SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

Metro Rail Project

CONSTRUCTION OPTIONS THROUGH MACARTHUR PARK LAKE

February 9, 1988

General Consultant
Metro Rail Transit Consultants
DMJM/PBQD/KE/HWA

CONSTRUCTION OPTIONS THROUGH MACARTHUR PARK LAKE

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I. EXECUTIVE SUMMARY

A. Background

The Metro Rail Project is an 18.6 mile rapid transit line that was adopted as the Locally Preferred Alternative (LPA) for construction. A capital grant application for the LPA was submitted to the Urban Mass Transportation Administration (UMTA). UMTA determined that it was unable to commit to funding the full 18.6 mile system or a shorter 8.8 mile segment identified in the FEIS due to budget constraints and a legislative prohibition on the commitment of federal funds beyond that current fiscal year (1986). The Southern California Rapid Transit District (SCRTD) proposed a 4.4 mile, five-station Minimum Operable Segment (MOS-1) extending from the Yard and shops facility to the Wilshire/Alvarado Station. MOS-1 was approved for full funding by Congress and signed by the President into law on December 19, 1985. Construction of MOS-1 is now underway.

In March, 1985, a fire attributed to natural gas seepage occurred at the Ross Dress-for-Less store located on Fairfax Avenue in close proximity to the Metro Rail LPA. This prompted what became known as the Congressionally Ordered Re-Engineering (CORE) study. The CORE study evaluated several alignments that avoided the area identified by the City of Los Angeles as a hazardous or potentially hazardous risk area.

On April 30, 1987, the District Board of Directors adopted a new preferred alignment for which a draft SEIS/SEIR was prepared in July, 1987. Several studies have been conducted to evaluate construction techniques and arrive at a cost-effective design for the Metro Rail segment past Wilshire/Alvarado Station. The first Metro Rail segment to be designed and constructed west of Alvarado Street will be under the MacArthur Park lake.

Los Angeles City Councilwoman Gloria Molina expressed a number of concerns regarding the impact of the Metro Rail Project on MacArthur Park. Her concerns included:

- Construction alternatives at MacArthur Park, including funding of the present study, an alternate location for the pocket track, and the construction duration period.

- Explicit commitment by SCRTD to fund the reconstruction and sealing of the MacArthur Park lake.

- o A community review of construction requirements, including securing construction area staging preventing visual blight or unsafe conditions in the area, the process SCRTD will use to develop the property after construction is completed, and prominent posting of the construction hot-line telephone number at or near the construction area.

- o Coordination with the Department of Recreation and Parks to drain MacArthur Park lake for cleaning and installation of a new filtration system.

- o How and when construction sequencing decisions will be made.

- o Adequate transport to alternate sites for special events routinely held at MacArthur Park, and the need to review requirements for special group trips on an intermittent basis during construction.

- o Public information campaigns and promotional ideas to mitigate the impacts of construction.

B. General Summary

This study was conducted to be responsive to many of Councilwoman Molina's concerns. It identifies the viable construction alternatives, discusses costs, schedule, and impact on MacArthur Park Lake, and describes the significant operational importance to Metro Rail operations.

- o It is the intention of SCRTD to maintain access and full use of the recreational facilities of MacArthur Park for the community, except for the lake, and to restore the property to its current usage on completion of the work. From 95 to 97 percent of the park land ~~can be used during construction~~. There is good public transport to nearby parks. It has been ascertained that draining the lake is not new to the MacArthur Park community. It has been frequently drained, most recently in 1984. In 1983 it was kept drained for six months.

will not be affected by construction and will be available for use by the community.

- o There will be no visual blight or unsafe condition. The construction staging area will be limited to the lake bed in order to avoid clearing additional areas within MacArthur Park, except for an access road. The entire lake will be secured by a chain-link fence. A construction staging area outside the lake bed is not required.

- o The Department of Recreation and Parks has indicated it has no plans and no budget for improvements to the lake bottom.

- During construction, the construction hot-line telephone number will be prominently posted in a number of locations, at or near the construction area.

- While certain assumptions on construction sequencing are made as part of this report, and will be later refined by Preliminary Engineering studies, the final construction schedule must be determined by the Contractor within the limits established by SCRTD and the City.

- Public information activities begun under construction of MOS-1 will be continued, and will include meetings with the MacArthur Park Community Council, individual meetings with merchants, dissemination of rail Metrogram publications by targeted mailing lists and personal deliveries, and communication with Councilwoman Molina and her staff.

- SCRTD assumes financial responsibility for project-related expenses, and will pay for the reconstruction of the entire lake bottom under Alternative B, B-1, and B-2, cut-and-cover construction. (see below).

- Because of the need for immediate action on the study and the detailed information needed for an intelligent decision, SCRTD is funding the study.

C. Summary of Construction Alternatives

The study evaluates in detail two methods to construct Metro Rail through MacArthur Park. It also establishes the optimal requirement for location of a pocket track.

The two methods for constructing Metro Rail through MacArthur Park are tunneling, and cut-and-cover. In each method, three alternatives have been studied to reduce impact on MacArthur Park and are detailed later in this report. The six alternatives are summarized in Table 1.

If a tunneling alternative is adopted, the lake bed will be regraded to its original contours in the area impacted by Metro Rail structure. No other reconstruction or improvement of the lake would be done.

- For the tunneling alternative, a pocket track for emergency train storage would be constructed by cut-and-cover under Wilshire Boulevard, west of Wilshire/Alvarado.

If a cut-and-cover alternative is adopted, the entire lake bottom will be reconstructed by draining the lake,

TABLE 1

Summary of Construction Alternatives

	TUNNELING ALTERNATIVES			CUT-AND-COVER STRUCTURE ALTERNATIVES		
	A	A-1	A-2	B	B-1	B-2
Cost	$27.9 M	$31.8 M	$30.1 M	$23.6 M*	$24.3 M*	$25.4 M*
Impact of Metro construction on park.	20 Months	26 Months	26 Months	24 Months	27 Months	27 Months
Impact of Metro construction on lake.	20 Months	19 Months	22 Months	24 Months	25 Months	15 Months
Lake available for use during construction.	None	Half	None	None	Half	None
Permanent improvement for lake and park.	None(1)	None(1)	None(1)	Yes(2)	Yes(2)	Yes(2)
Pocket Track	------ UNDER THE LAKE ------			---- UNDER WILSHIRE BLVD ----		

*Cost includes $2 Million for park improvements.

(1) Only the excavated portion of the lake will be replaced and improved. Fresh water will be added as needed.
(2) Entire lake bed will be cleaned, regraded, restored with permanent lining. Lake will be refilled with fresh water.

regrading the lake bottom to its original contours, installing an impermeable lining and lining protection, and refilling the lake with fresh water.

- For the cut-and-cover alternative, the pocket track will be included as part of a three-cell subway box structure constructed by the cut-and-cover method.

The six primary alternatives are summarized below. More detailed descriptions are found in Section IV.

1. Three tunneling construction alternatives:

   - Alternative A: Provides for construction of twin tunnels under MacArthur Park. It includes excavating of the soils and replacing them with lean concrete, draining the lake, tunneling, and repairing the bottom of the lake.

   - Alternative A-1: Provides for partial use of MacArthur Lake while constructing an earth dike, cofferdam, and preparing the substrata for construction of twin tunnels under the lake. Part of the lake will be drained, then restored and put back in service prior to tunneling under it.

   - Alternative A-2: Provides for draining the lake completely with use of sloped excavation through the lake bed. Excavation will be carried approximately 5 feet into the rock and be replaced with unreinforced lean concrete. The lake will be restored and put back in service prior to tunneling under it.

     This alternative A-2 will require a major portion of the lake for slope excavation and temporary storage of material.

2. Three cut-and-cover construction alternatives:

   - Alternative B: Provides for cut-and-cover construction of a three-cell subway box structure that extends from Wilshire/Alvarado Station to a point east of Park View Street. It involves decking of Alvarado Street, temporary support to minimize excavation outside the lake, and sloped side excavation through the lake bed. The lake will be drained for construction of the box structure, a permanent lining installed on the lake bottom to keep the water from seeping through the lake bed, and the lake restored to its present usage.

- o Alternative B-1: Provides for cut-and-cover construction of a three-cell subway box structure, installation of an earth dike and cofferdam allowing partial use of the lake. The lake north of the earth dike will be drained for construction purposes. Excavation will be carried out within the cofferdam. A permanent watertight tremie concrete seal will be installed to have a dry base for the grade slab. Cast-in-place or precast concrete elements may be used to build a three-cell box structure.

- o Alternative B-2: Provides for construction of a three-cell subway box structure by cut-and-cover method using sloped side excavation through the lake bed and by constructing two small dikes at either end of the lake.

  It is based upon first completing the subway structure inside the banks of the lake and then building the middle three-cell box structure. Support of excavation will be used for cut-and-cover construction inside the banks and side sloped excavation in the center 600 feet of lake bed. Smaller earth dikes will be built at the banks. The Lake will be drained only for construction of this middle 600-foot-long subway box structure in the lake. Major portion of the lake will be kept in full service while constructing the cut-and-cover subway box structures at east and west banks.

3. Other Construction Alternatives

   In addition, four other methods for constructing Metro Rail through the park have been studied, although not as extensively as the first six, and are described later. It is believed that they fall within the cost and time schedules generated for the initial six primary alternatives.

4. Pocket Track Location

   An essential requirement of any rapid transit system is the ability to maintain uninterrupted service when a train failure failure or other emergency occurs on the tracks. This need is filled by pocket tracks (and crossovers), which enable a failed train to be removed from the tracks to a safe area so trains behind it can proceed. The proper location of the pocket track is essential to the fast restoration of normal train service.

In addition, pocket tracks are needed to:

- o Store gap trains for revenue service
- o Act as a staging area for work trains
- o Reverse the direction of trains without interfering with revenue trackage.

A failed train causes not only major service delays, but safety hazards and erosion of passenger confidence in the rapid transit system.

Service Delays: When a train fails on a branch line, all passengers in following trains are delayed until the failed train is removed. When the train fails on a main (trunk) line feeding the branch lines, service on both trunk and branch lines is affected.

For example, all trains will travel the trunk line from Union Station to the Wilshire/Vermont Station (Figure 1A), where they alternately branch off to the west along Wilshire and to the north along Vermont. A failure on the trunk will delay all passenger lines. During rush hour this can precipitate a rapid degradation of train service.

Safety Hazards: Station platforms overcrowded by passengers waiting for delayed trains pose the risk of someone accidentally being pushed onto the tracks, quite possibly before an oncoming train. In an emergency, such as a fire, failed trains slow the evacuation of passengers.

Erosion of Passenger Confidence: Train failures affect actual travel times, diminish passenger confidence in system reliability, and can influence users to elect other modes of transit.

For these reasons optimal location of the pocket track is crucial to SCRTD operational requirements.

D. Recommendation

This evaluation leads to the recommendation that the cut-and-cover Alternative B be adopted, based on the total cost differential of $4.3 million, permanent and long-term improvement to the lake, the optimal operationally efficient location for the pocket track, and the minimization of disruption to heavily-traveled streets during pocket track construction. If the objective of minimizing the impact on lake use is of prime concern, cut-and-cover Alternative B-2 could be adopted for an additional cost of approximately $1.8 million.

II. INTRODUCTION AND PROJECT SETTING

A. Purpose and Scope

The extension of Metro Rail beyond Wilshire/Alvarado Station, known as MOS-2 (Figure 1A), is currently undergoing detailed environmental review. The construction method for the alignment between Alvarado Station and Wilshire/Vermont Station traversing under MacArthur Park and Lake (Figure 1B) is being studied to develop a cost-effective construction alternative that not only maximizes the operational benefits to Metro Rail but provides much-needed improvements to MacArthur Lake. The objective of this report is to evaluate the two alternatives, cut-and-cover and tunneling through the park, as discussed in the Draft Supplemental Environmental Impact dated November, 1987. The District is committed to minimizing disruption to the park. The goal is to work closely with the City Department of Recreation and Parks to determine requirements for and responsibilities concerning lake restoration and improvement.

The alignment through the park connects the trunk line to downtown with diverging main lines to the west and north. Operationally, it is essential that a pocket track is provided for storage of disabled trains before branching so that patrons are provided continuous and efficient service without incurring abnormal operational and maintenance cost. The operating requirements are addressed in detail later in this report. The report also describes the existing conditions of the park, impacts from construction, and improvements to the park required by each alternative.

B. Definition of Study Alternatives

This study evaluates two main alternative methods for constructing the Metro Rail Project through MacArthur Park. They are:

- Twin tunnel construction
- Cut-and-cover three-cell box structure construction.

Three different construction techniques are studied for each of the alternatives stated above. They are as defined below:

1. Tunneling Construction Alternatives

- Alternative A: (Figures 2 through 6)

  -- Fence the work area.

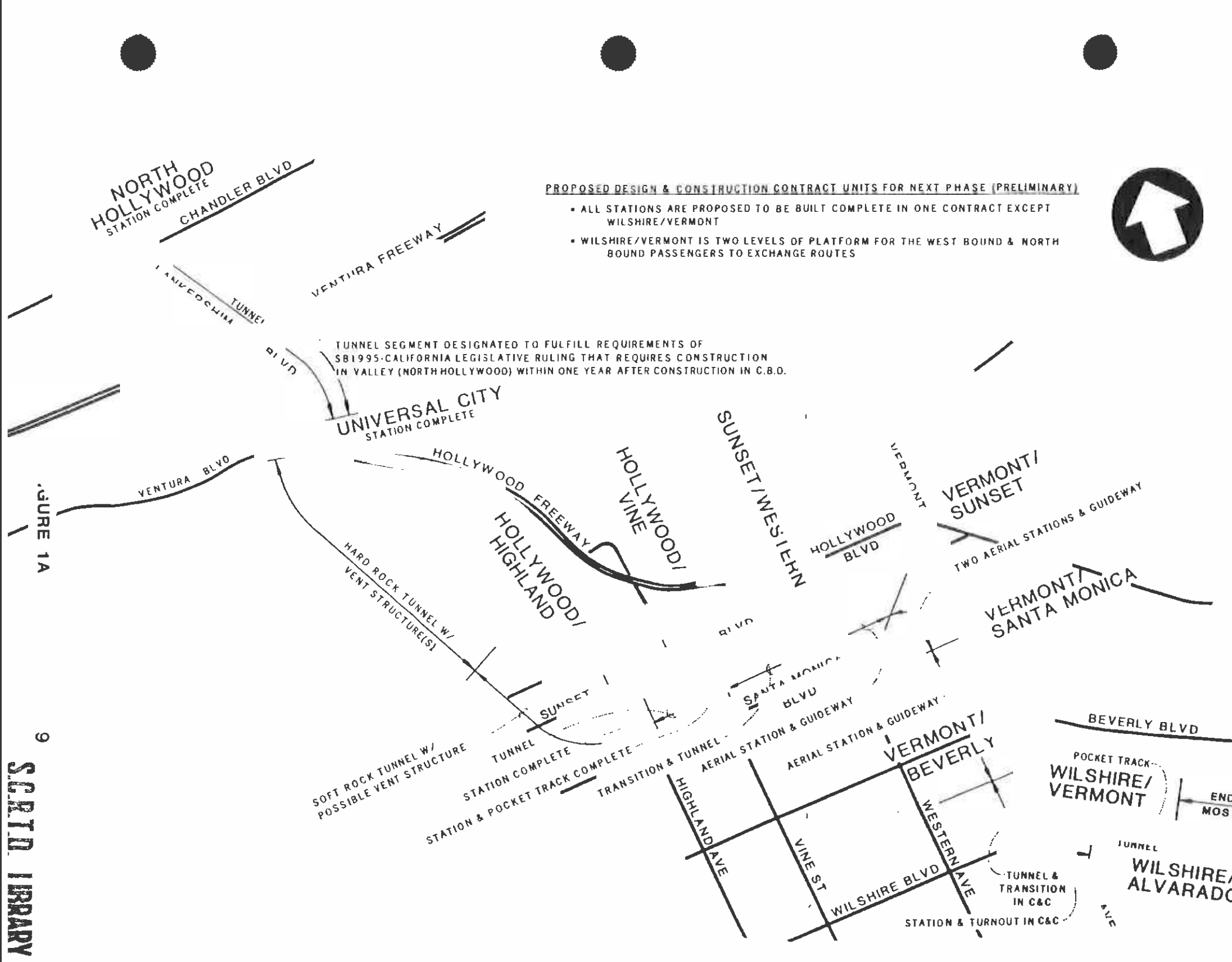
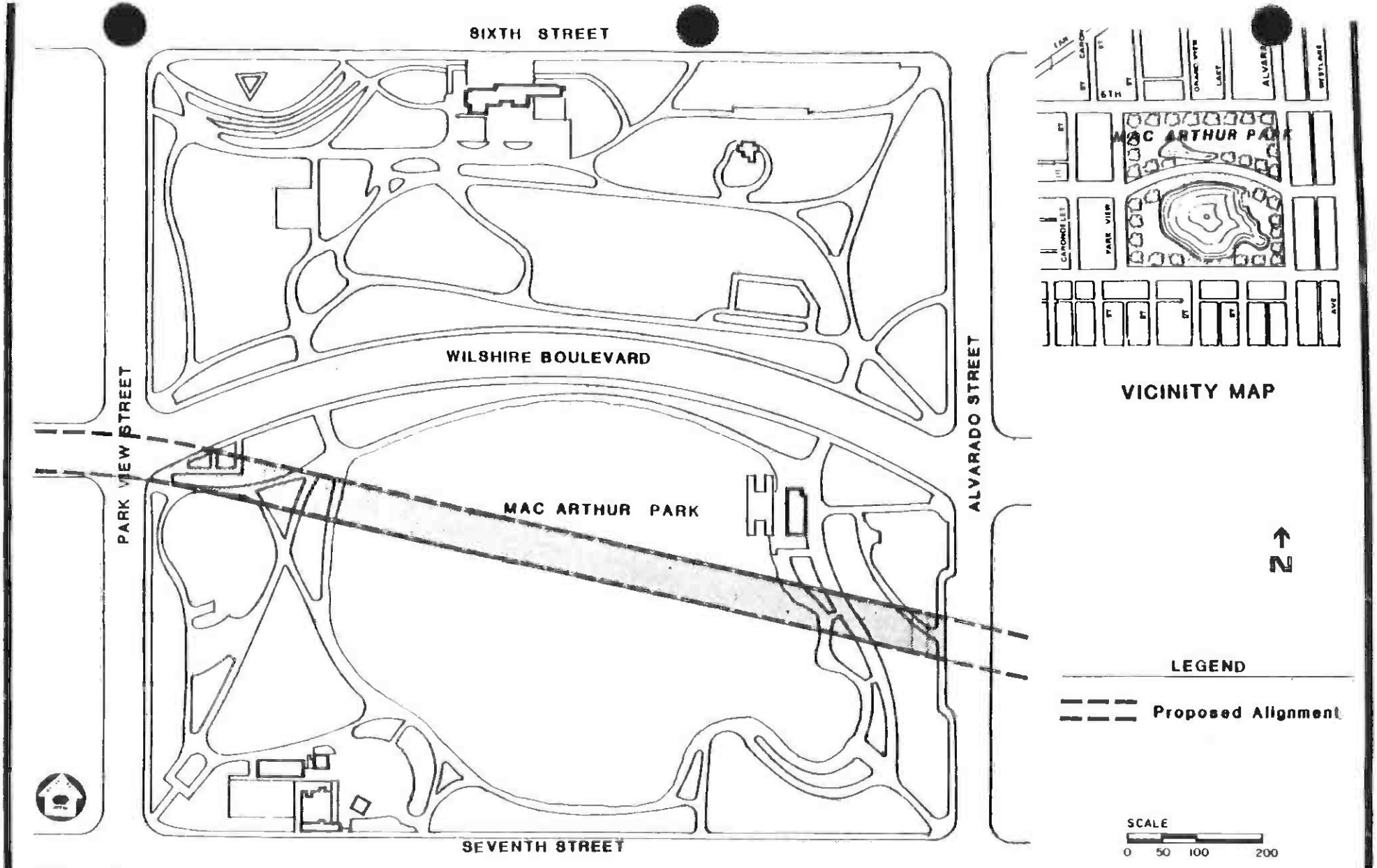


