANDO VALLEY
EAST-WEST RAIL TRANSIT PROJECT

SP BURBANK BRANCH ALIGNMENT
PRE-PRELIMINARY ENGINEERING STUDY

VOLUME I
FINAL REPORT

Prepared for:
Los Angeles County Metropolitan
Transportation Authority

Prepared by:
Engineering Management Consultant

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METRO

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Volume I :

FINAL REPORT

San Fernando Valley East-West Rail Transit Project

SP Burbank Branch Alignment
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TABLE OF CONTENTS

Page

Page

SAN FERNANDO VALLEY EAST-WEST RAIL TRANSIT PROJECT
SP BURBANK BRANCH ALIGNMENT

Executive Summary

The Los Angeles County Metropolitan Transportation Authority (MTA) is currently evaluating the costs and feasibility of two alternative rail corridors for the San Fernando Valley East-West Rail Transit Project. This study presents the Southern Pacific (SP) Burbank Branch Alignment — an extension of high-capacity rapid rail transit westward from the Red Line Station in North Hollywood. The line would run for 13.8 miles through the Valley along the SP Burbank Branch right-of-way to a terminal station near Topanga Canyon Boulevard.

Construction cost estimates were previously prepared in 1989 for the Draft Environmental Impact Report. At that time, 1998 costs were projected at $3.03 billion for the full project, and $1.32 billion for the initial 6-mile phase. Revised cost estimates, contained in this study and summarized on Table 1, project a reduction in construction costs to $2.27 billion for the full project and $796 million for the initial phase. Other cost saving options have been identified, including open air subway stations and open air subway alignments that could further reduce costs. In addition, certain route alignment and extension options have been identified for consideration by the MTA.

Baseline Alternates- Appendix A contains the final construction cost estimates for the following baseline alternatives and project options:

- **Alternate A** — (the previously adopted EIR solution) Approximately nine miles of deep-bore tunnels with six modular subway stations and approximately four miles of aerial structure with four aerial stations. (See Figures 2, 3, 4, 5, and 6)

- **Alternate A-2** — (same as Alternate A, but with shallower, lower-cost open-air subway stations) Open-air subway stations are particularly suitable along the former Southern Pacific railroad alignment because stations are not located beneath city streets and there is therefore no need to deck over the subway station after it is constructed. No mezzanine level is required for this stations and all ticketing and access can occur from street level. This station does not need to be as deep as conventional subway stations and the removal of the roof of the station not only saves construction costs, but reduces overall operation

and maintenance costs for the life of the project by reducing energy consumption for lighting, air conditioning, escalators and elevators.

Five open-air subway stations have replaced the modular subway stations for this alternative, except for the Topanga Station which is located beneath Victory Boulevard and must therefore utilize a conventional construction approach. Figure 7 provides a comparison of the open-air and conventional modular subway station designs.

- **Alternate B** — (same as Alternate A2, but using open-air subway guideways instead of deep-bore subway tunnels) For the same reasons that open-air subway stations were considered practical in Alternate A2, open-air subway alignments between the stations were designed for this alternative to determine if similar engineering advantages and cost savings could be realized. Although state legislation mandates covered subway in certain portions of the East Valley, this alignment follows engineering principles to include open-air alignments wherever it is possible to do so, and is therefore not consistent with state law in the area between Hazeltine and Fulton.

  Aerial guideway portions of this alignment were brought to grade wherever practical, without closing any cross streets. As an option to this alternate, the potential cost savings from deferring the Phase 2 construction of Woodley, White Oak and Tampa Stations are provided, as well as the cost for the full project with all ten stations (Figures 8, 9, 10, 11, 12, and 13).

- **Alternate C** — (same as Alternate B, but modified to be consistent with state legislation) This alternative provides covered subway in portions of the East Valley alignment specified in state legislation. The West Valley portion is designed as open-air subway.

  The initial cost deferrals from postponing Woodley, White Oak and Tampa Stations are an option to this alternate (Figures 14 and 15).

Route Alignment Option- Oxnard Street- Order-of-magnitude cost estimates have been provided for a horizontal realignment of the EIR solution to consider a route that follows Oxnard Street in the East Valley instead of Chandler Boulevard. Alignments along Oxnard Street had previously been considered as at-grade or aerial alignments but were rejected because of environmental impacts of an above-ground configuration. No alignments along Oxnard Street were ever considered as covered subway, and such a configuration may offer certain advantages to a subway alignment on Chandler Boulevard.

TABLE 1

SAN FERNANDO VALLEY EAST – WEST RAIL TRANSIT PROJECT
S. P. BURBANK BRANCH
SUMMARY OF COST ESTIMATES
($1998 MILLIONS)

	ALT A DEEP BORE SUBWAY & MODULAR STATIONS (EIR ADOPTED 3A)	ALT A 2 DEEP BORE SUBWAY & OPEN AIR STATIONS	ALT B * OPEN AIR SUBWAY OPEN AIR STATIONS (NOT CONSISTENT WITH LEGISLATION)	ALT C OPEN AIR SUBWAY & CUT/COVER (CONSISTENT WITH LEGISLATION)
FULL PROJECT UNIVERSAL CITY/ NORTH HOLLYWOOD TO WARNER CENTER	$2,274 (TABLE B-6)	$2,132 (TABLE B-8)	$2,061 (TABLE B-10)	$2,116 (TABLE B-12)
PHASE ONE ONLY UNIVERSAL CITY/ NORTH HOLLYWOOD TO SAN DIEGO FWY	$ 796 (TABLE B-7)	$ 760 (TABLE B-9)	$ 735 (TABLE B-11)	$ 809 (TABLE B-13)

* STATE LEGISLATION (SB211–JUNE 1991) PROHIBITS ANY ALIGNMENTS ON THE SP BURBANK BRANCH BETWEEN HAZELTINE AND THE HOLLYWOOD FREEWAY THAT ARE NOT COVERED SUBWAY.

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- **Oxnard Street Alignment Option—** (3-1/2-mile-long, deep-bore subway line from North Hollywood Station to Hazeltine Avenue via Oxnard Street, instead of along Chandler Boulevard) Cut-and-cover subway stations are located at Laurel Canyon Boulevard and Los Angeles Valley College. This alignment avoids a wide curve leaving North Hollywood Station, and allows an additional passenger station. It also permits contracting the heavy construction tunnels and station shells before installing entrances, appurtenances, finish work, and station equipment. This would restore at the earliest date, the street and city traffic on which the businesses in the vicinity depend (Figures 16 and 17).

Potential advantages of an Oxnard Street alignment in lieu of a Chandler Boulevard alignment include:

- Straighter alignment with only one major curve instead of four major curves on Chandler

- Better future connection to the North Hollywood Station without the need for underground easements required by the Chandler alignment

- Opportunity for a station in the vicinity of Laurel Canyon/Oxnard in the vicinity of the Laurel Plaza/Valley Plaza Regional Shopping Center. The Chandler alignment is prohibited by state legislation from having any stations between North Hollywood and Valley College. This distance is 2.8 miles, and a station is necessary in this area to serve the major activity centers and other transit services in the North Hollywood area. An Oxnard Street alignment would provide the opportunity for such a station, while still providing the environmental advantages of a full, covered subway alignment.

Route Alignment Extensions- Order-of-magnitude cost estimates have been provided for two possible future extensions of the SP Burbank Branch alignment. These include the following:

- Chatsworth Extension Option — extends the EIR alignment an additional 5 miles by turning north along Canoga Avenue to the Metrolink station at Chatsworth. The Topanga subway station would be omitted, but one additional at-grade and two additional aerial stations would be added. Although not costed or considered as a part of this project, people mover systems or bus shuttles could serve Warner Center, and the

Valley Circle Extension discussed below (Figures 18 and 19).

- **Valley Circle Extension Option** — extends the EIR alignment an additional 3 miles by turning south on Topanga Canyon Boulevard and then west along the north edge of the Ventura Freeway. One subway station and two aerial stations would be added. Although not costed or considered as a part of this project, people mover system to the north could serve Chatsworth Metrolink station and intermediate points (Figure 20).

CRITERIA FOR PRE-PRELIMINARY DESIGN STUDY

The MTA-owned SP Branch right-of-way allows a range of cost-effective rail guideway solutions on, above, and below the ground surface. Guideways at all elevations can be effectively isolated by barriers for environmental and grade-separated protection to the public in the manner consistent with many previously constructed rail transit systems throughout the United States.

Geotechnical Investigation- Prior to the commencement of engineering design and costing, a study entitled *Geotechnical Investigation for Limited Preliminary Engineering Program, San Fernando Valley East-West Segment, Metro Red Line Project,* was prepared, in December 1993, by Earth Technology Corporation.

The results of the site geotechnical and contamination investigations are detailed in the main body of this study. New exploration along the alignment included 14 new soil test borings and six ground water monitoring wells about 80 feet deep. No natural underground hydrocarbons were detected. It is therefore, unlikely that methane gas, hydrogen sulfide gas, asphalt, tar, or free oil will be encountered during subway or open trench construction.

Cost-effective design factors for the SP Branch alignment are the low groundwater table, the generally stable alluvial geology, and the absence of major structures near the new rail facilities. Conditions in both the western and eastern segments indicate conventional soft-ground tunneling and cut-and-cover excavation can be done at a high rate, using readily available equipment and conventional shoring.

Design Life of Project- Civil/structural facilities account for about two-thirds of initial project costs. Their useful life is measured by their rate of deterioration, date of system obsolescence, or failure to resist design loads. Subway guideways and stations are protected from deterioration by water proofing, cathodic protection, and the absence of significant dynamic forces. Their useful life exceeds the 100 years of service planned by the MTA. During an earthquake, they need mainly to

conform to the elastic distortion of the ground, and have greater strength than the soil prism they displace.

Using current highway bridge criteria, aerial guideways and stations have a code life of 75 years due to the dynamic loads of the transit vehicles. Each time structural concrete is stressed by a recurring load, it experiences a micro-failure. After a certain number of repetitions, structural distress is reached, guideway rideability performance deteriorates, and the useful service life ends unless maintenance is significantly increased. The life of concrete structures is also shortened by earthquake forces.

The service life of concrete structures can be increased by reducing the design stress below the code allowable. It may cost 15 percent more to increase concrete strength 25 percent but, by so doing, the service life is increased from 75 to 100 years. Of common construction materials, only structural steel does not have a stress-related life span. It has a level of stress, called its "endurance limit," below which failure will not occur. Protected from corrosion and abrasion, steel appears to last indefinitely. Many of the Nation's steel bridges continue in use after their concrete decks have been replaced. For the above reasons, both concrete and steel structures have been evaluated for the above-ground guideways and stations on this alignment.

Seismic Safety Considerations- The location or frequency of earthquakes is not predictable. They are surmised from historical records and the mathematics of probability (used by insurance companies predict losses). Recurrence periods up to 2500 years are used in earthquake calculations, although instrumental seismology is only 100 years old. Seismic design for any construction project is thus, at least partially, an exercise is prudent anticipation of a multitude of different seismic forces rather than an exact science.

Following the January 17, 1994 Northridge earthquake, MTA seismic codes were significantly strengthened, and are now among the strictest for any public works agency in the country. The MTA criterion for transit operations continuing after an earthquake is a 40 percent probability of quickly repairable damage during the 100 year life, but only a 5 percent likelihood of structural collapse. The criterion forces are similar to those of the magnitude 6.7 Northridge earthquake of January 1994. Worldwide, this level of earthquake occurs about 10 times a year. The potential earthquake accepted by most seismologists for the Los Angeles Basin is magnitude 7.0. This is twice the energy of the Northridge quake, and yet the ground shaking at some places in Northridge exceeded the MTA criterion for the collapse level earthquake. The result is, even with intensive scientific research, seismic forces cannot be pinpointed, and every structural design precaution that does not substantially increase costs should be investigated.

Earthquake codes are not specific about structural stability, covering a multitude of bridge types. They require higher earthquake forces for bridges on single columns than on multi-column bents. The actual resistance to collapse for multi-columns can be much greater than the small code allowance. To achieve this higher stability requires detailed analysis rather than simple acceptance of the code. All aerial structures for this study therefore use 2- to 4-column bents to increase this resistance.

Station Design- Station architecture is well established and, due to heavy design loads, demonstrates the inherent aesthetics of the correct structural and construction solution. Passenger functions follow the direct and obvious path for entering and leaving trains. This policy is common to airline waiting lounges where aesthetic, but simple and direct, pathways take the passenger from the security gates to the aircraft jetway. This reflects the greater concern for public safety and property.

Detail of Design- The designs used for estimating are pre-preliminary, that is, 15 percent complete studies. Designers have taken a conservative approach in minimizing facilities and optimizing constructability to reduce costs. Subway ancillary spaces were placed below grade and roofed over, whereas the placement of these spaces near or at the surface in the SP right-of-way would reduce costs. Also, improvements have been made to the EIR solution, in environmental, operational, and structural aspects.

Additional Route Options- Potential options not costed include providing express bus service in conjunction with the initial 6-mile phased construction length. This service would cover the Phase 2- 8 miles segment, operating along Victory Boulevard, Oxnard Street, and Topham Street adjacent to the SP Burbank right-of-way. Future subway station parking sites would be used as MTA park-and-ride facilities.

Postponing construction of lower-patronage stations could defer costs, and allow earlier express rail service in support of the present Valley bus system. The aerial passenger facilities at Woodley Station, and the subway passenger facilities at White Oak and Tampa Stations are candidates for deferral. The estimates for the options to Alternates B and C reflect these cost deferrals. Aerial and open retained cut subway guideways could be constructed through these sites, and future side-platform stations installed with little interruption to revenue service. With guideways installed, about 80 percent of the station construction would be deferred. Express buses would use the parking lots of the postponed stations for service between the rail stations.

Noise/Vibration Issues- The MTA criterion for maximum train passby noise levels in residential areas is 75 decibels. This criterion is modified to account for the ambient noise of the normal street and highway traffic. Ambient noise and vibration were measured along the SP Branch right-of-way in 1987. The noise level and the frequency of operations over 24 hours were used to determine the cumulative noise for residential areas.

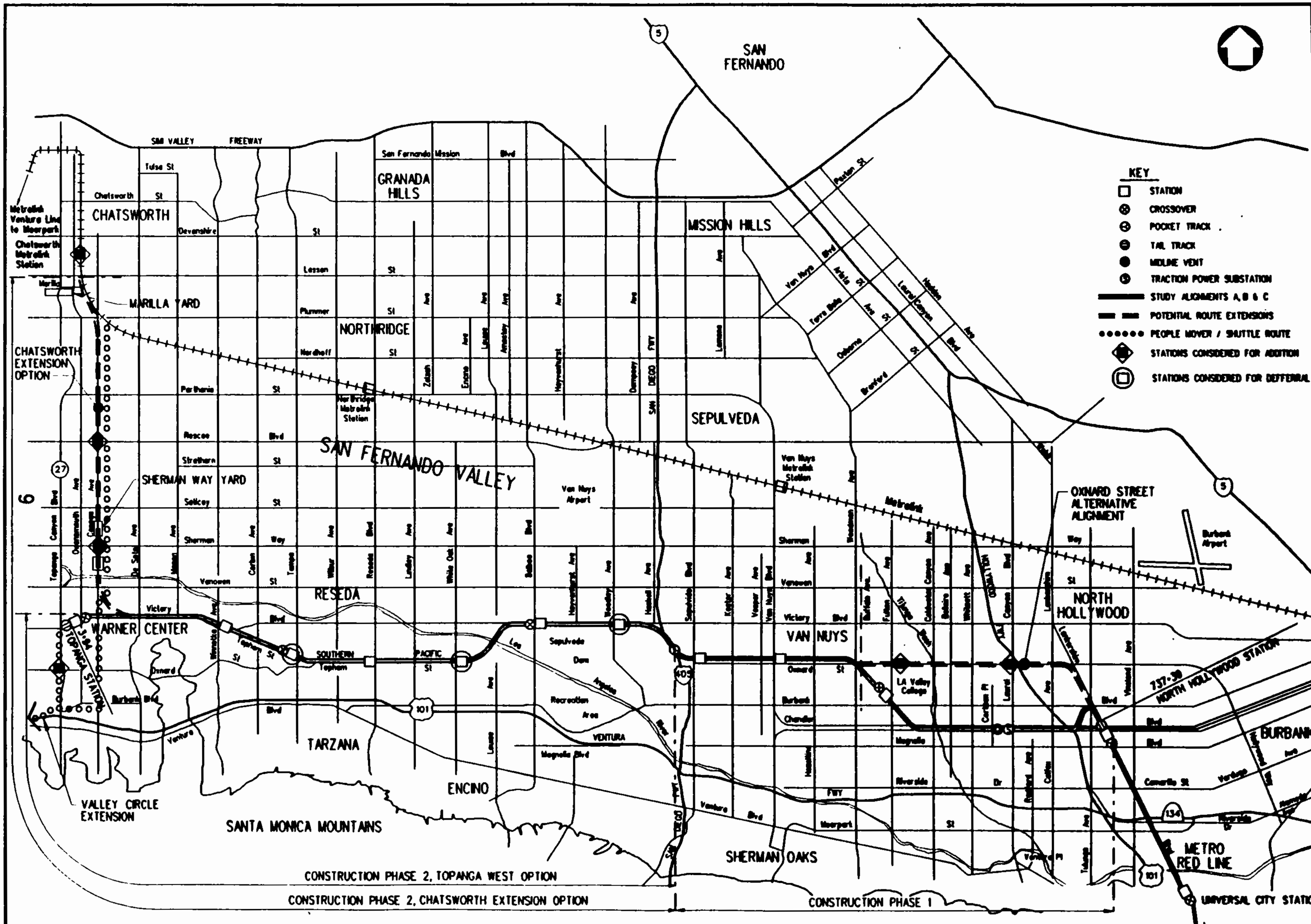
If transit system noise does not exceed ambient noise levels by more than 5 decibels, the impact is characterized as not significant, and not calling for mitigation. This report concludes that only aerial and at-grade guideways will exceed 75 decibels. The 75-decibel threshold will not be exceeded at either the open-air, or the covered stations and guideways. Moreover, there are practical sound attenuating solutions that ensure the ambient noise level is not exceeded, even for aerial and at-grade guideways. Pending more detailed field instrumentation, it is assumed that noise barriers will be used for all aerial and at-grade guideways.

All alternatives have potential for ground-borne vibration from crossovers and other special trackwork located in residential areas. The mitigation measures for vibration are assumed to use ballast mats on concrete or on compacted soil.

Conclusions

The cost impacts of the geotechnical, environmental, and alignment aspects of the SP Burbank Branch project have been reviewed. Cost-reducing construction studies included open retained cut guideways and stations, and the incorporation of value engineering recommendations. Concrete aerial guideways and stations were studied for reduced seismic risk, and an increased service life more comparable to subway construction.

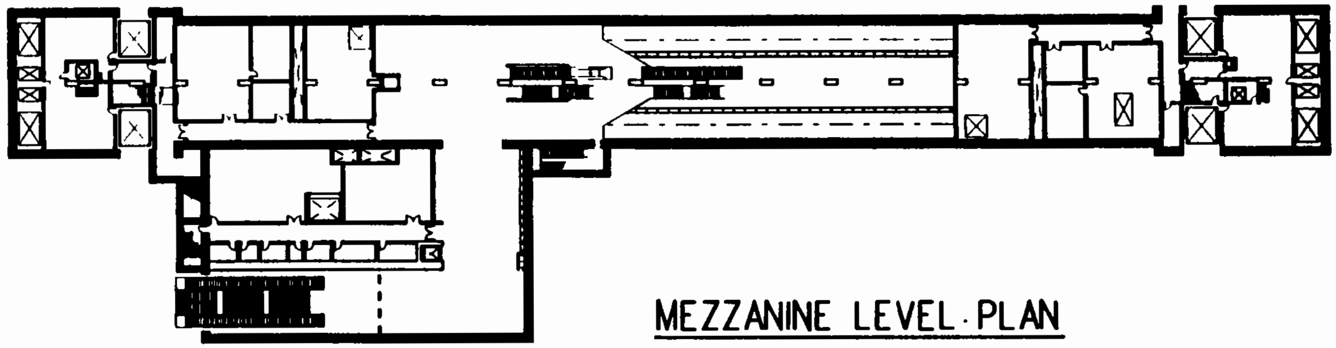
Construction of rail guideways is limited compared to highway bridges and buildings. The service life of concrete aerial guideways is 75 years, but a 100-year service life, more comparable to the project's subways should be considered. Technical analysis, of the high precision currently available, applied to standard designs, is the best for course combined safety and economic value. This strategy is one of striving for technical pre-eminence rather than accepting today's state-of-the-art.



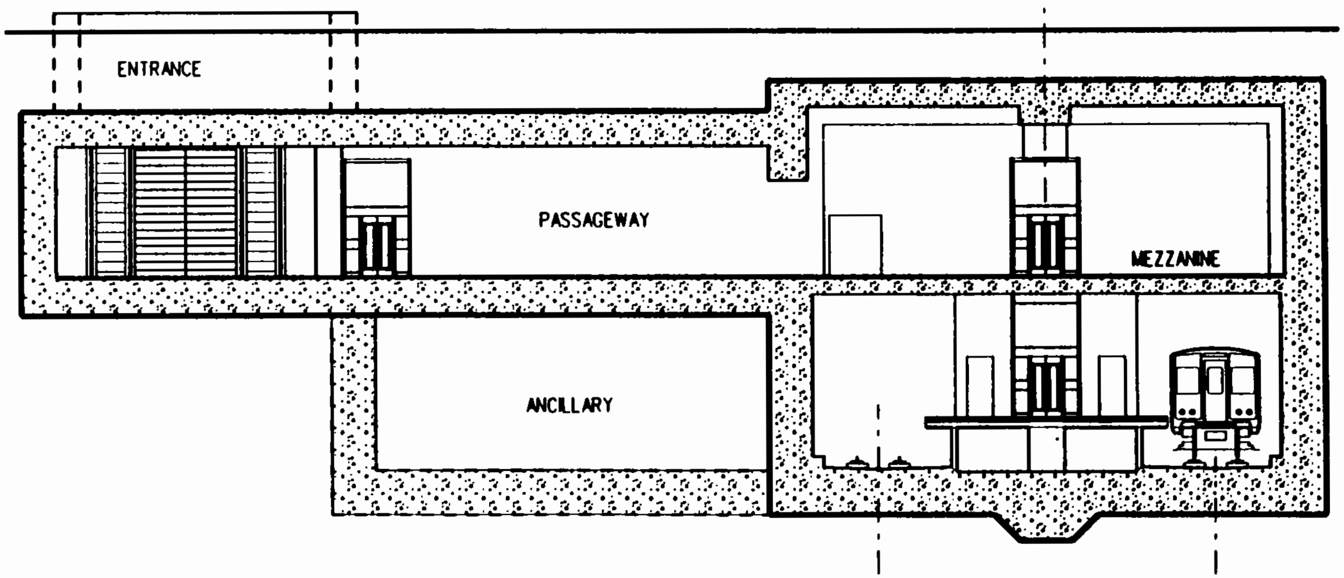
VICINITY MAP JUNE 2, 1994

SP BURBANK BRANCH RAIL ALIGNMENT

FIGURE 1



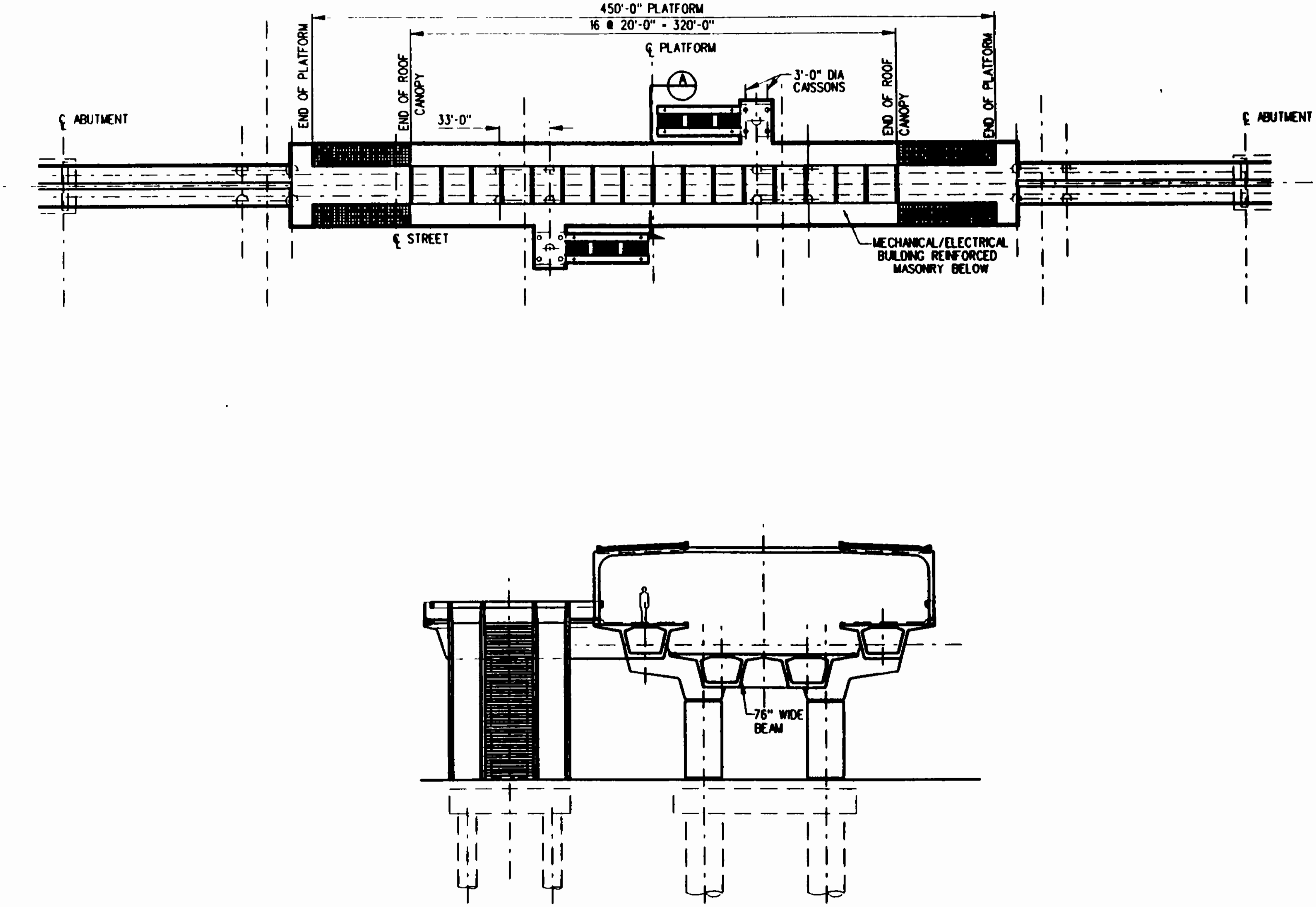
MEZZANINE LEVEL PLAN



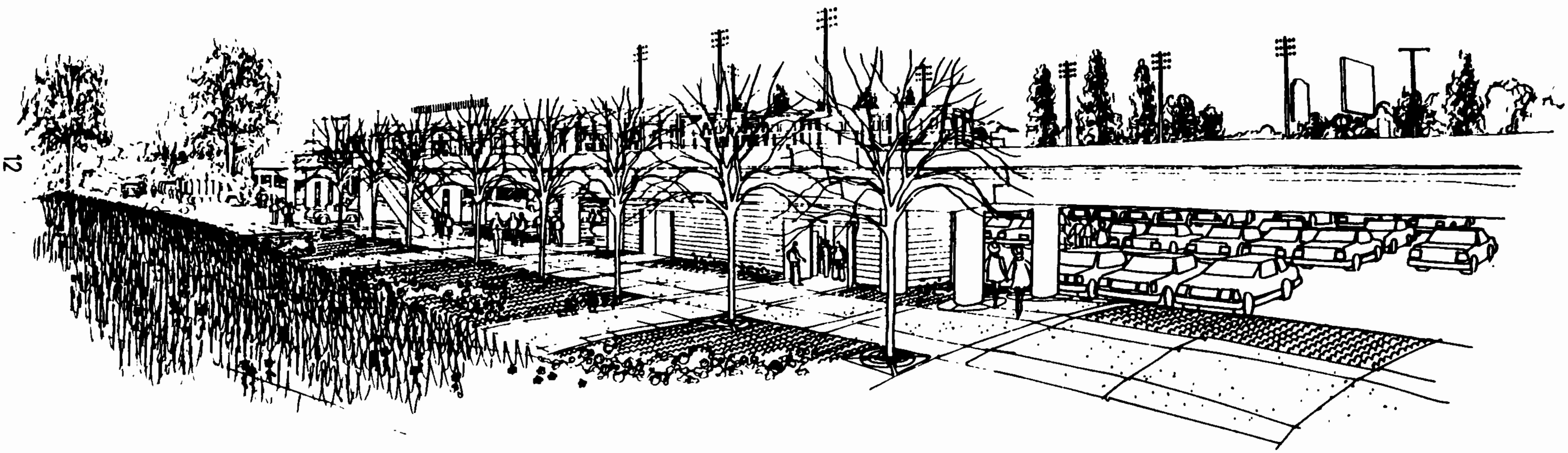
SECTION

ALTERNATE A
MODULAR STATION JUNE 2, 1994

FIGURE 2

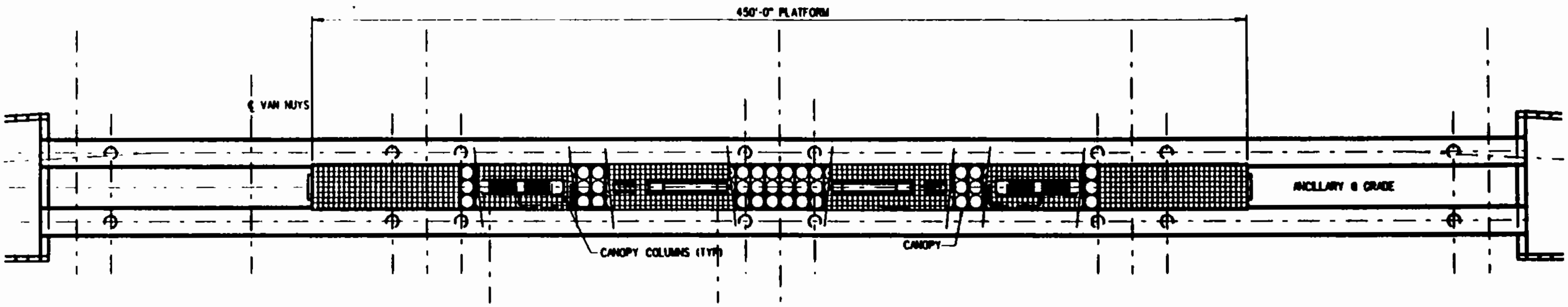


ALTERNATES A, B & C FIGURE 3
SIDE PLATFORM AERIAL STATION

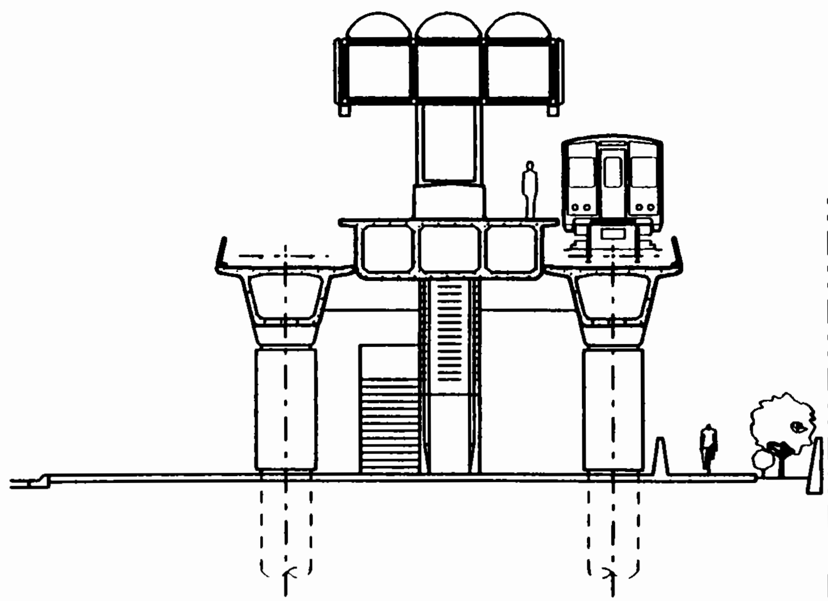


VIEW OF TYPICAL AERIAL STATION (STATION SHOWN AT BALBOA) FIGURE 4

13



PLATFORM PLAN



SECTION

ALTERNATES A, B & C FIGURE 5
CENTER PLATFORM AERIAL STATION

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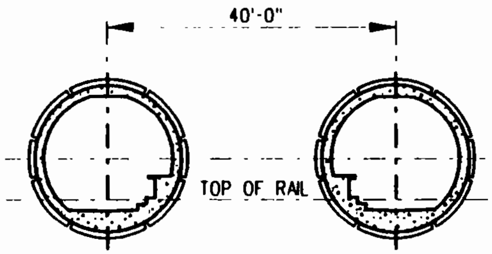
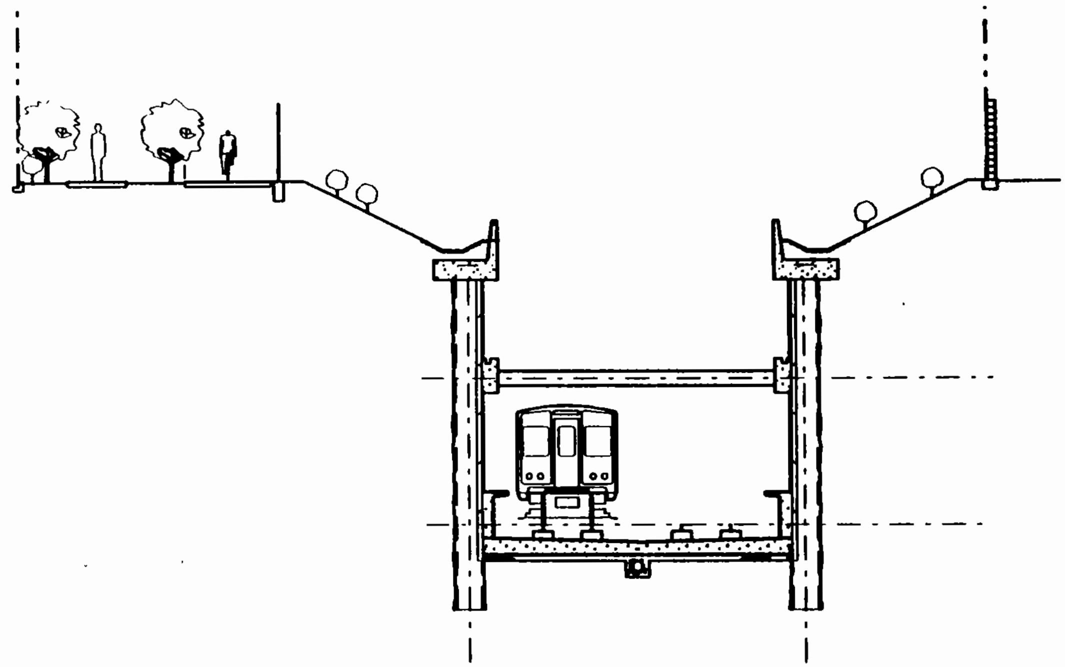
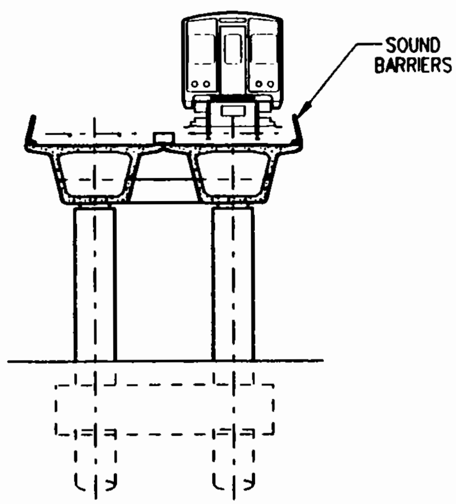