FIGURE 1A



Southern California Rapid Transit District

Metro Rail Project

MAC ARTHUR PARK

FIGURE 1B

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CONSTRUCTION OPTIONS THROUGH
MAC ARTHUR PARK

JOB NO.
DESIGNED BY W.WHEELER
APPROVED
SHEET NO.
DATE 12/18/87

ALTERNATIVE "A"
TUNNELS UNDER MAC ARTHUR PARK

PLAN

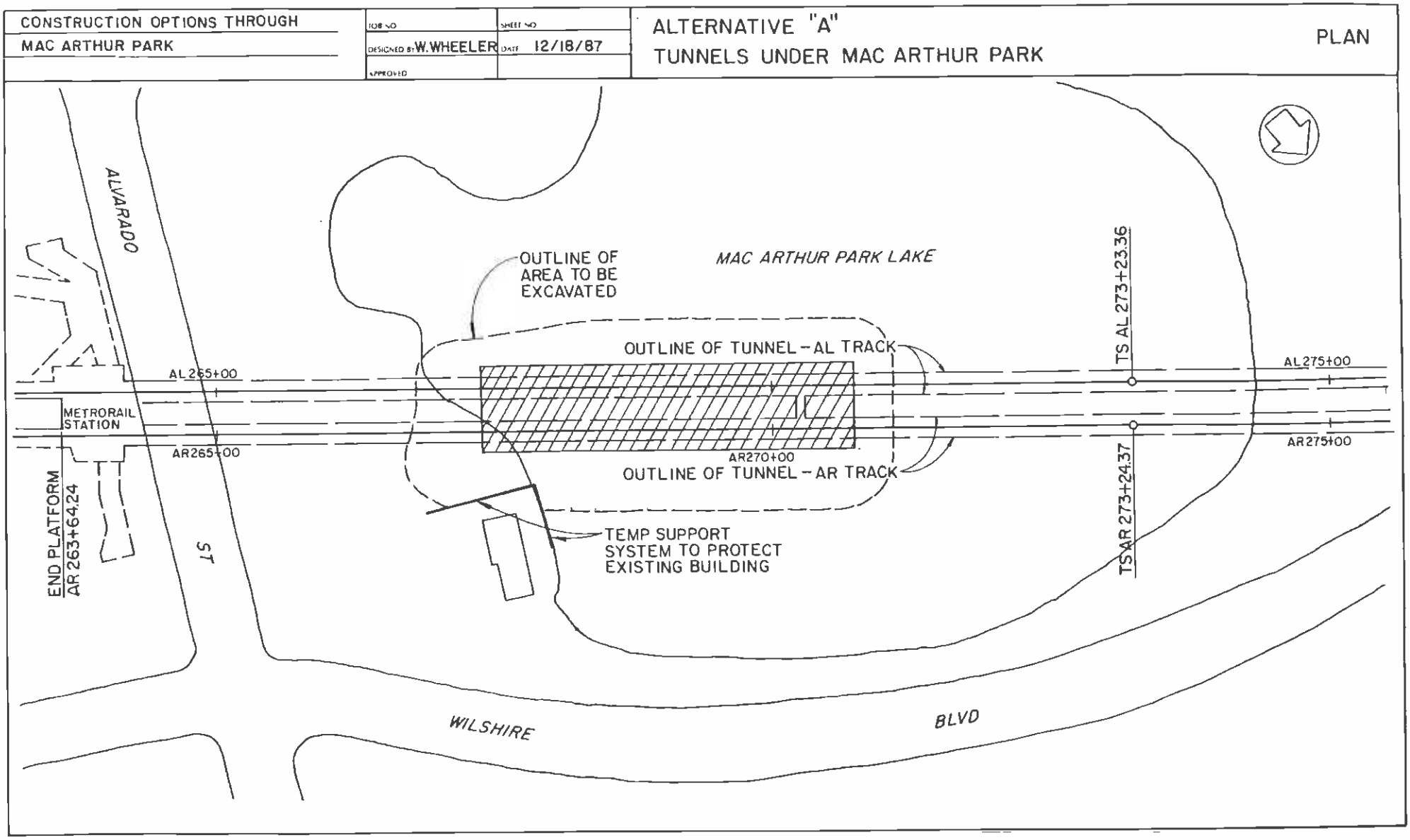

FIGURE 2

METRO RAIL TRANSIT CONSULTANTS
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CONSTRUCTION OPTIONS THROUGH MAC ARTHUR PARK LAKE	JOB NO	SHEET NO
	DESIGNED BY J.MONSEES	DATE 12/18/87
	APPROVED	

ALTERNATIVE "A"
TUNNELS UNDER MAC ARTHUR PARK
PROFILE

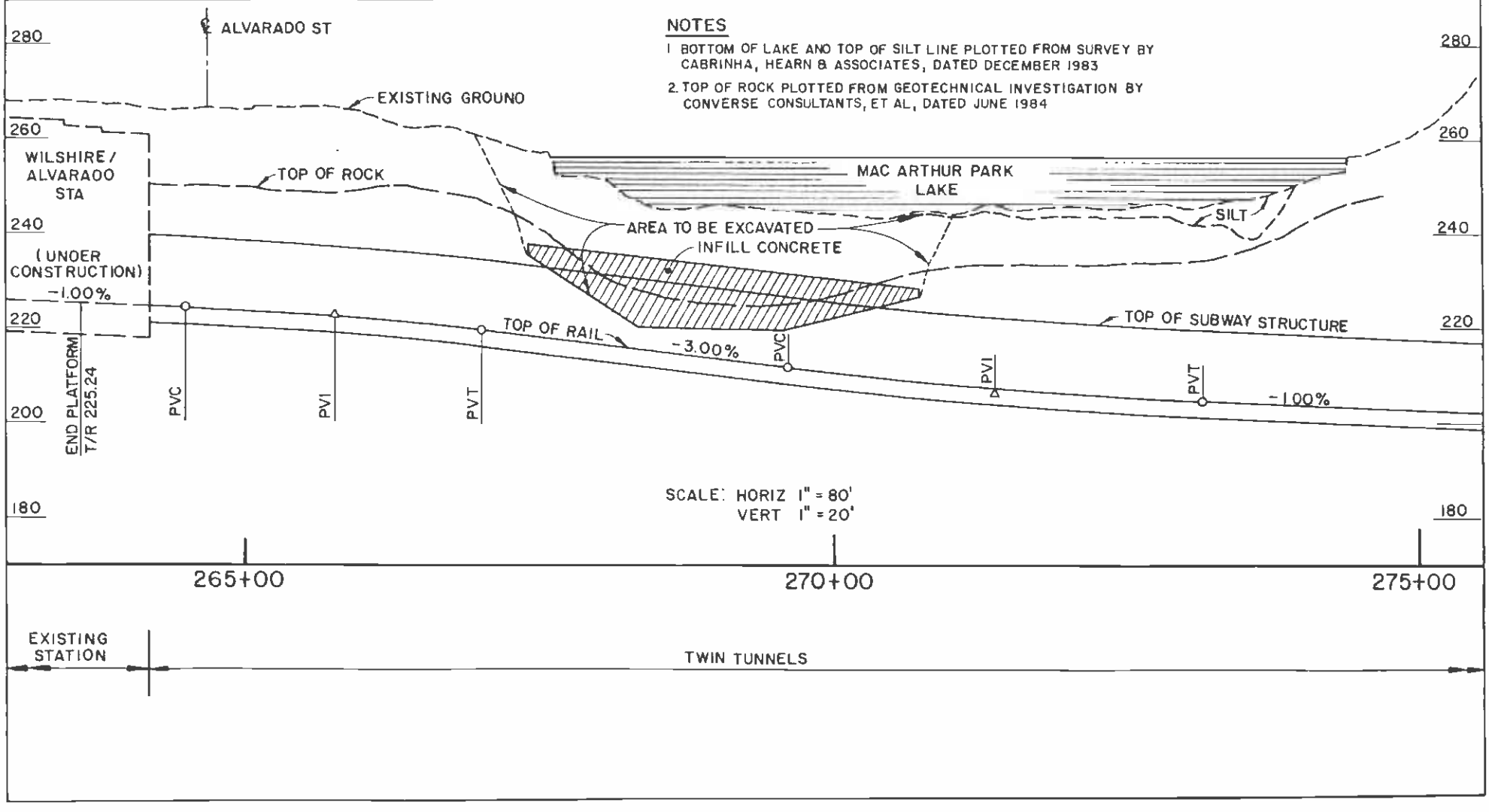

FIGURE 3

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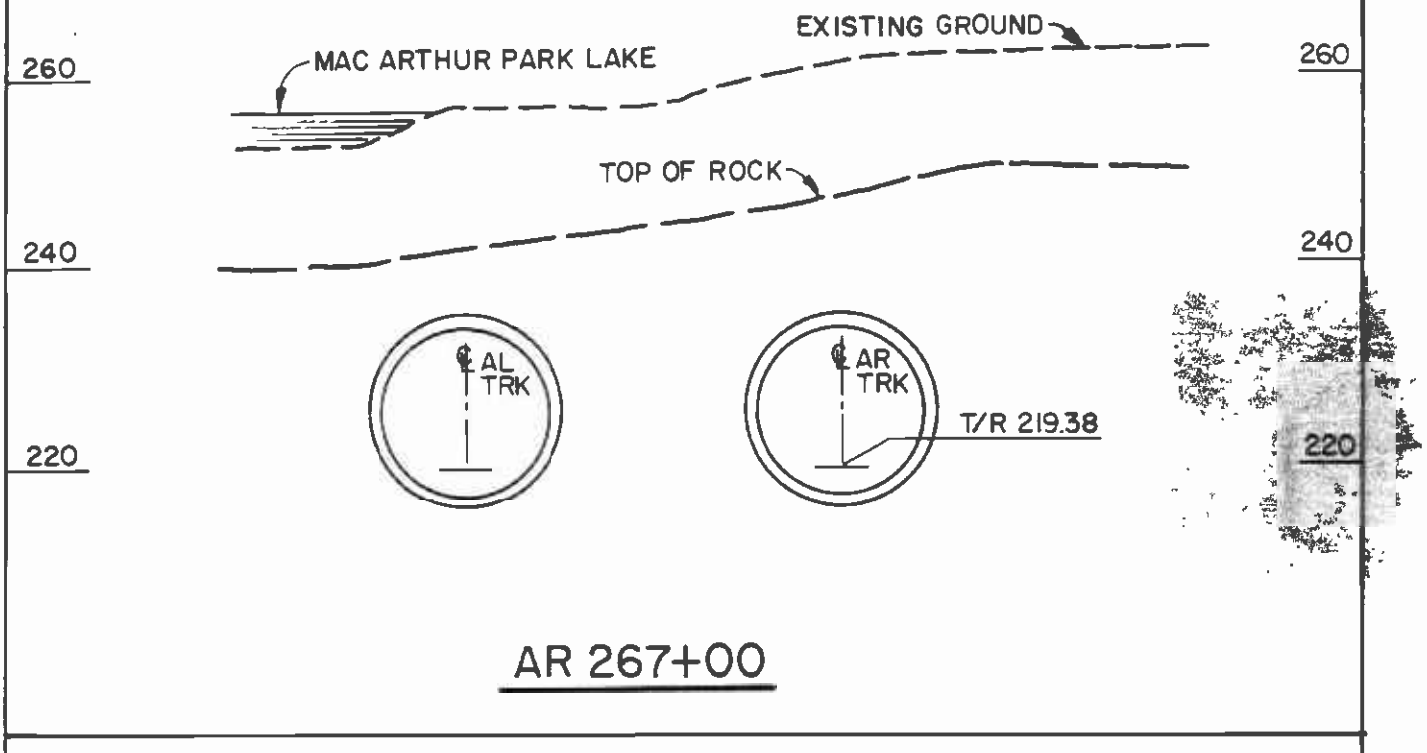
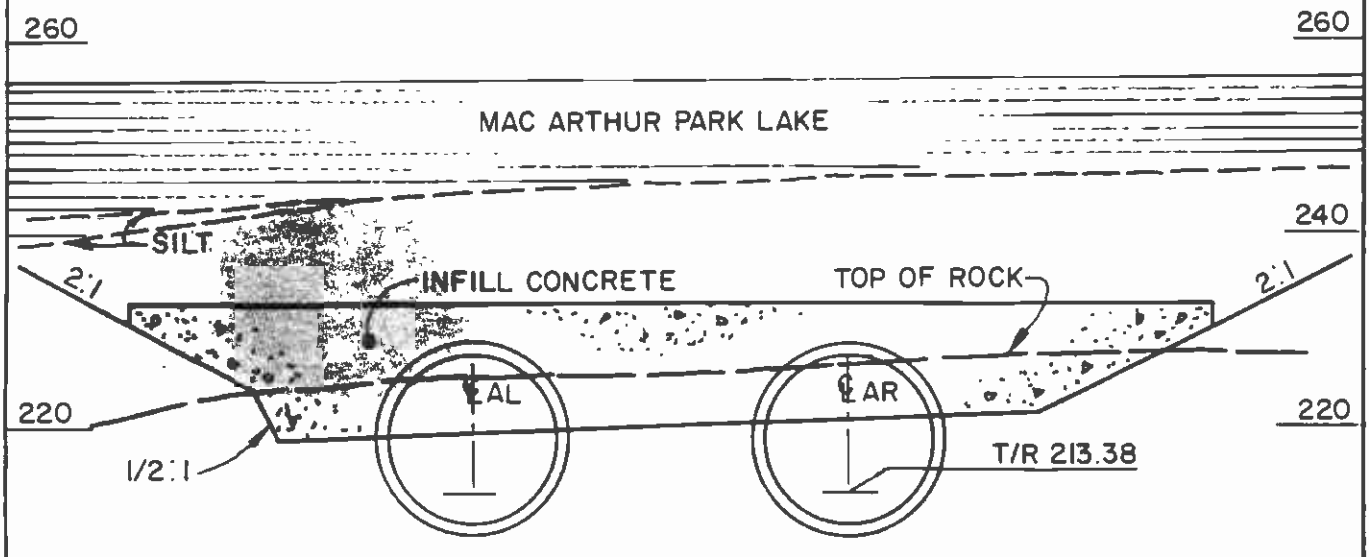
Q881 020-0784

CONSTRUCTION OPTIONS THROUGH	JOB NO.	SHEET NO.
MAC ARTHUR PARK	DESIGNED BY W.WHEELER	DATE 12/18/87
ALTERNATIVE "A" – TUNNEL SECTIONS	APPROVED	