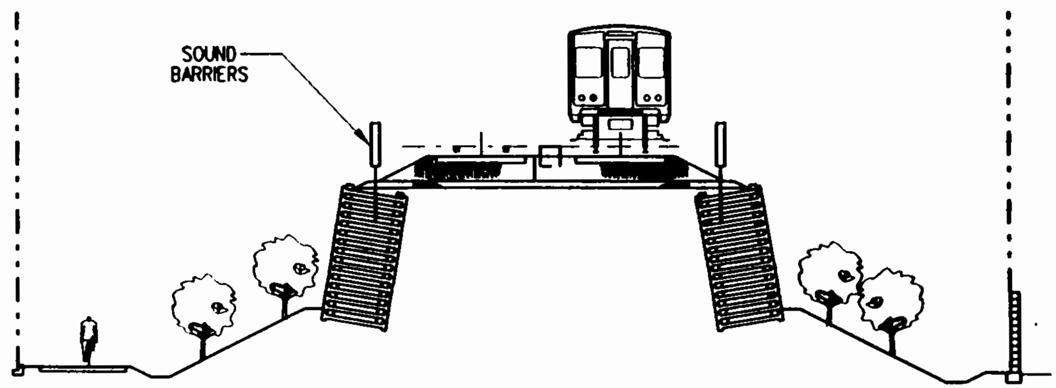
DEEP BORE TUNNELS



AT TRANSITIONS



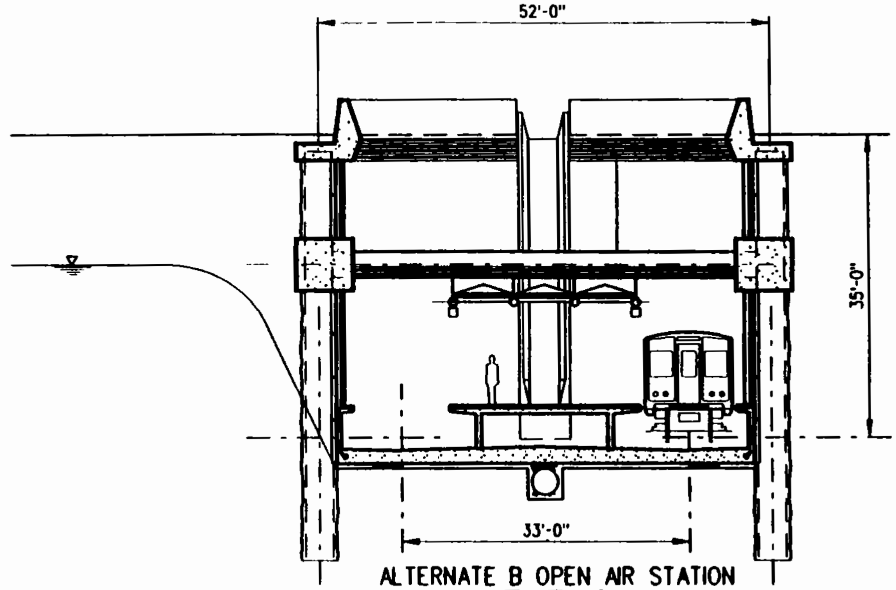
AERIAL GUIDEWAYS



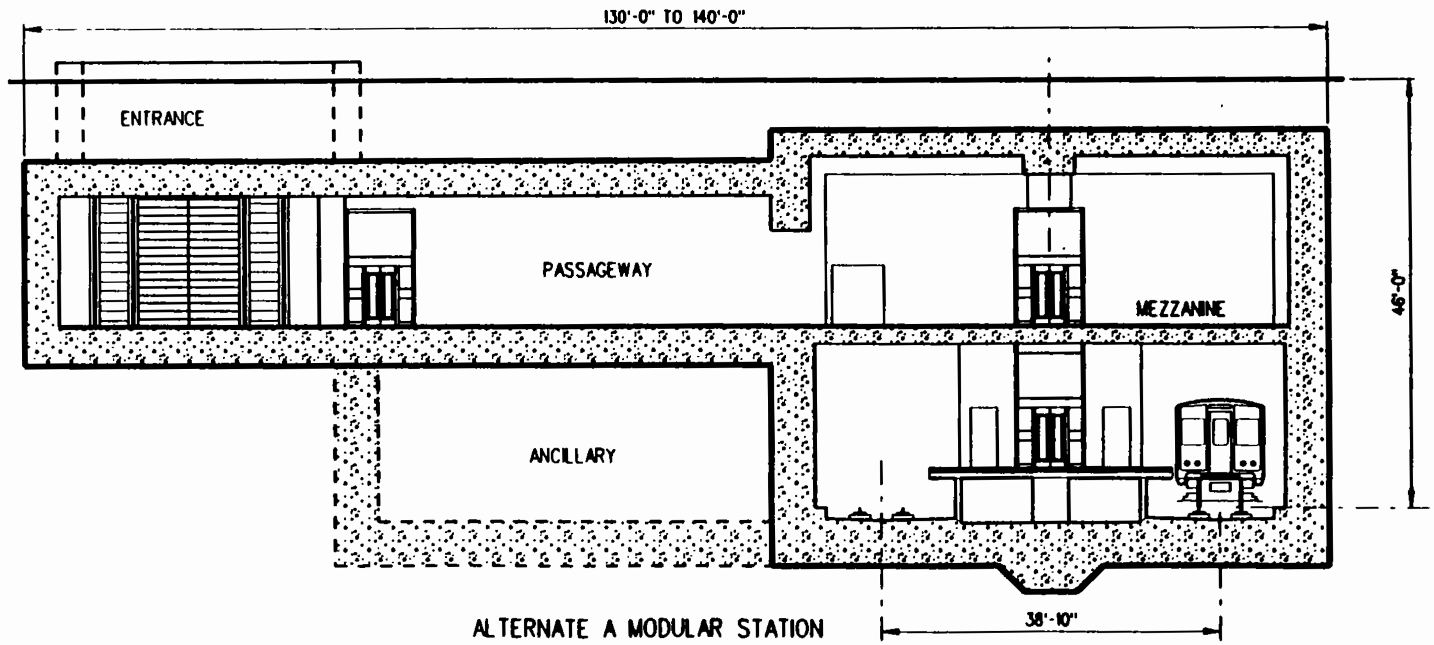
AT TRANSITIONS

ALTERNATE A
GUIDEWAYS

FIGURE 6



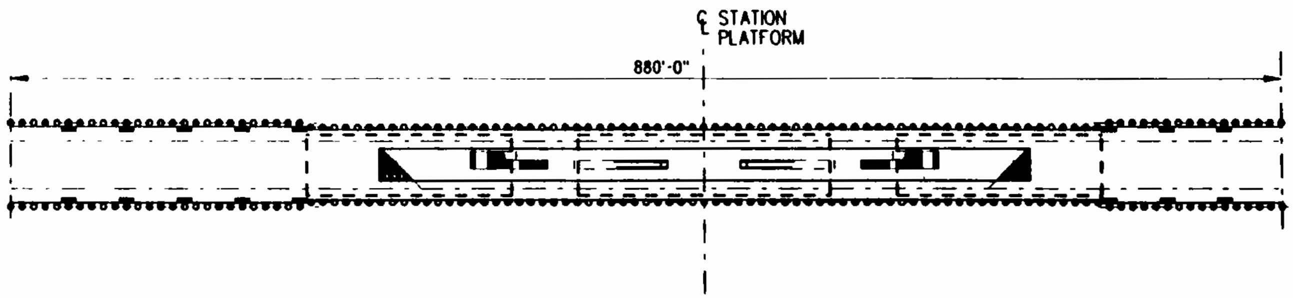
ALTERNATE B OPEN AIR STATION
SECTION



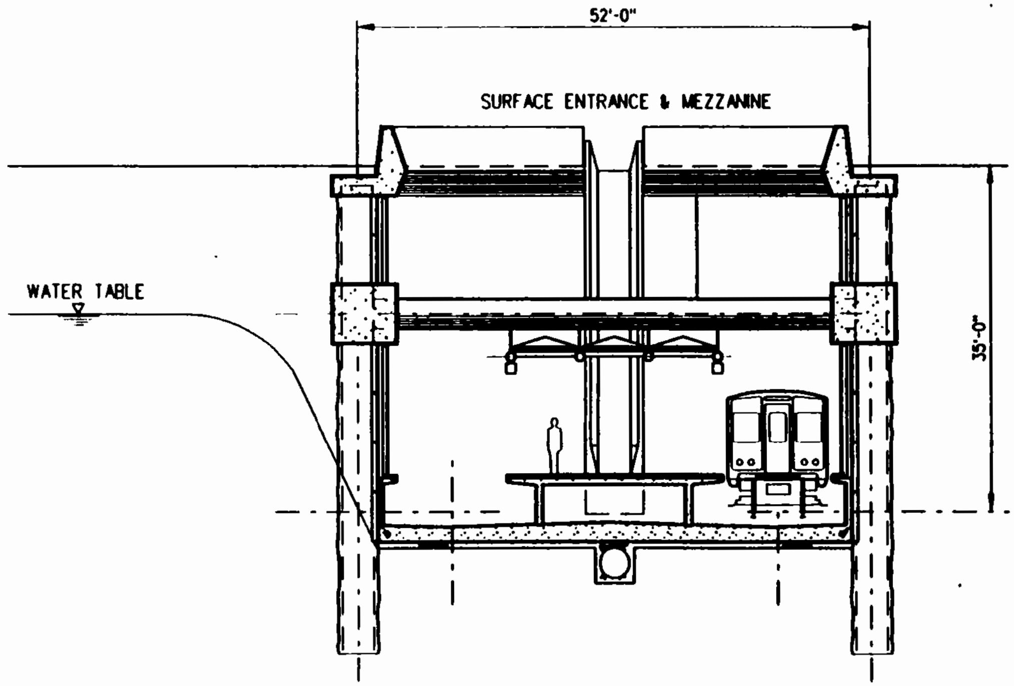
ALTERNATE A MODULAR STATION
SECTION

COMPARISON OF MODULAR AND OPEN AIR STATIONS

FIGURE 7

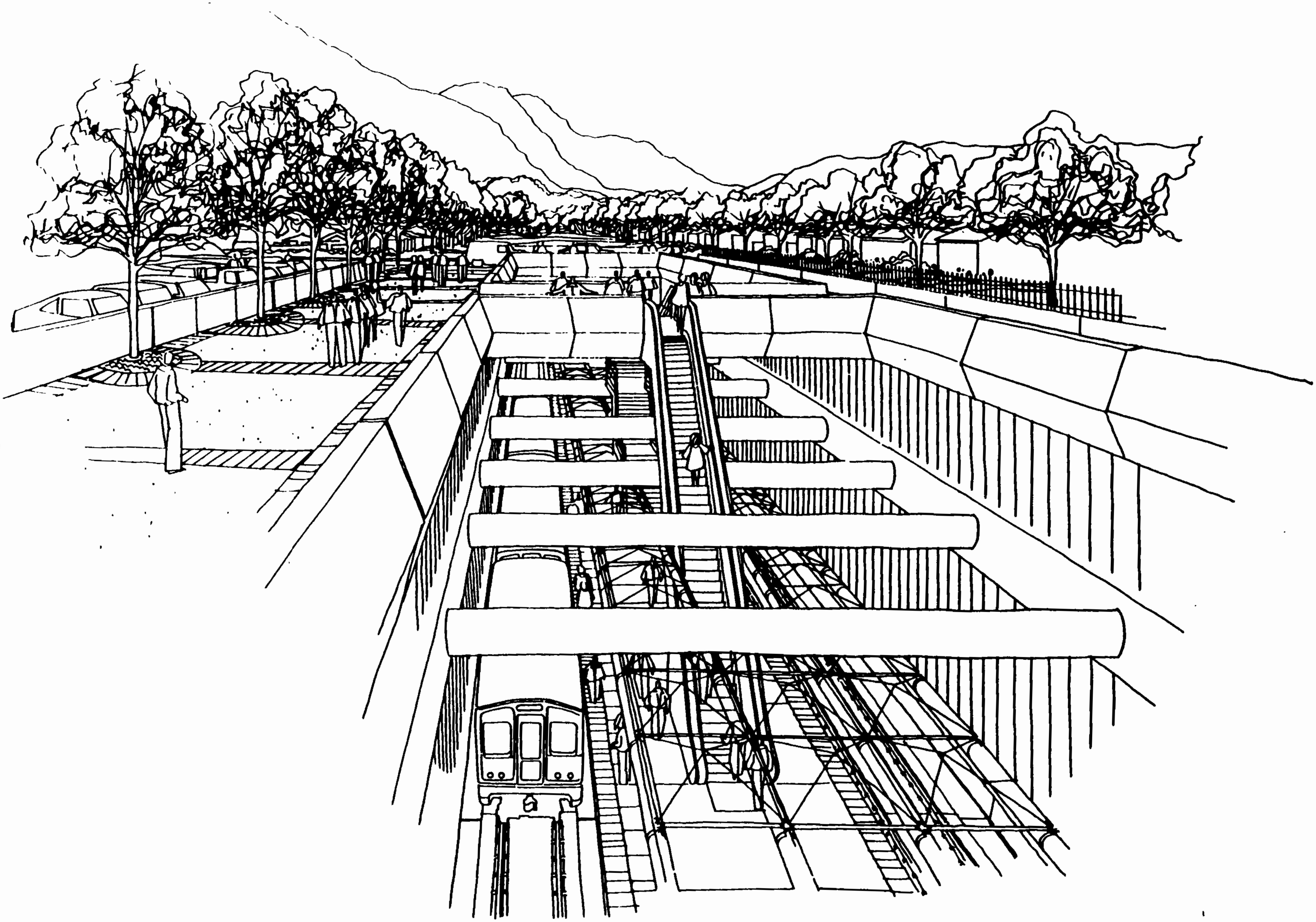


PLATFORM PLAN



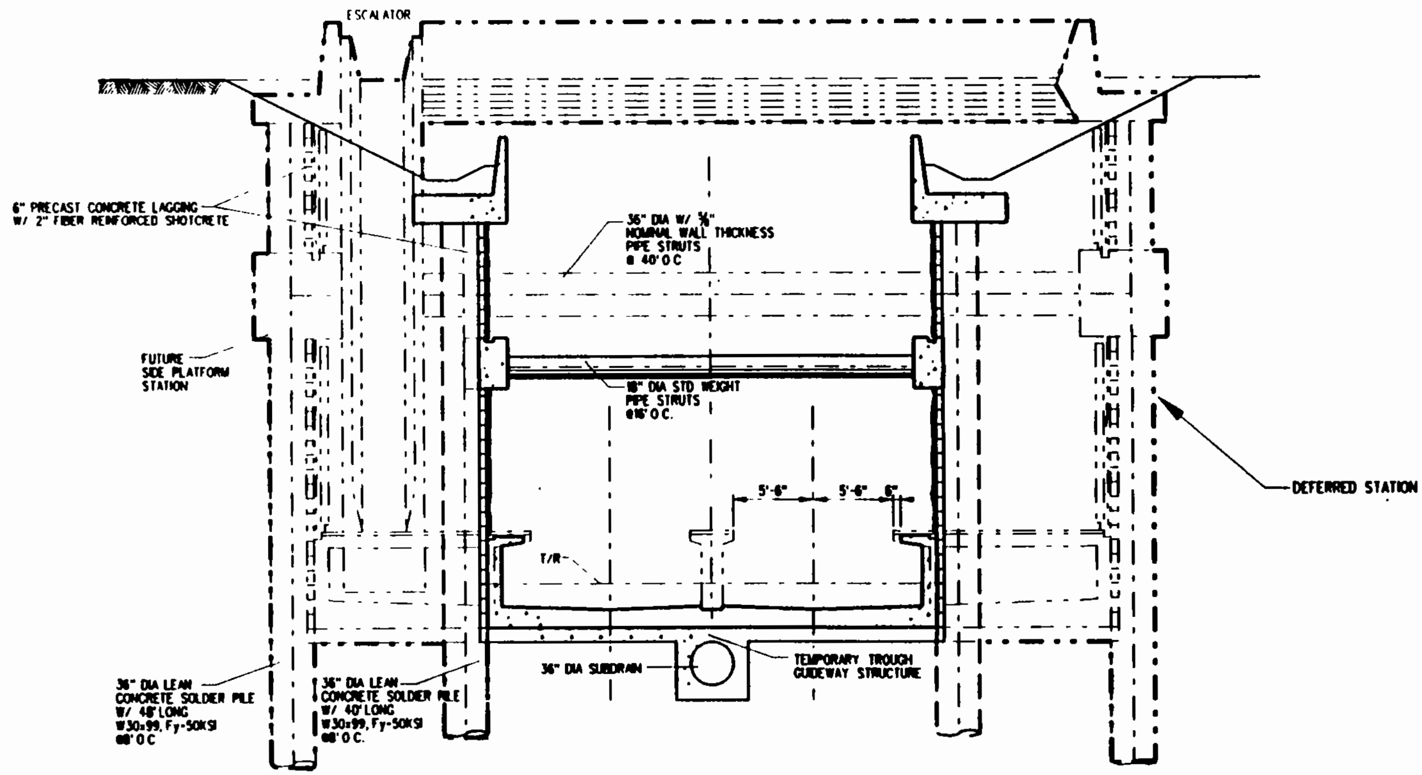
SECTION

ALTERNATES A , B & C FIGURE 8
CENTER PLATFORM OPEN AIR STATION



VIEW OF TYPICAL OPEN AIR SUBWAY STATION

FIGURE 9



ALTERNATE A , B & C
SIDE PLATFORM OPEN AIR STATION

FIGURE 10

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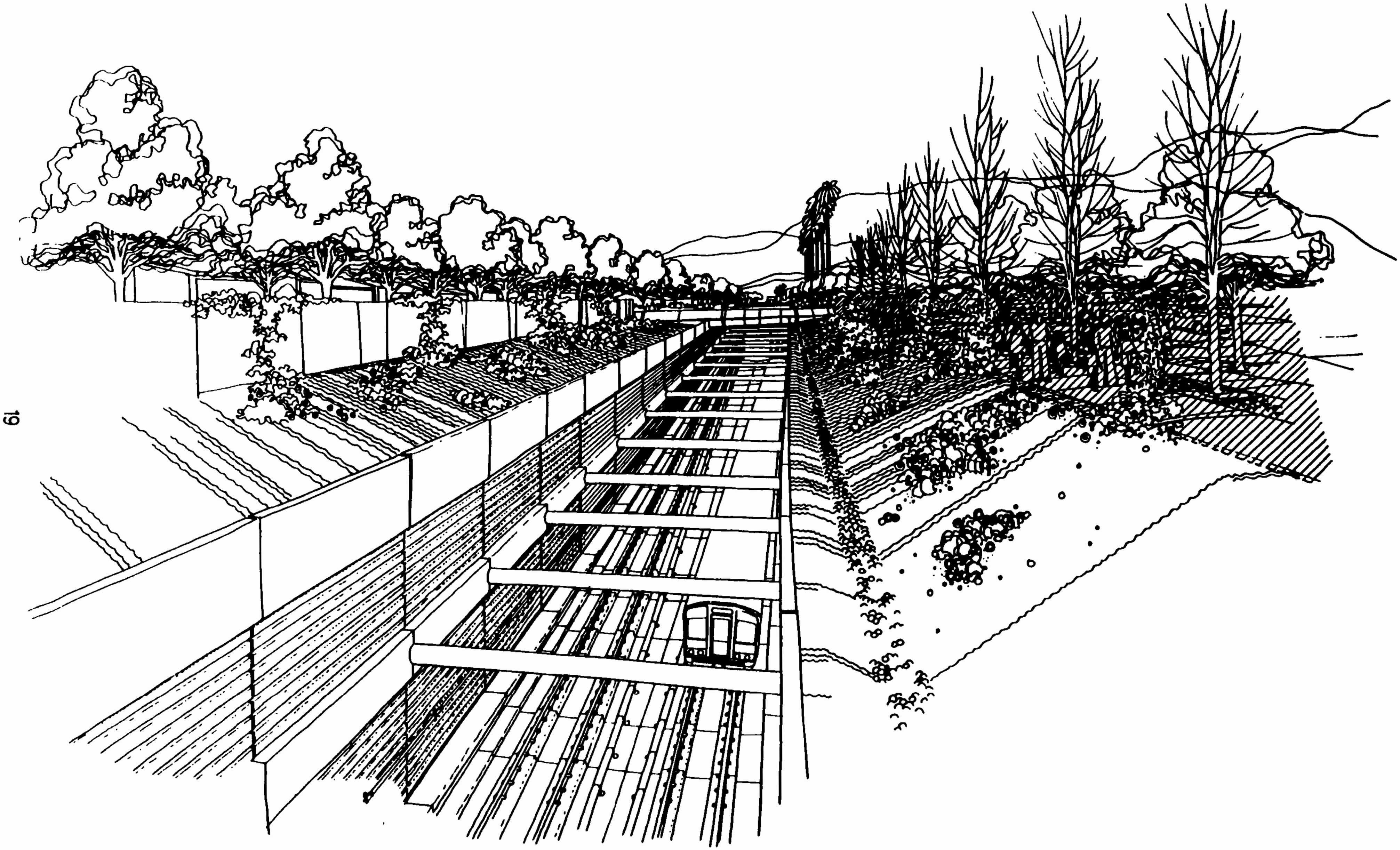
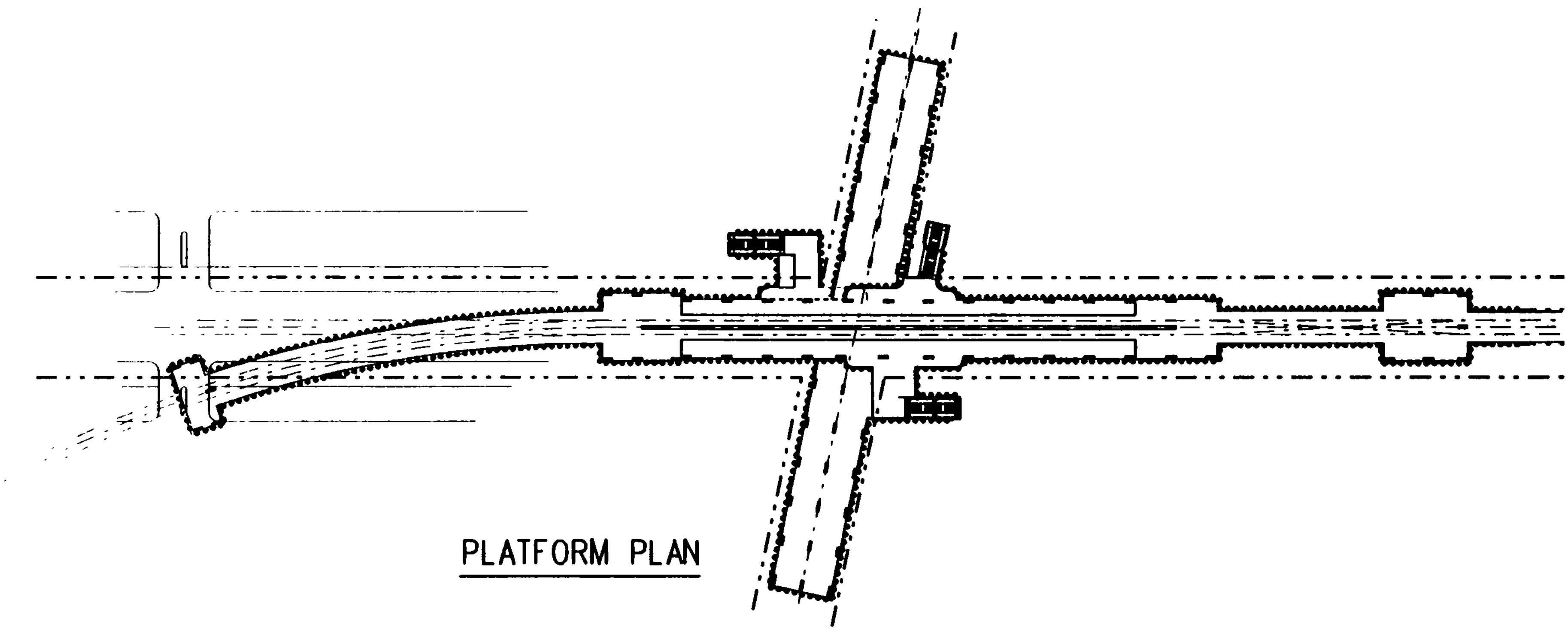
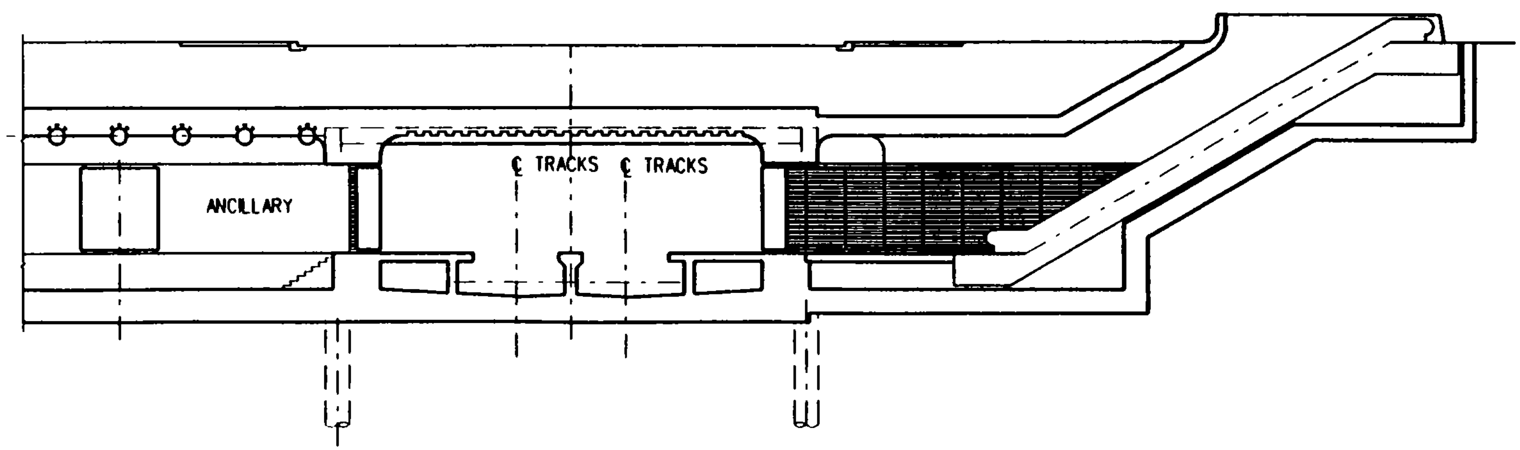


VIEW OF TYPICAL OPEN AIR SUBWAY ALIGNMENT

FIGURE 11



PLATFORM PLAN



SECTION

ALTERNATES B & C
TOPANGA STATION

FIGURE 12

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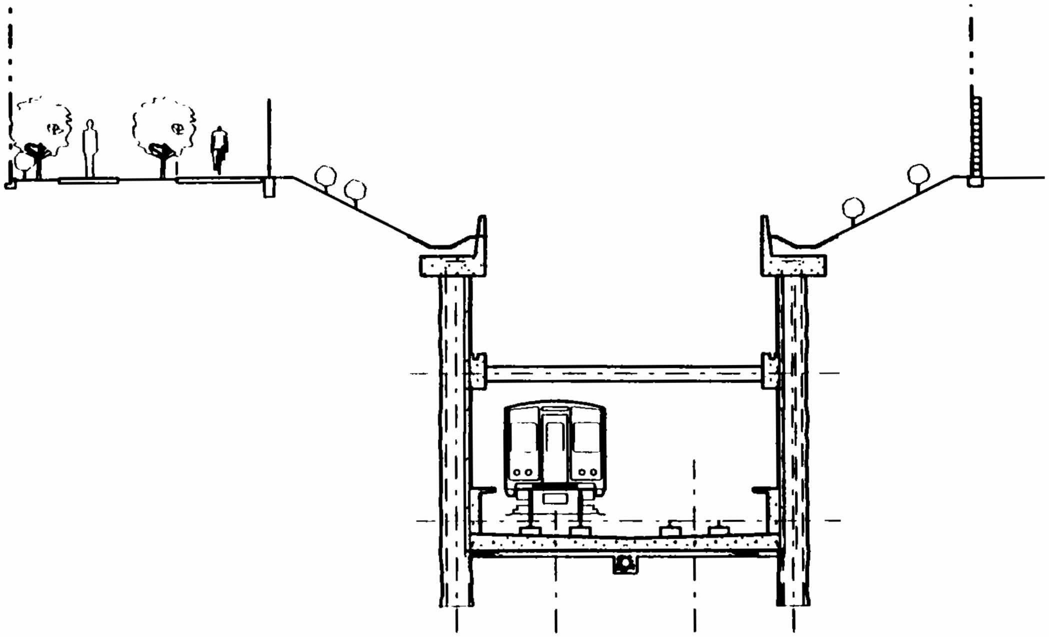
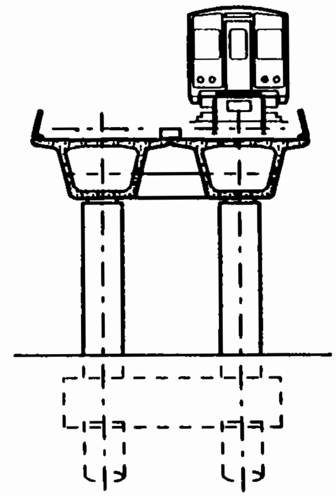
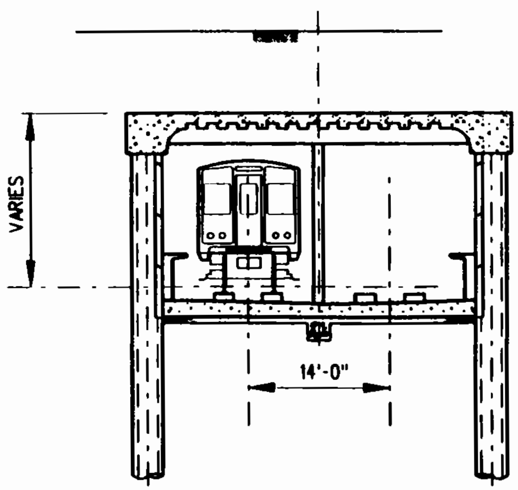


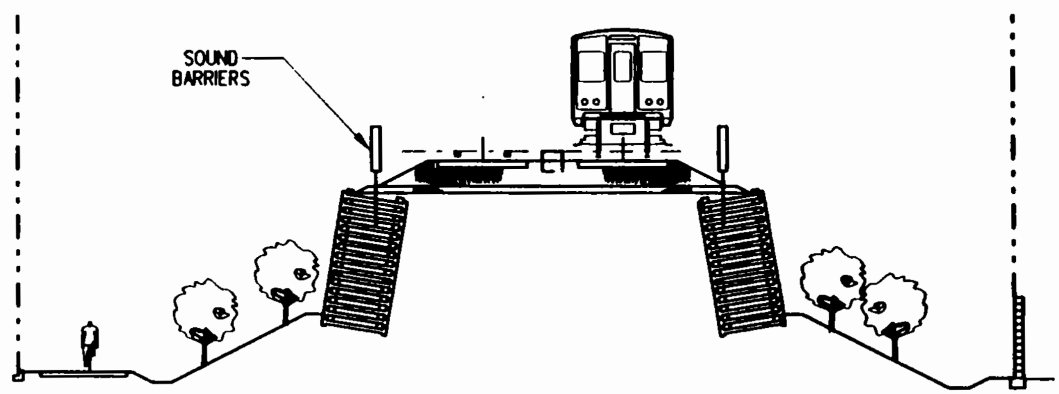
RETAINED CUT GUIDEWAYS



AERIAL GUIDEWAYS



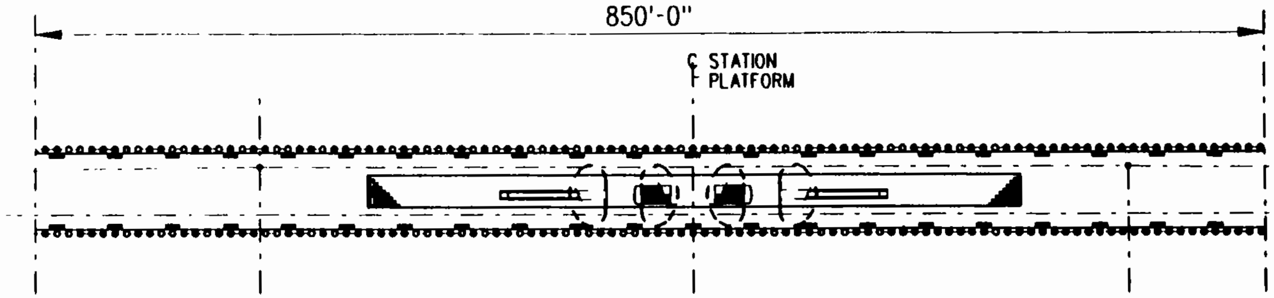
AT CROSS STREETS



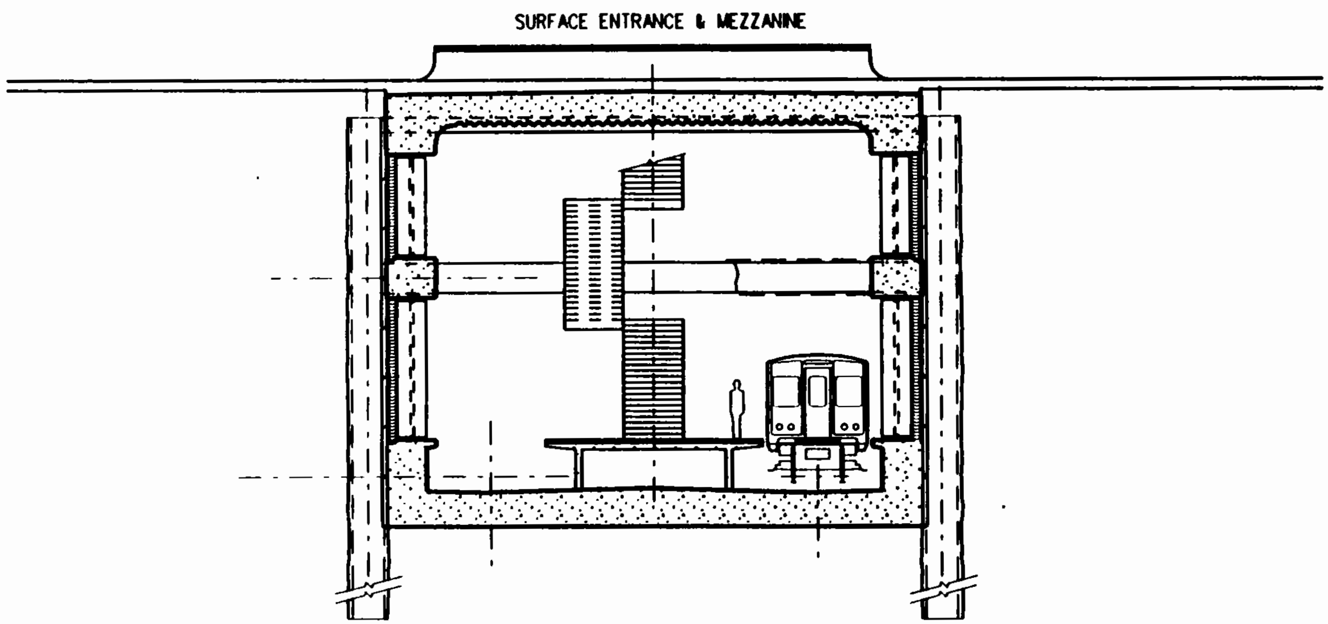
RETAINED FILL GUIDEWAYS

ALTERNATE B
GUIDEWAYS

FIGURE 13



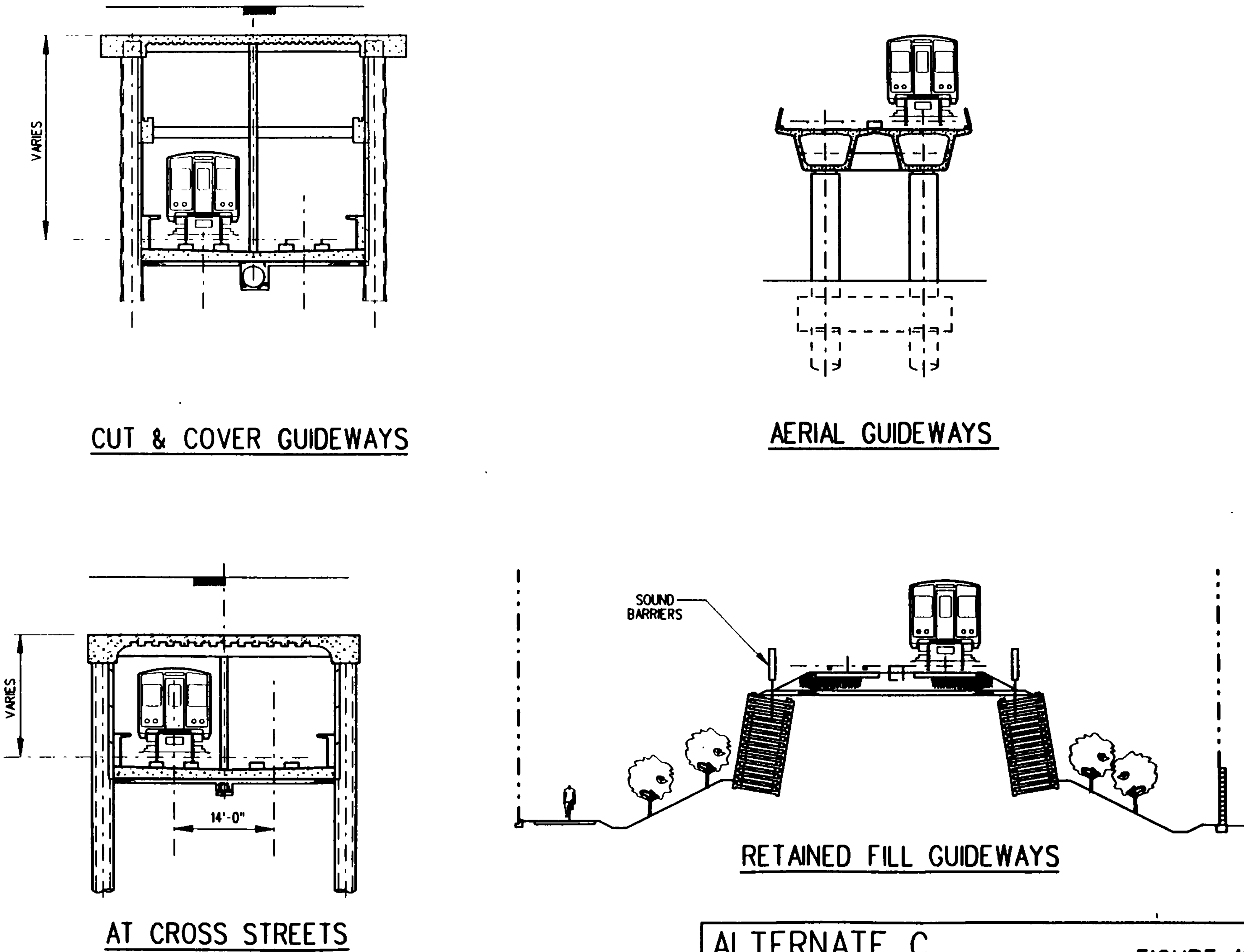
PLATFORM PLAN



SECTION

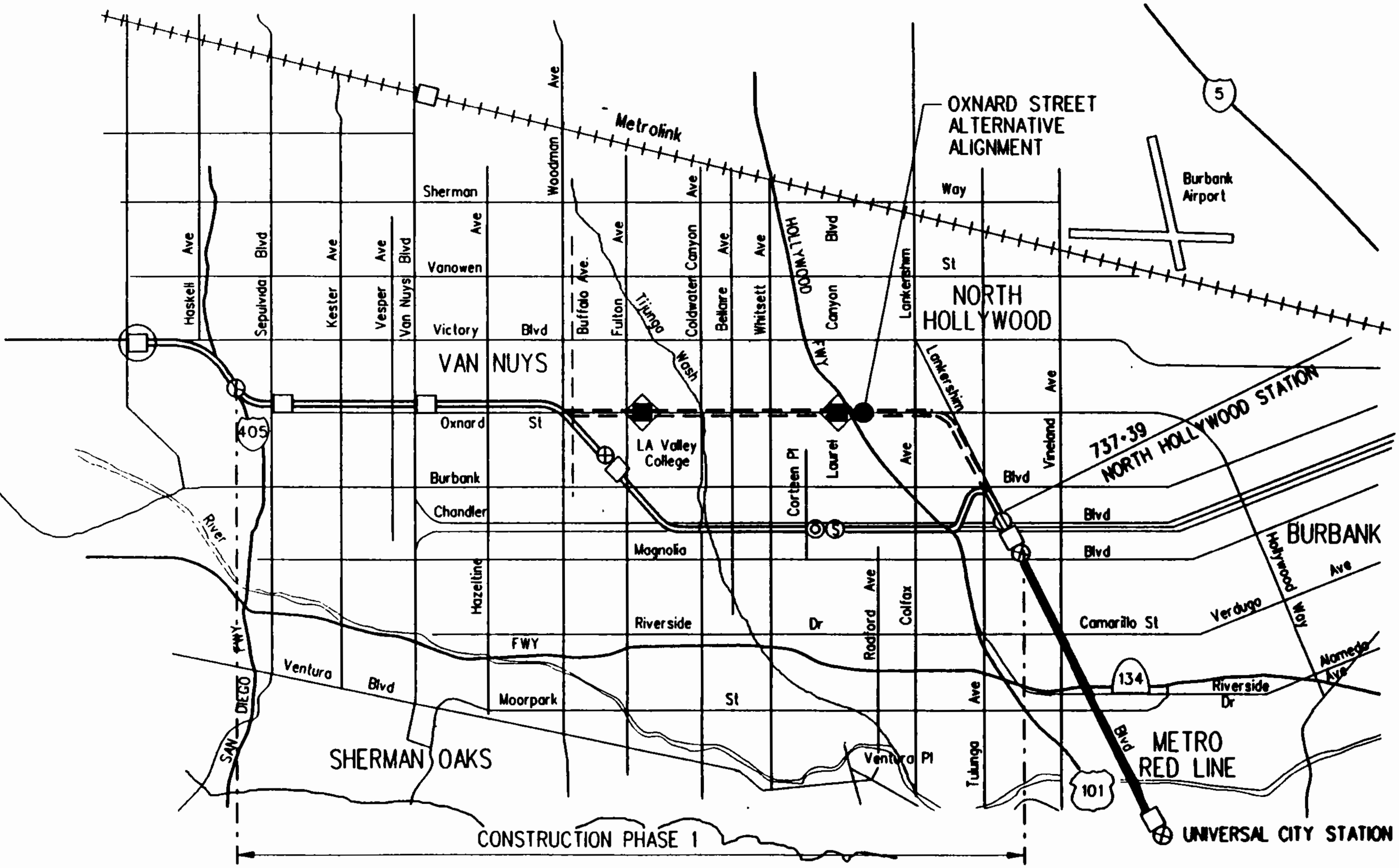
ALTERNATE C
FULTON-BURBANK STATION

FIGURE 14



ALTERNATE C
GUIDEWAYS

FIGURE 15



VICINITY MAP
OXNARD OPTION

FIGURE 16

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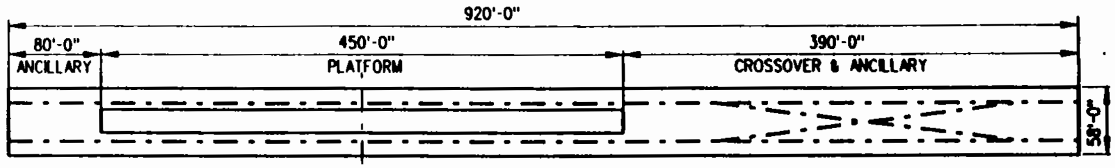
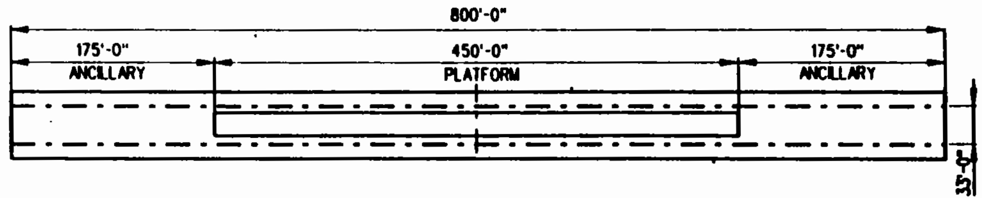
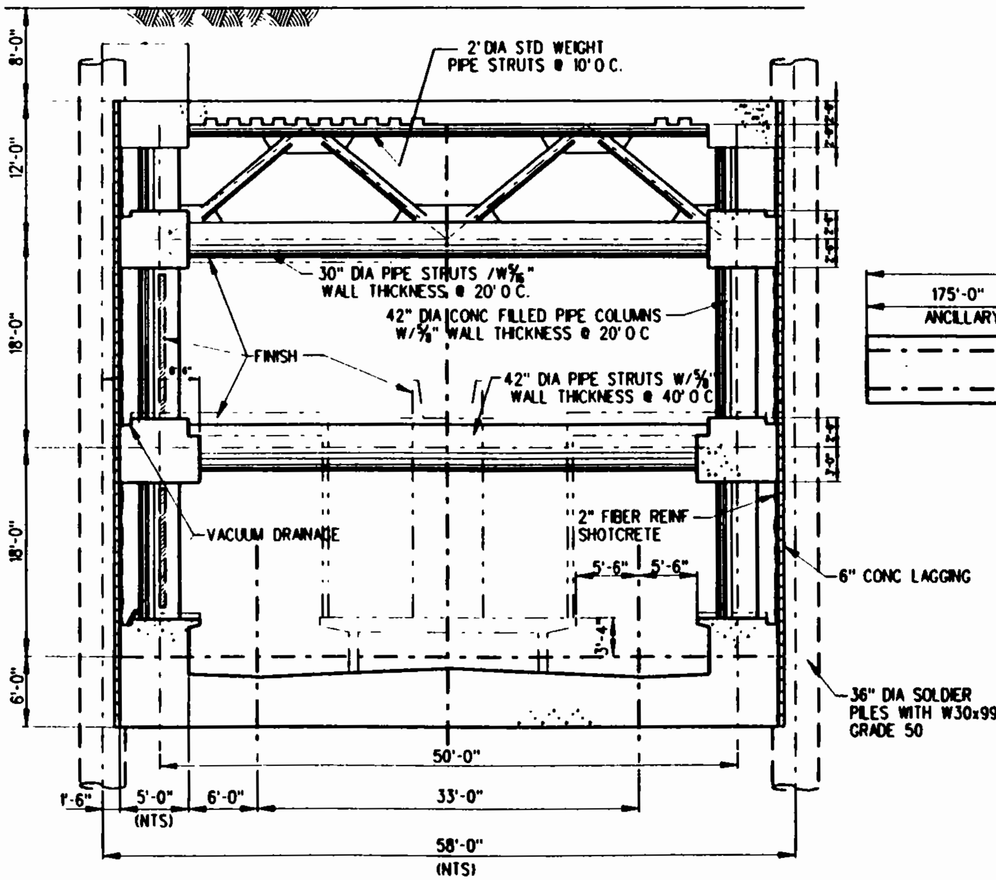


VALLEY COLLEGE STATION



LAUREL CANYON STATION



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ALTERNATES A, B & C
OXNARD STREET ALIGNMENT & VALLEY CIRCLE EXTENSION

FIGURE 17

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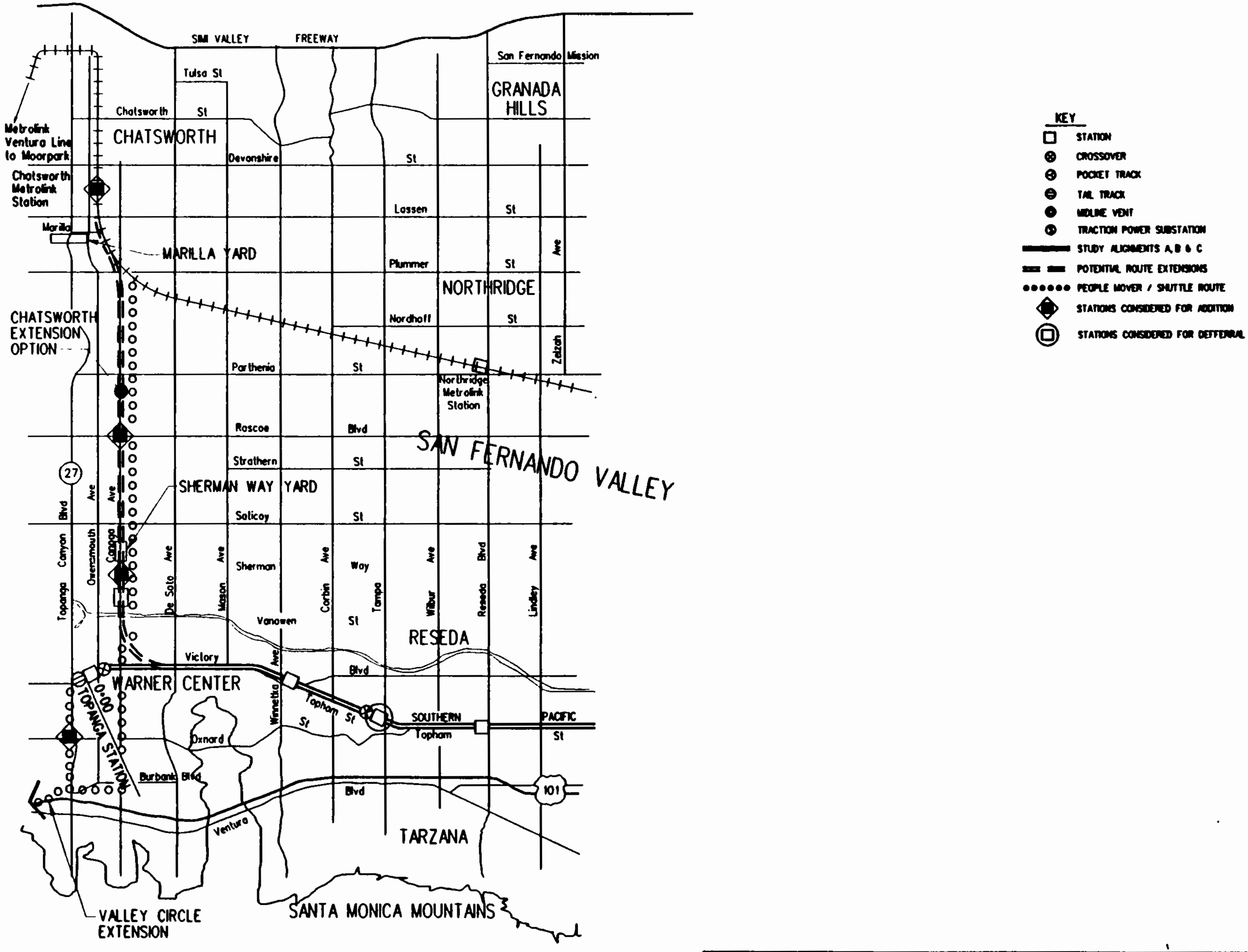

VICINITY MAP
CHATSWORTH EXTENSION

FIGURE 18

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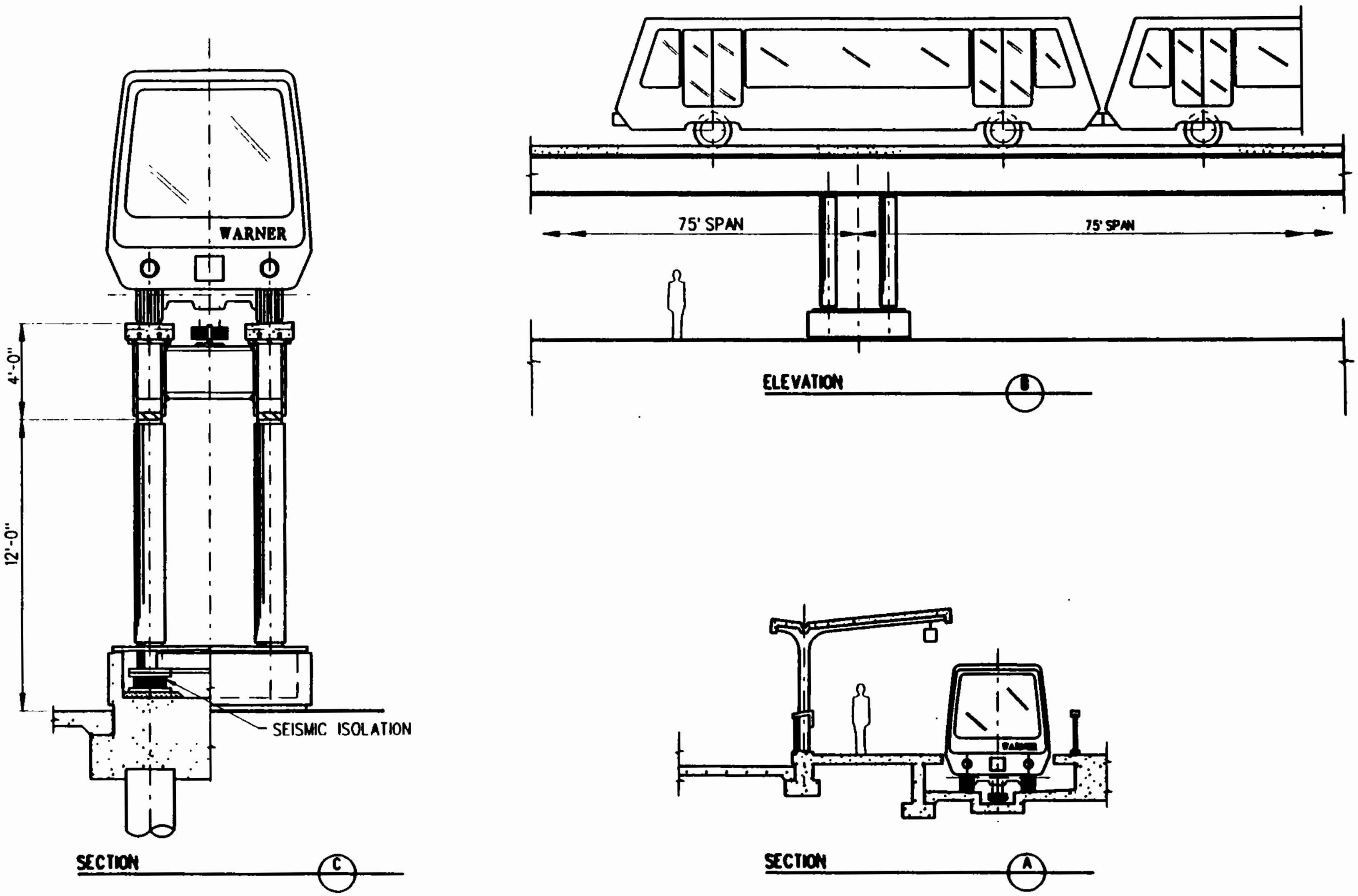
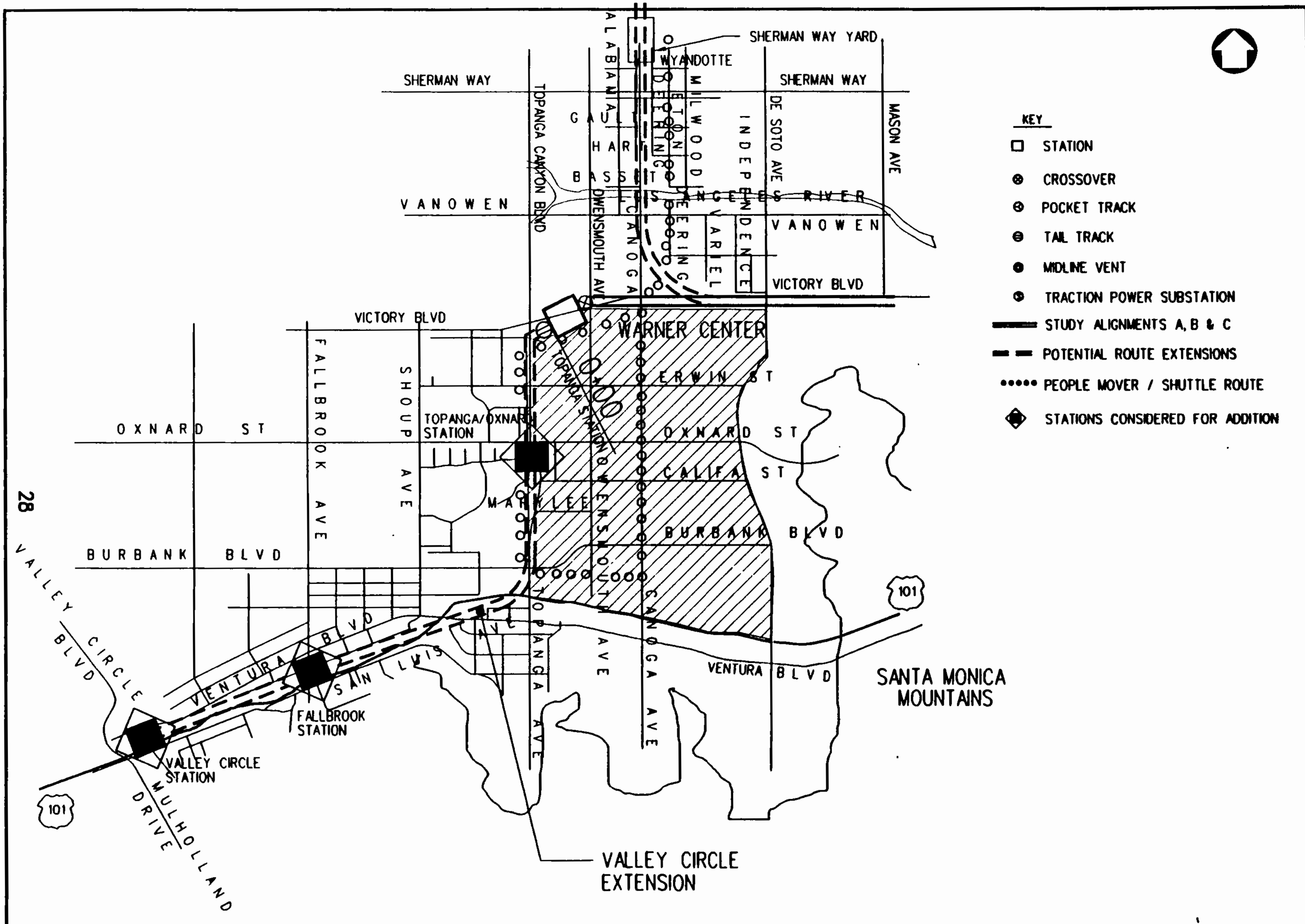


NOTE: THE PEOPLE-MOVER IS PRESENTED FOR CONSIDERATION ONLY. IT HAS NOT BEEN COSTED AND IS NOT A PART OF THE EAST-WEST RAIL TRANSIT PROJECT.

WARNER CENTER AERIAL PEOPLE MOVER
ALTERNATES A, B & C FIGURE 19



VICINITY MAP
VALLEY CIRCLE EXTENSION OPTION

FIGURE 20

cfo023ex.dgn

San Fernando Valley East-West Rail Transit Project

SP Burbank Branch Alignment Pre-Preliminary Engineering Study

1.0 INTRODUCTION

The Southern Pacific Burbank Branch alignment review is one of two alternative corridors presently being evaluated by the Los Angeles County Metropolitan Transportation Authority (MTA) in its program to extend County-wide rail service into the residential and employment centers of the San Fernando Valley.

The Valley is presently served by buses and Metrolink commuter rail traveling at-grade and sharing the streets with private and commercial vehicles. Reliable, and high capacity service can only be brought about by rail transit operating within its own dedicated right-of-way. This study plan extends high capacity rapid rail transit from the Red Line station in North Hollywood. The line runs westward through the Valley along the Southern Pacific Burbank Branch right-of-way to a terminal station near Topanga Canyon Boulevard.

Engineering Management Consultant's study scope is to explore three pre-preliminary alternative designs ranging from strict compliance with the EIR to a minimum cost solution that responds to the economics of building stations and guideways in a dedicated right-of-way relatively free of underground utilities. Nevertheless alternatives are to promote the environmental spirit of EIR, and other goals sought by the Valley communities.

Where the alignment is not in a city street, but rather within the MTA's own right-of-way, the cost between bored tunnels and cut and cover converges, and shallower, and less costly stations may be used. Additional underground passenger station cost reduction solutions were proposed in August of 1993 by the RCC-EMC-Flour Daniel, Inc. joint value engineering team. These included narrowing the station by arranging the vertical circulation elements to the platform in a single row, incorporating the temporary ground support system into the final structure, and raising the underground mechanical and electrical equipment spaces as close to the ground surface as possible. Each of these solutions is especially appropriate to the Valley environment.

Two and one-half miles of aerial guideway were used for the EIR alternate and are

retained in this study by Alternate A. This was to maintain cross-street vehicular traffic and pedestrian access to the Sepulveda Basin Park facilities and other community movements across opposite sides of the rail alignment. Aerial guideway is more costly than at-grade or low rise retained fill guideway. For Alternate B, aerial guideways are used only for the four station sites, and are therefore reduced in total length to about one mile. These aerial structures are replaced by at-grade and retained fill in conjunction with pedestrian overpasses and vehicular and pedestrian underpasses. Care is nevertheless taken to stay above the flood levels of the park basin.

1.1 Baseline Alternatives

Alternate A

Alternate A contains approximately 8 miles of deep bored tunnels, 2-1/2 miles of aerial guideway, 1-1/2 miles of at-grade, 1/2 mile of retained cut, six Modular subway stations, and four aerial stations. The construction method for the Alternate A cut and cover station is shown on Figure 2. This is the Modular Station developed during the design phase of Red Line Segment 3. This station was designed for use with twin bore tunnels interfacing with the ancillary modules specifically proportioned to accommodate tunnel construction. Of the six Alternate A cut and cover stations, four have a crossover module and one has a tail track module. The report drawing set shows only three crossovers at underground stations, but the costs have been estimated for the recommended operations criteria shown on Figure 21.

The aerial stations used to estimate the cost of Alternates A, B, and C are shown in Figures 3, 4, and 5. They are both side and center platform stations, and use a combination of precast and cast-in-place concrete to optimize both speed of erection and seismic stability. Two side platform stations built on retained embankments were also investigated as options and are shown in the report drawing set. Structural steel station and guideway options were also studied and discussed later as they relate to seismic resistance. See Figures 23, 24, 25, 27, and 28. Due to potential liquefaction of the underlying geology along the construction route, stations on embankments will require detailed geotechnical investigation before such potential cost savings can be considered.

The guideways for Alternate A are shown in Figure 6. The aerial guideway between stations and across the Los Angeles River are also the same for all three alternatives. For Alternate A the total length of aerial guideway is the same as proposed by the EIR. For Alternate B, the total length has been reduced to a minimum by increasing the guideway length at-grade and on retained embankment.

Deep bore tunnels are used for all the underground guideways between the Modular

cut and cover stations used in Alternate A. Open-cut, cut and cover, and retained fill guideway solutions are used only in the transition between underground, at-grade, and aerial construction.

Alternate A-2

This is the EIR solution modified by using shallow lower cost open air subway stations potentially suitable everywhere accept the station constructed under Victory Boulevard near Topanga Canyon Boulevard. See comparative Figure 7. These open air stations have an escalator rise of 32 feet from the platform to the ground surface. By comparison, the escalator rise at North Hollywood Station is 40 feet from the mezzanine to the surface. The value engineering recommendations are applied in the open air stations.

Alternate B

Alternate B has approximately 2-1/2 miles of deep bored tunnels, 4-1/2 miles of retained cut guideways, 3-1/2 miles of at-grade guideways, 1 mile of cut and cover guideways, 1 mile of aerial guideway, six cut and cover stations, and four aerial stations. Alternate B is characterized by its use of five center platform open air subway stations that are open over the 450 foot platforms for a length of 550 feet. These are shown in Figure 8 and by the rendering immediately following.

Only the main mechanical and electrical ancillary spaces are covered. This openness reduces the ventilation and blast relief spaces required, and the total ancillary requirements for a station reduces by about 30 percent. These station are less expensive due to this, and because of their shallow depth of rails that are about 35 feet below the surface rather than the 46 foot depth required for the Modular Stations. As an Option 2 to this alternate, the initial cost deferral of postponing construction of Woodley, White Oak and Tampa stations is included. See Figures 8, 9, 10, and 11.

The sixth cut and cover station is at Topanga Avenue and is side platform as shown in Figure 12. Its top of rails is about 30 feet below the surface of Victory Boulevard and all facilities including ancillary spaces are on a single shallow level that provides 8 feet of cover over the roof slab.

The guideways associated with the Alternate B stations are shown in Figure 13. Reduced costs are sought by replacing deep bored tunnels with open retained cut, and by cut and cover, with the top of rails as shallow as possible. Since the alignment is close to the Los Angles River, the storm drains are large and deep with inverts averaging about 18 feet below the surface. This has caused the top of rails for the open retained cut guideway to average 30 feet below the ground surface. The

rendering of this condition is shown on Figure 11. At this depth, open cut is still less costly than bored tunnels, but some of this advantage is lost by the cut and cover, and utility support required at thirteen streets crossing the alignment.

The 2-1/2 miles of aerial in Alternate A is reduced to 1 mile in Alternate B, and replaced by at-grade and low retained embankment guideways that are less costly than aerial even with the additional facilities required for sound barriers, pedestrians and street traffic overpassing and underpassing the rail alignment. If the community dividing wall aspect of grade separated at-grade, or low retained embankment guideways can be mitigated, the noise and visual impact on the surrounding community is less than for aerial with its trackways 22 feet above the streets. See Subsection 4.2, *Noise and Vibration.*

Alternate C

Alternate C is the same as Alternate B except the Fulton-Burbank subway station is roofed over in accord with state legislation and the guideway through the Sepulveda Basin returns to aerial between Woodley and Balboa Stations. As an Option 2, the initial cost deferral of postponing Woodley, White Oak and Tampa Stations is included in this alternate. See Figures 14 and 15.

The guideways presently assumed for Alternate C are shown on Figure 15 and cut and cover was used to replace the open retained cut between Fulton-Burbank Station and the aerial guideway section to the west. These cut and cover sections have the same advantage as bored tunnels in preserving the ground surface right-of-way for future Metro, public or joint development use.

1.2 Optional Alignments

Oxnard Street Alignment Option

The Oxnard Street Alignment Option continues up Lankershim Boulevard as it leaves the North Hollywood Station. See Figure 16. It then turns west on Oxnard Street where it proceeds under the city streets to where it reconnects with the present EIR SP Branch alignment in the vicinity of Woodman Avenue. This alignment would be bored tunnels with stations similar to that shown in Figure 17, with a circulation mezzanine added to allow tunnel entrance access from the right-of-way adjacent to the street.

This alignment avoids a wide curve leaving North Hollywood station that is complicated by the 726 foot tail track structure extending northward from the end of the station platform module. The Oxnard Street alignment would allow for an additional subway station during the initial six mile phased length that has been

disallowed by state legislation on the present alignment.

The Oxnard Street alignment option allows contracting the heavy construction of the twin bore tunnels and two station shells prior to the entrances, appurtenances, finish and equipment. This would restore the street and city traffic in front of businesses at its earliest possible date. This also affords the designers the opportunity of economically optimizing individual components using high-tech solutions. Drawings are minimized, shop and field problems are reduced, and the installation of equipment is simplified.

Chatsworth Extension Option

Chatsworth Extension Option extends the EIR alignment an additional 5 miles by turning north along Canoga Avenue to the Metrolink station at Chatsworth. The Topanga subway station would be omitted, but two additional aerial and one additional at-grade station would be added. Although not included as a part of this project, people mover systems or bus shuttles could serve Warner Center and the Valley Circle Extension discussed below. See Figures 18 and 19.

Valley Circle Extension Option

Valley Circle Extension Option extends the EIR alignment an additional 3 miles by turning south on Topanga Canyon Boulevard and then west along the north edge of the Ventura Freeway. One additional subway station, and two additional aerial stations would be added. Although not included as a part of this project, a people mover system or bus shuttle to the north could be provided to serve the Chatsworth Metrolink station as well as points in between. See Figure 20.

Postponing lower patronage stations is a solution that would add early express rail service to the present Valley street bus system. The aerial facility at the proposed Woodley Station site, and the subway facilities at White Oak and Tampa Station sites are possible candidates, and options for Alternates B and C estimate these cost deferrals. Aerial and open retained cut subway guideways could be constructed through these sites, and side platform stations installed in the future with little interruption to revenue service during the work. With guideways installed, about 80 percent of the final station construction would be deferred. Express buses could use the parking lots of the postponed stations for service between the rail stations.

An additional option, in conjunction with the initial 6 mile phased construction length is to provide express bus service for the final 8 miles that would operate along Victory Boulevard, Oxnard Street, and Topham Street adjacent to the SP Burbank right-of-way. Future subway station parking sites would be used as MTA park and ride facilities.

Deferring low patronage stations is another solution to adding earlier express rail service to the present street bus system. The aerial facility at the proposed Woodley Station site, and the subway facilities at White Oak and Tampa Station sites all have low initial patronage projections. Aerial and open retained cut subway guideways with trackways centered 14 feet apart could be constructed through these sites, with side platform stations installed in the future with little interruption to revenue service during their construction. With only the through guideways installed, about 80 percent of the final station construction costs would be deferred to the future. Buses could use the parking lots of the deferred stations to provide service between the rail stations.

1.3 Alignment Geology and Ground Contamination

Aspects of the alignment favorable to a potential for cost effective design are the low ground water table level, the stable alluvial geology, and the absence of existing major adjacent structures in the proximity of the proposed constructed facilities. No major underpinning will be required resulting from tunneling or excavation.

The detailed results of the site geotechnical and contamination investigations are summarized in Subsections 4.3 and 4.4. Exploration included 14 new test borings and 6 monitoring wells between 71 and 86 feet deep along the 14 mile alignment. No natural underground hydrocarbons were detected. This has reduced to a minimum the likelihood of encountering methane or hydrogen sulfide gases, asphalt, tar, or free oil during the construction of the subway or open trench solutions. Historically ground water elevations were higher than current levels. Present levels are only partially attributed to seasonal fluctuations. Future levels are mostly dependant on future ground water extraction and recharging patterns.

Based on the geotechnical investigation, and the design and construction experience under similar geology, subsurface conditions along most of the western and eastern tunnel segments are favorable for conventional soft ground tunneling techniques using mechanical excavation methods with a shield similar to those used in the current tunnel construction along the Metro Red Line Segments 1 and 2.

Conditions in both the western and eastern segments indicate that cut and cover excavation of proposed stations and guideways can be accomplished at a relatively high rate using mechanical excavation methods with readily available equipment and conventional shoring provisions. Potential liquefiable layers and pockets will induce additional lateral pressures and settlement. These have been successfully encountered on other Red Line segments and economically favor the more shallow construction solutions used in Alternates A-2, B, and C.

Eight sites were reviewed as having a potential for environmental contamination

impact to the tunnelling of twin bore guideways. Two additional contingency sites were also assumed to have both soil and groundwater contamination. The opinion of costs associated with mitigation of this contamination is given in Subsection 4.5. These costs are not directly applicable to the costed alternates, but are revised in the cost section to account for construction techniques different from the tunnelling methods assumed. It is presently understood that the Regional Water Quality Control Board has agreed that MTA needs only to be concerned with contaminated waste that is produced during construction activities. They will not be responsible for remediation of the remaining soil and groundwater in the vicinity of the MTA owned Southern Pacific right-of-way.

1.4 Seismic Safety Issues

Fundamental engineering precautions are needed to construct the civil-structural works in the deep alluvial geology of the seismic prone San Fernando Valley. Here, the physical laws of nature must be allowed to govern and lead to solutions that are understandable and satisfying to both the designers and lay public as being technically correct. The most challenging aspect of this is to formulate a design criteria that provides earthquake resistance that is consistent for all parts of the project, appropriate to the desired performance of the system, and yet economically attainable.

The philosophy of the criteria presently applied is for rail operations to continue after an earthquake that is likely to occur during the 100 year service life of the system, and that public safety be maintained even in an earthquake of a highly unlikely magnitude during the same period.

The structural form and materials used for the constructed facilities dramatically affect their seismic resistance. People are generally more safe in the middle of a parking lot or an open field, because the geological continuum underlying the ground surface seldom fails or faults near the surface. At-grade transportation facilities are therefore most safe.

Next in terms of public safety is underground construction, and especially bored or mined tunnels, because they cause a minimum of discontinuity to the surrounding geological continuum. Of lesser safety are cut and cover structures with backfill on the roof of the structure, that due to the discontinuity caused by excavation adds to the overburden weight to be supported by the building. Nevertheless, the majority of the forces applied to an underground structure are static loads that never change to any significant degree, or are one time construction forces that will never reoccur. Additionally, due to the geotechnical uncertainties, underground construction is usually continuous and heavily reinforced structural concrete designed to withstand

a wide range of potential loading conditions that substantially raise their resistance to collapse well beyond that of above ground structures.

Above ground structures are the most susceptible to failures leading to possible collapse and loss of life. Because they are so numerous, many and sometimes complex configurations and construction techniques have been developed to minimize materials, speed construction, and reduce costs. The codes governing these designs cannot cover all the details and techniques employed, but are only a consensus of how ordinary buildings should be designed. Special rail transportation structures require in depth investigation and careful peer review to accompany all such undertakings. These difficulties in design should be recognized because it is still impossible to completely define the maximum earthquake force with confidence, and to blindly follow the governing codes can lead to failures similar to those resulting from the recent Northridge earthquake.

1.5 Summary

Rail transportation facilities are characterized by their need to be true to the principals of heavy construction. This is especially true below the ground surface where geotechnical and construction forces far exceed all other load considerations that can occur as a result of their use in service except for earthquakes. Underground architecture therefore demonstrates the inherent aesthetic force of the correct structural solution. This is true in a similar but less rigid fashion for aerial guideways that are essentially bridges over the cross streets and ground surface.

Passenger stations allow for aesthetic innovation, but even here the function throughout the industry is well established and the most direct and obvious path for the patron to board and disembark from the trains has most often proven to be the economic solution. This format is now common to airline waiting lounges that are pleasingly aesthetic, but nevertheless, simple direct pathways from the security gates to the aircraft jetway. Airport operated concessions tend to mask this simplicity, but the airlines themselves function with a minimum of wasted space. In the valley environment the foremost concern must be for the public safety, the protection of property and the avoidance of social disruption.

Paramount to public safety and welfare is resistance to earthquakes. Rail transportation structures are rare, and experience is limited compared to highway bridges and ordinary buildings. Few aspects of current codes are directly applicable to rail structure design. Any structural system is no better than its weakest link, and therefore rigorous technical analysis of the highest precision currently available to the engineering profession is the best course to pursue to insure all system elements are equally safe. This strategy is above state-of-the-art, because state-of-the-art is current acceptable practice, rather than what is technically pre-eminent.

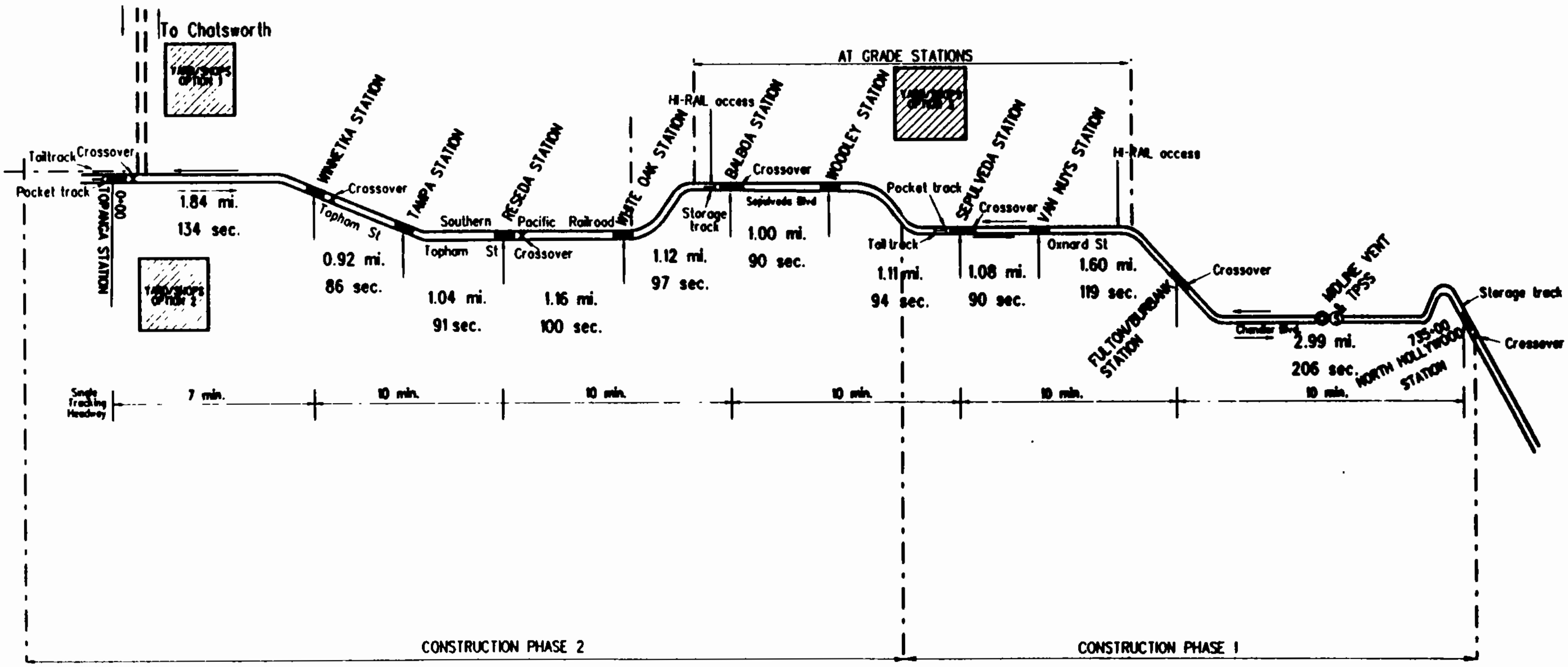
Both above and below ground, designers are sometimes tempted to pursue the allusion of slenderness and weightlessness to promote visual aesthetics, rather than the stability and solidarity suitable to construction in a seismically dynamic deep alluvial geology characteristic of the Valley. This has not been an aesthetic objective for the aerial guideways used to estimate costs for the SP Burbank Branch alternatives. All use double piers as shown in the Figures 22 through 27 appended to this introduction. Seismic bridge codes recognize the improved earthquake resistance of double piers over single piers by assigning a reduction of about 25 percent to the lateral forces to be resisted, but this variation is small compared to the capabilities the designer has to economically increase the resistance of double piers against collapse.

Structural steel is more ductile and resistant to collapse than reinforced concrete. The structural steel guideway shown in Figures 23 and 24 have been studied as an optional aerial structure for this reason. Bad structural detailing of either reinforced concrete or structural steel creates a weak link that can result in premature failure of a structure. Nevertheless, structural steel detailing is far easier to model and analyze at a finite element level than the decreet reinforcing bar elements within a concrete structure.

The aerial station shown in Figure 26 is structural concrete, while the station in Figure 27 is structural steel. The scales are not the same, and in profile their visual height and extent are about the same. The obvious visual difference is that steel requires fewer columns. Nevertheless, the steel structure can have its service life extended more cost effectively, and can more easily be made seismic resistant.