AR 267+00



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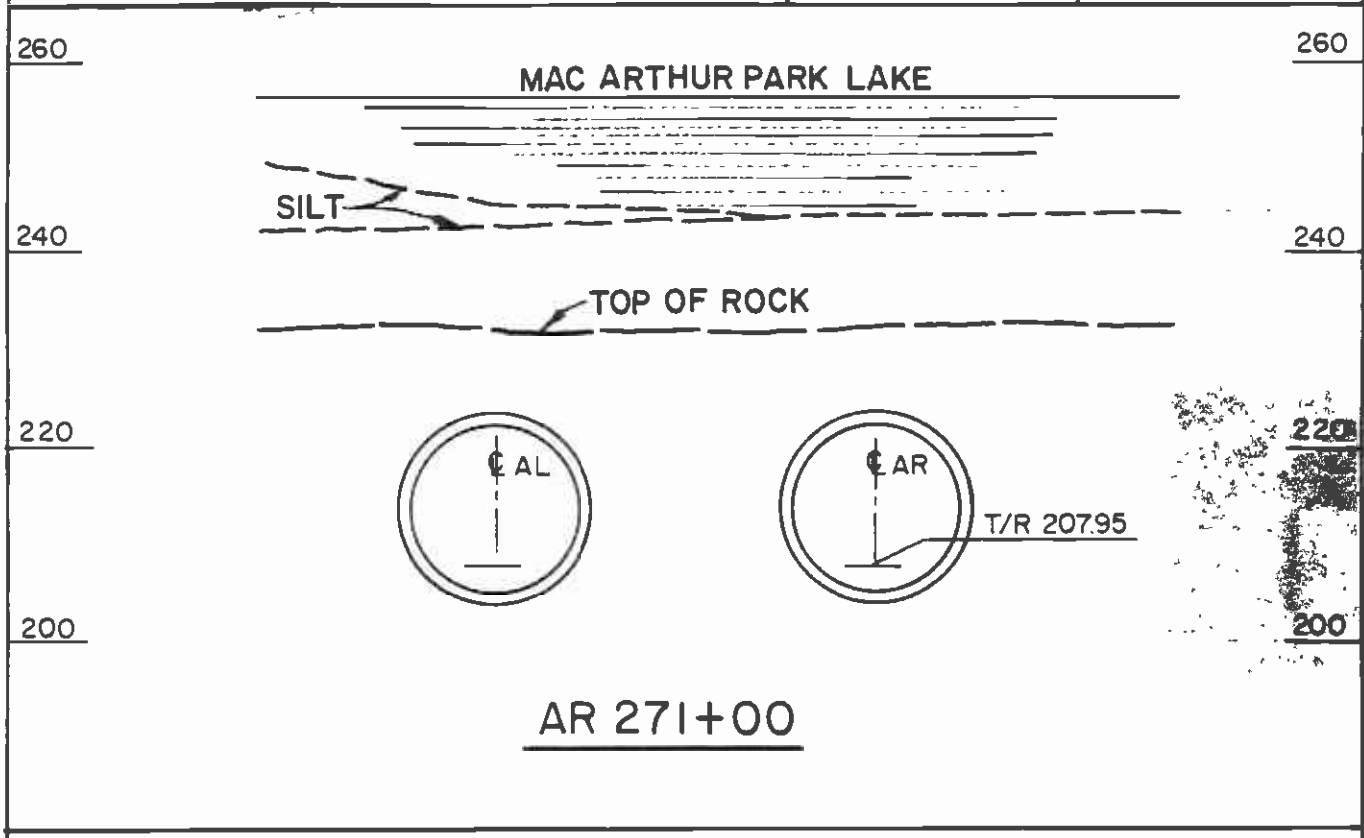
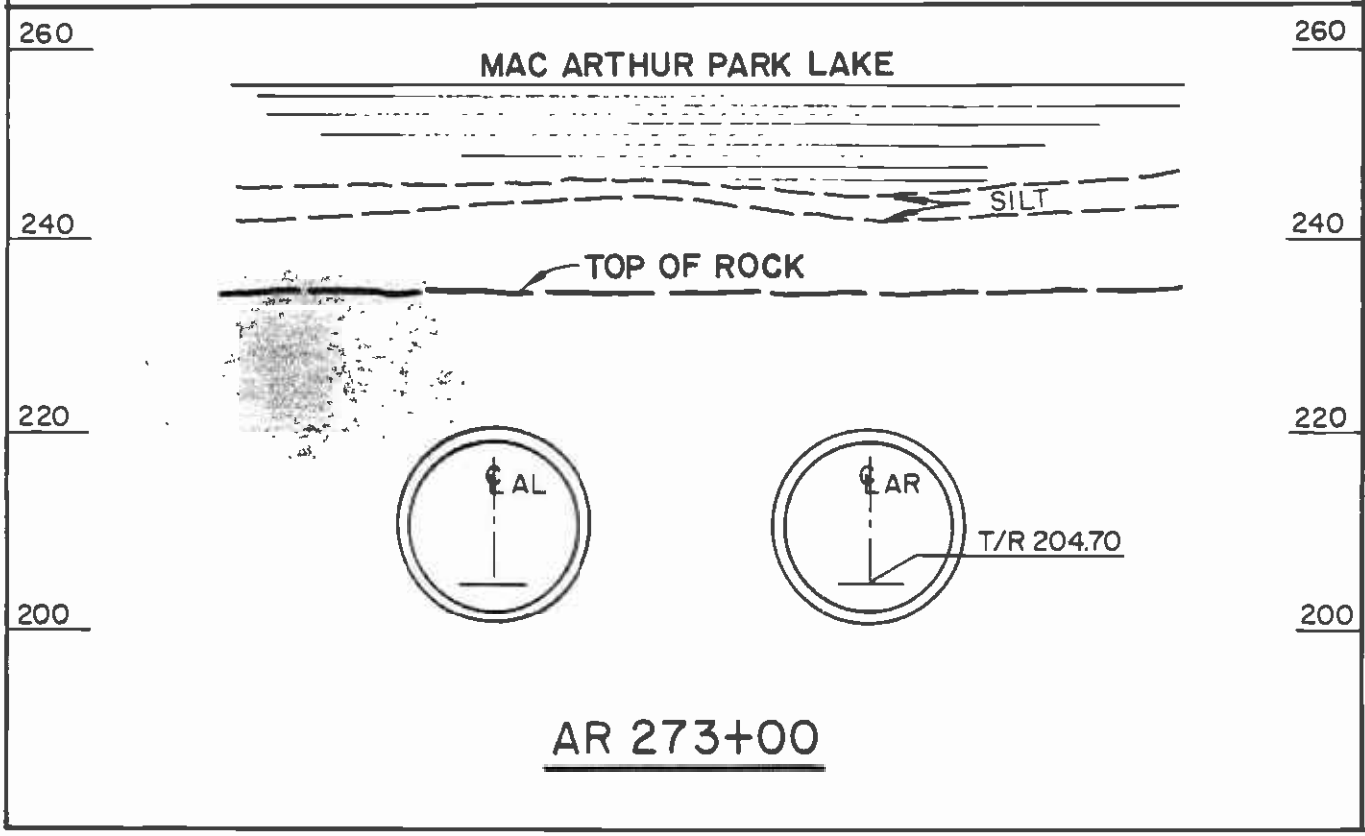
NOTES:
1. BOTTOM OF LAKE AND TOP OF SILT LINE PLOTTED FROM SURVEY BY CABRINHA, HEARN & ASSOCIATES, DATED DECEMBER 1983
2. TOP OF ROCK PLOTTED FROM GEOTECHNICAL INVESTIGATION BY CONVERSE CONSULTANTS, ET AL, DATED JUNE 1984

CONSTRUCTION OPTIONS THROUGH	JOB NO	SHEET NO.
MAC ARTHUR PARK	DESIGNED BY W.WHEELER	DATE 12/18/87
ALTERNATIVE "A" - TUNNEL SECTIONS	APPROVED	





CONSTRUCTION OPTIONS THROUGH	JOB NO.	SHEET NO.
MAC ARTHUR PARK	DESIGNED BY W.WHEELER	DATE 12/18/87
ALTERNATIVE "A" – TUNNEL SECTION	APPROVED	

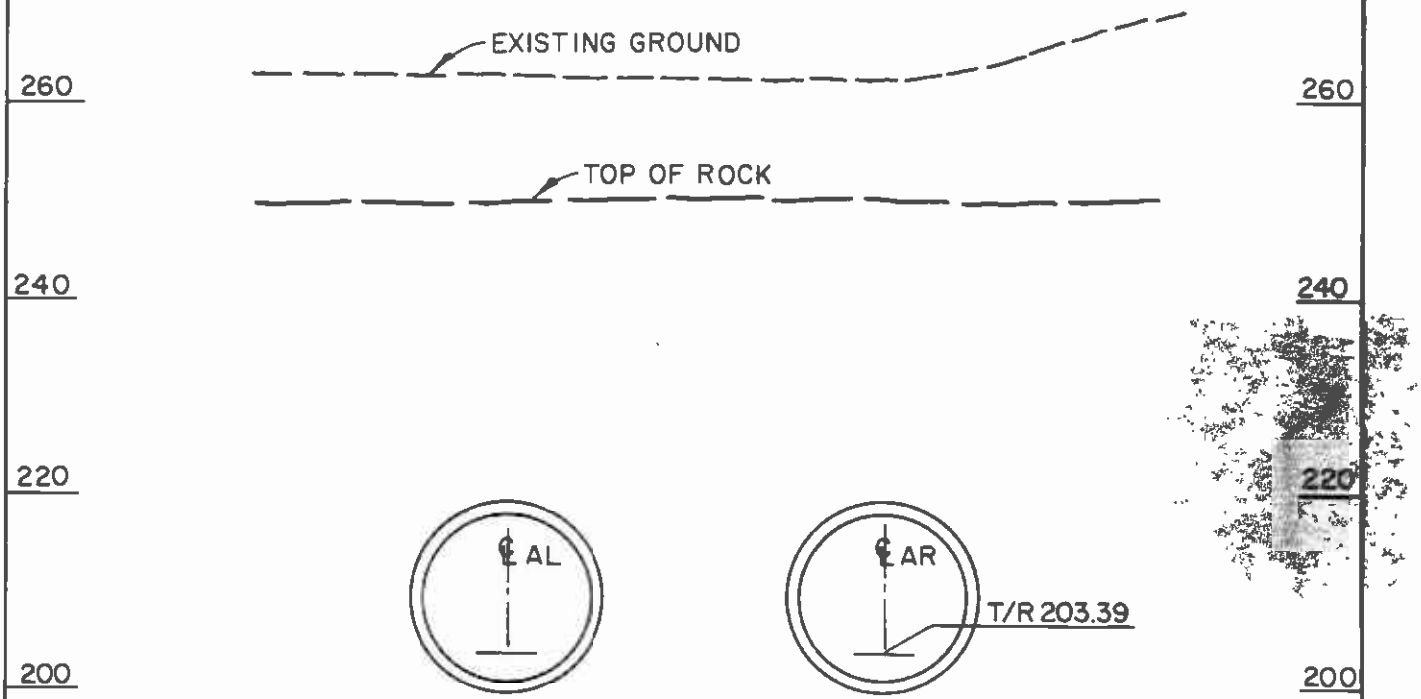


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FIGURE 6

-- Drain the lake.

-- Establish a lake bed access road from Alvarado.

-- Excavate a portion of the lake bottom and replace the alluvial soils with lean concrete in the tunnel area.

-- Construct twin tunnels under the park in drained condition of lake.

-- Fill the excavation.

-- Deck over and construct pocket track in Wilshire Boulevard by cut-and-cover.

This alternative will have a temporary adverse impact on the park. A portion of the lake bottom will be excavated to remove unacceptable soils in the tunnel area. The resulting void will be partially filled with concrete and the excavation backfilled. The lake would be refilled and be put back into service.

- o Alternative A-1 (Figures 7 through 9)

-- Construct earth dike and cofferdaam.

-- Drain part of the lake.

-- Replace excavated material with lean concrete.

-- Restore lake and put back in service.

-- Construct twin tunnels under the park with lake full of water.

-- Deck over and construct a pocket track in Wilshire Boulevard by cut-and-cover.

- o Alternative A-2 (Figures 10 through 13)

-- Fence the work area.

-- Drain the lake.

-- Excavate the lake bottom using sloped side excavation.

-- Fill excavated material with lean concrete.

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MacARTHUR PARK LAKE	JOB NO	SHEET NO
TUNNELS ALTERNATIVE A-1	DESIGNED BY	DATE 2.2.88
PLAN	APPROVED	

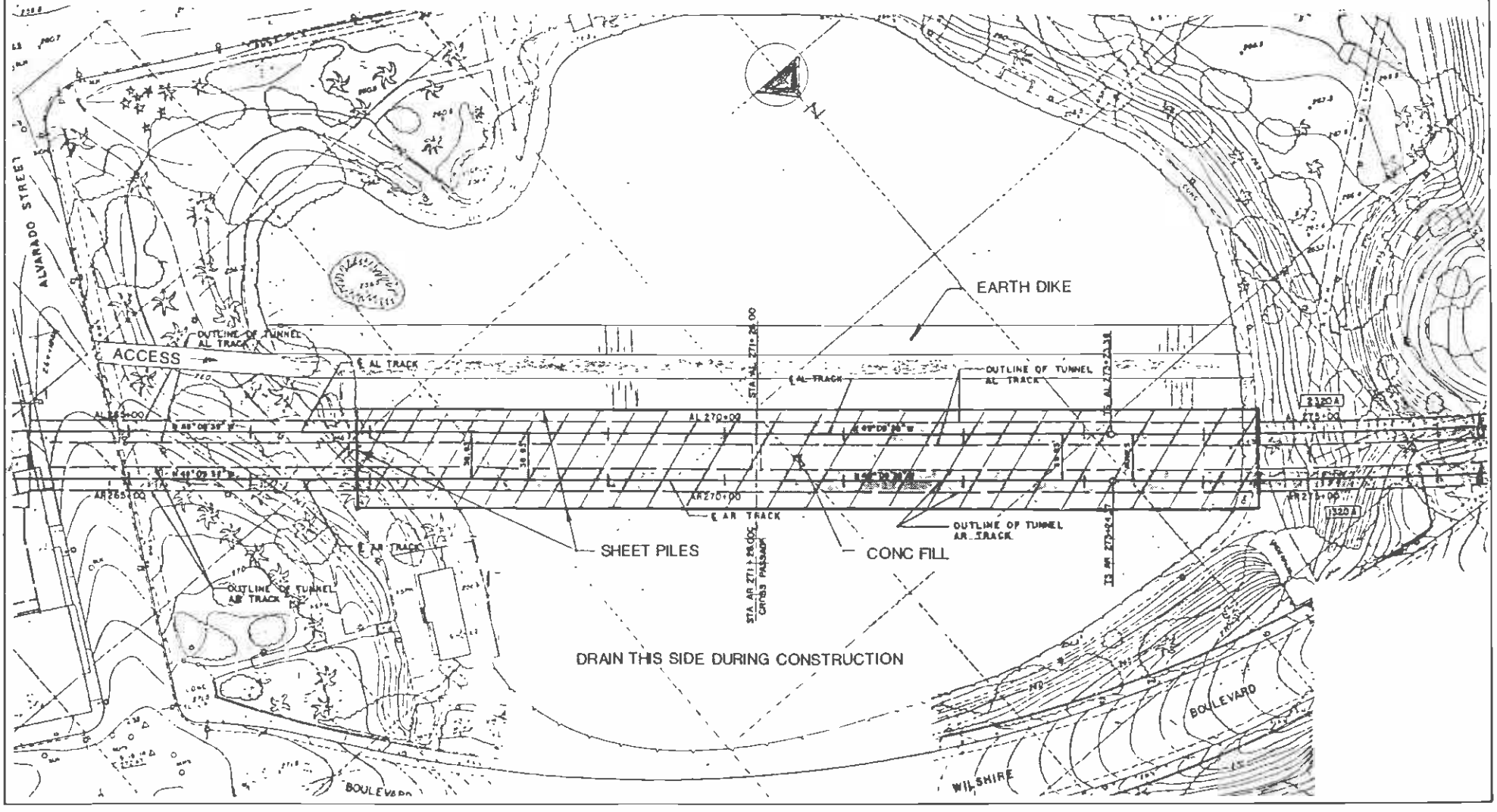

FIGURE 7

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MacARTHUR PARK LAKE	JOB NO	SHEET NO
TUNNEL ALTERNATIVE A-1	DESIGNED BY E. Fajardo	DATE 2 2 88
PROFILE	APPROVED	

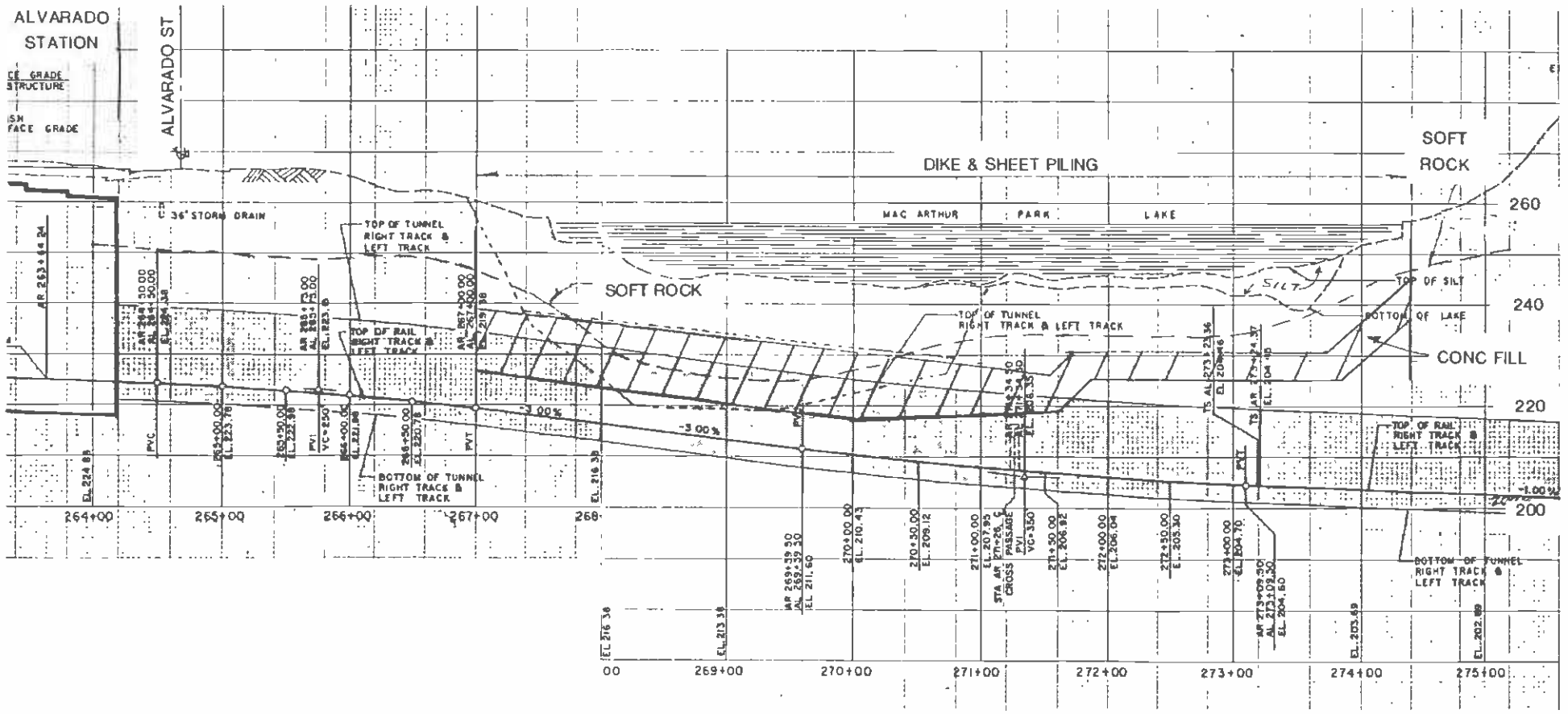

FIGURE 8

MacARTHUR PARK LAKE	JOB No.	SHEET No.
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SECTIONS	APPROVED	1 : 20