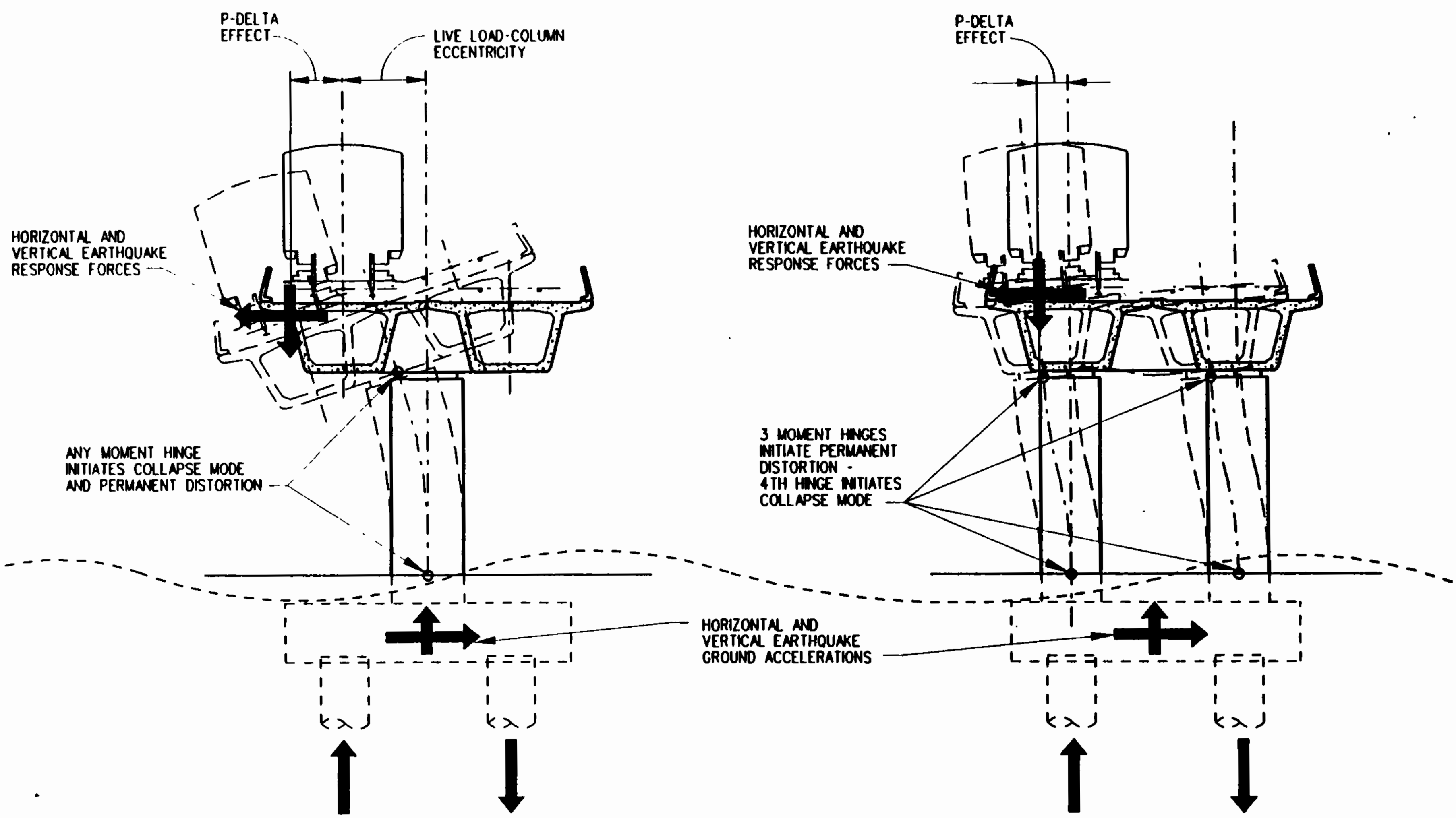
Recent design solutions using seismic isolation devices provide an economic design alternative for the seismic design of new bridges and the retrofit of existing bridges. Rather than resisting the large forces generated by earthquakes, seismic isolation decouples the bridge deck from the ground motion to reduce earthquake forces by factors of 5 to 10. This is equivalent to reducing a Richter Magnitude 8 event to one in the 5 to 6 range.

Seismic isolation of bridges between the girders and their pier cap supports has been used on several hundred bridges in the United States and around the world. It has been accomplished by Caltrans as a retrofit measure on several bridges and more are planned, especially for steel bridges. Due to the limited experience, the technical complexity of isolators, and Metro's continuously welded running rails, these should only be permitted if it can be demonstrated they can be economically built and maintained by rigorous precision analysis accompanied by physical testing. The investigation should include three dimensional dynamic and non-linear structural analyses. Further refinement would make the response of the structural system contiguous with a large geotechnical island of the alluvial soil continuum above the basement formation.



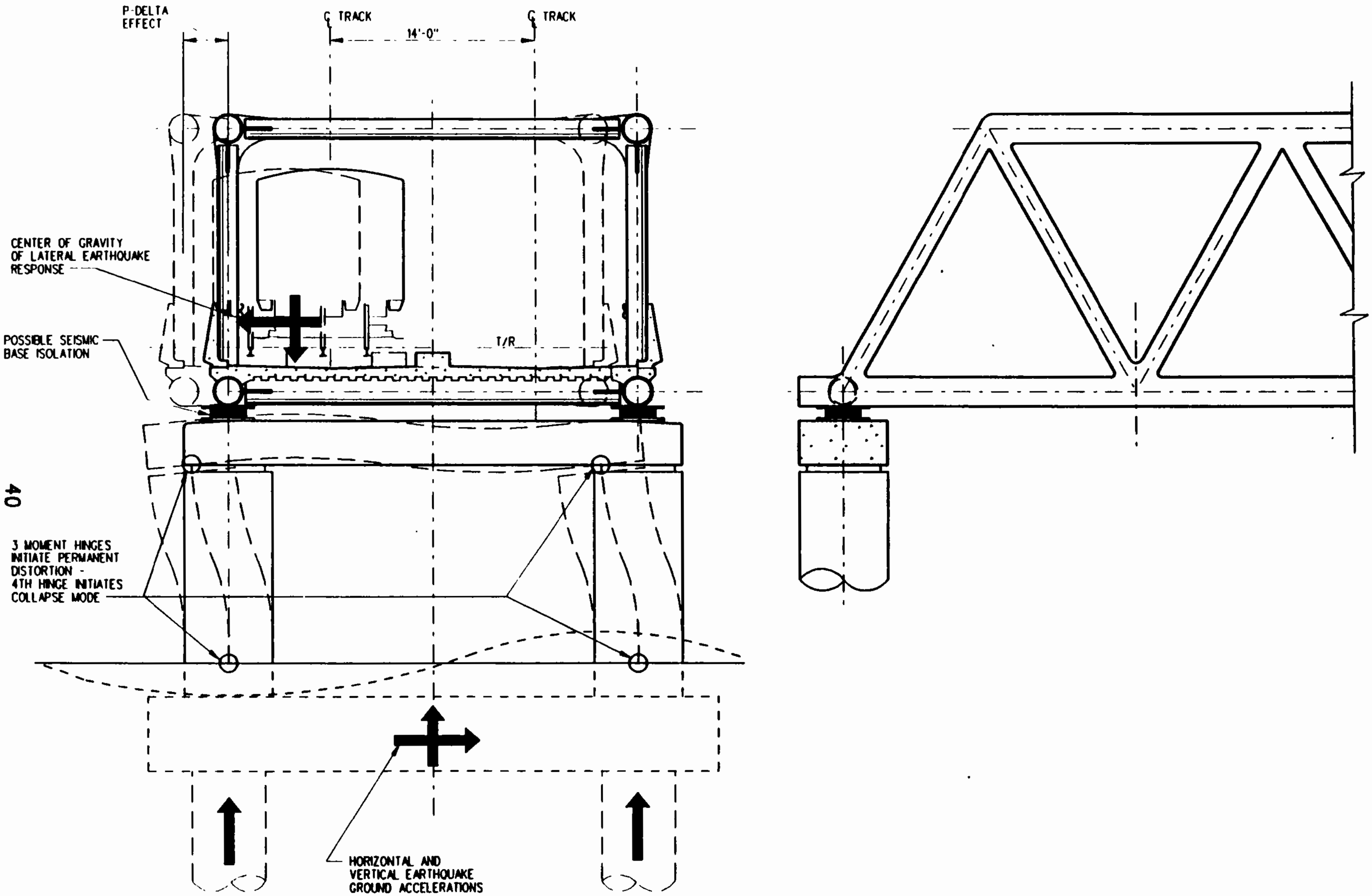
ALTERNATE A
OPERATIONS PLAN

FIGURE 21



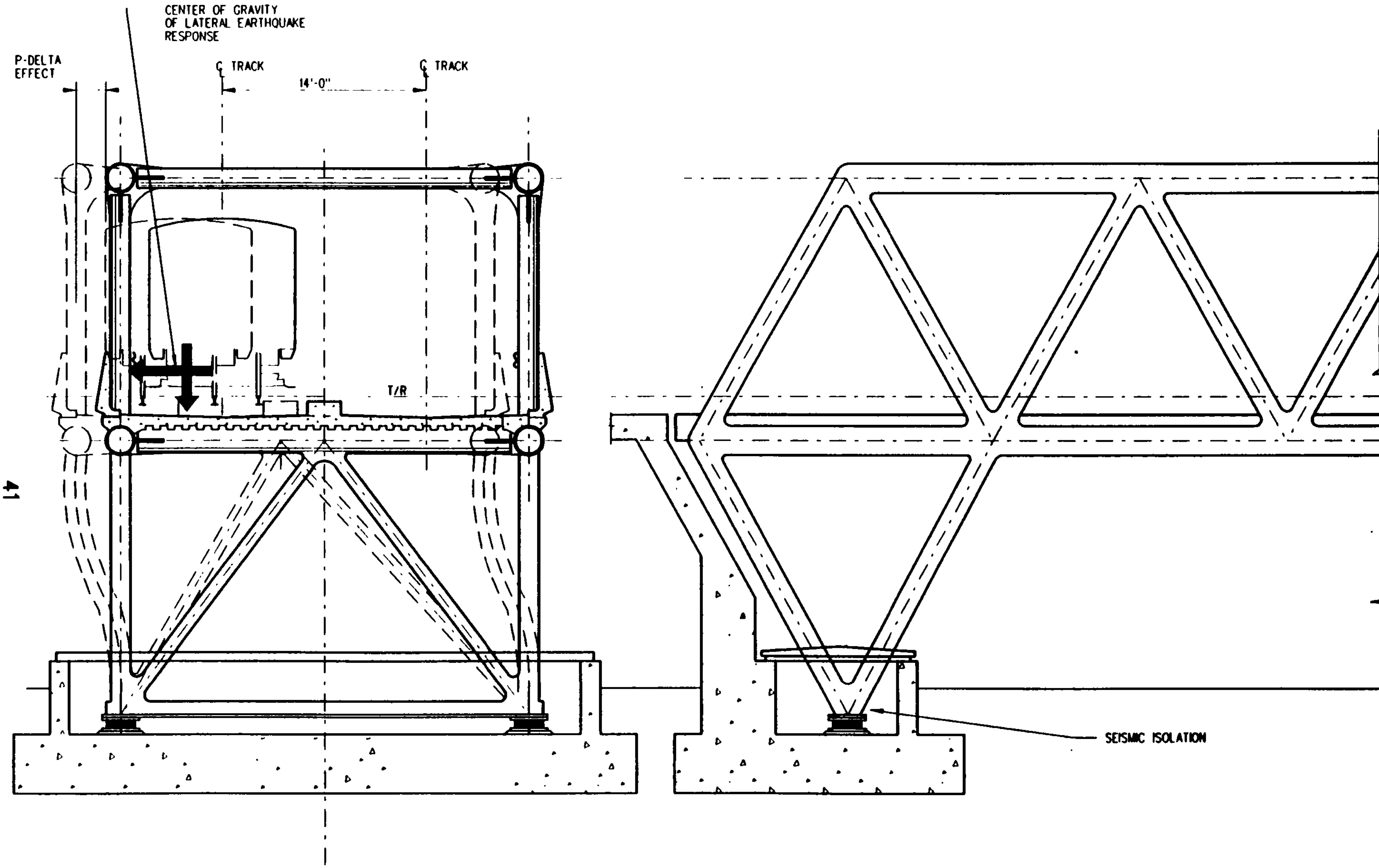
SEISMIC RESPONSE OF AERIAL GUIDEWAYS

FIGURE 22



SEISMIC RESPONSE OF AERIAL GUIDEWAYS

FIGURE 23



SEISMIC RESPONSE OF AERIAL GUIDEWAYS

FIGURE 24

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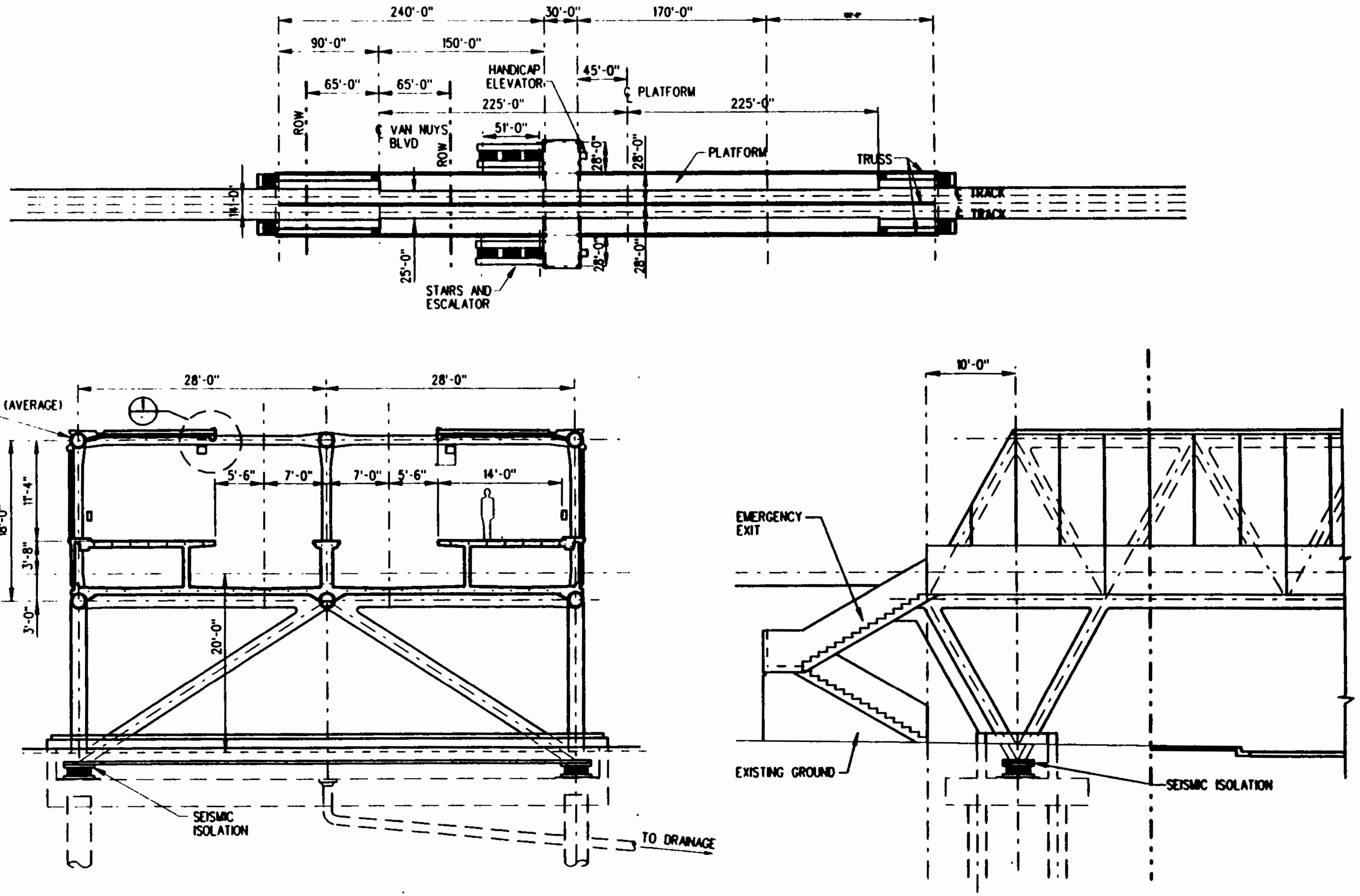
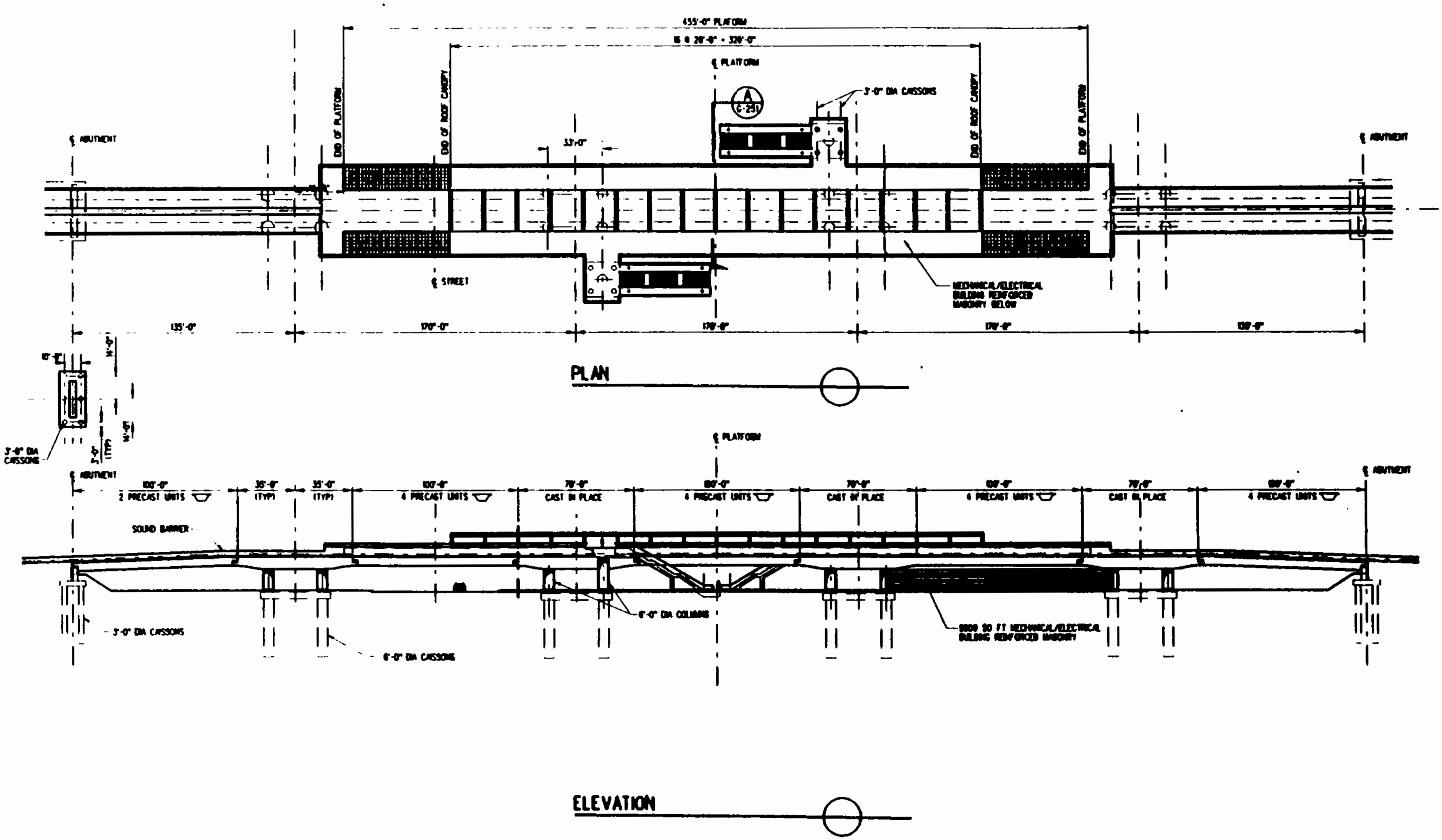


ALTERNATES A , B & C
STRUCTURAL STEEL STATION

FIGURE 25



CANOGA EXTENSION
SHERMAN WAY AERIAL STATION

FIGURE 26

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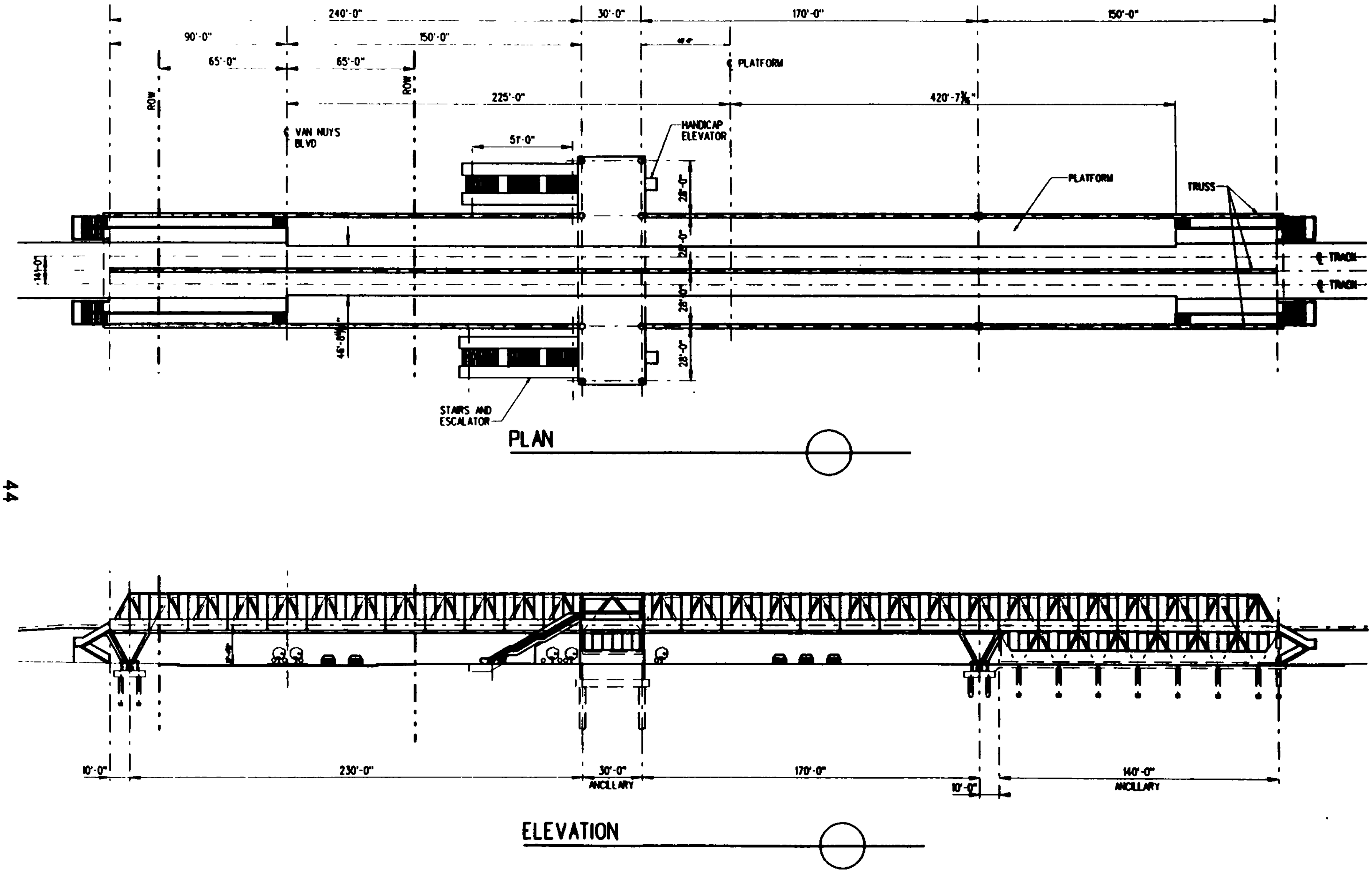
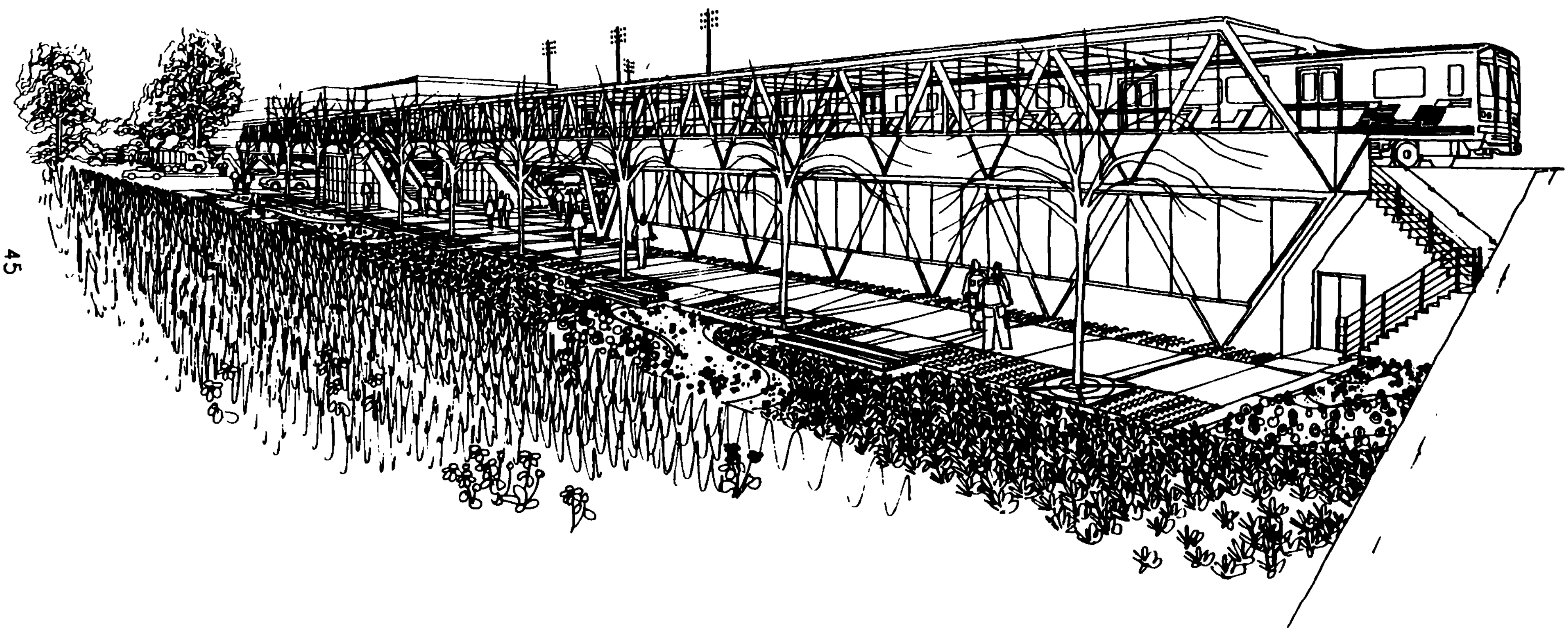
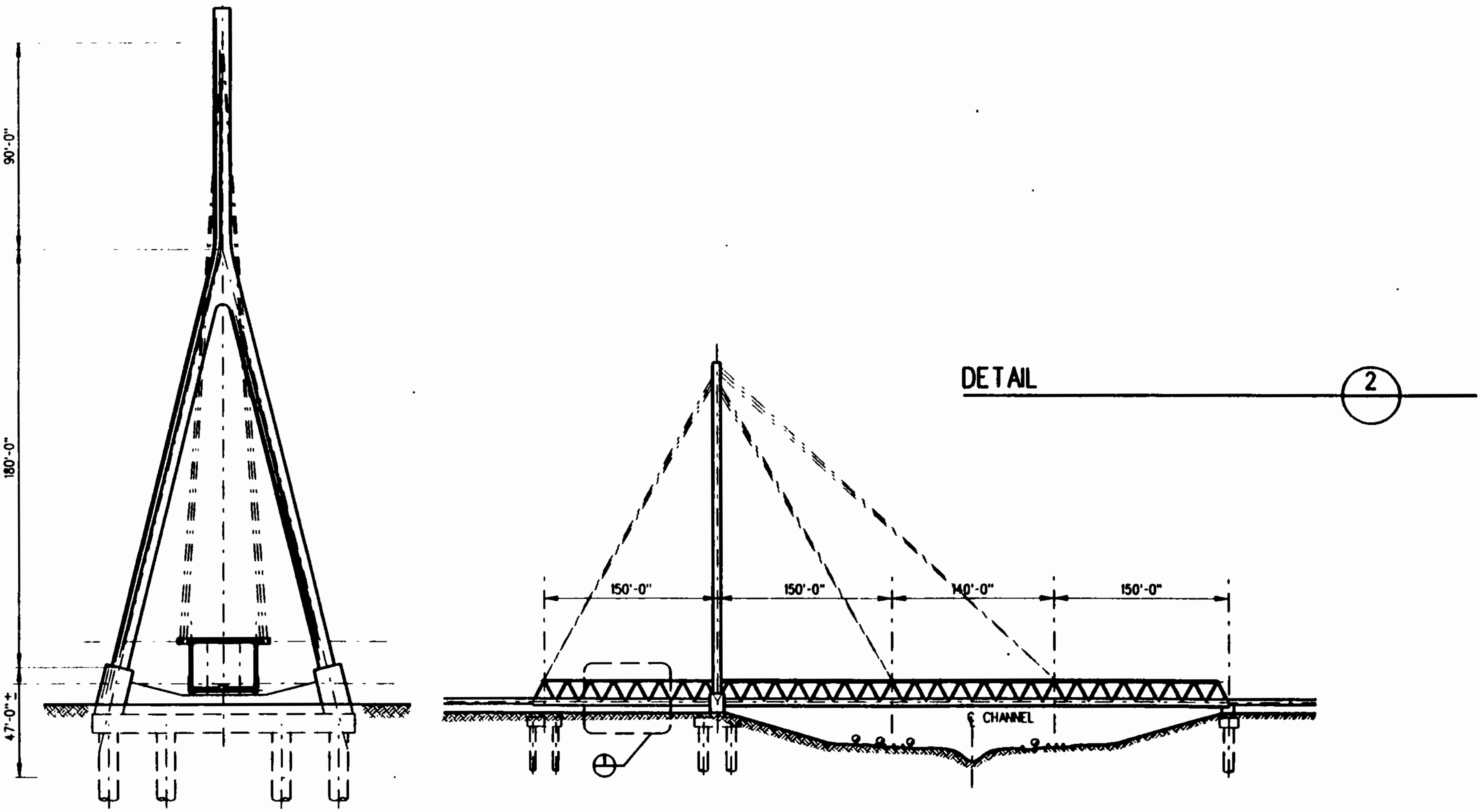


VAN NUYS AERIAL STATION
SIDE PLATFORM STATION

FIGURE 27



VIEW OF TYPICAL AERIAL STATION (STATION SHOWN AT BALBOA) FIGURE 28



LOS ANGELES RIVER CROSSING
CABLE ASSISTED TRUSS OPTION

FIGURE 29

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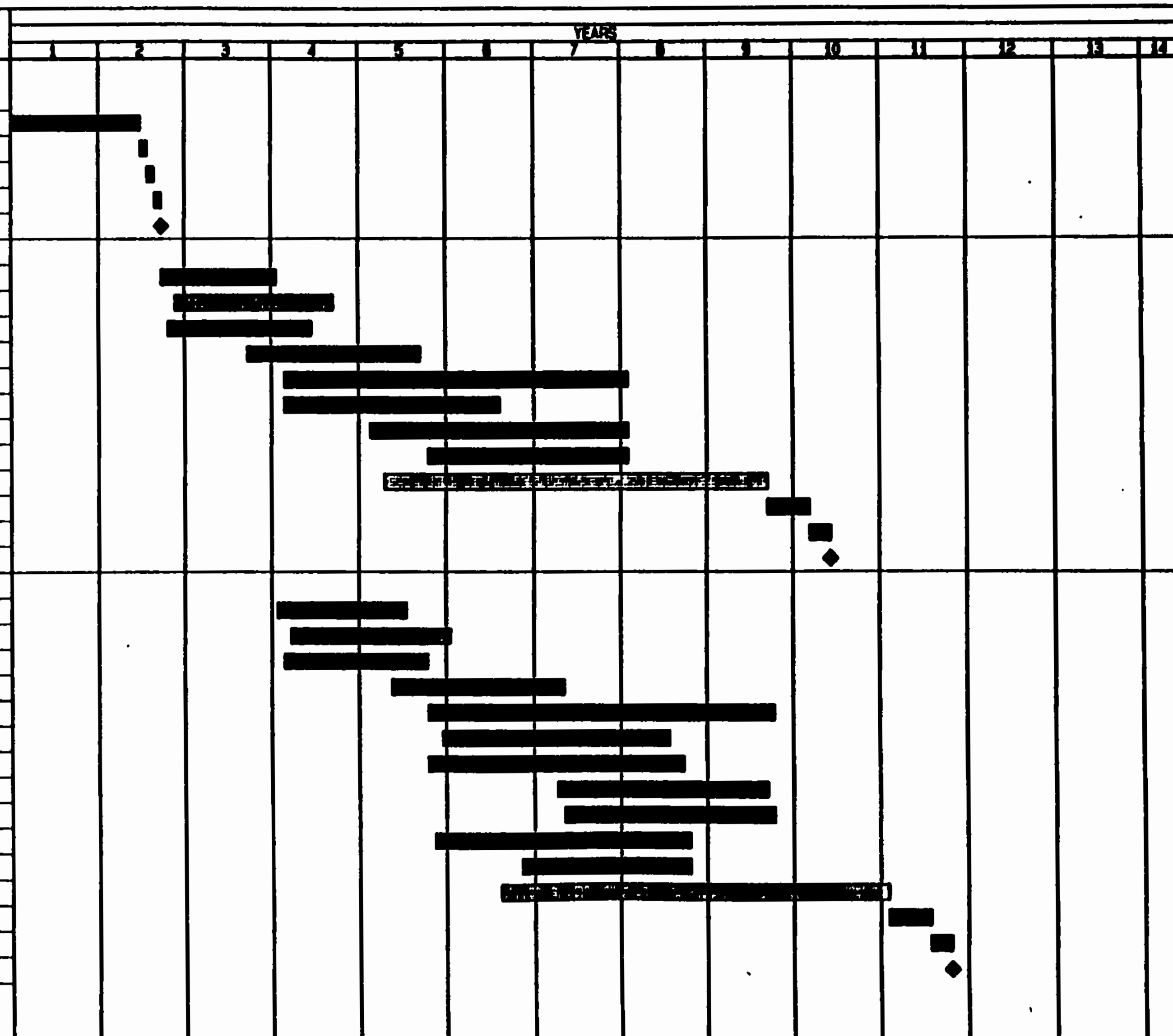
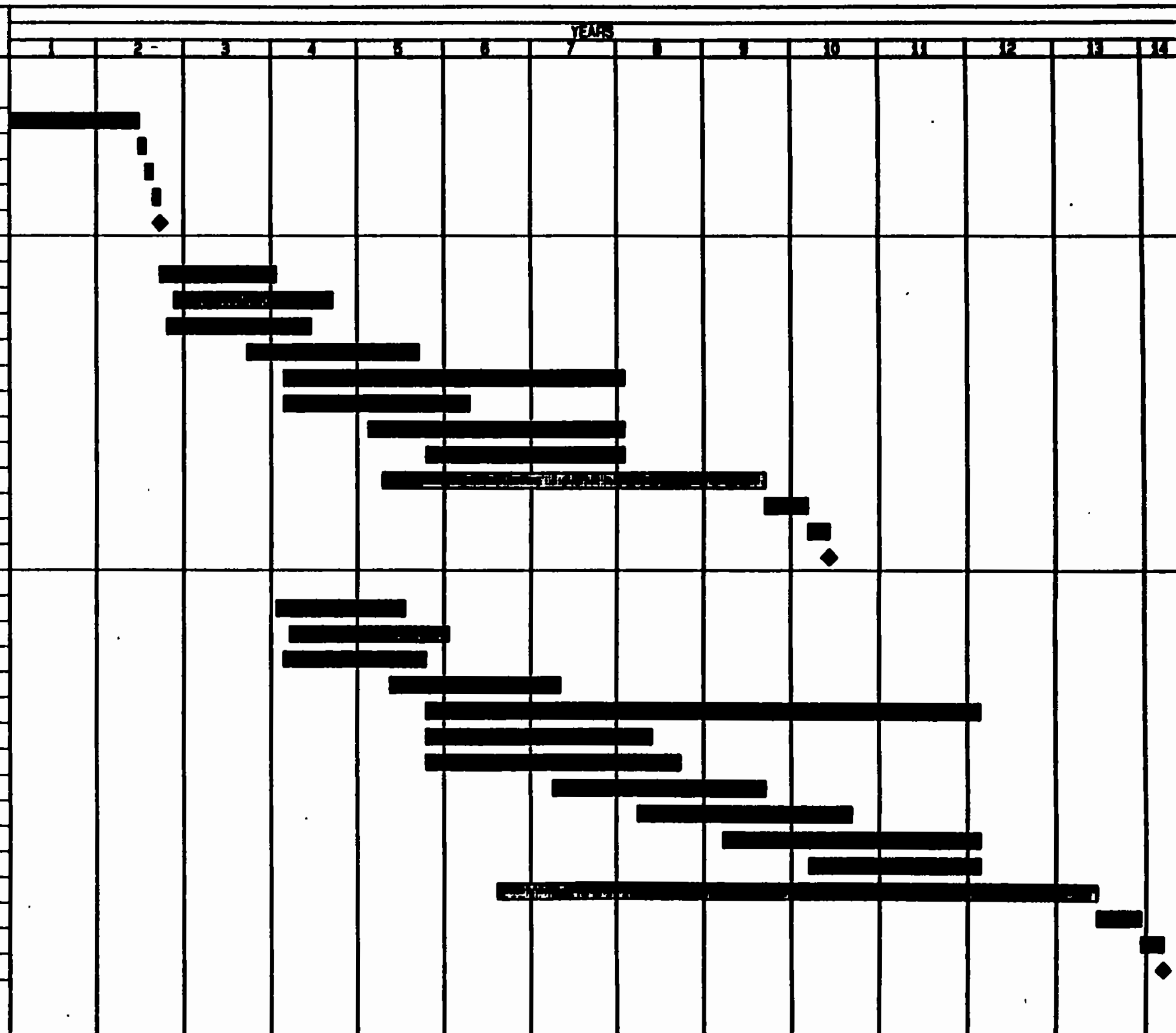
ACTIVITY DESCRIPTION	MNTH
Preliminary Engineering	18
RCC Review	1
RCC Board Approval	1
MTA Board Approval	1
Project Adoption	0
PHASE I	
Facilities Design	16
Systems Design	22
Real Estate Aquisition	20
Bid / Award Cycle	24
Phase I Facilities Construction	48
CXX10 NH Stn to Midline Vent (inc. vent struct)	30
CXX20 Midline Vent to sta 515+ (inc. LAVC stn)	36
CXX30 Sta 515+ to SDF sta 420+ (inc VN & SP st)	28
Systems Fabrication, Installation and Testing	54
Systems Integration Testing	6
Pre-Revenue Operations	3
Revenue Operations Date	0
PHASE II	
Facilities Design	18
Systems Design	22
Real Estate Acquisition	20
Bid / Award Cycle	24
Facilities Construction	49
CXX40 Sta 420+ to LARB (inc. WDLY & BALB stns)	32
CXX50 Sta 295+ to sta 210+ (inc. RES & WO stns)	36
CXX60 Sta 210+ to sta 152+ (inc. TMP stn & crv)	30
CXX70 Sta 152+ to sta 107+ (inc. WNTK stn)	30
CXX80 Sta 107+ to sta 6+ (inc. TO stn, TT & crv	36
CXX90 Yard Lead	24
Systems Fabrication, Installation and Testing	60
Systems Integration Testing	6
Pre-Revenue Operations	3
Revenue Operations Date	0



Los Angeles County MTA
San Fernando Valley E-W Rail Transit
Engineering Management Consultant

Alternate A Bored Tunnels
Phase II from both ends

ACTIVITY DESCRIPTION	MNTH
Preliminary Engineering	18
RCC Review	1
RCC Board Approval	1
MTA Board Approval	1
Project Adoption	0
PHASE I	
Facilities Design	16
Systems Design	22
Real Estate Aquisition	20
Bid / Award Cycle	24
Phase I Facilities Construction	48
CXX10 NH Stn to Midline Vent (inc. vent struct)	30
CXX20 Midline Vent to sta 515+ (inc. LAVC stn)	36
CXX30 Sta 515+ to SDF sta 420+ (inc VN & SP st)	28
Systems Fabrication, Installation and Testing	54
Systems Integration Testing	6
Pre-Revenue Operations	3
Revenue Operations Date	0
PHASE II	
Facilities Design	18
Systems Design	22
Real Estate Acquisition	20
Bid / Award Cycle	18
Facilities Construction	78
CXX40 Sta 420+ to LARB (inc. WDLY & BALB stns)	32
CXX50 Sta 295+ to sta 210+ (inc. RES & WO stns)	36
CXX60 Sta 210+ to sta 152+ (inc. TMP stn & crv)	30
CXX70 Sta 152+ to sta 107+ (inc. WNTK stn)	30
CXX80 Sta 107+ to sta 6+ (inc. TO stn, TT & crv	36
CXX90 Yard Lead	24
Systems Fabrication, Installation and Testing	84
Systems Integration Testing	6
Pre-Revenue Operations	3
Revenue Operations Date	0



(c) Primavera Systems, Inc.

Los Angeles County MTA
San Fernando Valley E-W Rail Transit
Engineering Management Consultant

Alternate A Bored Tunnels
Phase II from east to west

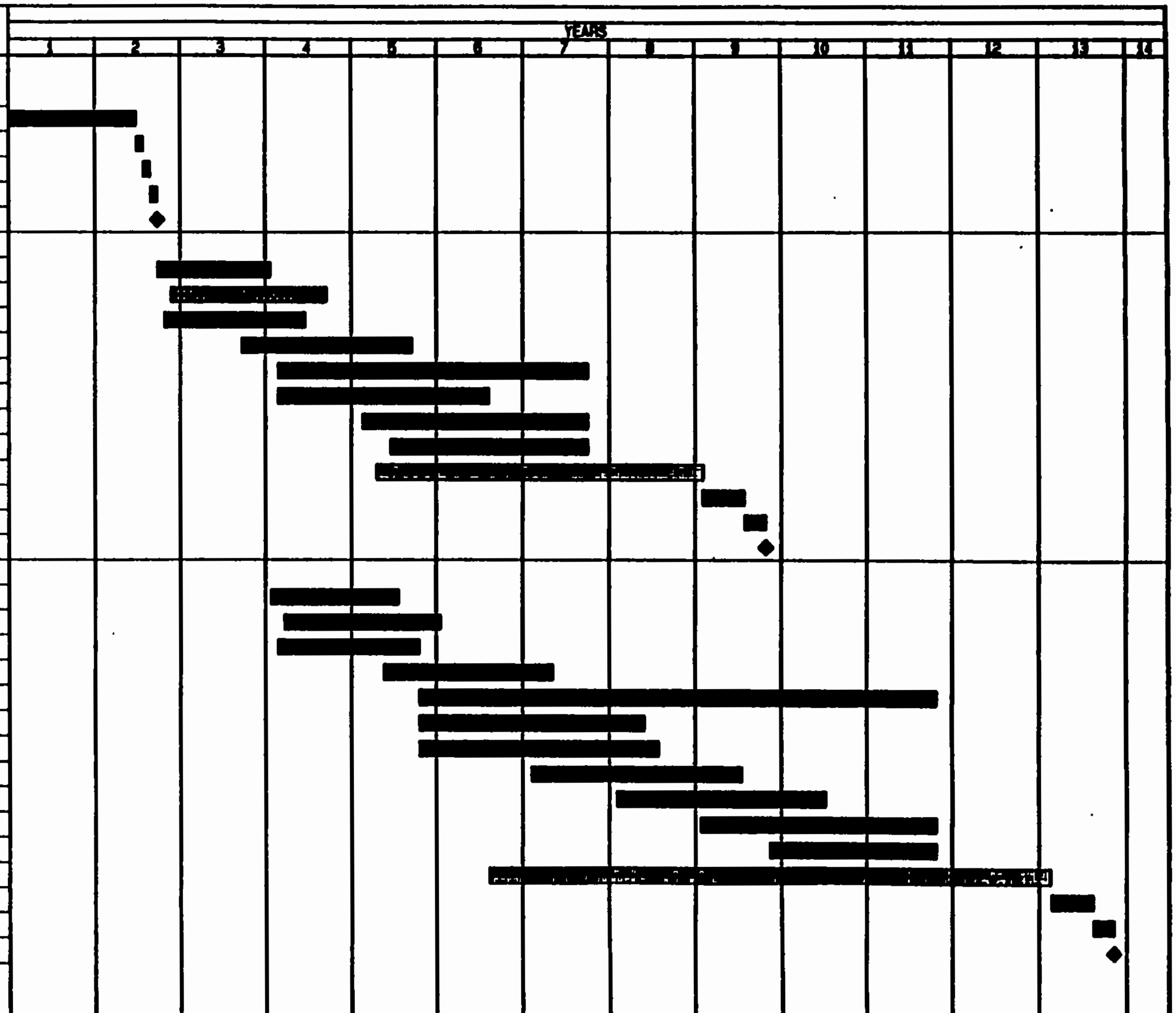
ACTIVITY DESCRIPTION	MNTH
Preliminary Engineering	18
RCC Review	1
RCC Board Approval	1
MTA Board Approval	1
Project Adoption	0
PHASE I	
Facilities Design	18
Systems Design	22
Real Estate Aquisition	20
Bid / Award Cycle	24
Phase I Facilities Construction	44
CXX10 NH Stn to Midline Vent (inc. vent struct)	30
CXX20 Midline Vent to sta 515+ (inc. LAVC stn)	32
CXX30 Sta 515+ to SOF sta 420+ (inc VN & SP st)	28
Systems Fabrication, Installation and Testing	46
Systems Integration Testing	6
Pre-Revenue Operations	3
Revenue Operations Date	0
PHASE II	
Facilities Design	18
Systems Design	22
Real Estate Acquisition	20
Bid / Award Cycle	24
Facilities Construction	47
CXX40 Sta 420+ to LARB (inc. WDLY & BALB stns)	32
CXX50 Sta 295+ to sta 210+ (inc. RES & WO stns)	34
CXX60 Sta 210+ to sta 152+ (inc. TMP stn & crv)	30
CXX70 Sta 152+ to sta 107+ (inc. WNTK stn)	30
CXX80 Sta 107+ to sta 6+ (inc. TO stn, TT & crv	34
CXX90 Yard Lead	24
Systems Fabrication, Installation and Testing	53
Systems Integration Testing	6
Pre-Revenue Operations	3
Revenue Operations Date	0

YEARS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Los Angeles County MTA
San Fernando Valley E-W Rail Transit
Engineering Management Consultant

Alternate B Retained Fill
Phase II from both ends

ACTIVITY DESCRIPTION	MNTH
Preliminary Engineering	18
RCC Review	1
RCC Board Approval	1
MTA Board Approval	1
Project Adoption	0
PHASE I	
Facilities Design	16
Systems Design	22
Real Estate Aquisition	20
Bid / Award Cycle	24
Phase I Facilities Construction	44
CXX10 NH Stn to Midline Vent (inc. vent struct)	30
CXX20 Midline Vent to sta 515+ (inc. LAVC stn)	32
CXX30 Sta 515+ to SOF sta 420+ (inc VN & SP st)	28
Systems Fabrication, Installation and Testing	46
Systems Integration Testing	6
Pre-Revenue Operations	3
Revenue Operations Date	0
PHASE II	
Facilities Design	18
Systems Design	22
Real Estate Acquisition	20
Bid / Award Cycle	24
Facilities Construction	74
CXX40 Sta 420+ to LARB (inc. WDLY & BALB stns)	32
CXX50 Sta 295+ to sta 210+ (inc. RES & WO stns)	34
CXX60 Sta 210+ to sta 152+ (inc. TMP stn & crv)	30
CXX70 Sta 152+ to sta 107+ (inc. WNTK stn)	30
CXX80 Sta 107+ to sta 6+ (inc. TO stn, TT & crv	34
CXX90 Yard Lead	24
Systems Fabrication, Installation and Testing	80
Systems Integration Testing	6
Pre-Revenue Operations	3
Revenue Operations Date	0



Los Angeles County MTA
San Fernando Valley E-W Rail Transit
Engineering Management Consultant

Alternate B Retained Cut
Phase II east to west

Cost as well as continuing serviceability is a primary concern in providing the maximum county-wide service in the shortest reasonable time frame. The construction schedules for the base case Alternates A and B are given at the end of this Introduction. Postponing low patronage stations assists in attaining this cost deferral and shortening the construction schedule leading to revenue operations. Side platform passenger stations are the most convenient for this purpose and allow future construction of the station with the least disruption to continuing rail operations.

All the guideways shown in Figure 13 can be used and economically built around with a minimum of service disruption. The aerial station shown in Figure 3 can easily be built around and existing aerial guideway. The open air side platform station shown in Figure 8, would be appropriate in conjunction with open retained cut guideways. The economics of current heavy construction favors openness and simplicity of configuration, and the minimizing of the number of different components and details even with increased element and component size and weight.

Structural detailing should be as independent of the architectural, mechanical and electrical arrangements as practical. This affords the structural designers the opportunity of optimizing a few individual components using high-tech solutions whose economy is realized by the confidence obtained from the design precision. Drawings are minimized, shop and field problems are reduced, and the installation of equipment is simplified. The design solutions presented by this report promote these cost economies.

The Los Angeles River crossing in the Sepulveda Recreation Area is designed the same as a concrete aerial structure with three piers in the river channel. The piers for the existing bridge to be removed have been continually marred by graffiti vandalism. The US Corps of Engineers is presently removing channel paving that has also been historically disfigured and are returning the basin to its original ground vegetation. A bridge that has no piers, as shown in Figure 29, would be a visual asset to the Sepulveda area. This guideway bridge is similar to the $10.5 million Federal grant design given to UC San Diego to construct a seismic resistant highway bridge.

2.0 BACKGROUND

The Los Angeles County Metropolitan Transportation Authority's San Fernando Valley East-West Rail Transit Project is planned to serve the residential and employment centers of the Valley as part of the expansion of public transit service County-wide. An environmental impact report was completed in August 1992 for two alternative fixed guideway routes. A final alignment has yet to be made.

The SP Burbank Branch alignment, studied here, parallels the Ventura Freeway an average of one mile to the north. Starting from the North Hollywood Station, the alignment extends the Metro Red Line 14 miles west to Topanga Canyon Boulevard in the vicinity of Warner Center. Over 12 miles of the alignment are in the former Southern Pacific right-of-way.

The EMC study scope is to prepare a pre-preliminary engineering design for a predominantly below-grade rapid rail transit extension placing emphasis on cost, schedule, constructability, value engineering, right-of-way takes, utility relocation needs, and station location, parking, handicap access, and life safety. The scope requires sufficient detail to estimate up to three predominantly below-grade design concepts, one of which will use the Modular Station from Red Line Segment 3 in conjunction with deep bore tunnels, and reflects full compliance with the EIR. Other construction solutions to be identified include cut-and-cover or open-air subways that could further reduce costs while maintaining the environmental sensitivity of a below-grade alignment.

Specific to the study scope is defining the provisions necessary to insure that future Red Line extension can be accommodated in existing MTA contracts at Universal City and the North Hollywood stations for both the SP Burbank Branch or Ventura Freeway alternative alignments.

The study recognizes two construction contract phases. The first 6 mile length starts at North Hollywood station and ends just east of the San Diego Freeway. This phase has a single underground subway station and two aerial stations. At a later date, an 8 mile length extends the line to Topanga Canyon Boulevard, and has five additional underground stations and two additional aerial stations.

A possible third phase results from investigation yard location options that would extend the line an additional 5 miles north to the vicinity of the present Chatsworth Metrolink Station. This phase would have up to three additional stations, but the Topanga subway station would become an aerial station at Sherman Way in

conjunction with the yard. An additional aerial and an at-grade station would be added to the north. This extension is aerial and at-grade is to be costed by a rough order of magnitude estimate in the study.

The total 18 miles of alignment in and around the former Southern Pacific right-of-way totals about 200 acres of land to be managed by MTA. Station entrances, parking facilities, and other sensitive locations such as cross streets, where the alignment is aerial, are only a small percentage of this acreage, but will become MTA's "front yard." Costs associated with design, construction and management of these areas, and public concerns already raised, are addressed by this study. For 2-1/2 miles the aerial guideway with two aerial stations occurs within the Sepulveda Basin Recreation Area. Costs resulting from mitigation measures needed to achieve compatibility with existing and proposed public use of this open space are investigated.

The recent Northridge Earthquake has emphasized the importance of applying diligent technical engineering judgement on behalf of the public safety and social welfare. Rail infrastructure has repeatedly shown itself to be the economic life-line within earthquake prone areas. Its general seismic design criteria for continuous operations is substantially above that of other forms of ground transportation. In addition, high capacity rapid rail operating within its own dedicated right-of-way is the logical preference where large numbers of passengers must be transported into and out of an otherwise temporarily isolated community.

MTA's rail projects are carrying out the public mandate to construct a county-wide rail transit system expressed by the voters in the 1980 Proposition A. The east-west rail transit line through the San Fernando Valley forms an important part of this system. The project will provide an alternative mode of transportation and help control the growth of traffic congestion in the Valley. Approximately 95 percent of the regions residents presently rely on the automobile for transportation.

A major component of the City of Los Angeles General Plan is the concept of creating centers. Centers are defined as areas with a high intensity of varied urban activities such as residential, commercial, cultural, recreational, and industrial uses. Rail transit is essential to economically interconnecting these centers. Designated major centers that the project may serve include Warner Center, Reseda, Van Nuys, North Hollywood and Universal City. Other major activity centers that would be served include Los Angeles Valley College and Los Angeles Pierce College.

The estimated completion of all studies is mid 1994, and is to be followed by a final route alignment decision. Depending on funding, the first phase of this project will proceed 6 miles up to the San Diego Freeway. The second 8 mile phase of the

project between the San Diego Freeway and Warner Center would be constructed at a later date. The timing of the project is dependent upon funding availability, but would not commence until after the year 2000.

2.1 State Legislation

State legislation (SB 211) controls the mode of the Metro construction in some areas along the alignment. The legislated mandate dictates only a subway system that is covered and below grade can be constructed from Hazeltine Avenue to the Hollywood Freeway. For one mile each side of Tujunga Wash, only deep bore subway technology with the top of the tunnel 25 feet below the ground surface may be used. Fulton-Burbank Station must have its main entrance located on the Los Angeles Valley college campus or on that portion of the existing railroad right-of-way located north of the Burbank Boulevard and east of Fulton Avenue.

2.2 Sepulveda Basin Recreation Area

Uppermost in the investigation has been the environmental assets and risks associated with the right-of-way through the Sepulveda Basin Recreation Area. The issues most frequently raised by the Valley community are noise and vibration, depreciation of property values, safety and security, traffic congestion, parking loss in neighborhoods, construction impacts, and the proximity impacts of visual and privacy intrusion.

Mitigation recommendations for the Sepulveda Basin Recreation Area include:

- Undulate bicycle paths both horizontally and vertically to add further interest. Provide safe pull-off areas.
- Continue the landscape pattern of clustered shade trees that engage the bicycle path.
- Provide safe passage across alignment right-of-way and into park areas.
- Encourage special gathering areas with high visual quality to create a hierarchy of places along the park edge.

2.3 Community Impacts and Response

There is understandable resistance to the visibility of major parking lots in the vicinity of residential neighborhoods, and concern over parking spill over into the neighborhood areas that would require residential on-street permit parking in some station areas. Nevertheless, sufficient right-of-way is available to accommodate more than an adequate number of parking spaces at MTA station sites, and solutions to mitigate these problems are more properly a matter of advanced

planning and economy than they are environmental.

As presently planned, the SP Burbank Branch solution connects directly with a number of major population centers. These will grow as a result of the new rail infrastructure. Numerous commercial and industrial leaseholds presently exist along the right-of-way. Some of these could be displaced by MTA construction along the alignment. Some limited displacement outside the presently acquired right-of-way will also occur for some of the alignment solutions investigated, but no homes or rental residences are anticipated to be displaced.

The alignment traverses next to 4 schools and within a quarter of a mile of 16 schools. Noise impacts are not significant as all guideways are below grade in most of these vicinities. Others would have appropriate screening as identified in the EIR. Schools near planned transit stations would experience increased traffic congestion in the morning rush hours when school and transit uses coincide. Stations would provide positive benefit to schools for students and faculty that would use the transit system.

Concern has been voiced that increased transit usage will result in increased demand on Los Angeles Police Department services to support transit security personnel, and on Los Angeles Fire Department fire fighting and paramedic units. It is anticipated that traffic concentrations around station areas may lengthen emergency response times during peak hours.

Homeowners, business and elected officials have responded to planning by addressing life cycle cost as well as environmental issues. These responses include:

- Lower cost cut-and-cover construction methods should be considered as an option to deep bore tunnels.
- Underground stations could utilize inexpensive at-grade facilities to minimize costs.
- The soil removed during construction of the underground portions of the alignment could be used to construct berms for the grade separated surface portions .

2.4 Previous Environmental Review and Alternatives Analysis

The San Fernando Valley is approximately 252 square miles in area. The Valley is separated from the Los Angeles coastal basin by the Santa Monica Mountains. The area is located northwest of downtown Los Angeles. Local topography is relatively flat with the majority of the surface area sloping toward the Los Angeles River which cuts diagonally through the Valley from the northwest to the southeast.

Access to the Valley from the Los Angeles basin through the Santa Monica Mountains is by way of the Sepulveda Pass, Cahuenga Pass and through the various other canyon routes.

The major surface drainage feature is the Los Angeles River. The 100-year floodplain limits of the river are mostly contained within a lined concrete channel. The exception to this is the Sepulveda Basin where the river course and surrounding floodplain have been left in or are being returned to a natural state. The northern limit of the Basin is adjacent to the rail alignment at Victory Boulevard and has experienced serious surface flooding in recent times. The Basin is owned and operated by the U.S. Army Corps of Engineers as a major drainage facility. Much of the basin has been leased to the city of Los Angeles for parks and recreation purposes and to Caltrans for the San Diego and Ventura Freeways. There are a number of smaller water courses that bisect the Valley from north-south and outfall into the river. These water courses are typically conveyed in lined channels or pipes. Due to their north-south orientation, these water courses present various engineering problems for the construction of the proposed project.

The San Fernando Valley is a highly developed urban environment. Nonetheless, the Valley does support significant plant and animal life in the Sepulveda Basin and in other sensitive natural areas located at the perimeter of the Valley in the foothills and mountains.

The Valley has experienced significant growth and development in the last decade. In particular there have been large increases in single family development in the Chatsworth-Porter Ranch area, and large increases in the number of apartments in the North Hollywood and Van Nuys areas. Commercial and office development along Ventura Boulevard has expanded significantly, along with the continued build-out of the Universal City and Warner Center office areas.

Recent growth trends have transformed the Valley from a bedroom community into a more self-sufficient subregion that has achieved an overall balance between populations and employment opportunities. A majority of the jobs in the Valley are occupied by workers that live within the Valley. Currently 40 percent of the working residents hold jobs outside of the Valley.

The most significant commute destination outside of the Valley is the large area in the in the Los Angeles basin west of downtown. This includes Mid-Wilshire, Culver City, Beverly Hills, West Los Angles, and Hollywood. Other major destinations are downtown Los Angeles, Glendale, South Gate/East Los Angeles, and West Los Angles/Santa Monica.

During peak travel hours and occasionally during non-peak periods the freeway system serving the Valley experiences extreme congestion. High travel demand on these facilities results in average speeds below 35 miles per hour.

The issues most frequently raised by the Valley community are noise and vibration, depreciation of property values, safety and security, traffic congestion, parking loss in neighborhoods, construction impacts, and the proximity impacts of visual and privacy intrusion.

For a full discussion of environmental impacts and mitigation measures, please refer to the following reports:

- ***San Fernando Valley East-West Rail Transit Project Draft Environmental Report***, November 1989.

- ***San Fernando Valley East-West Rail Transit Project Final Environmental Impact Report***, February 1990.

3.0 OPERATING PLAN AND ALIGNMENT DESCRIPTIONS

The alignment starts at the Red Line Segment 3 North Hollywood terminus station at Lankershim Boulevard and proceeds in its own dedicated grade separated guideway west along the SP right-of-way past suburban, commercial and light industrial real estate. Often city streets carry vehicular traffic on one or both sides of the right-of-way. City streets cross the SP right-of-way about twice each mile and construction methods that provide grade separation are provided for all occurrences that were chosen by the EIR.

3.1 Phase 1 Construction Contracts

Construction is to be in two phases. Phase 1 begins at the Red Line Segment 3 North Hollywood Station with twin deep bore tunnels continuing for 4.1 miles and then becomes at-grade and aerial for 1.8 miles. Phase 1 terminates with temporary at-grade storage tracks near the east side of the San Diego Freeway.

Major structures for this phase are one subway station, two aerial stations, and a midline subway vent facility that also incorporates a traction power substation located near Chandler and Laurel Canyon Boulevards. Only one underground passenger station occurs within this section near Los Angeles Valley College.

3.2 Phase 2 Construction Contracts

Phase 2 continues west along a route immediately north of Sepulveda Basin Recreation Area with at-grade and aerial guideway for about 2.5 miles to a point just west of the Los Angeles River Crossing. It then becomes deep bore subway for its final 5.5 miles to a cut and cover subway station at Canoga Park where it terminates in Victory Boulevard in the vicinity of Owensmouth Avenue and the Warner Center. This phase has 5 subway stations and 2 aerial stations.

While in the Sepulveda Basin Recreation Area, the guideway crosses the Los Angeles River. The guideway returns to underground near White Oak Avenue and Oxnard Street. The last 5 miles of the alignment is in a 100-feet right-of-way width. This segment has five passenger stations and fixed guideways below the surface of the ground through the Reseda, Tarzana and Encino areas.

The totally grade separated segment of the alignment travels through and adjacent to the Sepulveda Area for 2-1/2 miles as at-grade and aerial guideway, and is served by 2 aerial stations. These areas through which the rail transit project passes are planned for future recreational use and would be made available, outside of station areas, for use by the U.S. Army Corps of Engineers, and the L.A. Recreation and Parks Department planned recreation uses.

At six locations, the normally 100-foot wide SP right-of-way widens to over 200 feet for a distance of over a third of a mile. This provides the Burbank Branch alignment with 200 acres to use and share with Valley communities. This land can be made available on a priority basis for street widening, neighborhood park and recreation projects, and school, police and fire institutions. Secondly the land can be offered for commercial joint development with appropriate environmental and architectural restrictions.

3.3 OPERATING REQUIREMENTS

The purpose of this subsection is to define the operating requirements specifically associated with the first two phases of the San Fernando Valley East/West Rail Transit Project (Burbank Branch) of the Los Angeles Metro Red Line from North Hollywood to Sepulveda. It describes the plan for operating a service on the line, associated fleet requirements and facilities & equipment requirements for supporting operations and maintenance.The following is addressed:

- Service Plan
- Fleet Size
- Sherman Way Yard
- Special Trackwork

3.3.1 Service Plan

With Red Line Segments 1, 2 & 3, the East Side Extension and East\West - SP Burbank Branch operational, peak-period service will be operated along three routes:

- Topanga Canyon to Union Station [8-minute service w/4-car trains]
- North Hollywood to Whittier/Atlantic [8-minute service w/4-car trains]

- Pico/San Vicente to Whittier/Atlantic [4-minute service w/4-car trains]

This is consistent with recent planning documents for the Metro Red Line Side Extension FEIS/FEIR and the 30-Year Capital Plan. An assumption of 4-minute service across the Valley is a reasonable consideration for the ultimate needs of the Valley, but is not anticipated for sometime beyond the planning horizon of the current project.

3.3.2 Fleet Size

The total fleet size required for the service levels defined above is 216 vehicles. for the same service levels operated prior to construction of the East/West Valley extension (i.e., the service to Union Station originates at North Hollywood rather than from Topanga Canyon), 188 vehicles are required. Thus the increment of vehicles required by the Valley extension is 28. See Table 2.

3.3.3 Sherman Way Yard

For efficient operations, the yard to be constructed at the Sherman Way site must be capable of accommodating half of the trains that would be required for the Topanga Canyon-to-Union Station service. With 72 cars required for this service, the Sherman Way yard needs to be capable of accommodating 36 cars. this is lower than the estimated long term, requirement for the 4-minute Valley service.

The low initial storage requirements also reduces the size and function of the associated shop facility. The building layout shown on Figure 26 provides for operator reporting, and emergency maintenance and car cleaning activities. A between-the-rails pit (5-1/2 feet deep and 20 feet in length) located at least 175 feet from the end of a yard track will be required for emergency repairs.

3.3.4 Special Trackwork

The revision in planned service levels for the East/West Valley extension does not alter the locations for crossovers identified on Figure 18. These locations are based on the 10-minute single tracking headway criterion established in the design criteria. The locations are:

- East of Fulton/ Burbank Station
- East of Sepulveda Station
- East of Balboa Station
- East of Reseda Station

- East of Winnetka Station

- East of Topanga Canyon Station

3.3.5 Pocket Tracks

- West of North Hollywood - Entry and exit from pocket track will be provided at both ends and onto both main line tracks.

- West of Sepulveda Station - Entry and exit from pocket track shall be provided at both ends and onto both main line tracks.

- West of Topanga Canyon Station - With an 8 minute level of planned service, there will be no requirement for a center pocket track as the two platforms will be sufficient to meet turn backs within the schedule nor will it be required for off line storage due to the proximity of the yard at Sherman Way.

3.3.6 Storage Tracks

Storage tracks of a minimum length of 150' shall be provided at the following locations in order to allow effective off line storage of rail borne and hi-rail maintenance equipment:

- Immediately West of North Hollywood Station

- West of Balboa Station

3.3.7 Tail Tracks

Tail tracks shall be provided at the following locations and be capable of accommodating a train of maximum consist length and shall provide sufficient safe braking distance for trains to enter the station platform at 25 mph in ATO mode:

- North Hollywood Station

- West of Sepulveda Station

- West of Topanga Canyon Station - The requirements for 2 tail tracks west of the station are part of a fundamental requirement for storage and failure management strategy. However, in view of the planned proximity and accessibility of the Sherman Way Yard to the station, these pre-requisites will be adequately catered by the Yard that will provide storage requirements and supply replacements for bad order consists.

Therefore, the length of the tailtracks will be reduced from 726 feet to 350 feet which is the Safe Braking Distance required to allow trains to enter the platform at 25 miles per hour.

3.3.8 Terminal Station Transportation Facilities

Each transportation terminal shall have as a minimum but not limited to the following transportation facilities:

Permanent Terminal

- Train Operating Supervisor's (TOS) booth at platform level at the departure end of the station.

- TOS's booth to be preferably glass enclosed (in tunnel sections) with train radio, telephone communications and public address system, a writing surface and secure file drawers. Air conditioning and heating will be provided where applicable.

- Toilets for Train Operator's use shall be provided at track or platform level.

Temporary Terminal

- Train Operating Supervisor's (TOS) booth (of the removable type) at the departure end of station.

- TOS's booth to be preferably glass enclosed (in tunnel sections) with train radio, telephone communications and public address system, a writing surface and secure file drawers. Air conditioning and heating will be provided where applicable.

- Toilets for Train Operator's use shall be provided at track or platform level.

3.3.9 Maintenance-of-Way (MOW) Access Requirements

Access for MOW activities and equipment shall as a minimum be provided as follows:

- Hi-rail maintenance vehicle set-on/set-off pad and gate located on the at-grade section east of Van Nuys and east of White Oaks stations.

- Storage track for rail borne equipment and hi-rail vehicle access at the yard site provided at the west end of the line.

- Access road/gate as appropriate at the storage track located west of the Balboa Station.

- Access to the tail tracks west of the Topanga Canyon Boulevard Station.

- MOW satellite building as follows:

  - Sepulveda area - provide temporary facilites

  - Topanga Canyon or Chatsworth area - provide permanent facilities

3.3.10 Yards and Shops

Three potential yard and shop sites which are being considered the East-West Valley Line are as follows:

SITE LOCATION	ESTIMATED ACRES	NOTES
Sepulveda (Phase I)	2.8	Temporary storage tracks just west of the San Diego Freeway in SP right-of-way within Sepulveda Basin
Topanga Canyon (Phase II, Option 1)	17.1	2 parcels at Canoga Boulevard, Van Owen Street, Sherman Way, and Wyandotte Street
Topanga Canyon (Phase II, Option 2)	8.7	Near Topanga Canyon Boulevard, Marilla Street, and Owensmouth Avenue

TABLE 1

Because of the initial service fleets are relatively small, only very light or emergency maintenance capability is necessary. Cars requiring scheduled or corrective maintenance can be sent to the existing Red Line shop for work and replacement cars can be sent to the initial Valley Line yard.

3.3.11 POTENTIAL YARD AND SHOP SITES:

A brief evaluation of each of the three potential East-West Valley yard and shop sites is as follows:

- Sepulveda Site (Phase I):

Taking 1.4 additional acres immediately west of the San Diego Freeway (approximately 50 feet in width by 1200 feet in length) for this 2.8 acre site plus the presence of the double track main line, accommodating the initial share of the fleet of cars will be possible. The future fleet share of cars will not be possible, but this scenario may not occur if the Phase II extension to Topanga Canyon is implemented in a timely manner.

- Topanga Canyon Site, Phase II:

Even though this site totals approximately 17.1 acres, it consists of two parcels separated by a street (one parcel at 13.9 acres and one at 3.2 acres). The double track main line also passes through both parcels. While the smaller parcel can be utilized for a satellite maintenance-of-way facility, the larger site will only accommodate the initial 36-car share of the fleet. To significantly increase the capacity of this yard requires physically joining the two sites together by raising the site to permit Sherman Way to pass under the yard.

- Topanga Canyon Site, Phase II, Chatsworth Extension Option:

At approximately 8.7 acres (290' in width by 1300' in length), this site can accommodate the initial 36-car fleet, and a small maintenance of way or shop facility.

Ideally, the yard and shop site should be rectangular in shape with the main line passing adjacent to one of the shorter ends of the site. The site length must be long enough to accommodate storage tracks plus leads, ladders, and connections to the shop. The site width must accommodate the required number of storage tracks, car wash and cleaning platform tracks, and the shop facility shown on Figure 30. The satellite maintenance-of-way facility can be located in a corner or other convenient position.

4.0 SELECTED CONSTRUCTION OPTIONS

The deep storm drains crossing the alignment resulted in deep bore tunnel technology being selected as the adopted solution. In spite of this, the favorably wide dedicated right-of-way characteristics are substantially different from the more centralized business districts of Los Angeles and warrant selective environmental approaches. Ownership of the Southern Pacific right-of-way is the major economic influence on the civil-structural facilities needed to support operations without negatively impacting the environment. It is these civil-structural facilities and the architectural amenities they provide that are the main controllable economic factors.

4.1 Project Visibility

Visual principals developed to guide appropriate solutions in the dense business centers of Los Angeles need reinvestigation in areas where transit approaches suburban neighborhood environments. The appearance of at-grade and aerial facilities are substantially different from the subway access solutions used in the major business districts. In addition, Metro's visibility at all passenger station entrances is more closely related to passenger safety, system security, and the avoidance of vandalism.

Within the former Southern Pacific right-of-way, station entrances will occur in a plaza setting for both subway and aerial facilities. This study recommends softening their presence with landscaping and terracing rather than placing ticketing equipment and security barriers below the surface where special surveillance is needed.

In a spacious right-of-way, there can be too much buffer landscaping. It is important that Metro's 12 foot high identification pylon and other recognizable entrance cues be legible from a distance and understood by potential users.

The location and design of aerial guideways will consider the view from the transit system itself. Patrons riding on the trains will have a view that is quite different from the view of a street-level pedestrian. As such, the guideway placement and sight lines from the trains will reflect a sensitivity to intrusion on private properties and adjacent buildings.

The aesthetically crafted amenities of visual shape, arrangement, proportion, rhythm, and texture are explored, but the project is too new and uncertain for these to have become a public concern among the Valley communities.

Historically, transportation architecture has created highly developed forms. Fresh ideas have mostly resulted from innovative building construction techniques and the new problems encountered by the geotechnical and environmental conditions.

The former Southern Pacific right-of-way is in a period of abandonment with resulting deterioration. Although, MTA is limited in what it can do without the resources of joint development with the surrounding Valley communities, its presence will help to reverse this trend.

The importance of spacious right-of-way in alleviating visual problems and the public acceptability of aerial structures has been recognized on other transit systems. For example, the San Francisco Bay Area Rapid Transit system featured this solution as an aesthetic amenity. This right-of-way also provides the contractor with the needed cost effective work space for construction.

For aerial stations and their ground level passenger entrances, columns, and abutments must be thoughtfully planned in number, location, appearance, and susceptibility to vandalism such as graffiti. Terracing in suitable places can be used to minimize column and abutment exposure. This is commonly done by Caltrans, but their slopes can sometimes be climbed since the grade separation criteria is less stringent than for rapid rail transit. Two current Caltrans reinforced berm retainment systems are studied for cost estimating purposes. The concrete crib is more graffiti resistant, but more labor intensive to install than the vertical precast wall or soil nailing solution. Many proprietary systems have been developed to stabilize slopes, and their use should weighed against developing a system that more directly meets the specific needs of the Metro alignment. Where exposure to graffiti is not avoidable, paint-resistant coatings will be applied.

Entrances for these stations occur where the Metro alignment right-of-way intersects the cross streets. Patrons should not have to confront imposing columns on their way to the stairs and escalators providing vertical circulation. At night, an unobstructed well lit space provides a feeling of visual security. The shape and size of columns are also important. It is instinctive not to suspect anyone to be hiding behind a round column, which like an already opened door, reduces the sense of impending surprise.

That a row of geometrically arranged columns changes visual effect with the perspective of the viewer has always been recognized and used by architects. Some of these effects are not readily understood by the lay person. For example, the phenomenon called constancy scaling demonstrates that the visual images entering the human eye are reconstructed by the brain and sometimes create unfavorable illusions. In this case, the image of a row of columns continuing into the distance appears to foreshorten tending to make them appear as a continuous

barrier wall. An obvious example of constancy scaling is the appearance of the spectators across a sports stadium. To the brain of the observer, they all register as the same size.

Five stations would be located in residential areas. Such stations would contribute light and glare for all the SP Burbank Branch alternatives. Station designs will incorporate elements that minimize or otherwise address light glare impacts.

4.2 Noise and Vibration

The ambient noise and vibration levels were measured along the SP Branch alignment in 1987. Noise ranged from 56 to 72 decibels, with an average of 62 decibels. A third of these included a low speed diesel train passby. With modern electric driven transit cars on continuous welded rails, noise is not apt to exceed previous diesel powered freight, with the exception of aerial guideways which have a 3 foot high sound protection barrier.

The detailed review of the impact assessment presented in the EIR, particularly the use of a recommended noise impact criteria, has not been adopted by the Federal Transportation Administration. This criteria is very conservative and usually results in more extensive mitigation measures. The EIR will be supplemented using either the existing FTA Noise Impact Criteria or APTA guidelines for maximum wayside noise levels from a single event rain passby. Based on the results of this analysis, the locations where mitigation is required and the extent of mitigation will be determined.

Measures to mitigate wayside passby noise will be wayside noise barriers constructed at the edge of the rail right-of-way. Mitigation measures for vibration will be the use of a ballast mat on concrete or on compacted soil. The SP Burbank Branch alternatives have potential for ground-borne vibration from crossover track facilities located in residential areas. Special treatment of track rail and track bed will be considered where these potential conditions occur.

The SP Burbank Branch Alignment is completely below the ground surface for most of its length. For selected Alternate A described in detail in Section 5.0, the subsurface guideways are deep bored tunnels or recovered with earth backfill after construction. Therefore no noise impacts are anticipated.

For Alternates B and C, open air guideways are sufficiently depressed or bermed to assist noise buffering. The following analysis describes the potential noise levels. The below grade analysis considers various depths below ground level for houses (receptors) located at the right-of-way boundary and setback 25 and 50 feet from the right-of-way. The trackwork is assumed to be direct fixation on

concrete with no ballast. The calculated wayside maximum noise level from a single event train passby is listed in Table 3. Train speed is assumed to be 55 miles per hour through this section. If speeds are lower, a speed correction adjustment table has been provided to modify the predicted wayside noise levels presented in Table 4.

Below Grade Passby Noise Levels - L_{MAX} (decibels)

Location of Top-of-Rail	At ROW	25' Setback from ROW	50' Setback from ROW
35' Below Grade	81	75	73
30' Below Grade	81	76	73
25' Below Grade	81	76	74
18' Below Grade	82	78	75
At Grade	93*	89*	86*

* Assumes no noise barriers 3 foot above top of rail

Table 3

Speed Reduction Adjustment - L_{MAX} (decibels)

50 mph	-1 dBA
45 mph	-3 dBA
40 mph	-4 dBA
35 mph	-6 dBA

Table 4

The aerial structure analysis considers receptors at two distances from the centerline of the trainway: 50 feet and 75 feet. This has assumed a noise barrier at the edge of the aerial structure that is 3 feet above the top-of-rail.

Aerial Structure Passby Noise Levels - L_{MAX} (decibels)

Location of Receiver From Centerline of Structure	Wayside Noise Level
50 feet	82
75 feet	79
150 feet	76

Table 5

The MTA systemwide criteria for maximum train passby noise levels at a residential building is 75 decibels. The criteria is modified to consider the existing ambient noise level of the effected community. The noise level of train passbys and the frequency of operations are used to determined the cumulative noise level with the transit system in operation over the time period appropriate to the land use effected. A 24-hour period would be used for residential areas. If the transit system noise levels do not exceed the ambient levels by more that 5 decibels than the noise impact is not considered generally significant and mitigation measures would not be considered.

The result is that only aerial and at-grade guideways exceed 75 decibels, and through residential areas both open-air and covered stations and guideways maintain this criteria. Numerous solutions are available to insure this does not occur even where aerial and at-grade guideways are used. Final analysis requires more field instrumentation, but in the meantime noise barriers are assumed to be needed for all aerial and at-grade guideways.

As a point of reference, the criterion for vibration impact used in studies for the EIR was 72 decibels. Our measurements indicate that perceptible ground-borne vibration generally occurs only in the areas of the San Fernando Valley where there is existing rail traffic. When existing ambient noise levels have not been measured a design criteria of 75 decibels for a single train passby may be used for residential land uses.

4.3 Site Geotechnical, Utilities, and Ground Seismicity

4.3.1 Geotechnical

This subsection summarizes the study, ***Geotechnical Investigation for Limited***

Preliminary Engineering Program, San Fernando Valley East-West Segment, Metro Red Line Project, December 1993, conducted by Earth Technology Corporation. Exploration included 14 new test borings and 6 monitoring wells between 71 and 86 feet deep along the 14 mile alignment. No natural underground hydrocarbons were detected. This has reduced to a minimum the likelihood of encountering methane or hydrogen sulfide gases, asphalt, tar, or free oil during the construction of the subway or open trench solutions. Historically ground water elevations were higher than current levels. This is partially attributed to seasonal fluctuations, but is more dependant on future ground water extraction and recharging patterns.

Predominant soil types includes Tujunga-Soboba, Hansford, and Yolo associations. These are generally alluvial in nature. From a seismic standpoint, a number of faults and geologic features have been identified in the Valley. These faults run in a northwest to southeast direction and are generally concentrated in the northern third of the Valley. New faults have been identified as a result of the recent Northridge earthquake.