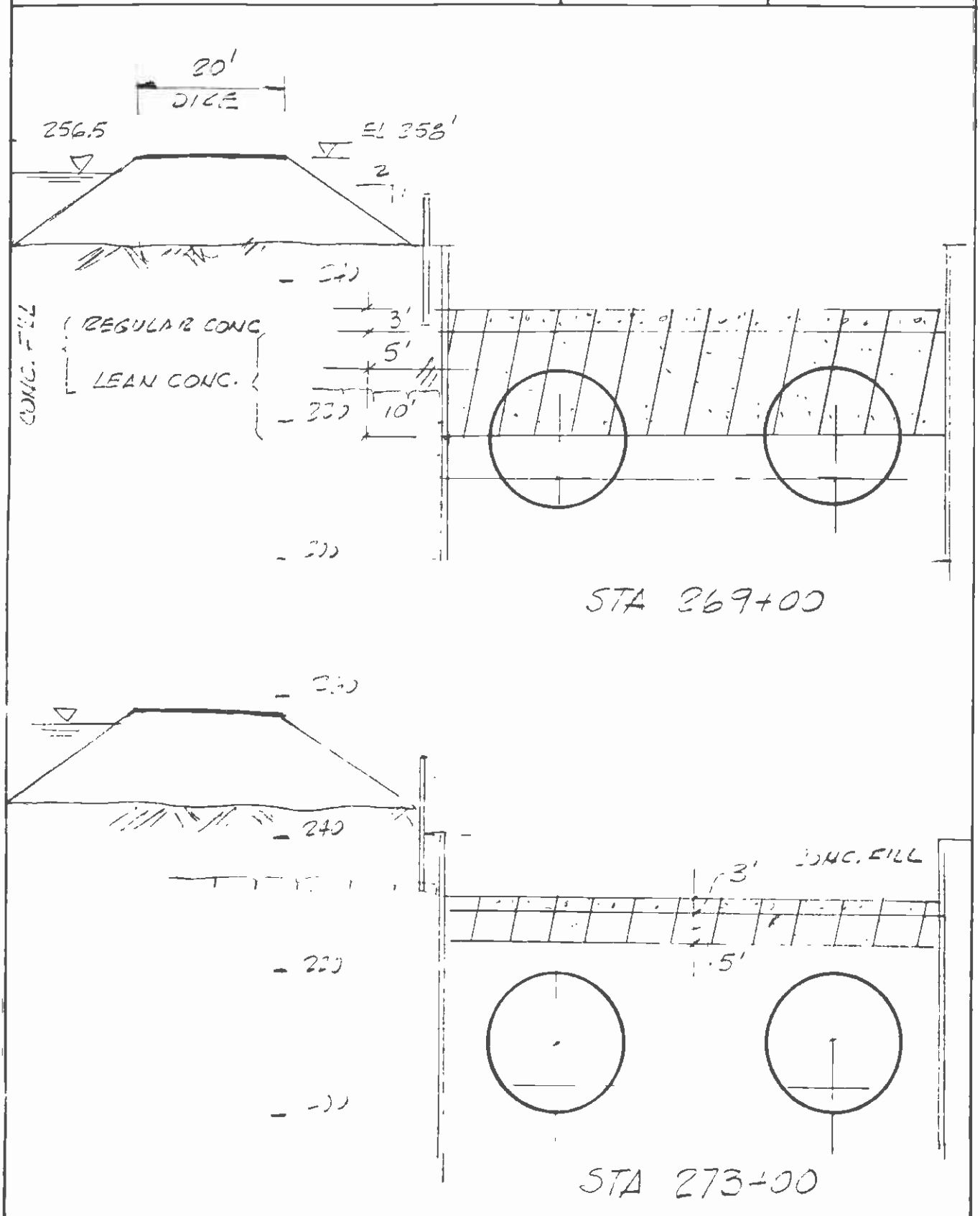

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FIGURE 9

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MacARTHUR PARK LAKE	JOB NO	SHEET NO
TUNNELS ALTERNATIVE A-2	DESIGNED BY Fortunato	DATE 2.2.88
PLAN	APPROVED	

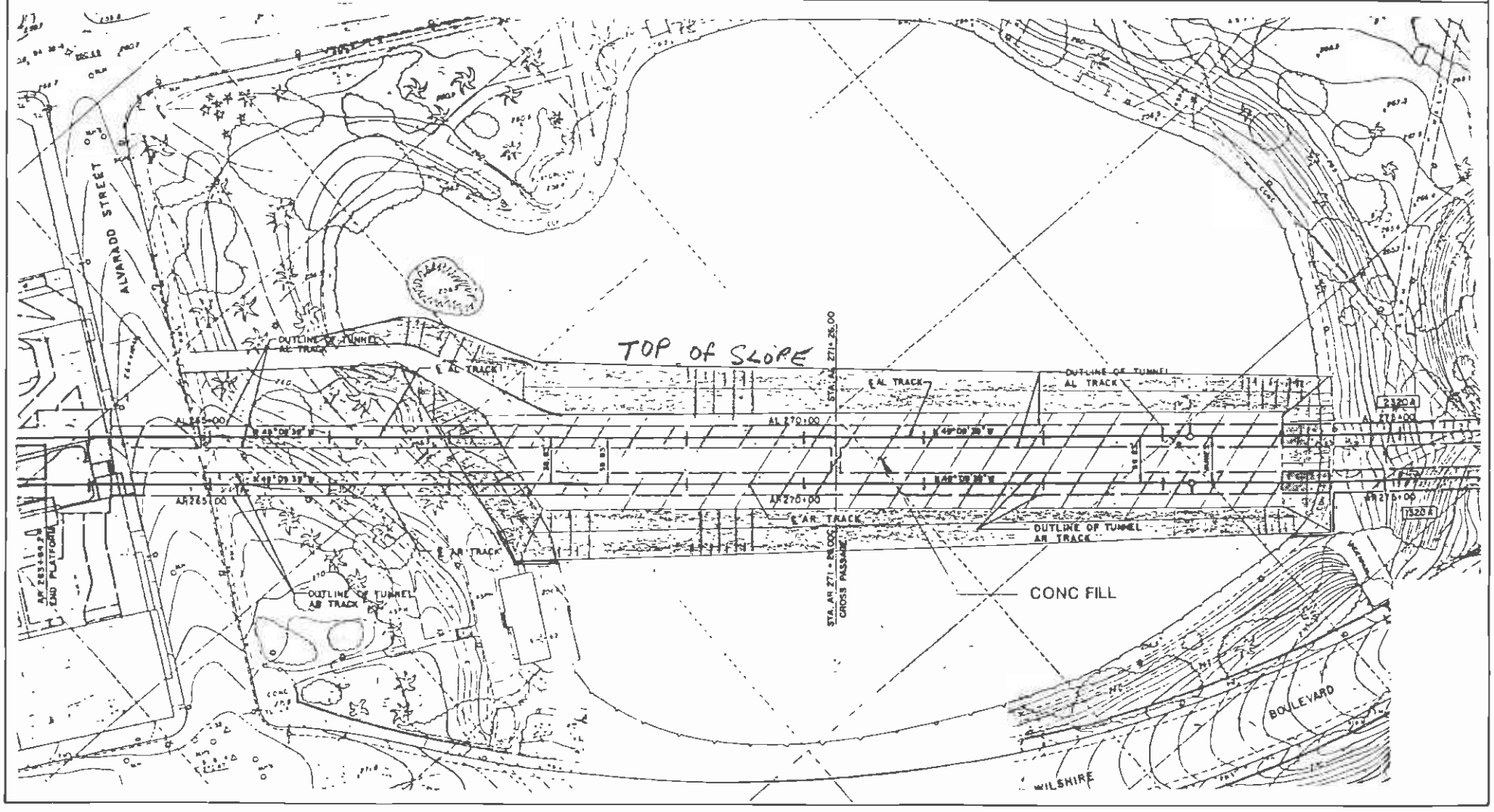

FIGURE 10

METRO RAIL TRANSIT CONSULTANTS
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MacARTHUR PARK LAKE TUNNEL ALTERNATIVE A-2 PROFILE	JOB NO	SHEET NO
	DESIGNED BY	DATE
	APPROVED	

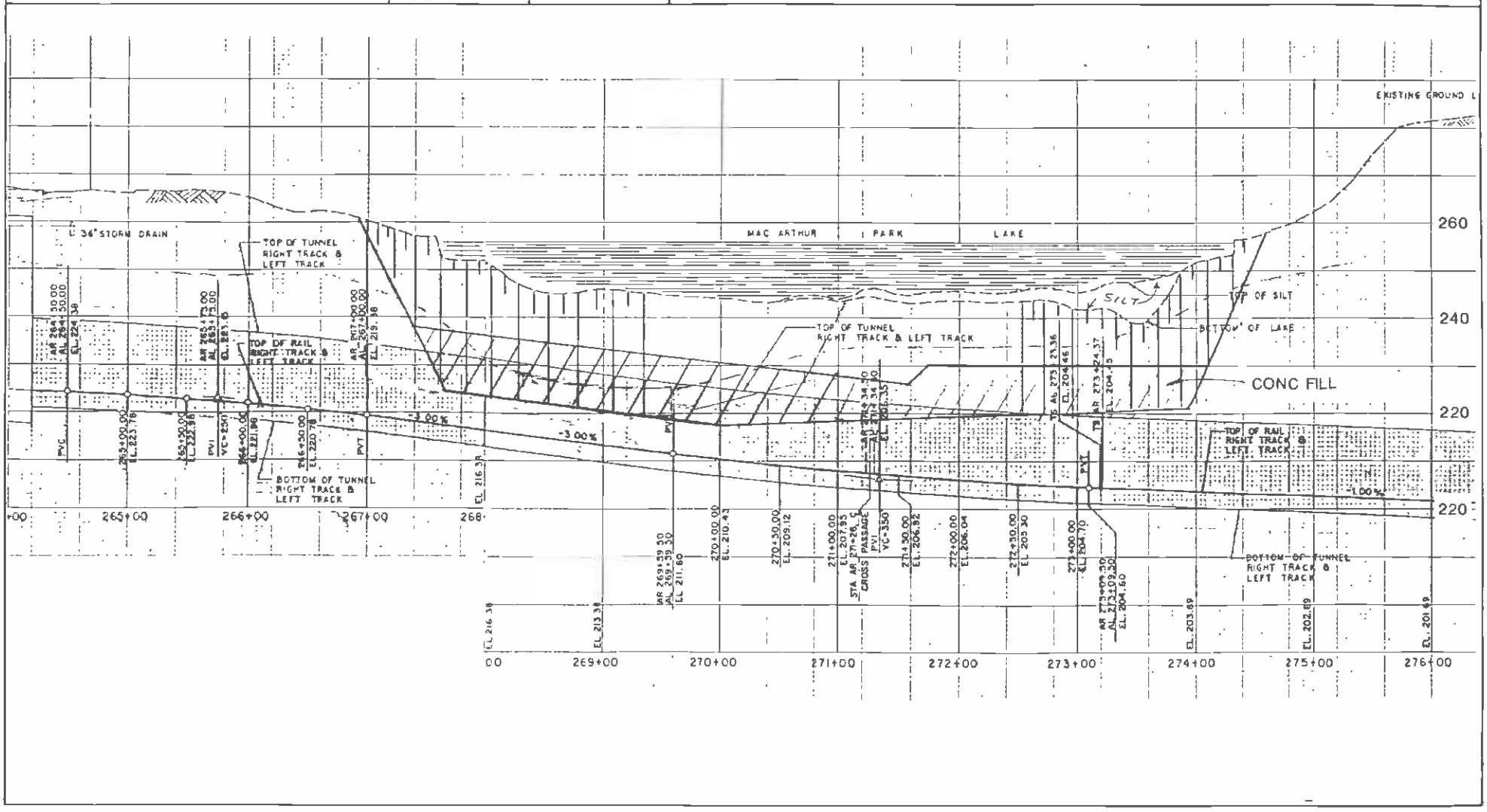
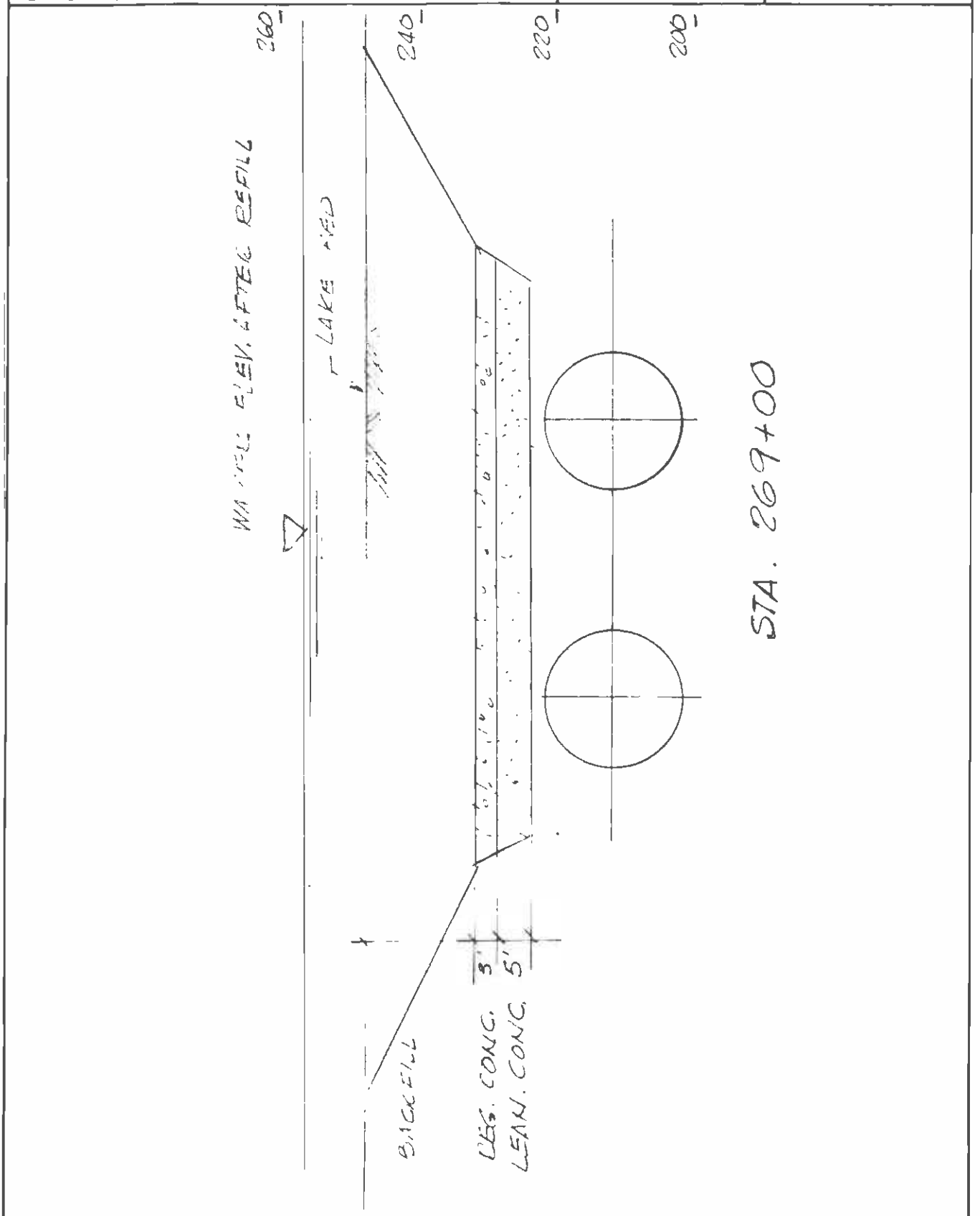


FIGURE 11

MacARTHUR PARK LAKE	JOB No.	SHEET No
TUNNEL ALTERNATIVE A-2	DESIGNED BY F. Fortunato	DATE
SECTION AT 269+00	APPROVED	1 : 20



MacARTHUR PARK LAKE	JOB No.	SHEET No.
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SECTION AT STA 273+00	APPROVED	1 : 20

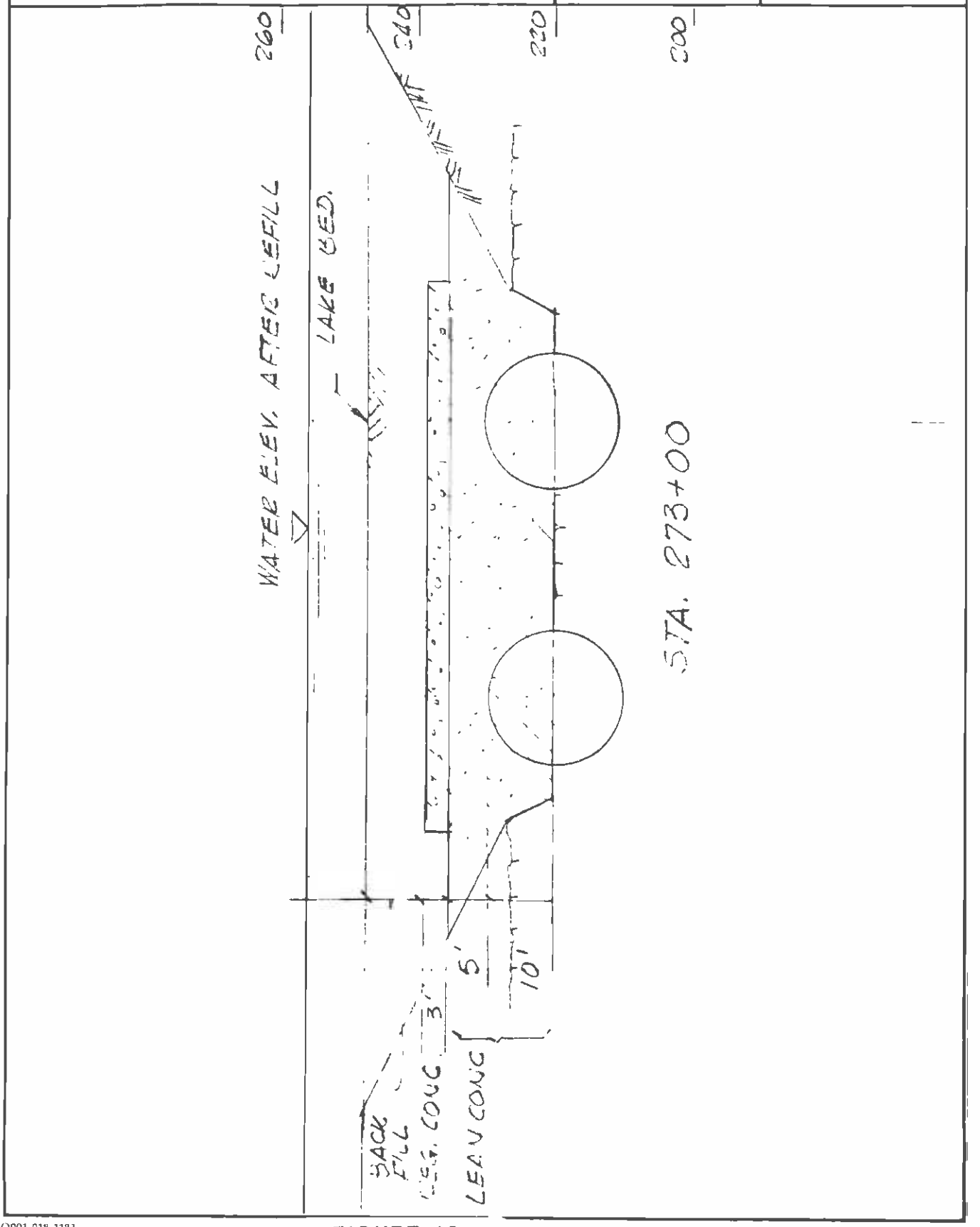

FIGURE 13

-- Backfill lake.