Favorable aspects of the alignment that suggest a potential for cost effective design concepts are the low ground water level, the stable alluvial geology and the absence of existing major adjacent structures in the proximity of the proposed constructed works. No major underpinning will result from Metro tunneling or excavation.

The southern part of the San Fernando Valley is a geological depression filled with alluvial sediments and located in the Transverse Ranges physiographic province. The Valley is a faulted, synclinal trough. Exposed bedrock units in the adjacent Santa Monica Mountain areas are also folded and faulted. Bedrock units range in age and composition from pre-Tertiary crystalline basement of pre-Tertiary through Quaternary sediments and volcanic deposits. Alluvium has been deposited in the basin through erosion of bordering bedrock. Alluvial deposits in the eastern portion of the Valley consist predominantly of coarse granular materials derived from erosion of granitic and metamorphic basement rocks of the western San Gabriel Mountains and Verdugo Mountains. In the western portion, alluvial deposits are generally finer grained, having been derived primarily from sedimentary rocks in the Santa Monica Mountains.

Groundwater levels in the vicinity of the alignment are influenced by groundwater extraction for water supply. Historically, groundwater levels in the alignment area were shallower than those present today. Thus, they will be affected by seasonal fluctuations, and future groundwater extraction and recharging patterns.

The groundwater level is in general low along the SP Burbank Branch alignment and below the zone of influence of the project construction. Over the first ten

miles, starting at North Hollywood, the groundwater is physically well below the guideway track level. Along a short four mile segment in the vicinity of Reseda and Canoga at the west end of the alignment, it varies between 15 and 50 feet below the ground surface. Although minor construction water might be encountered here, this condition does not pose any problems for design or construction.

Based on results of the geotechnical investigation, and design and construction experience under similar geology, subsurface conditions along most of the western and eastern tunnel segments are favorable for conventional soft ground tunneling techniques using mechanical excavation methods with a shield similar to those used in the current tunnel construction along the Metro Red Line Segments 1 and 2.

In localized areas, there exist a number of conditions that will either slow tunnel progress or create difficult face stability problems unless special construction equipment and provisions are utilized. Along the western tunnel segment, these conditions could include mixed face conditions, but this presently appears only to touch the in the vicinity of Topanga Station which is cut and cover. The possible short segment of bored tunnel in this area can most likely be adjusted to avoid a mixed face situation.

Along the western tunnel segment, there will be construction water inflow when granular alluvium is encountered, and running of the relatively clean sand and gravel as well as ravelling in the silty sand and clayey sand. The conditions along the eastern tunnel segment include the presence of running and ravelling alluvium, and boulders up to 4 feet in size. Large size boulders may require splitting at the tunnel face or on the mucking conveyor.

Conditions in both the western and eastern segments indicate that cut and cover excavation of proposed stations and guideways can be accomplished at a relatively high rate using mechanical excavation methods with readily available equipment and conventional shoring provisions. Potential liquefiable layers and pockets will induce additional lateral pressures and settlement, but these have been encountered on other Red Line segments and economically favor the more shallow construction solutions used in alternative alignments B and C.

Embankments and retained earth fills underlain by fine grained alluvium will experience settlement. Measures such as preloading, may help limit post-construction settlements to acceptable levels. Conventional shallow foundation support for at-grade facilities are anticipated. Over excavation of loose materials and recompaction are also anticipated for subgrade preparation in some areas. These characteristic are most apt to be moderate considering the years of heavy

rail trackbed loading of the subgrade. Bridge abutments and piers are judged to be supported on end-bearing piles founded on the dense sand layer encountered about 50 feet below the ground surface.

4.3.2 Ground Seismicity

The San Fernando Valley has a relatively high seismic potential. Negative aspects of the alluvial geology become most pronounced when considering earthquakes. Liquefaction occurs in areas of loosely packed, fine granular soil that is saturated by ground water. The particles of the soil move freely, lubricated by the water, and with repeated shock waves take on the characteristics of gelatin or liquid. Along the SP Burbank Branch alignment, low water levels on the eastern segment and high rock on the western segment both reduce the potential for the settlement effects of liquefaction.

Where ground water may not be a factor, the normally consolidated soil tends to amplify shock waves and intensify lateral and vertical seismic forces. This ground amplification has been borne out by the Northridge earthquake, the largest in the Valley's modern history, and by recent similarly large magnitude earthquakes in San Francisco, Mexico, and Caracas.

It is now known that none of the MTA's underground structures sustained any damage, even though some encountered similar geological conditions to the San Fernando Valley, whereas a number elevated structures of other agencies sustained damage. MTA's underground seismic criteria uses an operating design earthquake that has a return period of several hundred years. Such an event can reasonably be expected to occur during the 100-year facility design life, but should not cause Metro to cease operations.

The Metro underground facility criteria also designs for a maximum design earthquake event that has a return period of several thousand years. There is only a very small probability that this earthquake would be exceeded during the 100 year facility design life. With this earthquake, underground rail facilities are designed not to collapse and therefore there is a high assurance that public life safety will be maintained.

This Criteria is discussed in detail in ***Supplemental Criteria for Seismic Design of Aerial Structures and Bridges***, June 30, 1994, prepared by Engineering Management Consultants, and ***Seismological Investigation and Design Criteria***, May 1983, prepared by Converse Consultants.

Since the recent Whittier Narrows and Loma Prieta earthquakes, meaningful advances have been made by State of California transportation agencies in

understanding how different structural configurations and details influence the ultimate seismic resistance of their facilities. Another observation of the Northridge Earthquake is that structural steel buildings tended to perform better than concrete ones. Two things account for this result, steel building weigh less, and the components are more ductile. Failures in structural steel connections can be attributed to lack of diligence to engineering detail.

The alignment is located in a relatively high seismic potential area. The closest documented active faults to the alignment prior to the Northridge Earthquake where the Northridge Hills and Verdugo faults located at their closest point about 4 miles east of the west end of the alignment. Available aerial photographs and literature data indicate the possible presence of an unnamed fault crossing the eastern end of the alignment. Since the epicenter of the Northridge event occurred only 3 miles north of the western segment of the alignment and proceeded north along an unknown fault for seven miles to where it caused a surface disturbance north of highway 118. From after shocks that have occurred along two other fault zones, quake geologist are now confident a complex web of unknown faults exists within the Valley geology.

For ballasted guideways at-grade or on berms, no structural damage is likely to result from settlement associated with a seismic event caused by the liquefaction of deep underlying formations, and leveling of the trackways could be accomplished almost immediately. The rapid return to full operations by the Metrolink commuter rail through the Valley supports this. All passenger stations and operationally critical structures are supported vertically on caissons even when surrounded by landscaped terraces.

Both aerial and subway structural solutions have been selected for their innate resistance to earthquake forces. All aerial guideways are supported on double column bents rather than more susceptible single column piers. All current codes recognize this difference, but not to the extent that precision analysis would show. For single column piers designed for the maximum design earthquake, plastic damping occurs at the same time the collapse mechanism is reached. For double column piers, plastic damping occurs before the collapse mechanism is reached and this level can be substantially extended by the designer.

The maximum design earthquake is assumed to cause the reinforcing bars to yield. At yielding, 2 parts of an ultimate collapse strength of 3 is reached, and any further distortion will be permanent. A 5-foot reinforcing bar at the yielding hinge point will have stretched about 1/8 of an inch under the first 2 parts of the ultimate load and about 4 more inches under the final third part.

It is sometimes judged that the final third of the ultimate strength has such a high

increased damping, that the structure does not respond to the earthquake force. G.W. Housner's and P.C. Jenning's ***Earthquake Design Criteria***, Monograph Series, Earthquake Engineering Research Institute, California Institute of Technology, 1982, reports: "In designing for this range of response, it is not appropriate to reduce the design spectra by taking benefit of both the ductile response and high damping."

Individual precast concrete elements are post-tensioned together by high strength steel strands for seismic continuity wherever practical. Structural steel is used compositely with reinforced concrete elements both above and below grade structures in order to promote overall seismic ductility. A more precise analysis that accommodates improved earthquake ductility, and accounts for soil-structure interaction and the non-linear nature of the site geology should be applied to facilities along the entire alignment.

4.4 Toxic and Contaminated Soils

This subsection summarizes the study, ***Environmental Opinion of Costs San Fernando Valley Segment, Metro Rail Project***, March 1994, conducted by Law/Crandall, Inc. It evaluates impacts due to known and suspected sources of contamination along the SP Burbank Branch alignment and provides Law/Crandall, Inc.'s present opinion of costs associated with mitigation impacts. Of particular interest is an assessment of the possibility of encountering contaminated soil and groundwater during excavation of tunnels, open retained cuts, and cut and cover rail guideway structures and passenger stations. In addition, an estimate of the potential volume of contaminated wastes and associated disposal costs is estimated.

It is presently understood that the Regional Water Quality Control Board has agreed that MTA needs only to be concerned with contaminated waste that is produced during construction activities. They will not be responsible for remediation of the remaining soil and groundwater in the vicinity of the MTA owned Southern Pacific right-of-way.

The data reviewed for this study includes:

- Review MTA's Phase I and Phase II reports along the proposed San Fernando Valley Line (tunnel project).
- Review Law/Crandell's environmental and geotechnical reports along the proposed San Fernando Valley Line.
- Review of updated environmental record reports for sites along the line.
- Review of agency files regarding remediation sites.
- Review of existing EIR reports.
- Develop scope of work for additional Phase I/Phase II/Phase III assessments.

Six sites and two contingency sites were reviewed as having a potential for environmental impact to the tunnel. Actual laboratory analysis for soil and groundwater at these six sites was not readily available. Where data was available, it was typically for soil at a shallower depth than the tunnel. Using the known soil types in the area and infiltration rates, assumptions on the size of the contaminant plume and its concentrations were made. Known plume dimensions and concentrations were applied from one site to another if geologic and hydrogeologic conditions were similar. The two contingency sites were also assumed to have both soil and groundwater contamination. Data from sites with known contamination were used to estimate volumes of soil and groundwater that require treatment and disposal.

Asbestos removal will be required on 16 parcels due to building demolition and lead-based paint removal will be needed for the main bridge demolition a the Los Angeles river crossing in Sepulveda Basin.

The following table summarizes the opinion of costs:

Task	Opinion of Costs Alternate A	Opinion of Costs Alternate B and C
Soil remediation costs for the six potential sites, two contingency sites, and three rail stations	$2,940,000 to $5,375,000	$3,878,000 to $7,060,000
Groundwater treatment for four sites plus two contingency sites	$2,498,000 to $4,881,000	$2,498,000 to $4,881,000
Groundwater Treatment System (3) units	$300,000	$300,000
Transportation of soil[1]	$1,900,000 to $4,340,000	$2,500,000 to $5,600,000
Construction monitoring[2]	$750,000 to $1,000,000	$750,000 to $1,000,000
Laboratory analysis	Approximately $125,000	Approximately $125,000
Additional EIR/EIS monitoring[3]	Approximately $90,000	Approximately $90,000
Asbestos Removal[4] - (16 sites)	$1,523,000	$1,523,000
Bridge Removal[5] - (LA River Bridge)	$1,100,000	$1,100,000
TOTAL OPINION OF COSTS	**$11,226,000 to $18,734,000**	**$12,764,000 to $21,679,000**

[1] Range will vary dependent on the disposal site.
[2] Dependent on the tunneling rate.
[3] Includes the noise, biological, and cultural monitoring.
[4] Based on MTA disposal costs of $12-14 per square foot ACM.
[5] Dependent on quantity of lead-based paint used on bridge surface.

4.5 Structural Technology and Current Standards

Transportation structures have well established functions and configurations. The costs associated with their construction are known through previous experience. Open cut, then backfilled, guideways and stations have heavily reinforced concrete

sections. Deep mined caverns and tunnels have curvalinear walls that reinforce the natural arching action of the surrounding geotechnical continuum. Aerial guideways are concrete or steel deck girders supported on single column pedestals with cantilever pedestal caps that carry the trains suspended on each side, or double column bents called out-rigger bents that carry trains between the columns.

How the various pieces of most structures work is easily imagined. A two legged "A" frame has more lateral stability than a single legged free standing pole or wall. This difference is discussed by the codes only in general terms, because of the many structural configurations that are possible. It is taken for granted that the professional designer will know when to look beyond the letter of the code to its intent to protect human life and the public welfare.

Seismically active areas must consider the collapse mode of its structures, because collapse is what determines life safety and ultimately what must be guarded against. When the materials in a structure first start to yield under load is called the lower boundary of failure. Irreversible physical strains have started to occur, but collapse does not begin until the structure's upper boundary of failure is reached. Every structural configuration has its own upper boundary of failure, and some of the same characteristics determine how sudden the failure will be.

Only double column piers are shown for aerial designs, except in the Los Angeles River crossing where piers must be connected together to form a single pier in order to discourage trash collection. Double column piers form a contiguous frame with their foundations below, and horizontal cross beam above that supports the guideway girders. When loaded by the ultimate horizontal design force, a hinge will start to form at one of the four corners. This is the lower boundary failure level. The collapse or upper boundary level is not reached until all four corners have reached the point of first yielding.

For the pedestal "T" pier yielding might start in the cantilever arm, or the top or bottom of the column due to combined vertical and horizontal seismic forces. Whichever point is first, establishes both the lower and upper boundaries of failure because collapse has also begun. Most discussions point out that seismic damping increases with first yielding and prevents collapse, but this is equally true for the structures with the higher ultimate resistance to collapse. See Subsection 4.3 for further discussion.

The value engineering recommendation to incorporate the temporary support system in the cut and cover construction was a rationale to consider composite action between the temporary structure resisting the ground forces of excavation, and the permanent structure that again carries all of these ground forces plus the forces of the backfill overburden.

To accomplish composite construction, shear studs welded to the top of the structural steel sections and the deformations in the permanent metal deck forms, provide the bonding of the concrete slabs to the structural steel. The temporary steel support system, instead of being thrown away, is used to speed the construction of the remainder of the building, and remains, permanently incorporating the highly ductile steel into the reinforced concrete framing. The contractor's design costs are reduced, and his schedule reduced by his being able to order his ground support steel immediately after notice to proceed.

This type of composite construction is called a mixed steel-concrete system by the building tower industry. It has been brought to its highest economic achievement by the late Fazlur Khan of Skidmore, Owings and Merrill. The economic heights reached by recent building towers demonstrate the value of mixed systems that have taken advantage of the best characteristic of each material.

Mixed systems and all current design solutions should use the highest technology available in analyzing structures using any materials of strength higher than commonly assumed by the codes. Building codes have been formulated for only a narrow range of building material strengths and foundation conditions, because analysis has made possible a host of building configurations that only a few decades back were beyond our analytical capabilities.

The analytical sophistication used to design building towers made it possible to take economic advantage of current material industry capabilities. Similar solutions are available to all transportation structures today that can track the true collapse modes of structures making them contiguous to, and account for the three-dimensional effects of seismic forces and the elasto-plastic character of the surrounding geological continuum.

All the structural solutions presented would benefit economically by detailed analysis and the standardization of critical elements impacting life safety and the public welfare.

4.6 Aerial Stations and Guideways

Construction along the former southern Pacific track bed would extend for 2 to 3 months in at-grade areas and 8 to 12 months for aerial and retained fill guideway structures. In select areas adjacent to public open space, public institutions, and commercial and industrial usage, aerial guideway options are proposed. Guideway sound barriers will be used to mitigate noise where adjacent usage can significantly benefit by their use.

Although these guideways would be aesthetically designed and screened by

landscaping where possible, proximity impacts including loss of privacy and obstruction of view would occur.

Along most of the aerial alignment, twin columns, separated laterally by 14 or more feet will occur between 100 and 200 feet on center depending on the structural option selected. In all cases studied, options most appropriate to both the structural steel and concrete industries have been studied.

4.6.1 Reinforced Concrete Structures

Long span precast post-tensioned single track guideway box girders are one of the options selected for aerial guideway sections. These are commonly limited to spans of 100 feet whereas spans of around 130 feet are required for the alignment at some over the street crossings if comfortable sidewalk widths and entrance plaza setbacks are to be used. This additional length is provided by cast-in-place cantilever spans that also act as seismic anchor bents.

Cast-in-place concrete box girders are frequently use by Caltrans, but here the construction forms and falsework are a substantial disruption to cross street traffic. On the other hand, the individual 100 foot precast elements can be cast on the site, post-tensioned, and immediately lifted onto the 15 foot cast-in-place cantilever structures and abutments built entirely within the Metro right-of-way.

These long concrete components can be post-tensioned together for continuity. This is similar to the more familiar segmental concrete construction composed of a series of short precast elements, but with greater simplicity and fewer technical problems. The short element system was investigated only at the Los Angeles River crossing and would otherwise be useful only at the cross streets which are a small percentage of the aerial segments of the project.

Segmental bridges of short precast elements are built to precise tolerances and require a high degree of technical competence from designer's, field engineer's, and the contractor's engineers. Ingenuity is a requisite for the contractor's erection equipment, and his workers in the casting yards and at the erection site. Usually the contractor's design loads are greater than the engineer's and he must redesign the main girders. State departments of transportation report that claims on segmental elevated highways and bridges run far higher than on other types of construction.

4.6.2 Composite Steel and Concrete Structures

In actuality, reinforced concrete structures are a composite of concrete and steel reinforcing. The steel is the only source of the structure's tensile ductility. The

overriding purpose of composite structure design is to exploit the best qualities of both concrete and steel.

For concrete aerial bridges and guideways, the service life is 75 years using current highway bridge criteria. It is assumed for guideways, that increased maintenance will undertaken to the end of the 100 year service period after which it will be replaced.

Each time structural concrete is stressed by a reoccurring load, the material experiences a micro-failure. After an established number of repetitions, structural distress is reached, its code performance has deteriorated, and its useful service life is over, unless above normal maintenance is begun. This service life is also shortened by earthquake forces near the intended level of design.

The life span of concrete structures can be increased by reducing the design level of stress below that recommended by the codes. It may cost 15 percent more to increase concrete strength 25 percent, but the service life could increase from 75 to 100 years. Of common construction materials, only structural steel does not have a stress related life span. It has a design level of stress, called its endurance limit, that will not result in failure. If protected from corrosion and abrasion, steel appears to last indefinitely. Many of the Nations's steel bridges continue in use with their concrete decks replaced.

When considering major exterior steel components for structural purposes, the fire life safety criteria for at-grade and elevated construction requires special investigation. The present criteria requires that building construction for all new rapid transit stations shall be not less than Type I or Type II, or combinations of Type I and Type II approved fire resistive construction as defined in the Uniform Building Code or as determined by an engineering analysis of potential fire exposure hazards to the structure and approved by the Fire Life Safety Committee.

The Uniform Building Code does not differentiate between interior and exterior steel and is therefore difficult to apply to aerial stations and guideways that are mostly open to the outside atmosphere where protection against the heat the buildup intended by the code is not applicable. for structural steel members, it is necessary to demonstrate that the limiting temperatures similar to those specified in ASTM Standard E-119, ***Standard Methods of Fire Tests for Building Construction and Materials***, is equivalent to the design limits for interior members. The American Iron and Steel Institute provides a guide, ***Fire-Safe Structural Steel, A Design Guide***, 1983, that may be used to produce fire-safe structural steel design. To not consider these solutions in the economic evaluation of steel versus concrete options is to allow significant prejudice against an entire segment of industry.

Successful fire life safety reviews have been conducted for unprotected steel canopy support columns for at-grade and aerial stations, and for the Arroyo Seco Bridge. The bridge which was designated a Cultural Heritage Monument by the City of Los Angeles was passed without fire proofing by installing an automatic wet standpipe across the length.

4.6.3 Los Angeles River Bridge

While within the Sepulveda Basin Recreation area, the alignment crosses the Los Angles River. The present single track seven span structure is a structural steel girder bridge. The track elevation of an entirely new bridge crossing would be somewhat higher, and would have larger piers due to its height and recent flood and seismic requirements. Using the existing bridge by constructing a similar single track structure immediately adjacent to it was studied, but finally considered impractical. The US Army Corps of Engineers have the responsibility for the review and approval of all river crossings.

A replacement structure will have to be bridge of some type. Standard precast concrete aerial guideways can span the river bed with three piers. Segmental concrete girders can economically span the distance with two piers with a central span of 220 feet. A through truss of structural steel could span the river bed with two simple spans and a single pier. At least one design will be provided for all aerial guideway options from both the structural steel and concrete industries. Ultimate resistance to seismic forces will carefully evaluated in making final selections.

The Los Angeles River has a paved invert in the Sepulveda Basin, but where the present single track Southern Pacific bridge crosses, this is being removed. This is a steel deck girder bridge with six concrete piers about 40 feet above the river invert. These piers presently show extensive graffiti activity, as did the paved invert before it was removed. To erect a new bridge beside and similar to the existing would more than double the available writing space.

The present and future park environment concerns will be considered while examining the options available for this river crossing. The Metro trains will be running on a low at-grade embankment in a dedicated right-of-way and will be constructed in coordination with the US Army Corps of Engineers and the City of Los Angeles Department of Recreation and Parks. Designs for the rail transit guideway must avoid new embankments that would change the storage capacity of the basin, and both the guideways and stations will reflect the park like setting planned for the area.

The cost associated with providing a bridge crossing that is also a visual amenity

compared to a simple aerial viaduct has been studied but not costed. For an entirely new bridge, a design that considers vandalism can be employed. A few larger piers would be preferable as a solution. A bridge with no piers would be best, but only a small arch or cable stayed or assisted girder bridge would be visually unobtrusive.

One option, previously shown on Figure 25, is very similar to the $10.5 million dollar federal study grant awarded last year to UC San Diego to explore a new quake-resistant highway bridge. Technically sophisticated bridge systems using arch forms or cables are usually considered a visual asset within a park environment and are normally illuminated at night. At this river crossing several common concrete and structural steel bridge systems were investigated. Each has a different number of piers as appropriate to the solution studied.

For the present solutions, only 2000 to 6000 pound per square inch concrete has been considered. Higher strengths should be considered for subway structures where buoyancy is not a problem. This is the case over most of the SP Burbank Branch alignment. There is an industry-wide resistance in the Los Angeles area to concrete strengths in excess of 6000 pounds per square inch when seismic ductility is considered a factor in the design. The reason is usually ductility of joint details, and it is true that designing the reinforcement for 10,000 pound concrete members requires precision analysis. Nevertheless, this is where the economics of future construction practices occur. Finite element solutions in conjunction with appropriate concrete materials testing and field quality control are all common occurrences within the overall design and construction industry.

Open air trench guideways are proposed for use with Alternate B. A maintenance road and essential grade separation barriers are provided in all cases. Bicycle paths are assumed to be able to occupy the same width of right-of-way as the maintenance road. The level of landscaping will depend on the public visibility of the Metro right-of-way. Where not a visual amenity, landscaping will be drought resistant to maintain slope stability to minimize the need for large quantities of irrigation water.

4.7 SUBWAY STATIONS AND LINE STRUCTURES

Deep bore, cut and cover, and open air trench construction activities would require 3 to 4 years for construction. For deep bore tunnel segments, heavy construction equipment would be confined to station and midline vent structure areas. Excavation for below ground segments would require haul routes along the SP right-of-way and major streets during the above construction periods. The possibility exists that excavation along areas of this railroad-industrial corridor would uncover toxic materials. such materials would be disposed of in accord with

EPA guidelines. Underground hydrocarbons are a potential danger during excavation. To date, no areas of significant underground gas accumulation have been identified. See Subsection 4.4.

Subway stations are intended to be simple and unobtrusive both below the ground surface and for the visual elements that rise above the surrounding ground horizon. All elements that lie within the normal horizontal eye level will employ landscaping to soften their visual impact.

Straight forward access and egress to the station platforms is emphasized. Patron service is planned to be safe and secure within the parking facilities, and the bus and automobile interface points as well as coming to and from the station in a pedestrian mode. The designs of all surface entries for the subway assume that no provisions will be made for weather protection and all escalators will be specified to be the all-weather type.

Finish material choices will be consistent with MTA practices followed to date for the Modular Stations and will be select for longevity, durability, low maintenance, vandal resistance, and cost effectiveness. Such materials are exemplified by concrete, stainless steel, granite, brick, quarry tile, and tempered glass. Tempered glass is designed to disintegrate into non-lethal pebble size nodules when shattered. In locations where an earthquake would cause this to be unacceptable, only laminated glass should be used.

The stations will have a visual appearance resulting in most cases, from the construction techniques used and the finish materials appropriate to the structural systems required. Applied finishes will provide acoustic treatment on the ceiling structure and texture on selected wall surfaces in public concourses and corridors.

Station elements designated as standard for the Modular Stations because of their common functional, operational and maintenance character will also be standard in the newer station concepts. Likewise, elements that are commonly varied from site to site for the Modular subway Station to promote individuality will also be varied among the new subway solutions.

4.7.1 MODULAR STATION

The shortened (Olympic-Crenshaw) version of the Modular Station developed for Red Line Segment 3 to interface with deep twin bore tunnels is proposed for alignment Alternative A. A nominal 4 foot of cover is used where the alignment is in the existing right-of-way. This allows any type of future landscaping including the use of raised buffer terraces and full sized trees. At the Topanga Station site, 8 foot of cover is used to accommodate the utilities in Victory Boulevard.

The Modular Station must be built with the top of rails a minimum of 46 feet below the existing ground surface in order to have 4 feet of backfill cover on the station roof. This only works if the station is within its own dedicated right-of-way. If the station is built at the existing cross streets the top of rails will have to be about 60 deep to avoid the invert of the storm drains and sanitary sewers.

This station is characterized by its center platform that accommodates 2 vertical circulation elements on either side of its central column. Its below ground mezzanine provides for patron circulation between its two knock-out-panels, and its waterproofing membrane that envelopes the entire station box. In the absence of substantial ground water levels or any detectable gas pockets, a high density polyurethene membrane is not an anticipated requirement, but has been assumed included by the station costs. The initial excavation ground support system of soldier piles and lagging is designed by the contractor and is not structurally incorporated into the final reinforced concrete support elements.

4.7.2 OPEN AIR SUBWAY STATION

The Open Air Subway Station uses the main recommendations of the Value Engineering Study conducted in August of 1993. These include designing and incorporating the temporary structural steel ground support system into the final reinforced concrete structure, raising the underground ancillary spaces as close to the ground surface as practical, and narrowing the station width by placing the vertical circulation elements into a single row down the center of the platform. This latter recommendation requires the central row of columns to be eliminated.

This station has been investigated for both center and side platform configurations. The side platform station is about 7 feet wider than the center platform. This requirement is based on incorporating the vertical circulation elements within the overall station box width to allows either end or central loading of the patrons onto the platform. A center platform is also required where the station interfaces with twin bore tunnels. At the 5 station sites where this open design is applicable, only the Fulton-Burbank station must accommodate twin bore tunnels.

As the tracks leave the stations central platform area, they must narrow from 33 to 14 feet in order to make the line guideways economical. The cost of constructing the line guideway facilities to accommodate this track convergence sometimes offsets the savings achieved by the narrower center platform station. Investigations so far indicate that this is not the case either for the Open Air Subway Station or the roofed over Value Engineering Prototype shown in Figures 11 and 14.

The Open Air Station is excavated by installing permanent structural steel wide

flange section soldier piles in predrilled holes, along two opposing rows 50 to 60 feet apart.These holes will be backfilled with lean concrete that during excavation is removed to expose the flange face of the soldier pile. As this pile and the vertically cut ground surface is exposed, precast concrete lagging is installed and supported by the pile flange.

The soldier piles will be braced horizontally by permanent 36 inch diameter steel pipe struts at about 40 foot on center. Temporary struts and tie-backs may also be used to expedite construction until all the major permanent structural components of the final station shell are installed. Two inches of fiber reinforced shotcrete will be applied to the exposed faces of the precast lagging and soldier piles to minimize water seepage and exposure to corrosive conditions, and to prevent damage to the cathodic protection system.

In patron spaces, such as the platform area, the vertical shotcrete walls will be covered by precast finish panels or other finish that will not deteriorate from exposure to the weather. In ancillary spaces, concrete masonry units are assumed to cover all exposed shotcrete surfaces, although this level of treatment may not be necessary in some types of ancillary areas.

The train trackways are supported by a slab on grade. A fail safe drainage system is provided to insure no water pressures can develop that would cause a instability in the slab subgrade. In most instances the ground water table is below the trackway. Where a water table does exist, the draw down is localized within or near the right-of-way and no significant quantity of water or settlement is anticipated due this effect.

Any casual water that does seep through the lagging-shotcrete barrier is hidden behind the precast panels and concrete masonry walls and is picked up by a linear drainage canal at the base of the shotcrete walls. There is presently only a remote chance of encountering free gas pockets during construction. Should such occur, a vacuum can be created within the cavity between the shotcrete surface and the precast panels that carries throughout the drainage conduits and sumps similar to an airport drainage system to insure no gas enters a patron area.

Due to the availability of existing right-of-way immediately over the stations, access is normally directly from a ground surface mezzanine to the passenger platform. Nevertheless, underground pedestrian tunnel access through the exterior shotcrete walls is possible at any point to an intermediate mezzanine. This is more costly than the direct surface to platform solution and increases the visible line of site security surveillance problems.

Because this station is open, the ancillary spaces needed for ventilation are

substantially reduced. Where an enclosed station is required, this open air station may be covered over by a arched skylight, and the requisite ventilation system added.

4.7.3 VALUE ENGINEERING PROTOTYPE CUT & COVER STATION

This station solution, shown in Figure 14, incorporates all the same value engineering recommendations as the Open Air Subway Station except it is covered by a minimum roof structure that allows for automobile parking, minor turf and shrub landscaping and pedestrian circulation and promenades. Permanent 18 inch diameter steel pipe struts 8 foot on center match the location of the soldier piles. These will be made composite with the roof concrete and support permanent steel forms to eliminate the need for temporary false work and forms. Because of the increased roof loads and relatively long spans, vertical pilaster columns are presently provided at the side walls to insure seismic continuity and ductility. These are also used in the Open Air Station were underground ancillary spaces are covered.

For the same reason, these columns are founded on a heavy continuous base slab rather than a light slab on a drained subgrade as provided in the previous open air solution. Frangible (compressible) filler material is shown between the columns and the vertical shotcrete wall surface. This prevents bending in the columns that might be introduced by a slight inward movement of the shotcrete wall.

As with the open air station, this station must be built with its top of rails at a minimum depth of 40 feet below the ground surface in order to accommodate twin bore tunnels, or 35 feet below grade for open air trench or cut and cover, as controlled by the storm drains and sanitary sewers existing at the cross streets. A version of this station to be used beneath a street is shown in Figure 17.

Water and gas are handled in the same way as the open air station. Access to the station platform may be directly from the surface, or by providing an intermediate mezzanine that allows as pedestrian tunnel to access the station between the 30 foot wide openings between the side wall columns.

The extent of the finish in this station is similar to the Modular station due to the roof enclosure. Because it is enclosed, as a minimum, all exposed structural steel will have to have a fireproof finish.

4.7.4 COMPARISON OF SUBWAY STATION SOLUTIONS

The Modular Cut and Cover Subway Station was developed for construction in a congested central business district environment. Under these conditions, deep overburden roof fills are required to accommodate the congested utilities buried in the city streets. Continuous high density polyurethene membranes are used to envelop the entire station shell and prevent the intrusion of ground water and free gas pockets trapped in the geological formations. The need to control free gas is not anticipated in the Valley and more cost effective types of waterproofing will be investigated.

In the Modular Subway Station contracts, the contractor is mainly responsible for design of the temporary ground support system and any additional underpinning needed to protect the foundations of major structures existing along the transit route. The structural impacts from the construction of new buildings near and joint development entrances into the subway station within the geotechnical zone of influence of the MTA station facilities must be able to be built without unreasonable construction precautions, and supplementary reinforcement or support.

Most all of these concerns are reduced as the alignment leaves the central business district and enters less densely developed metropolitan areas. This opens the way to more innovative and cost effective solutions. This is especially true where almost all the construction occurs with right-of-way that becomes the permanent MTA ownership.

The Open Air Subway Station is easily the lowest cost solution of the options investigated. The structural steel ground support system is made permanent by constructing it compositely with the reinforced concrete elements of the station. These station structures are made composite using shear studs welded to the structural steel and by the deformations incorporated in the permanent metal forms and structural steel lagging.

Among the objectives of the composite design or mixed structural steel and concrete systems are:

- Speed of erection as best demonstrated in contemporary tubular high-rise building towers.

- Developing an economic balance in the optimum use of both steel and concrete by exploiting the best properties of each material. An example of this is providing the requisite combination of concrete stiffness for stability and steel ductility for resistance to seismic and induced

construction deformations.

- Increasing the unimpeded interior space by reducing the number of interior structural elements such as columns that conflict with station equipment spaces.

These objectives are equally applicable to the Value Engineering Prototype center platform station used in Alternate C. The ancillary spaces for both Alternate B and Alternate C stations are constructed as near to the existing ground surface as is practical to minimize excavation, ground support and backfill costs.

For Alternates B and C, this type of Value Engineering Prototype occurs in a side platform configurations at Topanga Station in the Victory Boulevard. This is done in order to keep the tracks at a depth of only 30 feet below the street level and still provide 8 feet of cover for utilities, and by keeping all the ancillary spaces at a similarly shallow depth. For the Alternate A Modular Station at the Topanga Station site, the tracks are about 50 feet below the surface.

For the Open Air Subway and Value Engineering Prototype Stations, the vertical circulation elements are minimized by providing a ground surface mezzanine. That is, patron access barriers, and proposed and future ticketing devices are all above the ground surface. This allows these two station designs to function with only 2 escalators. The Modular Station which always has a mezzanine intermediate between the surface and the platform requires a minimum of 4 escalators.

Alternates B and C have not taken full economic advantage of their configurations. For example, 550 feet of full height open space is provided over the 450 foot platform in Alternate B, and a total of 450 foot is full height over the platform in Alternate C. For the Modular Station used in Alternate A, only 150 feet is full-height. The rest of the space over the platform is used for ancillary in order to reduce the cost of the station. This principal could also be used in Alternates B and C.

5.0 Description of the SP Burbank Branch Alignment

The alternative alignment for this study is the SP Burbank Branch heavy rail continuance of the Metro Red Line subway presently being designed and constructed, and which extends from downtown to the Segment 3 North Hollywood Station terminus on Lankershim Boulevard in the vicinity of North Hollywood Park and Recreation Center.

The SP Burbank Branch alignment is 14 miles in length and is planned to exist within the limits of 12 miles of 60 and 100 foot wide railroad right-of-way now owned by the MTA. Most of the 2 miles occur within the most westerly end of Victory Boulevard in the vicinity of Warner Center. The remainder consists of relative minor takes and tunnel easements.

Midway through the alignment, aerial quideway passes between Victory Boulevard to the north, and Sepulveda Dam Recreation Area to the south, for a distance of two miles. Flooding has occurred in this area in the recent past and guideways will be constructed above the most credible long term flood level.

The western terminus of the present alignment planning is at the City of Canoga Park adjacent to the intersection of Victory and Topanga Canyon Boulevards. Several operational studies will have to be made here that consider the City of Canoga Park, Warner Center and MTA yard and storage facilities to the north.

Final selection between the SP Burbank Branch and Ventura Freeway alignments was made contingent upon the results of a project study report for the Freeway alignment, and a geotechnical study along the SP Burbank route. Since, the SP Burbank Branch study has been expanded to include investigations that include lower cost options to deep subway and aerial guideway construction that would maintain the high environmental character of the alignment while lowering the high projected cost. Options to be considered include shallow trenches and low terracing in appropriate areas, and deeper open air trenches and higher mechanically stabilized berms in others.

From these guidelines, two alternatives in addition to the EIR Alternate A have been formulated. Alternate B has been planned to minimize design and construction costs, regardless of EIR guidelines and State legislation. Also, this alternative investigates the value engineering recommendations set forth by the RCC-EMC-Flour Daniel, Inc. Team's value engineering proposal of August 1993.

From the options investigated for Alternate B, a new Alternative C has been formulated. This alternative incorporates many of the cost saving measures studied in Alternative B, but these attempt to meet the intent of State legislation and local restrictions in the vicinity of the Fulton-Burbank Station without compromising the high environmental character of the alignment.

5.1 Right-of-Way Development

5.1.1 Compatibility with Local Area Plans

Presently the SP Burbank Branch alignment connects directly with a number of

major population centers and areas of high population density. The Warner Center Specific Plan identifies a future station location at Oxnard-Owensmouth. Instead, the present SP Burbank Branch solution indicates the station to be at Victory-Owensmouth about 3300 feet away. The tail track structure for this station is nevertheless curved to the south so that a future station could be constructed at Topanga-Oxnard and would be about 2400 feet from the Warner Center Plan.

Numerous commercial and industrial leaseholds presently exist along the SP Burbank Branch right-of-way. Some of these could be displaced by Metro construction along the alignment. Some limited displacement outside the presently acquired right-of-way will also occur for some of the alternative solutions investigated, but no homes or rental residences are anticipated to be displaced.

The SP Burbank Branch alignment alternative is completely grade-separated from street traffic. Sufficient right-of-way is available to accommodate any number of parking spaces at MTA station sites. Nevertheless, there is resistance to the visibility of major parking lots in the vicinity of residential neighborhoods regardless of associated amenities such as terraces as visual buffers. A resultant spill over into the neighborhood areas is therefore possible. Neighborhoods may require residential on-street permit parking in some station areas to control this spill over.

This EIR adopted alignment has 4.3 miles of aerial and at-grade construction with 4 aerial passenger stations, and 9.6 miles of deep bore tunnel with 6 cut and cover subway stations. Only one street at Tyrone Avenue was closed for this alignment. It is anticipated by this study that the street may be made to remain open without significant cost consequence.

For about 10.7 of its 13.9 total miles, this alternative is in Metro acquired Southern Pacific right-of-way varying from 60 to 100 feet in width. In previous SP station and maintenance areas, the right-of-way widens to over 200 feet for lengths 2000 feet. This provides this solution with about 200 acres of land that must be dispositioned as MTA station entrances, vents, emergency exits, bus drop-off, patron parking, and various degrees of landscaping.

The MTA presently holds leases on various parcels of its right-of-way for commercial and industrial uses. A range of policy is discussed concerning the disposal of excess rights-of-way that remain after the initial system construction is complete. Where appropriate, some of these leases might be maintained and new ones undertaken.

For the purpose of cost analysis, two reasonable levels will be investigated. Alternate B will provide a lower boundary for landscaping and recreational improvement of the MTA rights-of-way. All displaced municipal facilities will be

assumed to be replaced in like kind. Where not visible to public view, a minimum drought resistant vegetation will be used to minimize use of irrigation water. The economic benefits of commercial leaseholds and joint development will be assumed to be aggressively sought.

Alternates A and C will both provide a similar upper boundary for right-of-way improvements by adding amenities in the passenger station areas and by using construction solutions that increasingly mitigate the negatively perceived aspects of the proposed MTA project.

A major economic benefit to the project is that this right-of-way provides the construction contractor with unlimited staging and work areas. Presently, there are no known detrimental cost restrictions for temporary construction use of this land.

To the Valley communities, this land can be made available on a priority basis to provide adjacent street widening, neighborhood parks and recreation facilities, school, police and fire institutions, and joint development with public projects. Secondly the land can be offered for commercial joint development.