-- Construct twin tunnels under the park with lake full of water.

-- Deck over and construct a pocket track in Wilshire Boulevard by cut-and-cover.

2. Cut-and-Cover Construction Alternatives

o Alternative B (Figures 14 through 18)

-- Fence the work area.

-- Establish a two-way lake bed access road from Alvarado Street.

-- Remove the muck from the lake bed.

-- Drain the lake.

-- Construct a three-cell subway box, including pocket track, by cut-and-cover construction from the Wilshire/Alvarado Station to a point east of Parkview Street (Station 175+25).

-- Deck over the construction in Alvarado Street.

-- Use a temporary support system to minimize excavation in the park outside of the lake.

-- Use sloped side excavation through the lake bed.

-- Since a significant area of the lake bed is affected, reconstruct the lake by removing all silt, regrading, installing permanent lining and liner protection. Reconstruct those facilities affected by this work.

o Alternative B-1 (Figures 20 through 22)

-- Construct earth dike and cofferdam.

-- Drain part of the lake.

-- Construct three-cell box structure within cofferdam, using precast concrete elements for walls and roof slab.

-- Drain the remainder of lake.

-- Backfill and regrade lake bottom to its original contours.

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CONSTRUCTION OPTIONS THROUGH MAC ARTHUR PARK	JOB NO	SHEET NO
	DESIGNED BY W.WHEELER	DATE 12/18/87
	APPROVED	

ALTERNATIVE "B"
CUT & COVER THROUGH MAC ARTHUR PARK

PLAN

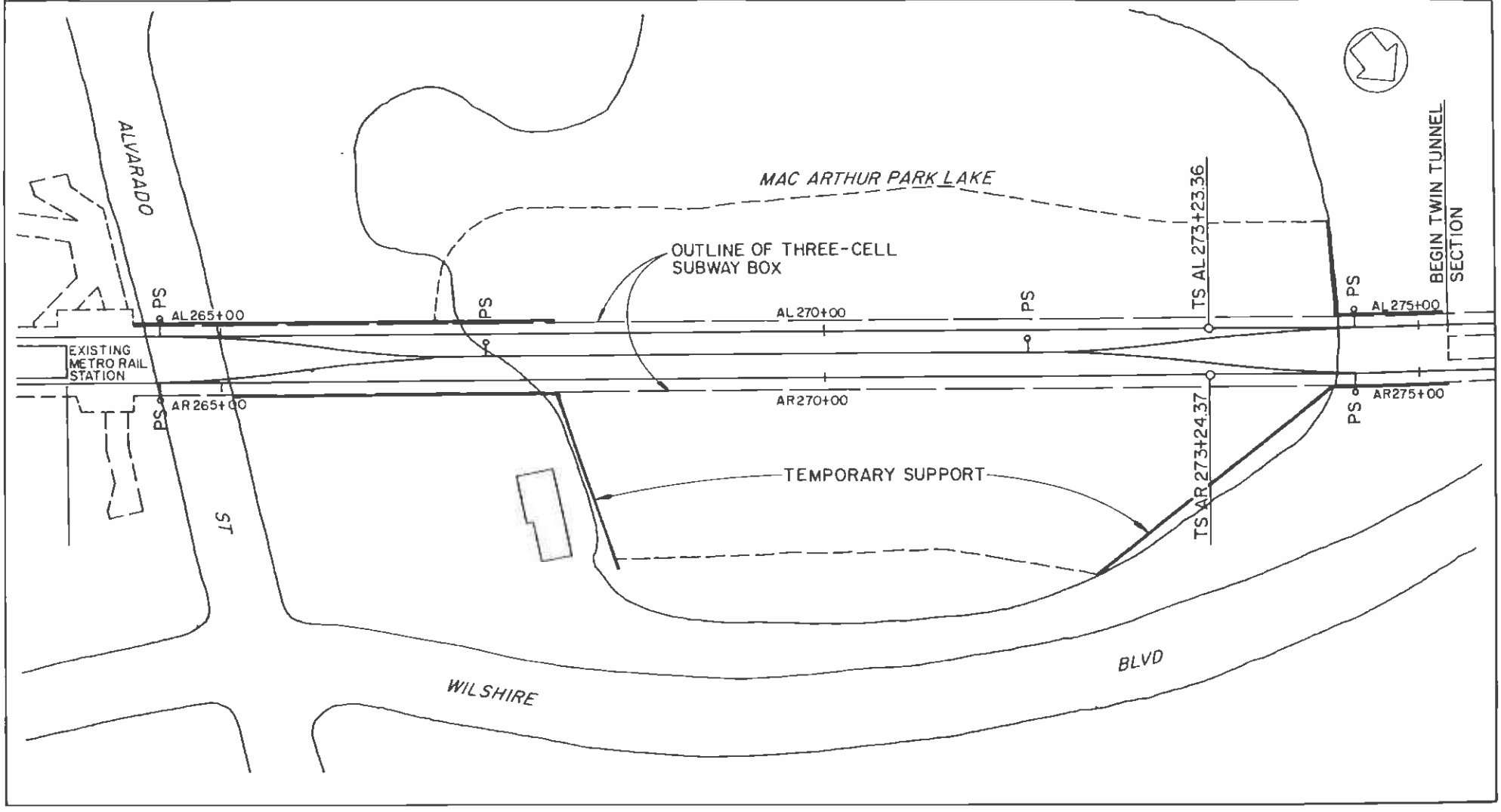

FIGURE 14

METRO RAIL TRANSIT CONSULTANTS
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CONSTRUCTION OPTIONS THROUGH MAC ARTHUR PARK LAKE	JOB NO	SHEET NO
	DESIGNED BY W. WHEELER	DATE 12/18/87
	APPROVED	

ALTERNATIVE "B"
CUT & COVER THROUGH MAC ARTHUR PARK

PROFILE

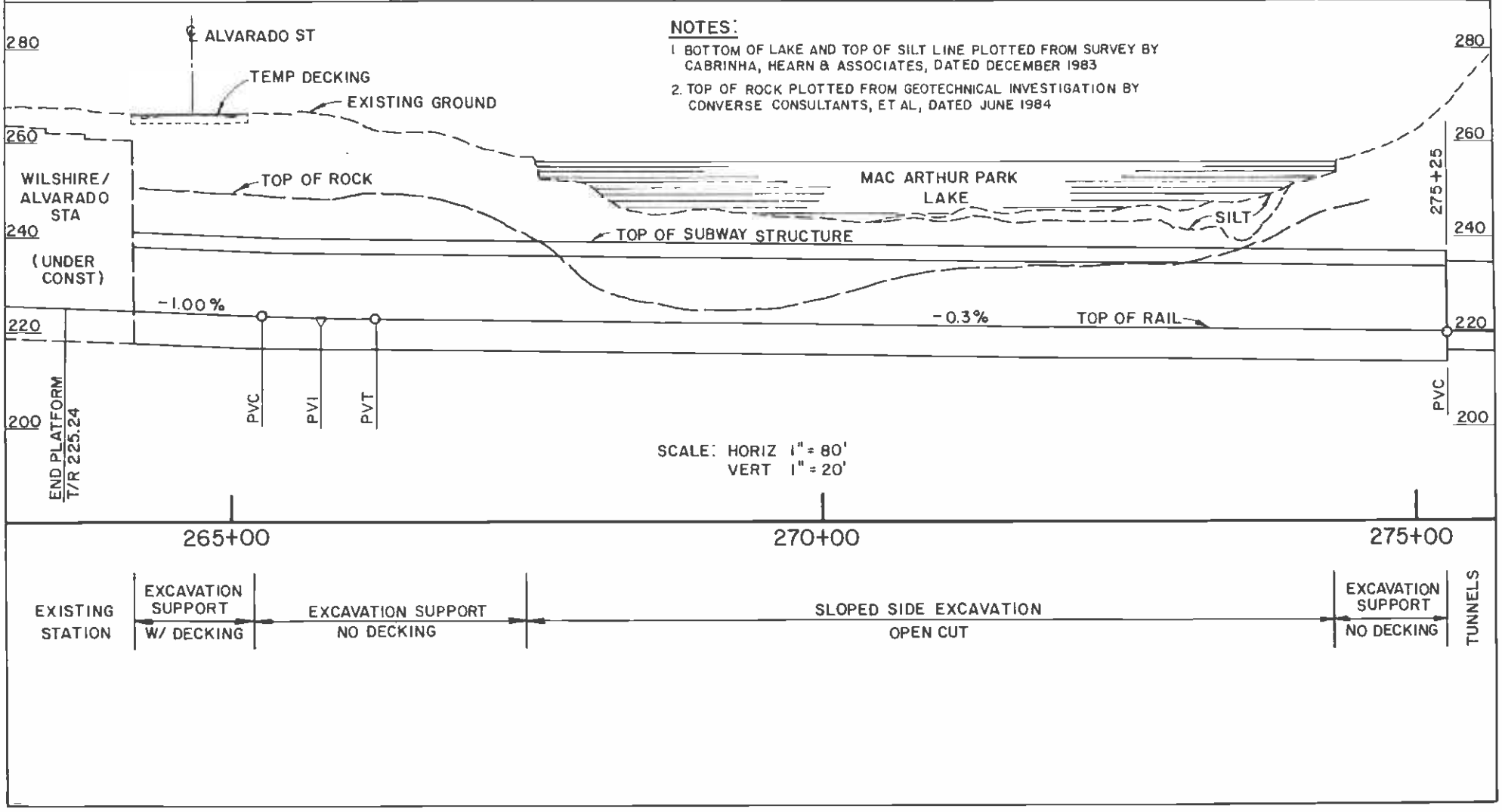
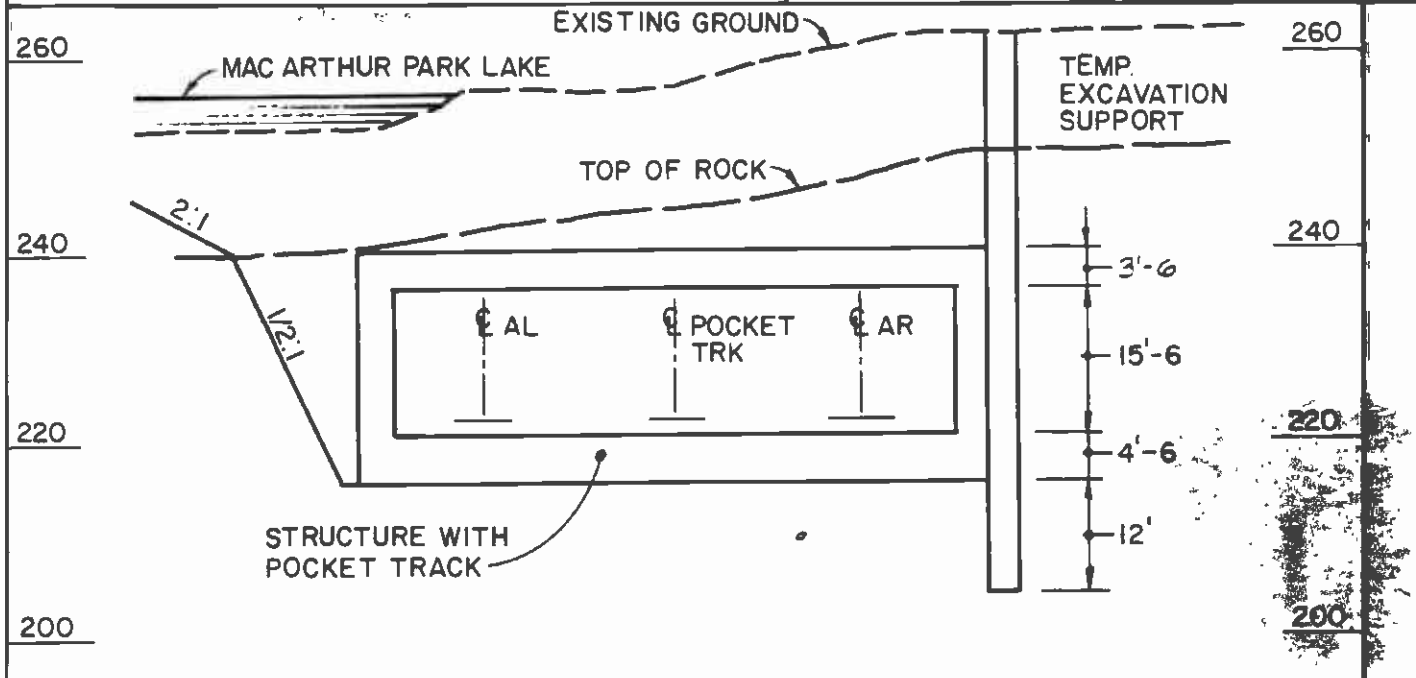


FIGURE 15

CONSTRUCTION OPTIONS THROUGH	JOB NO.	SHEET NO.
MAC ARTHUR PARK	DESIGNED BY W.WHEELER	DATE 12/18/87
ALTERNATIVE "B" – CUT & COVER SECTIONS	APPROVED	



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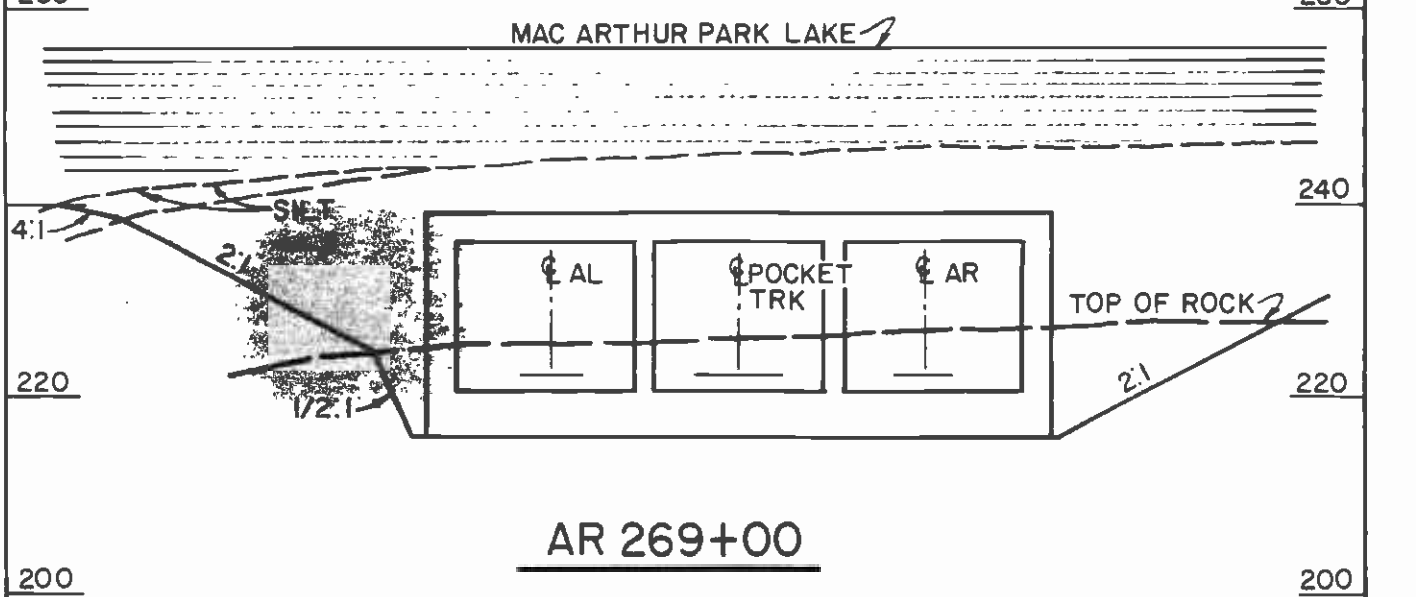