5.2 Deep Subway Alignment

Alternate A is deep subway over 9.4 miles of its vertical alignment in the form of bored tunnels and cut-and-cover construction. The configuration for the six subway stations is the present prototype subway station with its 7 interchangeable operational modules. This design has already advanced to completion levels on Red line Segment 3 and is understood by all operational interests.

Bored tunnels will be supported using the cast-in-place permanent liner solutions used for Segments 1, 2 and 3, but single precast concrete liner of interlocking and bolted segments cable of supporting the ground during all construction and seismic activities will also be studied. The inside diameter of the precast liner would be large enough to accommodate waterproofing and a cast-in-place liner if gas problems are unexpectedly encountered during construction or during future operations.

For 2.7 miles Alignment A is aerial guideway . There are numerous solutions for this guideway in structural steel and reinforced concrete. At least one practical solution from each industry will be considered. As for the LA River bridge crossing in the Sepulvida Recreational Area, aesthetics of the guideway will be a combination of structure and landscaping that is compatible with the bicycle pathway and other linear park facilities that are in existence and planned for this area.

The aerial segments are shown as common reinforced concrete by the 1989 tech-

nical report. An upgrade that will be evaluated here is the degree to which these structures should be segmentally constructed by post-tensioning for seismic continuity. For the nominal spans required along this alignment, long single track precast guideway units, similar to those shown by the 1989 report were be compared to the cost of more seismically resilient solutions including segmental construction and structural steel.

5.3 Open Air Subway Alignment

Various value engineering recommendations made during the course of Segment 3 design have been investigated for these cut-and-cover station structures. These include the incorporation of the temporary construction ground support system into the completed subway structure, narrowing the station by lining the vertical circulation stairs and escalators in a single row along the central patron platform, and moving ancillary spaces as close to the surface as practical.

In the Value Engineering Modular, the structural steel struts are made composite with the roof slab concrete and act compositely to increase overall strength. These struts also support permanent galvanized steel overhead forms. Post-tensioning the roof would be counter to the strut ground support action and therefore is not used. An important feature of the Value Engineering Modular is the option to use a vacuum drainage system between the soldier pile ground support wall and the station furred-out finish. This is commonly used at airports to eliminate hydrocarbon fumes from aircraft parking apron drainage systems. This could be implemented only when discovered a requirement during one of the phases of design or construction.

5.4 Open Station Design Comparison with the Modular Station

Cost Reductions	Cost Increases
Reduced ventilation requirements	Needs mining or cut & cover @ cross streets
2 escalators needed rather than 4	Requires increased drainage from rain
Trackways at 33' rather than 38'-10"	Requires additional parking ROW
No entrance structure needed	
No HDPE waterproofing required	

The below surface mezzanine is omitted and its ancillary requirements are nearly those of an at-grade station. An-line ventilation facility would be required for emergency ventilation of the tunnels between any two underground stations of this type. Two canopy options are shown. One is predominately above the visual street level, the other is mostly below the visible surface if the environment requires. The physical impact are the increased drainage needs for the below surface platform canopy.

For Alternate B, the lines between stations may either be mined tunnels or open cut. Various cut and backfilled options are studied that have proved economically efficient in previous projects. The Project Drawings show a concrete structure that could be made segmentally continuous for better seismic stability. It is capable of the 130-foot spans needed at the major street crossings, and interchangeable with the shorter economic spans of a concrete aerial structures commonly used in a dedicated right-of-way setting.

One solution is a composite structural steel and concrete guideway that would normally be associated with a long span requirement such as a river crossing. In the 100-foot wide right-of-way, this configuration leaves the most of the remaining usable width with about 50 feet available for patron drop-off beside the stations, and 70 feet available adjacent to the guideway segments.

The nature of this structure makes it seismically resistant and resilient. In addition, the mass of either one or two trains on the guideway during an earthquake is more nearly centered over its foundations.

Whereas the spans of the concrete structure will average between 90 and 100 feet, the composite system would average about 200 feet and be capable of 300 feet. This aesthetic advantage of the composite structure's long spans in a dedicated right-of-way setting is due to the tendency for a row of closely spaced columns to look like a solid wall.

With excavation available from the underground areas, some guideway alignments may be economically constructed on fills with mechanically stabilized and landscaped slopes. Many slope solutions are available. Several possibilities are shown.

Other comparative data is attached for use in the economic analysis of the study. This information includes the current site plans and profiles for Universal City and North Hollywood stations which are a part of this investigation.

6.0 Ventura Freeway Transit Interface Studies with Red Line Segment 3 Stations

This investigation studies the 16.2 mile Ventura Freeway rail transit alignment

where it intercepts the Segment 3 Red Line with an eastern terminal station at two possible locations. The Ventura Freeway Transit alignment is an aerial configuration in the median of the Ventura Freeway from the Canoga Park Area to its intersection with the Hollywood Freeway. From this point, the alignment either turns south for 1) about 1-1/2 miles following the eastern edge of the Hollywood freeway sideslope, passing through Weddington Park, to the adopted Universal City Station site, or 2) the Ventura Freeway transit alignment remains in the median of the Ventura Freeway for an additional half mile passed its crossing of the Hollywood Freeway to a terminal station where the Ventura Freeway intersects Lankershim Boulevard.

6.1 The Adopted Universal City Site at Lankershim Boulevard

For last half mile of this alternative for the Ventura Freeway Transit, the alignment enters open trench followed by cut and cover box that permits the turn toward the Universal City Station at a 350 foot radius paralleling the edge of Bluffside Drive. Twin bore tunnels would require a minimum construction radius of about 500 feet and would take the line beneath the Hollywood Freeway. See Drawings G-750 through G-765.

The Ventura Freeway station intersects the present preliminary cut and cover design location for the Universal City Station at an angle of about 35 degrees within the triangle bounded by Lankershim Boulevard, Bluffside Drive, and the Hollywood Freeway. Its 810 foot length consists of a 210 foot patron platform, a crossover, and a terminal tail track.

The track geometry for this alignment is shown in the Draft EIR of September 1991, and in more detail by the SEIR of July 1992, both by Gruen Associates. The alignment is again shown on a study drawing dated September 1992 by Benito A. Sinclair & Associates. This most recent alignment is the one approximated by this study. It is very similar to the alignment shown by the original EMC study dated February 1987.

6.1.1 Ventura Freeway Station Location Options at the Adopted Site

Two location options for the patron platform have been studied and delineated by the accompanying drawings. Option 1 places the operational sequence for trains entering the Ventura Freeway Transit station site as the platform, followed by the crossover, and then the terminal tail track. This centers the Ventura station platform immediately above the Universal City Station's structural envelope. Transfer access and egress from the Ventura station platform to the Universal City station mezzanine is through the western knock-out-panel of the southern mezzanine. This is the mezzanine planned for the initial phase of construction, but

the western knock-out-panel used is opposite to the one presently proposed.

Option 2 places the operational facility sequence for trains entering the Ventura Freeway Transit station site as the crossover, followed by the patron platform, and then the terminal tail track. This centers the Ventura station platform about 340 feet east of the middle of the Universal City station envelope. Transfer access and egress from the Ventura station platform to the Universal City station mezzanine is through the eastern knock-out-panel of the northern mezzanine. This mezzanine is presently planned for deferral to some post-construction period.

6.1.2.1 Ventura Station Option 1

Ventura Station Option 1 is shown with two entrances Options 1A and 1B. The patron vertical circulation logic is shown on attached Drawing No. G-756. Entrance Option 1A is the most direct access route from the parking surface to the Ventura station platform. All of its vertical circulation elements occur at the east platform end. The vertical circulation elements at the west end of the platform lead directly to the transfer tunnel and to the east knock-out-panel of the southern mezzanine of Universal City Station. For this solution, the presently planned eastern entrance is the direct entrance into the Universal city mezzanine. Either the planned entrance or entrance Options 1A can be used to access either the Universal City mezzanine or the Ventura platform without passing through future fare gates twice. This is the function of the interconnecting patron transfer tunnel.

Entrance Option 1B combines both the entrances of Option 1A into a single point of patron access and egress except for the required emergency exiting. If future ticketing is done at the Option 1B surface plaza, the interchange of patrons between stations occurs without passing through fare gates twice.

Due the end loading and unloading of the Ventura platform, a minimum platform width of about 26 feet is needed. This places the handicap elevator for Station Options 1 in a somewhat awkward position near the west end of the platform. The standard 8'-4" elevator width leaves about 8'-10" clear to either platform edge for patrons to bypass. This is substantially above the minimum 6'-2" required by fire life safety. The elevator surface plaza is about 200 feet away from escalators and stairs at entrance plaza Option 1A. For entrance Option 1B, two handicap elevators will be required, but the elevator surface plaza can be incorporated into the Option 1B entrance plaza.

6.1.2.2 Ventura Station Option 2

Station Option 2 is shown with two entrance Options 2A and 2B. No logic diagram is provided since its function is very similar to Station Option 1. Entrance Option

2A is the most direct route from the parking surface to the center of Ventura station platform. The handicap elevator can now be placed more conveniently at the east end of the platform and the narrowest platform path beside any stair or escalator is 10'-0." The vertical circulation elements at the west end of the platform lead directly to the east knock-out-panel of the northern Red Line mezzanine of Universal City Station. For this solution, the presently planned eastern entrance is the direct entrance into the mezzanine of Universal City Station. for this solution, both the southern and northern mezzanines would have to be installed in the early phase of construction.

Entrance Option 2B combines both the entrances of Option 2A into a single point of patron access and egress if future ticketing is done at the Option 2B surface plaza. Only the northern mezzanine of the Universal City Station would be needed, but would have to be revised to provide two escalators instead of one.

6.1.3 Ventura Station Structure

Their is over 24 foot of earth cover on the Red Line Universal City station structure where it is crossed over by the Ventura Freeway alignment. The Ventura station structure occupies this 24 feet as an enclosed reinforced concrete box.

The Red Line station roof is a rigid foundation for the crossing Ventura station base slab compared to the ground it rests on along the remainder of its length. Therefore, incorporating the temporary ground support system into the final structure is not studied. The vertical walls of the Ventura station should be solid reinforced concrete in order to act as a continuous shear walls resisting the tendency for differential settlement. Caissons are also added to reduce the difference in foundation stiffness between the ground and the Red Line station roof.

6.1.4 Constructability, Cost and Schedule

There are few outstanding differences in constructability, cost and schedule between the two station options or their A and B entrance solutions. None of the options require the redesign of the present Red Line Station at the Universal City site. Entrance Options 1B and 2B would require the relocation of the present entrance into the southern mezzanine. Option 2B would also require the long southern mezzanine with its two escalators to be reversed with the shorter single escalator mezzanine presently planned for deferral to some post-construction date.

Option 1A requires 8 total escalators and Option 2A requires 9 total including those for both the Red Line and the Ventura Freeway line stations at the Universal

City site. This is because the present Red Line entrance to the southern mezzanine is included. Both the 1B and 2B entrance options require 6 total escalators because they combine two entrances into one. Both of the A entrance options need 1 handicap elevator while both the B entrance options require 2 elevators.

6.1.5 Conclusions for the Adopted Universal City Site

Two Ventura Freeway line station locations intersecting the Red Line Station at the Universal City site were studied. Each station location was investigated for two entrance options. The one condition imposed on the designs is, that when fare gates are installed, the solution must have a free flow of patrons between the paid areas of the Ventura Freeway Line platform and the Red Line Universal City mezzanine.

The most likely candidates economically and functionally are Options 1A and 2A which combine the entrances for each of the two stations into a single entrance for both. Either of these options will allow the redesign of the presently proposed Red Line entrance for Universal City Station. The cost and efficiency of either of these solutions is about the same.

6.2 A New Ventura Freeway Median Transit Eastern Terminal Station and a New Red Line Station Adjacent to the Ventura Fwy at Lankershim Boulevard

The potential for relocating the eastern terminal station for the Ventura Freeway Transit alignment in the median of the Venture Freeway where it crosses Lankershim Boulevard is investigated. This proposal was raised in discussions between Mc Coy Associates and the Los Angeles Department of City Planning. See Drawings G-764 and G-765 This shortens the length of the Ventura Freeway aerial alignment by about one mile, but requires an additional Red Line Station near Riverside Drive at a point approximately midway between Red Line Universal City and North Hollywood Stations. These Red Line stations are presently about two miles apart.

A plaza is indicated at the northeast corner of the intersection between Lankershim Boulevard and Riverside Drive. The mezzanine for the Red Line Station would be about 60 feet below the street surface assuming the vertical alignment for the Red Line twin bore tunnels is not raised and the Red Line Modular station concept is used at this new location. The platform for the Red Line station would be about 16 feet below this mezzanine level. The platform for the Ventura Freeway Transit station would be between 50 and 55 feet above the street level depending on the final station design chosen. The minimum total vertical transfer distance from one station platform to the other would be about 125 feet.

The vertical circulation logic is simple with all ticketing functions occurring in a single plaza at street level, and the transfer between stations occurs entirely within the paid area. Nevertheless, to get from the outbound side platform of the Ventura Freeway Transit Station to the center platform of the Red Line Station Platform

would require the use of 5 sets of vertical circulation elements.

7.0 SP Burbank Branch Interface Studies with Red Line North Hollywood Station

The following interface studies between the subject alignments are in accord with discussions held during the joint RCC-EMC meeting of January 11, 1994. During subsequent meetings, the following criteria for the continuance of the Red Line from the Segment 3 North Hollywood Station was established. See Drawings G-740 and G-741:

- Maintain the present 500 foot North Hollywood tailtrack Module D, or;

- Replace Module D with a 122 foot Module A, installing a vent and exit structure in Tujunga Avenue or in Lankershim Boulevard, and interconnect Module A with the vent shaft by 750 feet of twin bore tunnels.

- Add 226 feet to Module D to increase the tail track length to extend 726 feet past the Nothe Hollywood Station platform.

The only physical structures to be quantified are Modules A and D, the vent and exit structure, and the twin bore tunnels. Module A for Hollywood/Highland Station has already been estimated. Its top of rails is 68 feet below the surface. Module D for North Hollywood is only 58 feet below the surface. The structural difference should be acceptable for this estimate, and only the difference in excavation and backfill should be revised. The vent and exit structure for Whittier/Atlantic Station in Contract C0591 with top of rails 66 feet below the surface, is nearly identical with the one proposed in Tujunga Avenue and has already been estimated for the East Side Extension. The utilities for the two locations should be reviewed for the site specific conditions.

The final decision was to add 226 feet to Module D for reasons of operating the trains in a efficient manner. See Section 3.0. Two conceptual drawings are included for Module D designated Options 1 and 2 that show the future operational consequences and maintaining this alternative.

APPENDIX A

Project Cost Estimate

Appendix A - Total Project Costs

The attached tables were prepared by The Rail Construction Corporation to incorporate MTA agency costs, escalation and project construction costs. Construction cost estimates were prepared by EMC and are documented in a report entitled San Fernando Valley East-West Rail Transit Project; Pre-Preliminary Construction Cost Estimate, Engineering Management Consultant, September 6, 1994.

TABLE 1

SAN FERNANDO VALLEY EAST – WEST RAIL TRANSIT PROJECT
S. P. BURBANK BRANCH
SUMMARY OF COST ESTIMATES
($1998 MILLIONS)

	ALT A DEEP BORE SUBWAY & MODULAR STATIONS (EIR ADOPTED 3A)	ALT A 2 DEEP BORE SUBWAY & OPEN AIR STATIONS	ALT B * OPEN AIR SUBWAY OPEN AIR STATIONS (NOT CONSISTENT WITH LEGISLATION)	ALT C OPEN AIR SUBWAY & CUT/COVER (CONSISTENT WITH LEGISLATION)
FULL PROJECT UNIVERSAL CITY / NORTH HOLLYWOOD TO WARNER CENTER	$2,274 (TABLE B-6)	$2,132 (TABLE B-8)	$2,061 (TABLE B-10)	$2,116 (TABLE B-12)
PHASE ONE ONLY UNIVERSAL CITY / NORTH HOLLYWOOD TO SAN DIEGO FWY	$ 796 (TABLE B-7)	$ 760 (TABLE B-9)	$ 735 (TABLE B-11)	$ 809 (TABLE B-13)

* STATE LEGISLATION (SB211–JUNE 1991) PROHIBITS ANY ALIGNMENTS ON THE SP BURBANK BRANCH BETWEEN HAZELTINE AND THE HOLLYWOOD FREEWAY THAT ARE NOT COVERED SUBWAY.

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SAN FERNANDO VALLEY EAST/WEST RAIL TRANSIT PROJECT
PROJECT COST ESTIMATE SUMMARY

TABLE A-2
SP BURBANK BRANCH
– ALTERNATIVE A
– FULL PROJECT (NORTH HOLLYWOOD TO WARNER CENTER)

ITEM DESCRIPTION	1994 $ ESTIMATED COST	1998 $ ESTIMATED COST
1A) GUIDEWAYS AND STRUCTURES	$420,260,000	$483,003,966
1B) DEWATERING/GROUND TREATMENT/WASTE HANDLING	$15,300,000	$17,584,259
2) STATIONS	$294,555,000	$338,531,466
3) MAIN YARD AND SHOP	$32,641,000	$37,514,235
4) SYSTEMWIDE EQUIPMENT	$211,790,000	$243,409,819
5) VEHICLES	$67,200,000	$77,232,824
SUBTOTAL (A)	$1,041,746,000	$1,197,276,571
6) PRE REVENUE OPERATION	$26,043,650	$29,931,914
7) OWNERS INSURANCE	$83,339,680	$95,782,126
8) MASTER AGREEMENTS	$26,043,650	$29,931,914
SUBTOTAL (B)	$135,426,980	$155,645,954
9) ART FOR TRANSIT (C)	$5,208,730	$5,986,383
SUBTOTAL (C)	$5,208,730	$5,986,383
10 A) RIGHT OF WAY (MTA PROPERTIES)	$159,000,000	$159,000,000
10 B) RIGHT OF WAY (PROPOSED TAKES)	$50,000,000	$57,464,899
SUBTOTAL (D)	$209,000,000	$216,464,899
11) PROF. SERVICES (E)	$419,009,781	$481,567,094
SUBTOTAL (E)	$419,009,781	$481,567,094
12) CONTINGENCY (F)		
A) ITEM 1A 12 %	$50,431,200	$57,960,476
B) ITEM 1B 10 %	$1,530,000	$1,758,426
C) ITEM 2 17 %	$50,074,350	$57,550,349
D) ITEMS 3, 4, 5 10 %	$31,163,100	$35,815,688
E) ITEMS 6, 7, 8 10 %	$13,542,698	$15,564,595
F) ITEM 10B 10 %	INCL. IN ITEM	INCL. IN ITEM
G) ITEM 11 10 %	$41,900,978	$48,156,709
SUBTOTAL (F)	$188,642,326	$216,806,244
GRAND TOTALS:	$1,999,033,818	$2,273,747,146

NOTES: (COSTS ARE SHOWN IN 1994 DOLLARS)

1A) GUIDEWAYS & STRUCTURES: DEEP BORE TUNNEL: NO. HLYWD TO HAZELTINE
AERIAL GUIDEWAY: HAZELTINE TO WHITE OAK
DEEP BORE TUNNEL: WHITE OAK TO TOPANGA

1B) WASTE HANDLING: LUMP SUM PER RCC ENVIRONMENTAL DEPT.

2) STATIONS: AERIAL (4 EA @ $6.8 MILLION)
MODULAR SUBWAY (3 EA @ $44 TO $47 MIL / 1 EA @ $58.5 MIL)
CUT & COVER (2 EA @ $37.4 MILLION)

3) YARD & SHOPS: SHERMAN WAY YARD @ $32.6 MILLION

4) SYSTEMWIDE EQUIPMENT: STANDARD TRACKWORK, COMMUNICATIONS, SIGNALIZATION, SIGNS & GRAPHICS

5) VEHICLES (HEAVY RAIL): (28 EA @ $2.4 MILLION)

6) PRE-REVENUE OPERATION: 2.5 % OF ITEMS 1 THRU 5

7) OWNERS INSURANCE: 8.0 % OF ITEMS 1 THRU 5

8) MASTER AGREEMENTS: 2.5 % OF ITEMS 1 THRU 5

9) ART IN TRANSIT: 0.5 % OF ITEMS 1 THRU 5

10) RIGHT-OF-WAY: A) PREVIOUSLY ACQUIRED MTA PROPERTIES
- S.P.T.C. RIGHT OF WAY : $116 MILLION
- DRIVE IN & OTHERS: $ 43 MILLION

B) NEW PARCELS TO BE ACQUIRED
- PER MTA REAL ESTATE DEPT.: $ 50 MILLION

11) PROFESSIONAL SERVICES: 22 % OF GRAND TOTAL

12) CONTINGENCIES:

GUIDEWAY & STRUCTURES	– 12.0%
WASTE HANDLING	– 10.0%
STATIONS	– 17.0%
SYSTEMS/YARD/VEHICLES	– 10.0%
STARTUP & OCIP	– 10.0%
RIGHT OF WAY	– 10.0%
PROFESSIONAL SERVICES	– 10.0%

ESCALATION FACTOR: 3.54 % PER ANNUM

HTL:[\123R3\ESTIMATE\SFV\SUBA2.WK3]

SAN FERNANDO VALLEY EAST/WEST RAIL TRANSIT PROJECT
PROJECT COST ESTIMATE SUMMARY

TABLE A-3
SP BURBANK BRANCH
– ALTERNATIVE A
– PHASE ONE ONLY (NORTH HOLLYWOOD TO I-405)

ITEM DESCRIPTION	1994 $ ESTIMATED COST	1998 $ ESTIMATED COST
1A) GUIDEWAYS AND STRUCTURES	$192,185,000	$220,877,832
1B) DEWATERING/GROUND TREATMENT/WASTE HANDLING	$750,000	$861,973
2) STATIONS	$60,490,000	$69,521,035
3) MAIN YARD AND SHOP	$2,045,000	$2,350,314
4) SYSTEMWIDE EQUIPMENT	$86,147,000	$99,008,573
5) VEHICLES	$19,200,000	$22,066,521
SUBTOTAL (A)	$360,817,000	$414,686,248
6) PRE REVENUE OPERATION	$9,020,425	$10,367,156
7) OWNERS INSURANCE	$28,865,360	$33,174,900
8) MASTER AGREEMENTS	$9,020,425	$10,367,156
SUBTOTAL (B)	$46,906,210	$53,909,212
9) ART FOR TRANSIT (C)	$1,804,085	$2,073,431
SUBTOTAL (C)	$1,804,085	$2,073,431
10 A) RIGHT OF WAY (MTA PROPERTIES)	$79,500,000	$79,500,000
10 B) RIGHT OF WAY (PROPOSED TAKES)	$8,450,000	$9,711,568
SUBTOTAL (D)	$87,950,000	$89,211,568
11) PROF. SERVICES (E)	$142,112,280	$163,329,356
SUBTOTAL (E)	$142,112,280	$163,329,356
12) CONTINGENCY (F)		
A) ITEM 1A 12 %	$23,062,200	$26,505,340
B) ITEM 1B 10 %	$75,000	$86,197
C) ITEM 2 17 %	$10,283,300	$11,818,576
D) ITEMS 3, 4, 5 10 %	$10,739,200	$12,342,541
E) ITEMS 6, 7, 8 10 %	$4,690,621	$5,390,921
F) ITEM 10B 10 %	INCL. IN ITEM	INCL. IN ITEM
G) ITEM 11 10 %	$14,211,228	$16,332,936
SUBTOTAL (F)	$63,061,549	$72,476,511
GRAND TOTALS:	$702,651,124	$795,686,327

NOTES: (COSTS ARE SHOWN IN 1994 DOLLARS)

1A) GUIDEWAYS & STRUCTURES: DEEP BORE TUNNEL: NO. HLYWD TO HAZELTINE
AERIAL GUIDEWAY: HAZELTINE TO I405 FRWY

1B) WASTE HANDLING: LUMP SUM PER RCC ENVIRONMENTAL DEPT.

2) STATIONS: AERIAL (2 EA @ $6.8 MILLION)
MODULAR SUBWAY (1 EA @ $56.5 MIL)

3) YARD & SHOPS: TEMPORARY STORAGE YARD FOR 28 VEHICLES

4) SYSTEMWIDE EQUIPMENT: STANDARD TRACKWORK, COMMUNICATIONS, SIGNALIZATION, SIGNS & GRAPHICS

5) VEHICLES (HEAVY RAIL): (8 EA @ $2.4 MILLION)

6) PRE-REVENUE OPERATION: 2.5 % OF ITEMS 1 THRU 5

7) OWNERS INSURANCE: 8.0 % OF ITEMS 1 THRU 5

8) MASTER AGREEMENTS: 2.5 % OF ITEMS 1 THRU 5

9) ART IN TRANSIT: 0.5 % OF ITEMS 1 THRU 5

10) RIGHT-OF-WAY: A) PREVIOUSLY ACQUIRED MTA PROPERTIES
– S.P.T.C. RIGHT OF WAY: $59.0 MILLION
– DRIVE IN & OTHERS: $20.5 MILLION
B) NEW PARCELS TO BE ACQUIRED
– PER MTA REAL ESTATE DEPT.: $8.45 MIL

11) PROFESSIONAL SERVICES: 22 % OF GRAND TOTAL

12) CONTINGENCIES:

GUIDEWAY & STRUCTURES	– 12.0%
WASTE HANDLING	– 10.0%
STATIONS	– 17.0%
SYSTEMS/YARD/VEHICLES	– 10.0%
STARTUP & OCIP	– 10.0%
RIGHT OF WAY	– 10.0%
PROFESSIONAL SERVICES	– 10.0%

ESCALATION FACTOR: 3.54 % PER ANNUM

HTL:[\123R3\ESTIMATE\SFV\SUBA1.WK3]

SAN FERNANDO VALLEY EAST/WEST RAIL TRANSIT PROJECT

PROJECT COST ESTIMATE SUMMARY

TABLE A-4
SP BURBANK BRANCH
– ALTERNATIVE A2
– FULL PROJECT (NORTH HOLLYWOOD TO WARNER CENTER)

ITEM DESCRIPTION	1994 $ ESTIMATED COST	1998 $ ESTIMATED COST
1A) GUIDEWAYS AND STRUCTURES	$428,893,000	$492,925,858
1B) DEWATERING/GROUND TREATMENT/WASTE HANDLING	$15,300,000	$17,584,259
2) STATIONS	$214,426,000	$246,439,368
3) MAIN YARD AND SHOP	$32,641,000	$37,514,235
4) SYSTEMWIDE EQUIPMENT	$212,989,000	$244,787,827
5) VEHICLES	$67,200,000	$77,232,824
SUBTOTAL (A)	$971,449,000	$1,116,484,371
6) PRE REVENUE OPERATION	$24,286,225	$27,912,109
7) OWNERS INSURANCE	$77,715,920	$89,318,750
8) MASTER AGREEMENTS	$24,286,225	$27,912,109
SUBTOTAL (B)	$126,288,370	$145,142,968
9) ART FOR TRANSIT (C)	$4,857,245	$5,582,422
SUBTOTAL (C)	$4,857,245	$5,582,422
10 A) RIGHT OF WAY (MTA PROPERTIES)	$159,000,000	$159,000,000
10 B) RIGHT OF WAY (PROPOSED TAKES)	$50,000,000	$57,464,899
SUBTOTAL (D)	$209,000,000	$216,464,899
11) PROF. SERVICES (E)	$391,882,169	$450,389,385
SUBTOTAL (E)	$391,882,169	$450,389,385
12) CONTINGENCY (F)		
A) ITEM 1A 12 %	$51,467,160	$59,151,103
B) ITEM 1B 10 %	$1,530,000	$1,758,426
C) ITEM 2 17 %	$36,452,420	$41,894,693
D) ITEMS 3, 4, 5 10 %	$31,283,000	$35,953,489
E) ITEMS 6, 7, 8 10 %	$12,628,837	$14,514,297
F) ITEM 10B 10 %	INCL. IN ITEM	INCL. IN ITEM
G) ITEM 11 10 %	$39,188,217	$45,038,938
SUBTOTAL (F)	$172,549,634	$198,310,945
GRAND TOTALS:	$1,876,026,418	$2,132,374,990

NOTES: (COSTS ARE SHOWN IN 1994 DOLLARS)

1A) GUIDEWAYS & STRUCTURES: DEEP BORE TUNNEL: NO. HLYWD TO HAZELTINE
AERIAL/RETAIN FILL: HAZELTINE TO WHITE OAK
DEEP BORE TUNNEL: WHITE OAK TO TOPANGA

1B) WASTE HANDLING: LUMP SUM PER RCC ENVIRONMENTAL DEPT.

2) STATIONS: AERIAL (4 EA. @ $6.8 MILLION)
OPEN AIR (3 EA. @ $22.7 MIL / 1 EA. @ $36.5 & $26.1 MIL)
MODULAR SUBWAY (1 EA. @ $56.5 MILLION)

3) YARD & SHOPS: SHERMAN WAY YARD @ $32.6 MILLION

4) SYSTEMWIDE EQUIPMENT: STANDARD TRACKWORK, COMMUNICATIONS, SIGNALIZATION, SIGNS & GRAPHICS

5) VEHICLES (HEAVY RAIL): (28 EA. @ $2.4 MILLION)

6) PRE-REVENUE OPERATION: 2.5 % OF ITEMS 1 THRU 5

7) OWNERS INSURANCE: 8.0 % OF ITEMS 1 THRU 5

8) MASTER AGREEMENTS: 2.5 % OF ITEMS 1 THRU 5

9) ART IN TRANSIT: 0.5 % OF ITEMS 1 THRU 5

10) RIGHT-OF-WAY:
A) PREVIOUSLY ACQUIRED MTA PROPERTIES
– S.P.T.C. RIGHT OF WAY : $116 MILLION
– DRIVE IN & OTHERS: $ 43 MILLION
B) NEW PARCELS TO BE ACQUIRED
– PER MTA REAL ESTATE DEPT.: $ 50 MILLION

11) PROFESSIONAL SERVICES: 22 % OF GRAND TOTAL

12) CONTINGENCIES:

GUIDEWAY & STRUCTURES	– 12.0%
WASTE HANDLING	– 10.0%
STATIONS	– 17.0%
SYSTEMS/YARD/VEHICLES	– 10.0%
STARTUP & OCIP	– 10.0%
RIGHT OF WAY	– 10.0%
PROFESSIONAL SERVICES	– 10.0%

ESCALATION FACTOR: 3.54 % PER ANNUM

HTL:[\123R3\ESTIMATE\SFV\SUBA22.WK3]

SAN FERNANDO VALLEY EAST/WEST RAIL TRANSIT PROJECT
PROJECT COST ESTIMATE SUMMARY

TABLE A-5
SP BURBANK BRANCH
- ALTERNATIVE A2
- PHASE ONE ONLY (NORTH HOLLYWOOD TO I-405)

ITEM DESCRIPTION	1994 $ ESTIMATED COST	1998 $ ESTIMATED COST
1A) GUIDEWAYS AND STRUCTURES	$195,066,000	$224,211,945
1B) DEWATERING/GROUND TREATMENT/WASTE HANDLING	$750,000	$861,973
2) STATIONS	$39,681,000	$45,605,293
3) MAIN YARD AND SHOP	$2,045,000	$2,350,314
4) SYSTEMWIDE EQUIPMENT	$86,147,000	$99,008,573
5) VEHICLES	$19,200,000	$22,066,521
SUBTOTAL (A)	$342,909,000	$394,104,620
6) PRE REVENUE OPERATION	$8,572,725	$9,852,616
7) OWNERS INSURANCE	$27,432,720	$31,528,370
8) MASTER AGREEMENTS	$8,572,725	$9,852,616
SUBTOTAL (B)	$44,578,170	$51,233,601
9) ART FOR TRANSIT (C)	$1,714,545	$1,970,523
SUBTOTAL (C)	$1,714,545	$1,970,523
10 A) RIGHT OF WAY (MTA PROPERTIES)	$79,500,000	$79,500,000
10 B) RIGHT OF WAY (PROPOSED TAKES)	$8,450,000	$9,711,568
SUBTOTAL (D)	$87,950,000	$89,211,568
11) PROF. SERVICES (E)	$135,201,583	$155,386,906
SUBTOTAL (E)	$135,201,583	$155,386,906
12) CONTINGENCY (F)		
A) ITEM 1A 12 %	$23,410,320	$26,905,433
B) ITEM 1B 10 %	$75,000	$86,197
C) ITEM 2 17 %	$6,745,770	$7,752,900
D) ITEMS 3, 4, 5 10 %	$10,739,200	$12,342,541
E) ITEMS 6, 7, 8 10 %	$4,457,817	$5,123,360
F) ITEM 10B 10 %	INCL. IN ITEM	INCL. IN ITEM
G) ITEM 11 10 %	$13,520,158	$15,538,691
SUBTOTAL (F)	$58,948,265	$67,749,122
GRAND TOTALS:	$671,301,563	$758,656,340

NOTES: (COSTS ARE SHOWN IN 1994 DOLLARS)

1A) GUIDEWAYS & STRUCTURES: DEEP BORE TUNNEL: NO. HLYWD TO HAZELTINE
AERIAL GUIDEWAY: HAZELTINE TO I405 FRWY

1B) WASTE HANDLING: LUMP SUM PER RCC ENVIRONMENTAL DEPT.

2) STATIONS: AERIAL (2 EA @ $6.8 MILLION)
OPEN AIR (1 EA @ $26.1 MIL)

3) YARD & SHOPS: TEMPORARY STORAGE YARD FOR 28 VEHICLES

4) SYSTEMWIDE EQUIPMENT: STANDARD TRACKWORK, COMMUNICATIONS, SIGNALIZATION, SIGNS & GRAPHICS

5) VEHICLES (HEAVY RAIL): (8 EA @ $2.4 MILLION)

6) PRE-REVENUE OPERATION: 2.5 % OF ITEMS 1 THRU 5

7) OWNERS INSURANCE: 8.0 % OF ITEMS 1 THRU 5

8) MASTER AGREEMENTS: 2.5 % OF ITEMS 1 THRU 5

9) ART IN TRANSIT: 0.5 % OF ITEMS 1 THRU 5

10) RIGHT-OF-WAY:
A) PREVIOUSLY ACQUIRED MTA PROPERTIES
- S.P.T.C. RIGHT OF WAY: $59.0 MILLION
- DRIVE IN & OTHERS: $20.5 MILLION
B) NEW PARCELS TO BE ACQUIRED
- PER MTA REAL ESTATE DEPT.: $8.45 MIL

11) PROFESSIONAL SERVICES: 22 % OF GRAND TOTAL

12) CONTINGENCIES:

GUIDEWAY & STRUCTURES	- 12.0%
WASTE HANDLING	- 10.0%
STATIONS	- 17.0%
SYSTEMS/YARD/VEHICLES	- 10.0%
STARTUP & OCIP	- 10.0%
RIGHT OF WAY	- 10.0%
PROFESSIONAL SERVICES	- 10.0%

ESCALATION FACTOR: 3.54 % PER ANNUM

HTL:(\123R3\ESTIMATE\SFV\SUBA12.WK3)

SAN FERNANDO VALLEY EAST/WEST RAIL TRANSIT PROJECT

PROJECT COST ESTIMATE SUMMARY

TABLE A-6
SP BURBANK BRANCH
– ALTERNATIVE B
– FULL PROJECT (NORTH HOLLYWOOD TO WARNER CENTER)

ITEM DESCRIPTION		1994 $ ESTIMATED COST	1998 $ ESTIMATED COST
1A) GUIDEWAYS AND STRUCTURES		$381,099,000	$437,996,310
1B) DEWATERING/GROUND TREATMENT/WASTE HANDLING		$16,600,000	$19,078,346
2) STATIONS		$224,590,000	$258,120,833
3) MAIN YARD AND SHOP		$32,641,000	$37,514,235
4) SYSTEMWIDE EQUIPMENT		$212,189,000	$243,868,389
5) VEHICLES		$67,200,000	$77,232,824
SUBTOTAL (A)		$934,319,000	$1,073,810,937
6) PRE REVENUE OPERATION		$23,357,975	$26,845,273
7) OWNERS INSURANCE		$74,745,520	$85,904,875
8) MASTER AGREEMENTS		$23,357,975	$26,845,273
SUBTOTAL (B)		$121,461,470	$139,595,422
9) ART FOR TRANSIT (C)		$4,671,595	$5,369,055
SUBTOTAL (C)		$4,671,595	$5,369,055
10 A) RIGHT OF WAY (MTA PROPERTIES)		$159,000,000	$159,000,000
10 B) RIGHT OF WAY (PROPOSED TAKES)		$50,000,000	$57,464,899
SUBTOTAL (D)		$209,000,000	$216,464,899
11) PROF. SERVICES (E)		$377,553,702	$433,921,706
SUBTOTAL (E)		$377,553,702	$433,921,706
12) CONTINGENCY (F)			
A) ITEM 1A	12 %	$45,731,880	$52,559,557
B) ITEM 1B	10 %	$1,660,000	$1,907,835
C) ITEM 2	17 %	$38,180,300	$43,880,542
D) ITEMS 3, 4, 5	10 %	$31,203,000	$35,861,545
E) ITEMS 6, 7, 8	10 %	$12,146,147	$13,959,542
F) ITEM 10B	10 %	INCL. IN ITEM	INCL. IN ITEM
G) ITEM 11	10 %	$37,755,370	$43,392,171
SUBTOTAL (F)		$166,676,697	$191,561,191
GRAND TOTALS:		$1,813,682,464	$2,060,723,210

NOTES: (COSTS ARE SHOWN IN 1994 DOLLARS)

1A) GUIDEWAYS & STRUCTURES: DEEP BORE TUNNEL: NO. HLYWD TO FULTON
OPEN AIR: FULTON TO HAZELTINE
AERIAL/RETAIN FILL: HAZELTINE TO WHITE OAK
OPEN AIR: WHITE OAK TO DESOTO

1B) WASTE HANDLING: LUMP SUM PER RCC ENVIRONMENTAL DEPT.