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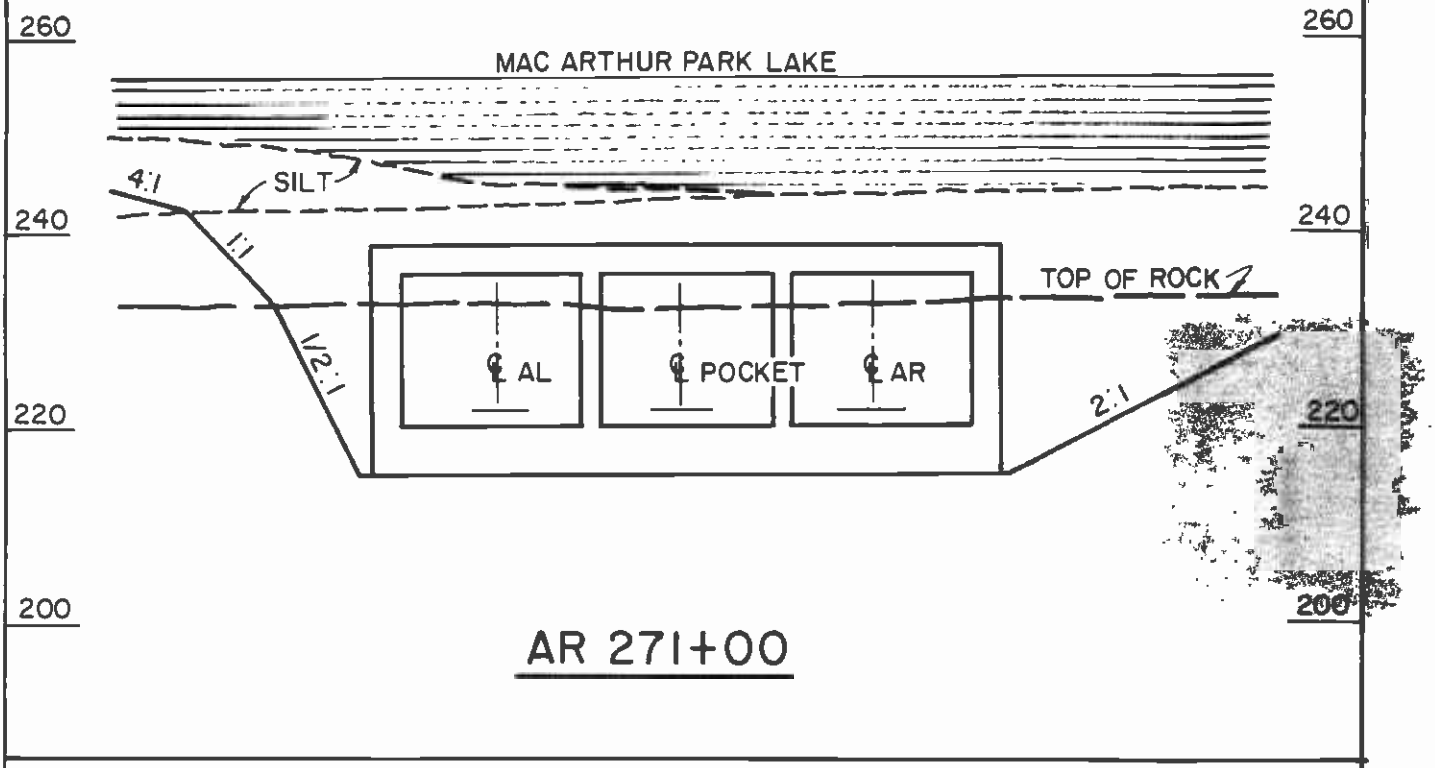
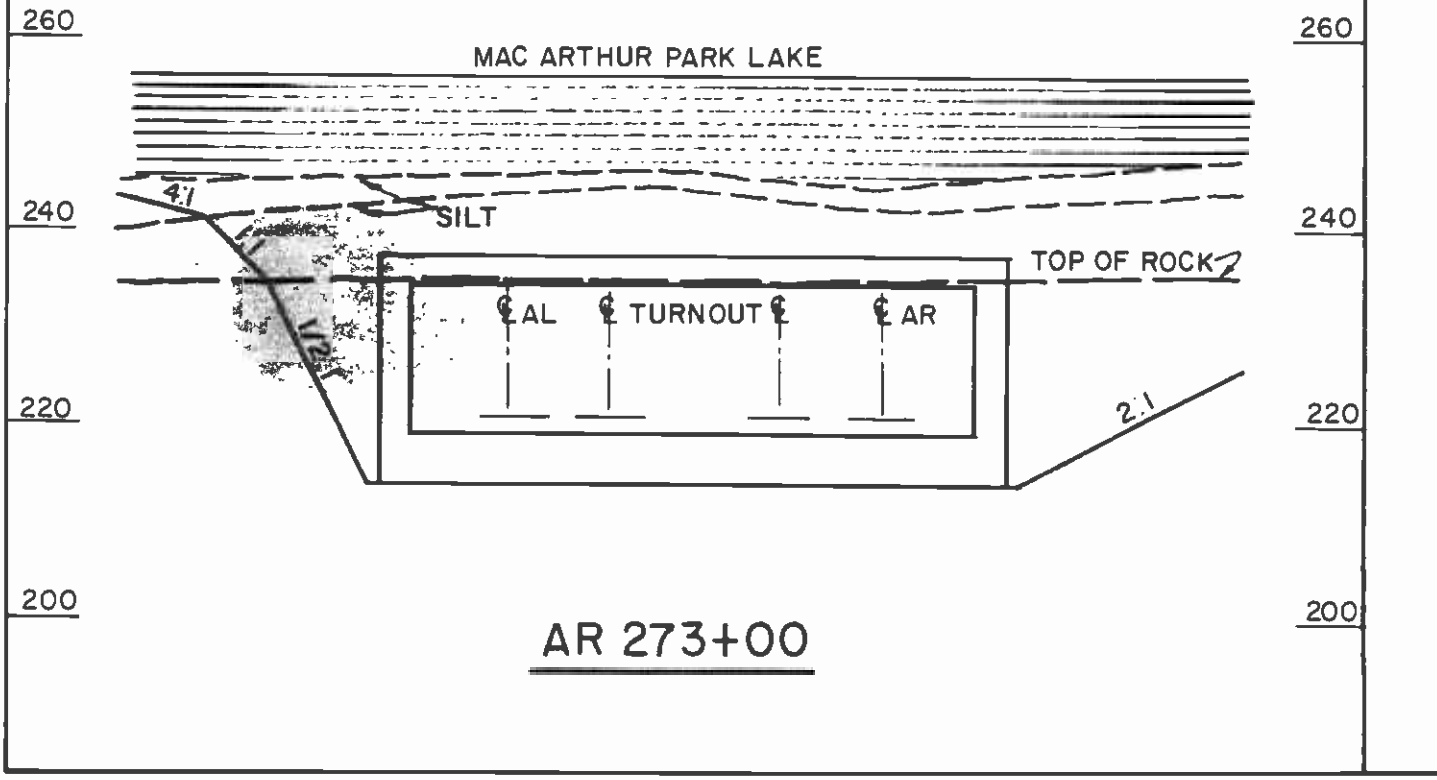
NOTES:
1. BOTTOM OF LAKE AND TOP OF SILT LINE PLOTTED FROM SURVEY BY CABRINHA, HEARN & ASSOCIATES, DATED DECEMBER 1983
2. TOP OF ROCK PLOTTED FROM GEOTECHNICAL INVESTIGATION BY CONVERSE CONSULTANTS, ET AL, DATED JUNE 1984

CONSTRUCTION OPTIONS THROUGH	JOB NO	SHEET NO.
MAC ARTHUR PARK	DESIGNED BY W.WHEELER	DATE 12/18/87
ALTERNATIVE "B" – CUT & COVER SECTIONS	APPROVED	

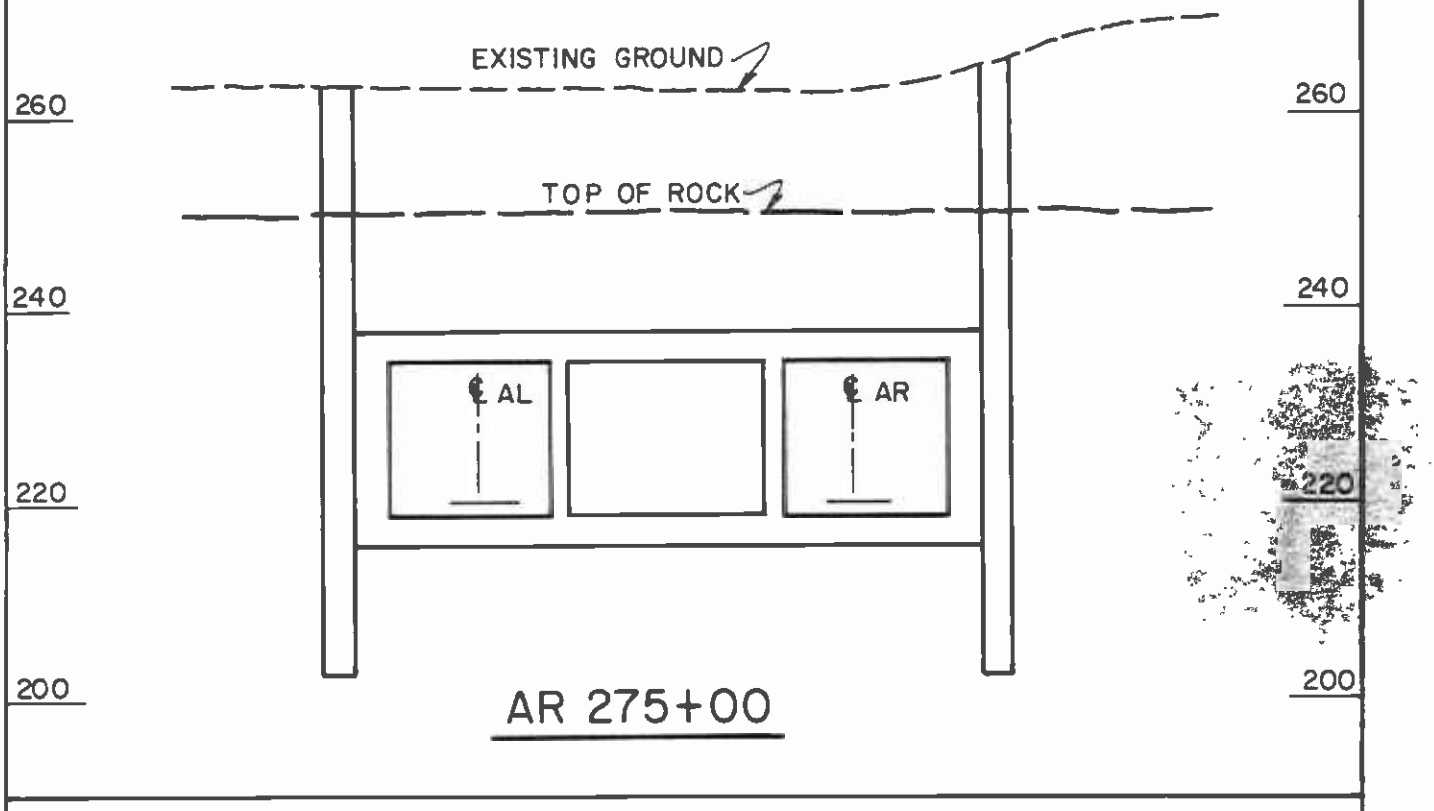


AR 271+00



AR 273+00

CONSTRUCTION OPTIONS THROUGH	JOB NO.	SHEET NO.
MAC ARTHUR PARK	DESIGNED BY W.WHEELER	DATE 12/18/87
ALTERNATIVE "B" – CUT &COVER SECTION	APPROVED	