2) STATIONS: AERIAL (4 EA. @ $6.8 MILLION)
OPEN AIR (4 EA. @ $26.1 MIL / 1 EA. @ $36.5 MIL)
MODULAR SUBWAY (1 EA. @ $56.5 MILLION)

3) YARD & SHOPS: SHERMAN WAY YARD @ $32.6 MILLION

4) SYSTEMWIDE EQUIPMENT: STANDARD TRACKWORK, COMMUNICATIONS, SIGNALIZATION, SIGNS & GRAPHICS

5) VEHICLES (HEAVY RAIL): (28 EA. @ $2.4 MILLION)

6) PRE-REVENUE OPERATION: 2.5 % OF ITEMS 1 THRU 5

7) OWNERS INSURANCE: 8.0 % OF ITEMS 1 THRU 5

8) MASTER AGREEMENTS: 2.5 % OF ITEMS 1 THRU 5

9) ART IN TRANSIT: 0.5 % OF ITEMS 1 THRU 5

10) RIGHT-OF-WAY:
A) PREVIOUSLY ACQUIRED MTA PROPERTIES
– S.P.T.C. RIGHT OF WAY : $116 MILLION
– DRIVE IN & OTHERS: $ 43 MILLION
B) NEW PARCELS TO BE ACQUIRED
– PER MTA REAL ESTATE DEPT.: $ 50 MILLION

11) PROFESSIONAL SERVICES: 22 % OF GRAND TOTAL

12) CONTINGENCIES:

GUIDEWAY & STRUCTURES	– 12.0%
WASTE HANDLING	– 10.0%
STATIONS	– 17.0%
SYSTEMS/YARD/VEHICLES	– 10.0%
STARTUP & OCIP	– 10.0%
RIGHT OF WAY	– 10.0%
PROFESSIONAL SERVICES	– 10.0%

ESCALATION FACTOR: 3.54 % PER ANNUM

HTL:[\123R3\ESTIMATE\SFV\SUBB2.WK3]

SAN FERNANDO VALLEY EAST/WEST RAIL TRANSIT PROJECT

PROJECT COST ESTIMATE SUMMARY

TABLE A-7
SP BURBANK BRANCH
– ALTERNATIVE B
– PHASE ONE ONLY (NORTH HOLLYWOOD TO I-405)

ITEM DESCRIPTION	1994 $ ESTIMATED COST	1998 $ ESTIMATED COST
1A) GUIDEWAYS AND STRUCTURES	$182,379,000	$209,607,816
1B) DEWATERING/GROUND TREATMENT/WASTE HANDLING	$750,000	$861,973
2) STATIONS	$39,681,000	$45,605,293
3) MAIN YARD AND SHOP	$2,045,000	$2,350,314
4) SYSTEMWIDE EQUIPMENT	$86,147,000	$99,008,573
5) VEHICLES	$19,200,000	$22,066,521
SUBTOTAL (A)	$330,202,000	$379,500,491
6) PRE REVENUE OPERATION	$8,255,050	$9,487,512
7) OWNERS INSURANCE	$26,416,160	$30,360,039
8) MASTER AGREEMENTS	$8,255,050	$9,487,512
SUBTOTAL (B)	$42,926,260	$49,335,064
9) ART FOR TRANSIT (C)	$1,651,010	$1,897,502
SUBTOTAL (C)	$1,651,010	$1,897,502
10 A) RIGHT OF WAY (MTA PROPERTIES)	$79,500,000	$79,500,000
10 B) RIGHT OF WAY (PROPOSED TAKES)	$8,450,000	$9,711,568
SUBTOTAL (D)	$87,950,000	$89,211,568
11) PROF. SERVICES (E)	$130,297,952	$149,751,173
SUBTOTAL (E)	$130,297,952	$149,751,173
12) CONTINGENCY (F)		
A) ITEM 1A 12 %	$21,885,460	$25,152,938
B) ITEM 1B 10 %	$75,000	$86,197
C) ITEM 2 17 %	$6,745,770	$7,752,900
D) ITEMS 3, 4, 5 10 %	$10,739,200	$12,342,541
E) ITEMS 6, 7, 8 10 %	$4,292,626	$4,933,506
F) ITEM 10B 10 %	INCL. IN ITEM	INCL. IN ITEM
G) ITEM 11 10 %	$13,029,795	$14,975,117
SUBTOTAL (F)	$56,767,871	$65,243,200
GRAND TOTALS:	$649,795,083	$734,938,997

NOTES: (COSTS ARE SHOWN IN 1994 DOLLARS)

1A) GUIDEWAYS & STRUCTURES: DEEP BORE TUNNEL: NO. HLYWD TO FULTON
OPEN AIR: FULTON TO HAZELTINE
AERIAL GUIDEWAY: HAZELTINE TO I405 FRWY

1B) WASTE HANDLING: LUMP SUM PER RCC ENVIRONMENTAL DEPT.

2) STATIONS: AERIAL (2 EA @ $6.8 MILLION)
OPEN AIR (1 EA @ $26.1 MIL)

3) YARD & SHOPS: TEMPORARY STORAGE YARD FOR 26 VEHICLES

4) SYSTEMWIDE EQUIPMENT: STANDARD TRACKWORK, COMMUNICATIONS, SIGNALIZATION, SIGNS & GRAPHICS

5) VEHICLES (HEAVY RAIL): (8 EA @ $2.4 MILLION)

6) PRE-REVENUE OPERATION: 2.5 % OF ITEMS 1 THRU 5

7) OWNERS INSURANCE: 8.0 % OF ITEMS 1 THRU 5

8) MASTER AGREEMENTS: 2.5 % OF ITEMS 1 THRU 5

9) ART IN TRANSIT: 0.5 % OF ITEMS 1 THRU 5

10) RIGHT-OF-WAY:
A) PREVIOUSLY ACQUIRED MTA PROPERTIES
– S.P.T.C. RIGHT OF WAY: $59.0 MILLION
– DRIVE IN & OTHERS: $20.5 MILLION
B) NEW PARCELS TO BE ACQUIRED
– PER MTA REAL ESTATE DEPT.: $8.45 MIL

11) PROFESSIONAL SERVICES: 22 % OF GRAND TOTAL

12) CONTINGENCIES:

GUIDEWAY & STRUCTURES	– 12.0%
WASTE HANDLING	– 10.0%
STATIONS	– 17.0%
SYSTEMS/YARD/VEHICLES	– 10.0%
STARTUP & OCIP	– 10.0%
RIGHT OF WAY	– 10.0%
PROFESSIONAL SERVICES	– 10.0%

ESCALATION FACTOR: 3.54 % PER ANNUM

HTL:[\123R3\ESTIMATE\SFV\SUBB1.WK3]

SAN FERNANDO VALLEY EAST/WEST RAIL TRANSIT PROJECT

PROJECT COST ESTIMATE SUMMARY

TABLE A-8
SP BURBANK BRANCH
– ALTERNATIVE C
– FULL PROJECT (NORTH HOLLYWOOD TO WARNER CENTER)

ITEM DESCRIPTION	1994 $ ESTIMATED COST	1998 $ ESTIMATED COST
1A) GUIDEWAYS AND STRUCTURES	$388,181,000	$446,135,638
1B) DEWATERING/GROUND TREATMENT/WASTE HANDLING	$16,600,000	$19,078,346
2) STATIONS	$245,619,000	$282,289,420
3) MAIN YARD AND SHOP	$32,641,000	$37,514,235
4) SYSTEMWIDE EQUIPMENT	$211,789,000	$243,408,669
5) VEHICLES	$67,200,000	$77,232,824
SUBTOTAL (A)	$962,030,000	$1,105,658,134
6) PRE REVENUE OPERATION	$24,050,750	$27,641,478
7) OWNERS INSURANCE	$76,962,400	$88,452,731
8) MASTER AGREEMENTS	$24,050,750	$27,641,478
SUBTOTAL (B)	$125,063,900	$143,735,687
9) ART FOR TRANSIT (C)	$4,810,150	$5,528,296
SUBTOTAL (C)	$4,810,150	$5,528,296
10 A) RIGHT OF WAY (MTA PROPERTIES)	$159,000,000	$159,000,000
10 B) RIGHT OF WAY (PROPOSED TAKES)	$50,000,000	$57,464,899
SUBTOTAL (D)	$209,000,000	$216,464,899
11) PROF. SERVICES (E)	$388,247,377	$446,211,925
SUBTOTAL (E)	$388,247,377	$446,211,925
12) CONTINGENCY (F)		
A) ITEM 1A 12 %	$46,581,720	$53,536,277
B) ITEM 1B 10 %	$1,660,000	$1,907,835
C) ITEM 2 17 %	$41,755,230	$47,989,201
D) ITEMS 3, 4, 5 10 %	$31,163,000	$35,815,573
E) ITEMS 6, 7, 8 10 %	$12,506,390	$14,373,569
F) ITEM 10B 10 %	INCL. IN ITEM	INCL. IN ITEM
G) ITEM 11 10 %	$38,824,738	$44,621,193
SUBTOTAL (F)	$172,491,078	$198,243,647
GRAND TOTALS:	$1,861,642,505	$2,115,843,588

NOTES: (COSTS ARE SHOWN IN 1994 DOLLARS)

1A) GUIDEWAYS & STRUCTURES: DEEP BORE TUNNEL: NO. HLYWD TO FULTON
CUT & COVER: FULTON TO HAZELTINE
AERIAL/RETAIN FILL: HAZELTINE TO WHITE OAK
OPEN AIR: WHITE OAK TO DESOTO

1B) WASTE HANDLING: LUMP SUM PER RCC ENVIRONMENTAL DEPT.

2) STATIONS: AERIAL (4 EA @ $6.8 MILLION)
OPEN AIR (3 EA @ $26.1 MIL / 1 EA @ $36.5 MIL)
MODULAR SUBWAY (1 EA @ $56.5 & $47.1 MILLION)

3) YARD & SHOPS: SHERMAN WAY YARD @ $32.6 MILLION

4) SYSTEMWIDE EQUIPMENT: STANDARD TRACKWORK, COMMUNICATIONS, SIGNALIZATION, SIGNS & GRAPHICS

5) VEHICLES (HEAVY RAIL): (28 EA @ $2.4 MILLION)

6) PRE-REVENUE OPERATION: 2.5 % OF ITEMS 1 THRU 5

7) OWNERS INSURANCE: 8.0 % OF ITEMS 1 THRU 5

8) MASTER AGREEMENTS: 2.5 % OF ITEMS 1 THRU 5

9) ART IN TRANSIT: 0.5 % OF ITEMS 1 THRU 5

10) RIGHT-OF-WAY:
A) PREVIOUSLY ACQUIRED MTA PROPERTIES
– S.P.T.C. RIGHT OF WAY: $116 MILLION
– DRIVE IN & OTHERS: $ 43 MILLION
B) NEW PARCELS TO BE ACQUIRED
– PER MTA REAL ESTATE DEPT.: $ 50 MILLION

11) PROFESSIONAL SERVICES: 22 % OF GRAND TOTAL

12) CONTINGENCIES:

GUIDEWAY & STRUCTURES	– 12.0%
WASTE HANDLING	– 10.0%
STATIONS	– 17.0%
SYSTEMS/YARD/VEHICLES	– 10.0%
STARTUP & OCIP	– 10.0%
RIGHT OF WAY	– 10.0%
PROFESSIONAL SERVICES	– 10.0%

ESCALATION FACTOR: 3.54 % PER ANNUM

HTL [\123R3\ESTIMATE\SFV\SUBC2.WK3]

SAN FERNANDO VALLEY EAST/WEST RAIL TRANSIT PROJECT
PROJECT COST ESTIMATE SUMMARY

TABLE A-9
SP BURBANK BRANCH
- ALTERNATIVE C
- PHASE ONE ONLY (NORTH HOLLYWOOD TO I-405)

ITEM DESCRIPTION		1994 $ ESTIMATED COST	1998 $ ESTIMATED COST
1A) GUIDEWAYS AND STRUCTURES		$198,583,000	$228,231,040
1B) DEWATERING/GROUND TREATMENT/WASTE HANDLING		$750,000	$861,973
2) STATIONS		$60,710,000	$69,773,880
3) MAIN YARD AND SHOP		$2,045,000	$2,350,314
4) SYSTEMWIDE EQUIPMENT		$86,147,000	$99,008,573
5) VEHICLES		$19,200,000	$22,066,521
SUBTOTAL (A)		$367,435,000	$422,292,302
6) PRE REVENUE OPERATION		$9,185,875	$10,557,308
7) OWNERS INSURANCE		$29,394,800	$33,783,384
8) MASTER AGREEMENTS		$9,185,875	$10,557,308
SUBTOTAL (B)		$47,766,550	$54,897,999
9) ART FOR TRANSIT (C)		$1,837,175	$2,111,462
SUBTOTAL (C)		$1,837,175	$2,111,462
10 A) RIGHT OF WAY (MTA PROPERTIES)		$79,500,000	$79,500,000
10 B) RIGHT OF WAY (PROPOSED TAKES)		$8,450,000	$9,711,568
SUBTOTAL (D)		$87,950,000	$89,211,568
11) PROF. SERVICES (E)		$144,666,167	$166,264,533
SUBTOTAL (E)		$144,666,167	$166,264,533
12) CONTINGENCY (F)			
A) ITEM 1A	12 %	$23,829,960	$27,387,725
B) ITEM 1B	10 %	$75,000	$86,197
C) ITEM 2	17 %	$10,320,700	$11,861,560
D) ITEMS 3, 4, 5	10 %	$10,739,200	$12,342,541
E) ITEMS 6, 7, 8	10 %	$4,776,655	$5,489,800
F) ITEM 10B	10 %	INCL. IN ITEM	INCL. IN ITEM
G) ITEM 11	10 %	$14,466,617	$16,626,453
SUBTOTAL (F)		$64,208,132	$73,794,276
GRAND TOTALS:		$713,863,023	$808,572,140

NOTES: (COSTS ARE SHOWN IN 1994 DOLLARS)

1A) GUIDEWAYS & STRUCTURES: DEEP BORE TUNNEL: NO. HLYWD TO FULTON
CUT & COVER: FULTON TO HAZELTINE
AERIAL GUIDEWAY: HAZELTINE TO I405 FRWY

1B) WASTE HANDLING: LUMP SUM PER RCC ENVIRONMENTAL DEPT.

2) STATIONS: AERIAL (2 EA @ $6.8 MILLION)
CUT & COVER (1 EA @ $47.1 MIL)

3) YARD & SHOPS: TEMPORARY STORAGE YARD FOR 26 VEHICLES

4) SYSTEMWIDE EQUIPMENT: STANDARD TRACKWORK, COMMUNICATIONS, SIGNALIZATION, SIGNS & GRAPHICS

5) VEHICLES (HEAVY RAIL): (8 EA @ $2.4 MILLION)

6) PRE-REVENUE OPERATION: 2.5 % OF ITEMS 1 THRU 5

7) OWNERS INSURANCE: 8.0 % OF ITEMS 1 THRU 5

8) MASTER AGREEMENTS: 2.5 % OF ITEMS 1 THRU 5

9) ART IN TRANSIT: 0.5 % OF ITEMS 1 THRU 5

10) RIGHT-OF-WAY: A) PREVIOUSLY ACQUIRED MTA PROPERTIES
- S.P.T.C. RIGHT OF WAY: $59.0 MILLION
- DRIVE IN & OTHERS: $20.5 MILLION
B) NEW PARCELS TO BE ACQUIRED
- PER MTA REAL ESTATE DEPT.: $8.45 MIL

11) PROFESSIONAL SERVICES: 22 % OF GRAND TOTAL

12) CONTINGENCIES:

GUIDEWAY & STRUCTURES	- 12.0%
WASTE HANDLING	- 10.0%
STATIONS	- 17.0%
SYSTEMS/YARD/VEHICLES	- 10.0%
STARTUP & OCIP	- 10.0%
RIGHT OF WAY	- 10.0%
PROFESSIONAL SERVICES	- 10.0%

ESCALATION FACTOR: 3.54 % PER ANNUM

HTL:[\123R3\ESTIMATE\SFV\SUBC1.WK3]

APPENDIX B

Tables II, III, IV

Alternative Construction Type by Alignment Station

T E II

San Fernando Valley SP Burbank Branch Alignment. **Phase I Alternate A**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
420+00 to 427+50	Shallow open cut guideway	750	-3.5	87.0	Start Phase I, Sta. 420+00	
427+50 to 434+00	On fill guideway	650	+2.5	37.0		
434+00 to 442+50	Retained fill guideway	850	+13.5	45.0		
442+50 to 443+70	Aerial guideway	120	+21.0	28.0		
443+70 to 448+80	Aerial station	510	+23.0	56.0	Sepulveda Station	
448+80 to 472+00	Aerial guideway	2320	+23.0	28.0		
472+00 to 473+50	Aerial guideway	150	+25.0	28.0	Kester Ave. Overpass	
473+50 to 492+20	Aerial guideway	1870	+25.0	28.0		
492+20 to 494+30	Aerial guideway	210	+24.0	28.0	Vesper Ave. Overpass	
494+30 to 498+70	Aerial guideway	440	+22.0	28.0		
498+70 to 499+00	Aerial guideway	30	+23.0	28.0	Van Nuys Blvd. Overpass	
499+00 to 504+10	Aerial station	510	+22.0	56.0	Van Nuys Station	

T E II

San Femando Valley SP Burbank Branch Alignment. **Phase I Alternate A**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
504+10 to 510+00	Aerial guideway	590	+22.0	28.0		
510+00 to 514+00	Retained fill guideway	400	+9.0	44.0	Tracks intercept grade at 515+00	
514+00 to 525+20	Open retained cut guideway	1120	-18.0	34.0	Portal at 526+20	
525+20 to 527+20	Cut & cover street utility	200	-38.0	34.0		
527+20 to 532+20	Cut & cover guideway	500	-40.0	34.0		
532+20 to 581+38	Twin bore tunnels	4918	-47.0	----		
581+38 to 585+10	Modular station	372	-47.0	64.2	Fulton Burbank Station	Station width shown is from outside face to outside face of station wall typical
585+10 to 589+60	Modular station	450	-47.0	59.8	Fulton Burbank Station	
589+60 to 590+40	Modular station	80	-47.0	67.7	Fulton Burbank Station	
590+40 to 614+00	Twin bore tunnels	2360	-50.0	----		
614+00 to 637+00	Twin bore tunnels	2300	-63.0	----	Under Tujunga Wash	
637+00 to 666+15	Twin bore tunnels	2915	-56.5	----	On 60 feet SP ROW	

T E II

San Fernando Valley SP Burbank Branch Alignment. **Phase I Alternate A**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
666+15 to 667+65	Cut & cover structure	135	-45.5	----	Mid-Line Vent Structure	
667+50 to 702+00	Twin bore tunnels	3450	-52.0	----	In 60 feet SP ROW	
702+00 to 715+00	Twin bore tunnels	1300	-55.0	----	In 60 feet SP ROW	
715+00 to 732+70	Twin bore tunnels	1770	-57.0	----	End Phase II, Sta. 750+00	Tunnel easement required
	TOTAL:	31,270				

T/ : II

San Fernando Valley SP Burbank Branch Alignment. **Phase II Alternate A**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
0+00 to 6+20	Twin bore tunnels	<620>	No Tracks	----	Begin Phase II, Sta. 0+00 Line in Victory Blvd.	
6+20 to 11+20	Modular station	500	-51.0	64.2	Topanga Station	Phase II construction start @ Sta. 6+20
11+20 to 15+70	Modular station	450	-50.0	60.8	Topanga Station	
15+70 to 19+42	Modular station	372	-50.0	64.5	Topanga Station	
19+42 to 95+00	Twin bore tunnels	7558	-50.0	----	Line in Victory Blvd.	
95+00 to 107+70	Twin bore tunnels	1270	-47.0	----	In 100 ft. SP ROW	
107+70 to 108+50	Modular station	80	-47.0	68.7	Winnetka Station	
108+50 to 113+00	Modular station	450	-47.0	60.8	Winnetka Station	
113+00 to 113+80	Modular station	80	-47.0	68.7	Winnetka Station	
113+80 to 153+03	Twin bore tunnels	3923	-48.0	----	In 100 ft. SP ROW	
153+03 to 153+83	Modular station	80	-48.0	67.7	Tampa Station	
153+83 to 158+33	Modular station	450	-48.0	59.8	Tampa Station	

T[illegible] II

San Fernando Valley SP Burbank Branch Alignment. **Phase II Alternate A**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
158+33 to 162+05	Modular station	372	-48.0	64.2	Tampa Station	
162+05 to 211+20	Twin bore tunnels	4915	-52.0	-----	In 100 ft. SP ROW	
211+20 to 212+00	Modular station	80	-48.0	67.7	Reseda Station	
212+00 to 216+50	Modular station	450	-48.0	59.8	Reseda Station	
216+50 to 217+30	Modular station	80	-48.0	67.7	Reseda Station	
217+30 to 272+20	Twin bore tunnels	5490	-49.0	-----	In 100 ft. SP ROW	
272+20 to 273+00	Modular station	80	-47.0	67.7	White Oak Station	
273+00 to 277+50	Modular station	450	-46.0	59.8	White Oak Station	
277+50 to 278+30	Modular station	80	-46.0	67.7	White Oak Station	
278+30 to 282+00	Cut & cover guideway	370	-46.0	58.8	Portal at 282+00	
282+00 to 298+10	Retained Open cut guideway	1610	-22.0	34.0		
298+10 to 302+60	Deck bridge	450	-1.0	28.0	L. A. River Crossing	

San Fernando Valley SP Burbank Branch Alignment. **Phase II Alternate A**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
302+60 to 304+40	At grade guideway	180	+0.0	37.0		
304+40 to 325+00	Retained fill guideway	2060	+8.0	43.0	Tracks became aerial 325+00	
325+00 to 330+75	Aerial guideway	575	+10.0	28.0	Not in SP ROW	
330+75 to 335+85	Aerial station	510	+22.0	56.0	Balboa Station	
335+85 to 383+30	Aerial guideway	4745	+22.0	28.0		
383+30 to 383+65	Aerial guideway	35	+23.0	28.0	Woodley Ave. Overpass	
383+65 to 388+75	Aerial station	510	+22.0	56.0	Woodley Station	
388+75 to 399+00	Aerial guideway	1025	+19.0	28.0		
399+00 to 409+00	Retained Fill	1000	+8.5	43.0	Tracks Intercept ground @ 409+00	
409+00 to 420+00	Tracks at grade	1100	+3.0	37.0	End Phase II Station 420+00	
	TOTAL:	41,380				

San Fernando Valley SP Burbank Branch Alignment. **Phase I Alternate B**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
420+00 to 427+50	Shallow open cut guideway	750	-3.5	87.0	Start Phase I, Sta. 420+00	Tracks intercept ground at Sta. 427+00
427+50 to 434+00	On fill guideway	650	+2.5	37.0		
434+00 to 442+50	Retained fill guideway	850	+13.50	45.0		
442+50 to 443+70	Aerial guideway	120	+21.0	28.0		
443+70 to 448+80	Aerial station	510	+23.0	56.0	Sepulveda Station	
448+80 to 491+00	Retained fill guideway	4220	+13.0	45.0		
491+00 to 499+00	Aerial guideway	800	+21.0	28.0		
499+00 to 504+10	Aerial station	510	+22.0	56.0	Van Nuys Station	
504+10 to 510+00	Aerial guideway	590	+22.0	28.0		
510+00 to 514+00	Retained fill guideway	400	+9.0	44.0		
514+00 to 525+20	Open retained cut guideway	1120	-18.0	34.0		
525+20 to 527+20	Cut and cover street utility	200	-37.0	34.0		

T E III

San Fernando Valley SP Burbank Branch Alignment. Phase I Alternate B

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
527+20 to 552+00	Open retained cut guideway	2480	-38.0	34.0		
552+00 to 554+00	Cut and cover street utility	200	-39.0	34.0		
554+00 to 556+40	Open retained cut guideway	240	-38.0	34.0	Tracks intercept grade at 515+00	
556+40 to 558+40	Cut and cover street utility	200	-36.50	34.0	Portal at 526+00	
558+40 to 573+77	Open retained cut guideway	1537	-24.0	34.0		
573+77 to 581+40	Open retained cut guideway	763	-23.0	40.0		
581+40 to 584+00	Cut and cover ancillary	260	-35.0	58.0	Fulton Burbank Station	
584+00 to 588+50	Open air station	450	-34.50	52.0	Fulton Burbank Station	
588+50 to 590+20	Cut and cover ancillary	170	-36.0	58.0	Fulton Burbank Station	
590+20 to 594+20	Cut and cover street utility	400	-40.0	38.0		
594+20 to 595+50	Cut and cover guideway	130	-47.50	38.0		
595+50 to 666+20	Twin bore tunnels	7070	-59.0	----		

T : III

San Fernando Valley SP Burbank Branch Alignment. **Phase I Alternate B**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
666+20 to 667+70	Cut and cover guideway	150	-45.0	----	Mid-Line Vent Structure	
667+70 to 710+00	Twin bore tunnels	4230	-50.0	----	In 60 feet SP ROW	
710+00 to 750+00	Twin bore tunnels	4000	-58.0	----	Tunnel easement required	
	TOTAL:	**33,000**				

T :III

San Fernando Valley SP Burbank Branch Alignment. **Phase II Alternate B**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
0+00 to 6+15	Cut & cover guideway	<615>	No tracks	----	Line in Victory Blvd.	No construction
6+15 to 11+20	Cut & cover ancillary	505	-32.0	58.0	Topanga Station	
11+20 to 15+70	Cut & cover side station	450	-31.0	60.0	Topanga Station	Phase II begin @ Sta. 6+15
At 13+45	Cut & cover ancillary	460	-31.0	60.0	Under Owensmouth Ave. at Topanga Station	
15+70 to 18+95	Cut & cover ancillary	325	-31.0	58.0	Topanga Station	
18+95 to 48+00	Cut & cover guideway	2905	-32.0	34.0	Line in Victory Blvd.	
48+00 to 49+00	Cut & cover guideway	100	-32.0	34.0		
49+00 to 51+80	Open retained cut guideway	280	-32.0	34.0	In 100 ft. SP ROW	
51+80 to 53+80	Cut & cover guideway	200	-32.0	34.0		
53+80 to 78+80	Open retained cut guideway	2500	-19.0	34.0		
78+80 to 80+80	Cut & cover street utility	200	-29.0	34.0		
80+80 to 92+30	Open retained cut guideway	1150	-31.0	34.0		

TA :III

San Femando Valley SP Burbank Branch Alignment. **Phase II Alternate B**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
92+30 to 92+70	Cut & cover street utility	40	-32.0	34.0		
92+70 to 101+75	Open retained cut guideway	905	-31.0	34.0		
101+75 to 106+00	Open retained cut guideway	425	-31.5	44.2		
106+00 to 107+75	Cut & cover street utility	175	-32.0	44.2	In 100 ft. SP ROW	
107+75 to 109+50	Cut & cover ancillary	175	-33.0	58.0	Winnetka Station	
109+50 to 114+00	Open air station	450	-36.0	52.0	Winnetka Station	
114+00 to 116+55	Cut & cover ancillary	255	-36.0	58.0	Winnetka Station	
116+55 to 119+20	Cut & cover street utility	265	-37.0	42.8		
119+20 to 121+75	Open retained cut guideway	255	-36.0	42.8		
121+75 to 123+30	Open retained cut guideway	155	-36.0	34.0		
123+30 to 123+80	Cut & cover street utility	50	-36.0	34.0		
123+80 to 134+50	Open retained cut guideway	1070	-36.0	34.0		

San Fernando Valley SP Burbank Branch Alignment. **Phase II Alternate B**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
134+50 to 136+50	Cut & cover street utility	200	-37.0	34.0		
136+50 to 146+77	Open retained cut guideway	1027	-36.0	34.0		
146+77 to 153+15	Open retained cut guideway	638	-35.0	38.0		
153+15 to 157+00	Cut & cover ancillary	385	-35.0	58.0	Tampa Station	
157+00 to 162+00	Open air station	500	-36.0	52.0	Tampa Station	
162+00 to 165+20	Cut & cover street utility	320	-36.0	58.0		
165+20 to 169+25	Open retained cut guideway	405	-34.0	40.0		
169+25 to 174+00	Open retained cut guideway	475	-27.0	34.0		
174+00 to 184+00	Open retained cut guideway	1000	-21.0	34.0		
184+00 to 190+30	Open retained cut guideway	630	-28.0	34.0		
190+30 to 192+30	Cut & cover street utility	200	-36.0	34.0		
192+30 to 203+50	Open retained cut guideway	1120	-38.0	34.0		

T… III

San Fernando Valley SP Burbank Branch Alignment. **Phase II Alternate B**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
203+50 to 208+70	Open retained cut guideway	520	-38.0	42.8		
208+70 to 211+25	Cut and cover ancillary	255	-36.0	58.0	Reseda Station	
211+25 to 215+75	Open air station	450	-34.0	52.0	Reseda Station	
215+75 to 217+50	Cut and cover ancillary	175	-33.0	58.0	Reseda Station	
217+50 to 219+00	Cut & cover street utility	150	-33.0	44.2		
219+00 to 223+50	Open cut guideway	450	-34.0	44.2		
223+50 to 232+90	Cut and cover guideway	940	-35.0	34.0		
232+90 to 233+30	Cut & cover street utility	40	-36.0	34.0		
233+30 to 237+50	Open cut guideway	420	-37.0	34.0		
237+50 to 237+90	Cut & cover street utility	40	-38.0	34.0		
237+90 to 243+50	Open cut guideway	560	-37.0	34.0		
243+50 to 245+50	Cut & cover street utility	200	-33.0	34.0		

TABLE III

San Fernando Valley SP Burbank Branch Alignment. **Phase II Alternate B**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
245+50 to 265+75	Open cut guideway	2025	-22.0	34.0		
265+75 to 270+05	Open retained cut guideway	430	-27.5	44.2		
270+05 to 271+75	Cut & cover street utility	170	-34.0	44.2		
271+75 to 273+50	Cut & cover ancillary	175	-34.0	58.0	White Oak Station	
273+50 to 278+00	Open air station	450	-33.0	52.0	White Oak Station	
278+00 to 280+55	Cut & cover ancillary	255	-34.0	58.0	White Oak Station	
280+55 to 285+75	Open retained cut guideway	520	-31.5	42.8		
285+75 to 298+20	Open retained cut guideway	1245	-12.0	34.0		
298+20 to 302+60	Deck bridge	440	-3.0	28.0	L. A. River Crossing	
302+60 to 304+40	At grade guideway	180	0.0	37.0		
304+40 to 325+00	Retained fill guideway	2060	+8.0	43.0		
325+00 to 330+75	Aerial guideway	575	+21.0	28.0		

T[illegible] III

San Fernando Valley SP Burbank Branch Alignment. **Phase II Alternate B**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
330+75 to 335+85	Aerial station	510	+22.0	56.0	Balboa Station	
335+85 to 342+80	Aerial guideway	695	+22.0	28.0		
342+80 to 346+50	Retained fill guideway	370	+13.0	45.0		
346+50 to 374+30	On fill guideway	2780	+6.0	47.0		
374+30 to 379+00	Retained fill guideway	470	+9.0	43.5		
379+00 to 383+65	Aerial guideway	465	+22.0	28.0		
383+65 to 388+75	Aerial Station	510	+23.0	56.0	Woodley Station	
388+75 to 394+70	Aerial guideway	595	+20.0	28.0		
394+70 to 404+00	Retained fill guideway	930	+12.0	44.5		
404+00 to 409+00	On fill guideway	500	+4.0	37.0		
409+00 to 420+00	Shallow open cut guideway	1100	-4.0	87.0		Phase II ends @ Sta. 420+00
	TOTAL:	**41,385**				

T/ :IV

San Fernando Valley SP Burbank Branch Alignment. **Phase I Alternate C**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
420+00 to 427+50	Retained fill guideway guideway	750	-3.5	87.0		
427+50 to 434+00	On fill guideway	650	+2.5	37.0	Start Phase 420+00	
434+00 to 442+50	Retained fill guideway	850	+13.5	45.0		
442+50 to 443+70	Aerial guideway	120	+21.0	28.0		
443+70 to 448+80	Aerial station	510	+23.0	56.0	Sepulveda Station	
448+80 to 491+00	Retained fill	4220	+13.0	45.0		
491+00 to 499+00	Aerial guideway	800	+21.0	28.0		
499+00 to 504+10	Aerial station	510	+22.0	56.0	Van Nuys Station	
504+10 to 510+00	Aerial guideway	590	+22.0	28.0		
510+00 to 514+00	Retained fill guideway	400	+9.0	44.0	Tracks intercept grade at 515+00	
514+00 to 525+20	Open retained cut guideway	1120	-18.0	34.0		
525+20 to 527+20	Cut and cover street utility	200	-37.0	34.0		

TA[illegible] IV

San Fernando Valley SP Burbank Branch Alignment. **Phase I Alternate C**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
527+20 to 552+00	Cut and cover guideway	2480	-38.0	34.0		
552+00 to 554+00	Cut and cover street utility	200	-39.0	34.0		
554+00 to 556+40	Cut and cover guideway	240	-38.0	34.0		
556+40 to 558+40	Cut and cover street utility	200	-36.5	34.0		
558+40 to 581+40	Cut and cover guideway	2300	-32.5	34.0		
581+40 to 584+00	Cut and cover ancillary	260	-35.0	58.0	Fulton Burbank Station	
584+00 to 588+50	Cut and cover station	450	-34.5	52.0	Fulton Burbank Station	
588+50 to 590+20	Cut and cover ancillary	170	-36.0	58.0	Fulton Burbank Station	
590+20 to 594+20	Cut and cover street utility	400	-40.0	38.0		
594+20 to 595+50	Cut and cover guideway	130	-42.0	34.0		
595+50 to 666+20	Twin bore tunnels	7070	-59.0	—	Under Tujunga Wash	
666+20 to 667+70	Cut & cover structures	150	-45.0	—	Mid-Line Vent Structure	

TABLE IV

San Fernando Valley SP Burbank Branch Alignment. **Phase I Alternate C**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
667+70 to 710+00	**TOTAL:**	4230	-50.0	-----	In 60 feet SP ROW	
710+00 to 750+00	Twin bore tunnels	4000	-58.0	-----	Tunnel easement required	
	TOTAL:	**33,000**				

T E IV

San Fernando Valley SP Burbank Branch Alignment. **Phase II Alternate C**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
0+00 to 6+15	Cut & cover guideway	<615>	No tracks	-----	Line in Victory Blvd.	No construction
6+15 to 11+20	Cut & cover ancillary	505	-32.0	58.0	Topanga Station	
11+20 to 15+70	Cut & cover side station	450	-31.0	60.0	Topanga Station	Phase II begin @ Sta. 6+15
At 13+45	Cut & cover ancillary	460	-31.0	60.0	Under Owensmouth Ave. at Topanga Station	
15+70 to 18+95	Cut & cover ancillary	325	-31.0	58.0	Topanga Station	
18+95 to 48+00	Cut & cover guideway	2905	-32.0	34.0	Line in Victory Blvd.	
48+00 to 49+00	Cut & cover guideway	100	-32.0	34.0		
49+00 to 51+80	Open retained cut guideway	280	-32.0	34.0	In 100 ft. SP ROW	
51+80 to 53+80	Cut & cover guideway	200	-32.0	34.0		
53+80 to 78+80	Open retained cut guideway	2500	-19.0	34.0		
78+80 to 80+80	Cut & cover street utility	200	-29.0	34.0		
80+80 to 92+30	Open retained cut guideway	1150	-31.0	34.0		

TABLE IV

San Fernando Valley SP Burbank Branch Alignment. **Phase II Alternate C**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
92+30 to 92+70	Cut & cover street utility	40	-32.0	34.0		
92+70 to 101+75	Open retained cut guideway	905	-31.0	34.0		
101+75 to 106+00	Open retained cut guideway	425	-31.5	44.2		
106+00 to 107+75	Cut & cover street utility	175	-32.0	44.2	In 100 ft. SP ROW	
107+75 to 109+50	Cut & cover ancillary	175	-33.0	58.0	Winnetka Station	
109+50 to 114+00	Open air station	450	-36.0	52.0	Winnetka Station	
114+00 to 116+55	Cut & cover ancillary	255	-36.0	58.0	Winnetka Station	
116+55 to 119+20	Cut & cover street utility	265	-37.0	42.8		
119+20 to 121+75	Open retained cut guideway	255	-36.0	42.8		
121+75 to 123+30	Open retained cut guideway	155	-36.0	34.0		
123+30 to 123+80	Cut & cover street utility	50	-36.0	34.0		
123+80 to 134+50	Open retained cut guideway	1070	-36.0	34.0		

T E IV

San Fernando Valley SP Burbank Branch Alignment. **Phase II Alternate C**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
134+50 to 136+50	Cut & cover street utility	200	-37.0	34.0		
136+50 to 146+77	Open retained cut guideway	1027	-36.0	34.0		
146+77 to 153+15	Open retained cut guideway	638	-35.0	38.0		
153+15 to 157+00	Cut & cover ancillary	385	-35.0	58.0	Tampa Station	
157+00 to 162+00	Open air station	500	-36.0	52.0	Tampa Station	
162+00 to 165+20	Cut & cover street utility	320	-36.0	58.0		
165+20 to 169+25	Open retained cut guideway	405	-34.0	40.0		
169+25 to 174+00	Open retained cut guideway	475	-27.0	34.0		
174+00 to 184+00	Open retained cut guideway	1000	-21.0	34.0		
184+00 to 190+30	Open retained cut guideway	630	-28.0	34.0		
190+30 to 192+30	Cut & cover street utility	200	-36.0	34.0		
192+30 to 203+50	Open retained cut guideway	1120	-38.0	34.0		

T E IV

San Fernando Valley SP Burbank Branch Alignment. **Phase II Alternate C**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
203+50 to 208+70	Open retained cut guideway	520	-38.0	42.8		
208+70 to 211+25	Cut and cover ancillary	255	-36.0	58.0	Reseda Station	
211+25 to 215+75	Open air station	450	-34.0	52.0	Reseda Station	
215+75 to 217+50	Cut and cover ancillary	175	-33.0	58.0	Reseda Station	
217+50 to 219+00	Cut & cover street utility	150	-33.0	44.2		
219+00 to 223+50	Open cut guideway	450	-34.0	44.2		
223+50 to 232+90	Cut and cover guideway	940	-35.0	34.0		
232+90 to 233+30	Cut & cover street utility	40	-36.0	34.0		
233+30 to 237+50	Open cut guideway	420	-37.0	34.0		
237+50 to 237+90	Cut & cover street utility	40	-38.0	34.0		
237+90 to 243+50	Open cut guideway	560	-37.0	34.0		
243+50 to 245+50	Cut & cover street utility	200	-33.0	34.0		

T[illegible] IV

San Fernando Valley SP Burbank Branch Alignment. **Phase II Alternate C**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
245+50 to 265+75	Open retained cut guideway	2025	-22.0	34.0		
265+75 to 270+05	Open retained cut guideway	430	-27.5	44.2		
270+05 to 271+75	Cut & cover street utility	170	-34.0	44.2		
271+75 to 273+50	Cut & cover ancillary	175	-34.0	58.0	White Oak Station	
273+50 to 278+00	Open air station	450	-33.0	52.0	White Oak Station	
278+00 to 280+55	Cut & cover ancillary	255	-34.0	58.0	White Oak Station	
280+55 to 285+75	Open retained cut guideway	520	-31.5	42.8		
285+75 to 298+20	Open retained cut guideway	1245	-12.0	34.0		
298+20 to 302+60	Deck bridge	440	-3.0	28.0	L. A. River Crossing	
302+60 to 304+40	At grade guideway	180	0.0	37.0		
304+40 to 325+00	Retained fill guideway	2060	+8.0	43.0		
325+00 to 330+75	Aerial guideway	575	+21.0	28.0		

T[illegible] IV

San Fernando Valley SP Burbank Branch Alignment. **Phase II Alternate C**

Stationing	Type of Construction	Length (Feet)	Average Top of Rail Depth/ Height (Feet)	Average Width (Feet)	Remarks	Comments
330+75 to 335+85	Aerial station	510	+22.0	56.0	Balboa Station	
335+85 to 383+30	Aerial guideway	4745	+21.5	28.0		
383+30 to 383+65	Aerial guideway	35	+22.0	28.0	Woodley Ave. Overpass	
383+65 to 388+75	Aerial station	510	+22.0	56.0	Woodley Station	
388+75 to 399+15	Aerial guideway	1040	+19.0	28.0		
399+15 to 403+15	Retained fill guideway	400	+13.0	45.0		
403+15 to 409+00	On fill guideway	585	+5.0	43.0		
409+00 to 420+00	Shallow open cut guideway	1100	-4.0	87.0	End Phase 2 Station 420+00	
	TOTAL:	**41,385**				