AR 275+00

METRO RAIL TRANSIT CONSULTANTS
DMJM . PBQD KE HWA

MacARTHUR PARK	JOB NO	SHEET NO
CUT & COVER ALTERNATIVE B-1	DESIGNED BY Srivastava	DATE 2.2.88
PLAN	APPROVED	

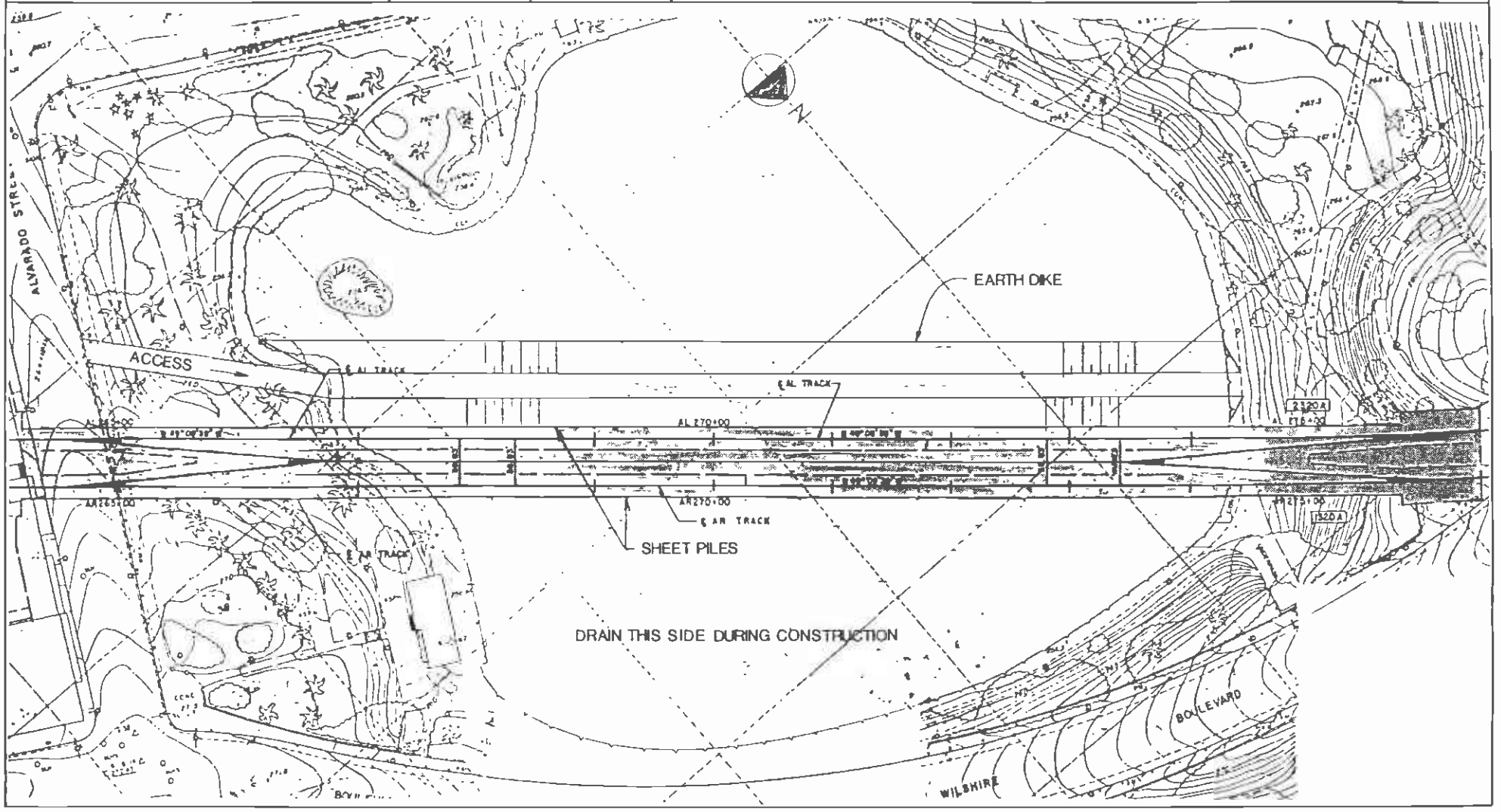


FIGURE 20

METRO RAIL TRANSIT CONSULTANTS
DMJM / PBQD / KE / HWA

MacARTHUR PARK LAKE	JOB NO	SHEET NO
CUT & COVER ALTERNATIVE B-1	DESIGNED BY F. Fortunato	DATE 2.2.88
PROFILE	APPROVED	

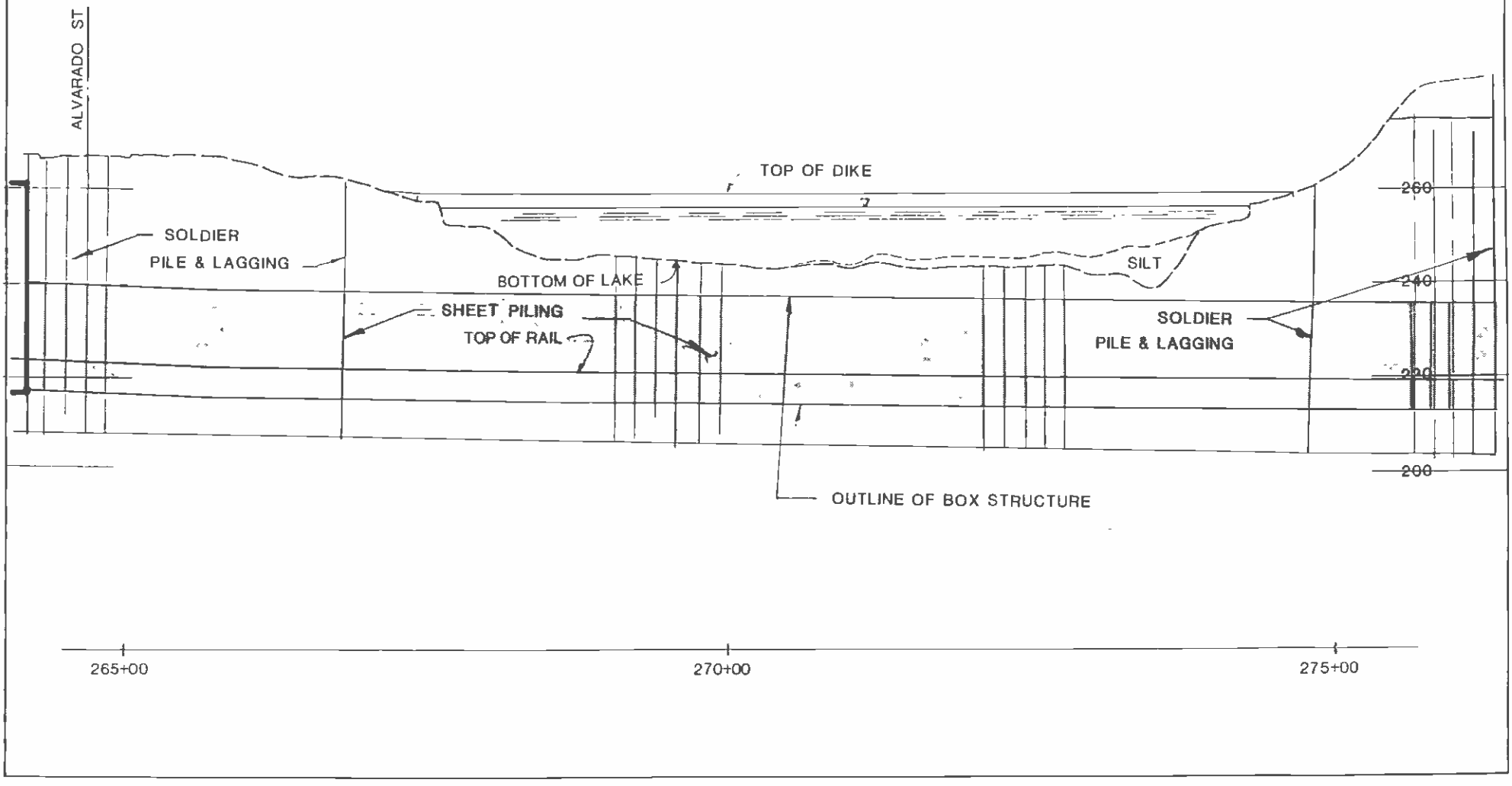
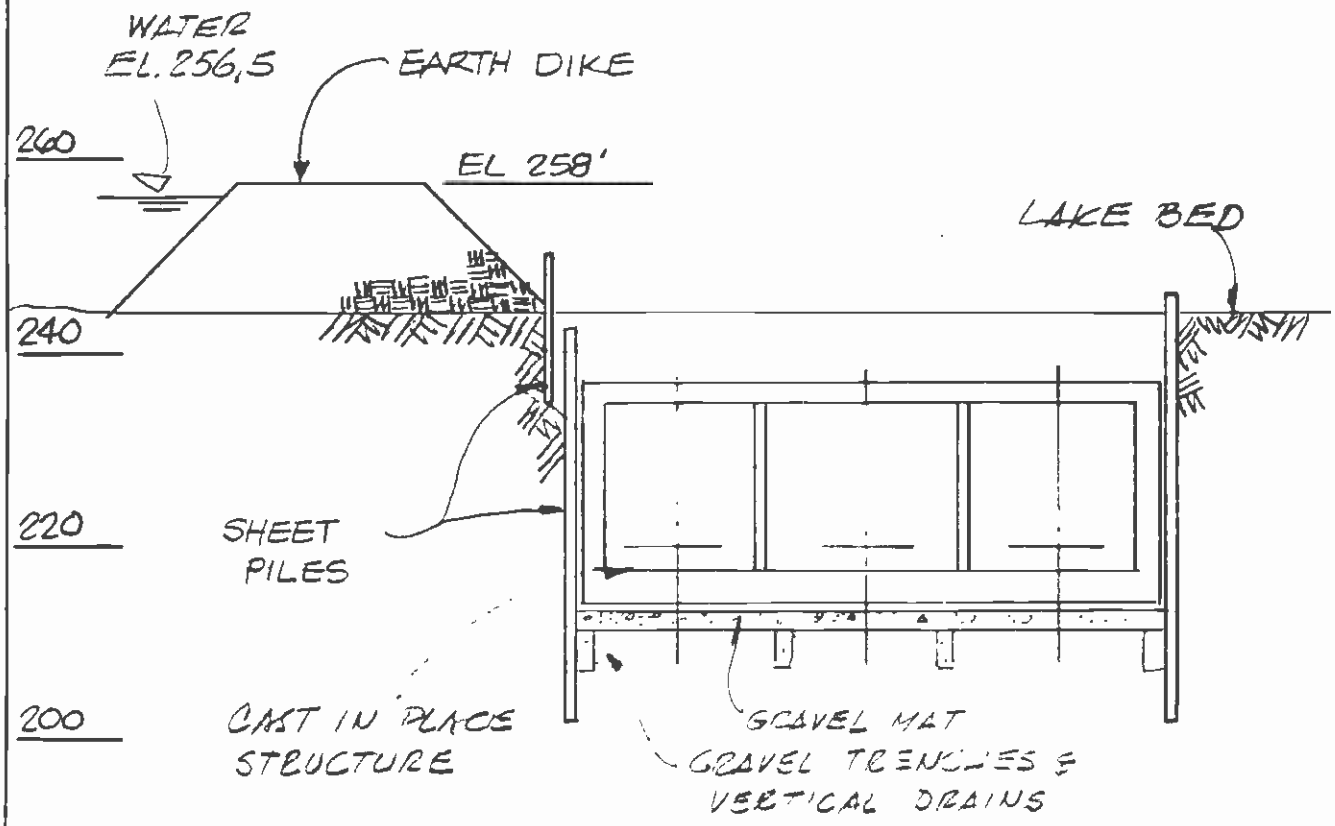


FIGURE 21

MacARTHUR PARK LAKE	JOB No.	SHEET No.
CUT & COVER ALTERNATIVE B-1	DESIGNED BY F. Fortunato	DATE 2.2.88
SECTION AT LAKE	APPROVED	1 : 20



Q001-018-1183

FIGURE 22

-- Install permanent lining and lining protection.

-- Refill lake with fresh water.

-- Deck over the construction in Alvarado Street.

o Alternative B-2 (Figures 23 through 26)

In this alternative, the cut-and-cover structure will be constructed in three segments. They are:

1) Wilshire Alvarado Station to east bank of lake
2) Park View Street to west bank of lake
3) Middle 600-foot-long box structure in the lake.

Construction steps are:

-- Construct earth dike on both banks.

-- Complete first cut-and-cover structure in conventional manner using support of excavation up to the lake banks.

-- Drain the lake completely.

-- Excavate for box structure using sloped side excavation through the lake bed.

-- Complete construction of box structure using cast-in-place concrete for grade slab and precast concrete elements for walls and roof slab.

-- Backfill around box structure to original lake bottom elevation.

-- Regrade lake bottom, install permanent lining and lining protection.

-- Refill lake with fresh water and put lake back in service.

This alternative will also have a temporary adverse impact on the park. The excavation for Metro Rail will be approximately 70 feet wide in the park outside the lake. The two-way access road will be 35-feet wide. The lake will be regraded, unacceptable soil removed, and the lake bed reconstructed, thereby eliminating any long-term impacts on the park facilities and improving the conditions of the lake.

METRO RAIL TRANSIT CONSULTANTS
DMJM PBQD / KE / HWA

MacARTHUR PARK PARK	JOB NO	SHEET NO
CUT & COVER ALTERNATIVE B-2	DESIGNED BY Frank Fortunato	DATE 2.2.88
PLAN	APPROVED	

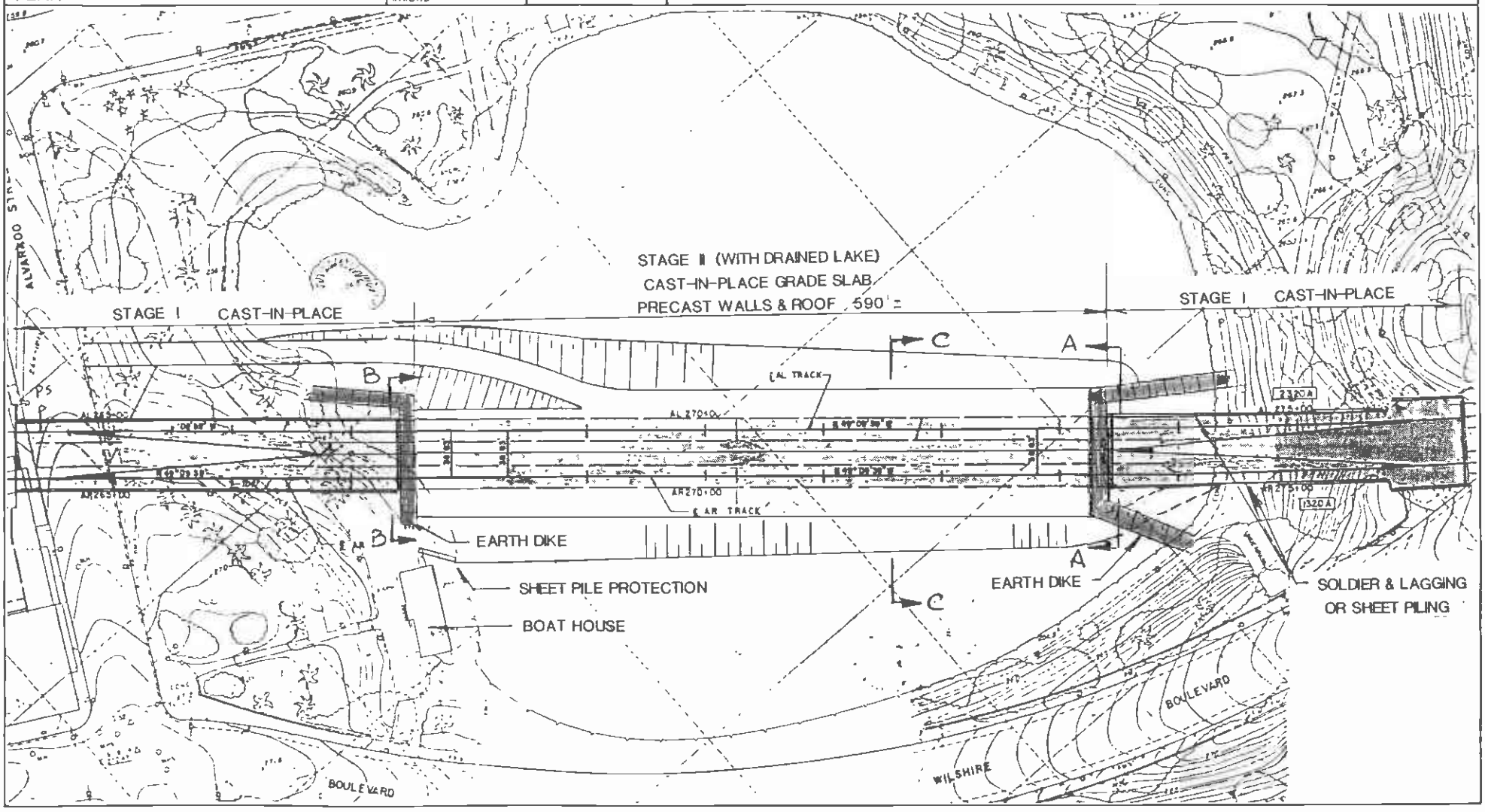


FIGURE 23

METRO RAIL TRANSIT CONSULTANTS
DMJM / PBQD KE HWA

MacARTHUR PARK LAKE	JOB NO.	SHEET NO.
CUT & COVER ALTERNATIVE B-2	DESIGNED BY [illegible]	DATE 2.2.83
PROFILE	APPROVED	

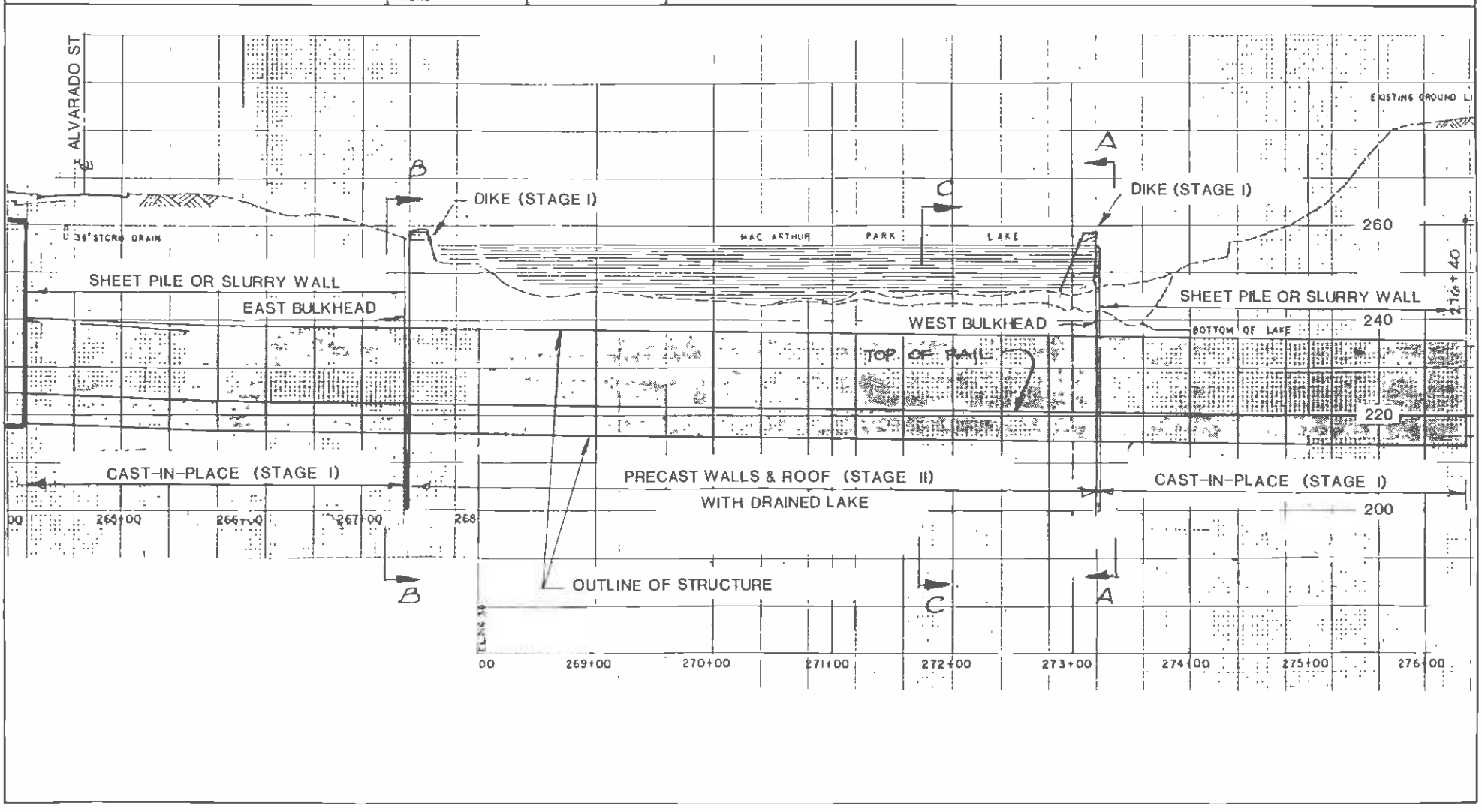


FIGURE 24

METRO RAIL TRANSIT CONSULTANTS
DMJM / PBQD / RE HWA

MacARTHUR PARK LAKE	JOB NO	SHEET NO
CUT & COVER ALTERNATIVE B-2	DESIGNED BY E. Fruin	DATE 2 2 83
SECTIONS	APPROVED	

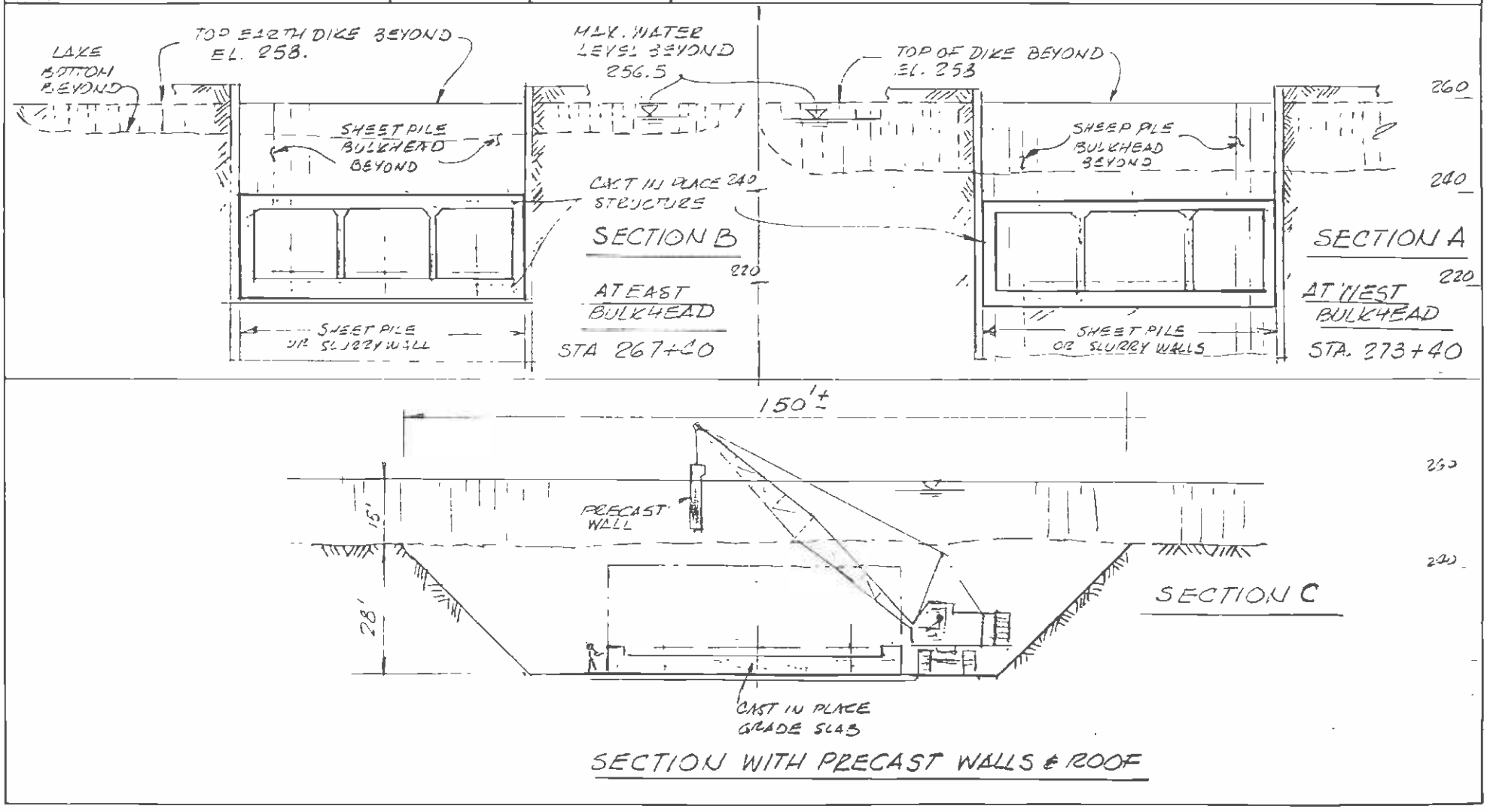


FIGURE 25

MacARTHUR PARK LAKE	JOB No.	SHEET No
CUT & COVER ALTERNATIVE B-2	DESIGNED BY F. Fortunato	DATE 2.2.88
PRECAST WALL & ROOF SECTION	APPROVED	1 : 20

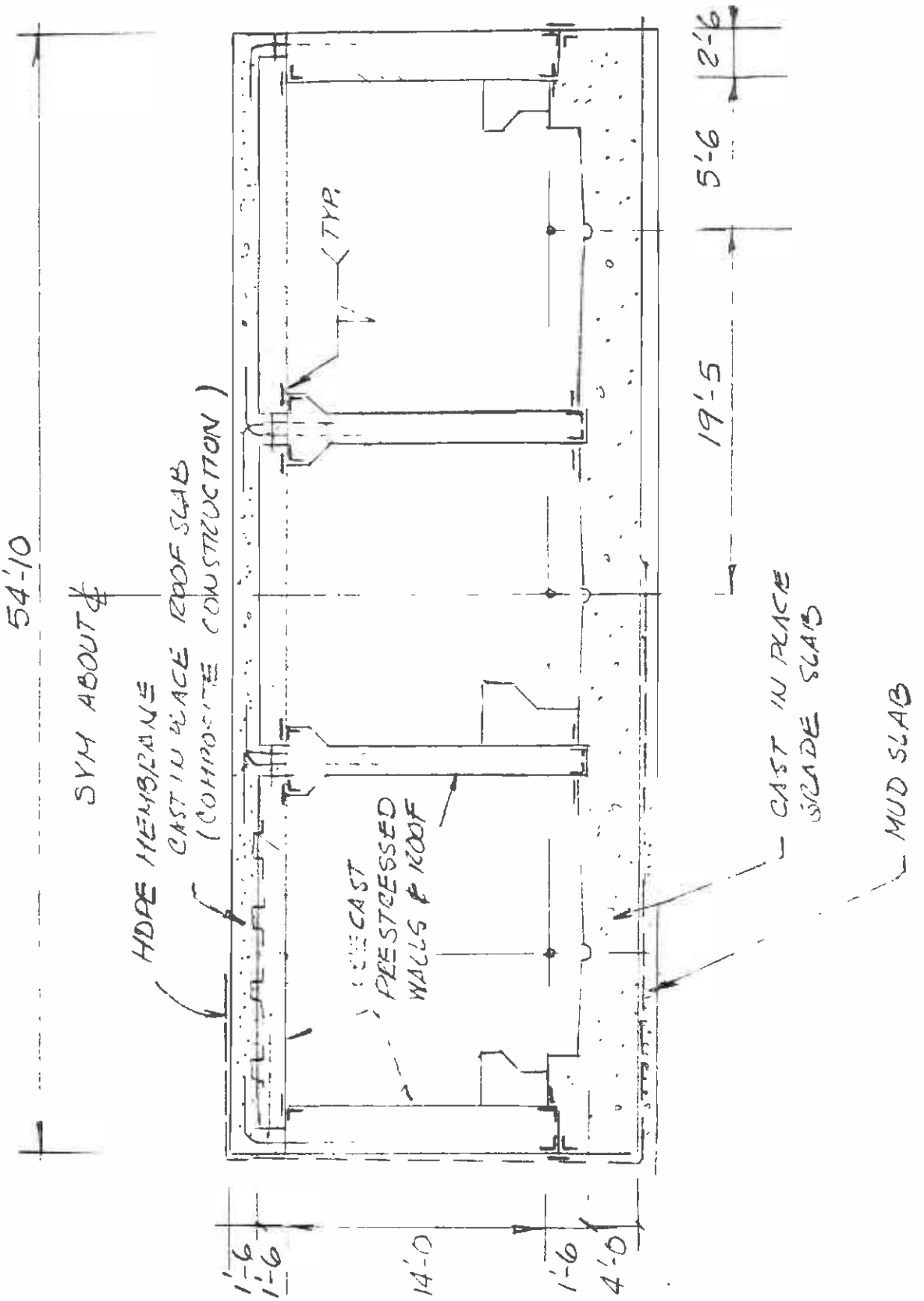


FIGURE 26

C. MacArthur Park - Wilshire Boulevard/Alvarado Street

The park was acquired by Los Angeles in 1886 and was named Westlake Park. The lake, which had been a neglected pond, was enlarged in 1980, and a bandstand was erected in 1896. This 32-acre park was renamed MacArthur Park in 1942 at the height of General Douglas MacArthurs's popularity. A map of the park and the route of the alignment are shown in Figure 1-B.

MacArthur Park is approximately 1/4-mile on a side. It is divided into two sections by Wilshire Boulevard, which bows to the north to accommodate the lake situated on the south side of the park. Pedestrian tunnels on the east and west sides carry park visitors under Wilshire Boulevard. The gross area within the surrounding sidewalks is about 29-1/2 acres. Subtracting the lake 8-1/2 acres area leaves a land area of roughly 21 acres.

The park facilities include:

rest rooms
three food concessions
boating concession
bandshell
card shelter
horseshoe pits
shuffleboard courts
children's play area
fire department training and administrative facility
monuments and statues
lake aeration system which creates three fountains
furniture (e.g., benches, tables, lights, and trash cans)
landscaping
walkways

The food and boating concessions are operated under a contract with Mark Woody, DBA "Woody's Goodies." Only two of the three food concessions are operating. The third, in the bath house, is expected to reopen in the near future. The food concessions contribute $16,680 annually, of which the boating concession contributes $1,320 to the Department of Recreation and Parks annually.

D. Community

The Los Angeles Department of Recreation and Parks estimates that the park is used by patrons within 1 to 1-1/2 miles walking distance of the park. The park is situated in the Westlake area, which has one of the highest

residential densities in Los Angeles. Lafayette Park lies 1/4-mile west of MacArthur Park and serves much of the same area.

Access to other parks and recreation areas is available through the excellent network of bus service in the area. Some nearby parks are Harold Henry Park (3 miles), L.A. High Memorial Park (3-1/4 miles), and Barnsdall Park (3-1/2 miles). All can be reached by a single bus ride and walk of less than 1/4 mile, or by a bus ride and transfer.

The Hollywood and Harbor Freeways form substantial barriers to pedestrian movement. These freeways are the north and east boundaries of the neighborhood served by the park, while Lafayette Park is the west boundary.

Some 69,500 people who are all potential patrons of the park live within 1 mile of the park boundaries. Another 15,750 potential park patrons reside within an additional 1/2-mile of the park. The Department of Recreation and Parks has no origin analyses or attendance figures for MacArthur Park. Their staff estimates that the main groups using the park are senior citizens; people playing chess, checkers, cards, and other games of skill and chance; children; ethnic groups (mostly Latino) celebrating special holidays; and Fire Department personnel.

There are major entrances to the park on Alvarado and Park View Streets, on 6th Street, on Wilshire Boulevard, and on 7th Street, with minor entrances along the perimeter of the southern portion at four other locations. The 7th and Alvarado Streets entrance is the most active. From that entrance, patrons move west along the south side to the games and senior citizens complex in the southwest corner or, in greater numbers, north along the east side of the park to the food and boating concessions. From there, heavy foot traffic continues north under Wilshire Boulevard to facilities in the northern section of the park. The lake dominates the south portion of the park and establishes circulation pathways around the shoreline. Foot traffic in the northern segments is reported heavier on the east side of the park.

III. METRO RAIL PROJECT

A. General Description

The Metro Rail Project is a rail rapid transit line planned by the Southern California Rapid Transit District (SCRTD) from downtown Los Angeles to the San Fernando Valley. This line is planned to be the core element of a regional rail rapid transit system.

Future extensions of the Metro Rail Project will be added as this regional system is developed. Currently, two segments have been defined as described below.

B. Description of MOS-1 Alignment

The first 4-1/2 miles of the line have been designated as MOS-1. This initial segment extends from the Yard and Shops near Union Station to the Wilshire/Alvarado Station.

The MOS-1 line has five stations. The segment begins at Union Station, northeast of the Los Angeles Civic Center, and runs through the central business district, terminating east of Alvarado Street at the Wilshire/Alvarado Station. The MOS-1 rail line is entirely in subway with line segments constructed by tunnel boring machines and stations and crossovers excavated by cut-and-cover construction techniques. Three double crossovers are included in MOS-1, one at each side of Union Station and one at the east end of the Wilshire/Alvarado Station.

Service for MOS-1 is planned to consist of four-car trains operating at headways of 5 minutes during peak hours, with headways increasing to 20 minutes during evenings and weekends. However, six-car trains operating at 3-1/2 minute headways will be required to serve projected demand for the 18-mile line to the San Fernando Valley.

C. Description of MOS-2 Alignment

There have been extensive studies of various alternative alignments from west of Alvarado Street to the San Fernando Valley. All of the proposed alignments cross MacArthur Park at the same location as shown in Figure 1B.

The alignment currently proposed generally follows Wilshire Boulevard below grade from Wilshire/Alvarado to Wilshire/Vermont, then rises to aerial through Vermont/Beverly, Vermont/Santa Monica, Sunset/Edgemont, Sunset/Western, and Sunset/Vine, then back below grade through

Highland/Hollywood, Universal City, and North Hollywood as shown in Figure 1A.

D. Operational Requirements - MOS-2 and Full System

A requirement of any rail rapid transit system is the ability to continue train service when there is a train failure on the mainline tracks. Special trackwork such as pocket tracks and crossovers enable the quick removal of a failed train to an area of safe refuge. A failed train on the mainline will cause major service delays since the train will be required to operate or be pushed at greatly reduced speed (usually after an extended period of immobility) to an area of safe refuge, causing other trains to queue behind it. The sooner a failed train can be removed from the mainline, the shorter the resulting delays will be. Severe train delays cause overcrowding at station platforms, which poses the possible safety hazard of overcrowded passengers being accidentally pushed onto the tracks before an oncoming train, and also of overcrowding during a potential fire or other emergency evacuation. At the very least, delays impact perceived system reliability and actual travel times, erode passenger confidence in the system, and may influence passenger modal choice away from mass transit.

The route configuration beyond MOS-1 will eventually be a trunk and branch system and necessitates provision of a pocket track at some locations more than at others. The trunk is the route between Union Station and Wilshire/Vermont on which all trains must travel. The branches are the remainder of the route west of the junction station at Wilshire/Vermont where the mainline diverges or "branches" out to the west along Wilshire, and to the north along Vermont (hence the terms "west branch" and "north branch"). Trains will be sent alternately to each branch from the trunk, resulting in equal train service frequency to both branches, a frequency equal to one-half the train frequency on the trunk. Thus, a train failure on the trunk will impact many more trains and cause greater delays to passengers than will a failure on one of the branches. During rush hours, a train failure could precipitate a rapid degradation train service. For this reason, it is imperative to provide a pocket track on the trunk to accommodate a failed train. By locating the pocket track near the Wilshire/Vermont junction station on the trunk, a train failure on the critical trunk line or nearby on the branch lines can be quickly removed to this pocket track, minimizing delays to queued trains behind it. Technical analyses supported by computer simulations have confirmed that a pocket track immediately west of Wilshire/Alvarado is ideally located for this purpose.

A pocket track at Sunset/Vine is planned in MOS-2, but it will not be useful for train failure near the junction station.

A pocket track at Wilshire/Alvarado is capable of serving several other important functions. It provides a strategic location near the peak passenger load point (location where the most number of passengers pass) to position a gap train that can be placed into revenue service as required by delays or extraordinary passenger loads. It functions as a staging location for a work train in order to maximize use of the available repair time for maintenance of way. The pocket track also facilitates turning of trains (reverse direction). This might be desirable on a scheduled basis during periods of light patronage in order to reduce operating costs, or on an unscheduled basis during service disruptions downtown. If a pocket track is not feasible under the park because tunneling is used, an alternative location either along Wilshire Boulevard or along both branches adjacent to the junction station must be designated for the pocket track(s).

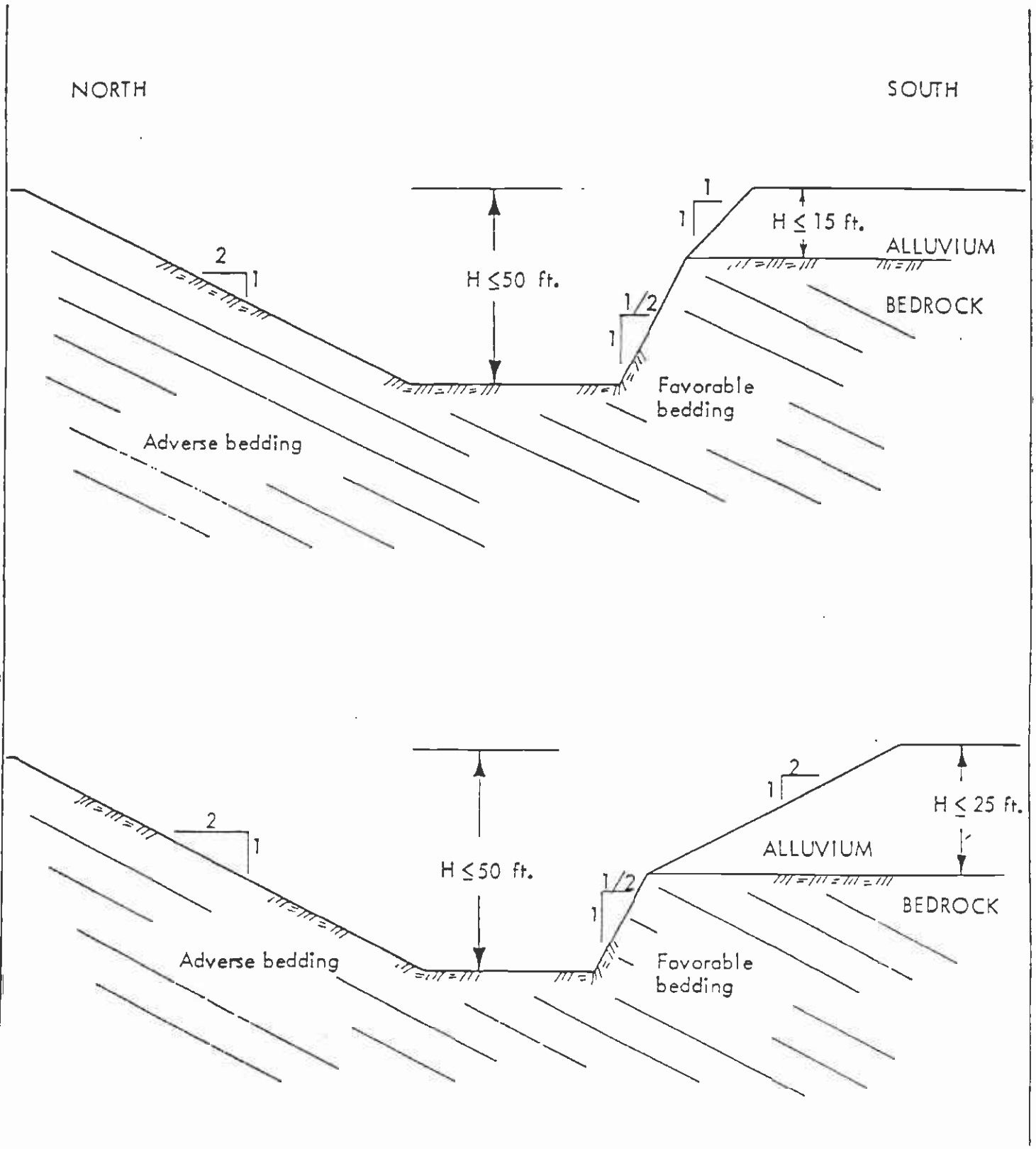
E. Existing Soil Conditions

Based on soil investigations conducted, the geologic materials at the MacArthur Lake site can be grouped into three general subsurface units: fill (including debris and soft sediments (mud), fine-grained alluvium, and bedrock of the Puente formation. There is no man-made liner on the lake bottom.

Fill. Fill soils include silt and silty clay with sand, gravel, cobbles, and boulders. Asphalt, wood, building debris, and other undesirable materials can also be expected. Although in some areas the fill may be somewhat comparable to the alluvium in density and strength, the fill is highly variable and contains soft/loose (mud) zones that require special consideration in design and construction. The fill varies in thickness from zero to approximately 10 feet. Side slopes of 4 feet horizontal for each 1 foot vertical are assumed to be adequate for open excavation.

Alluvium. The alluvium is generally a fine-grained soil consisting of clay, silty clay, and sandy clay. It is generally soft to firm and may be treated as a cohesionless material with an effective stress friction angle of 25°. This allows side slopes as shown on Figure 19 (from Converse Consultants). The alluvium thickness varies from 5 to 20 feet, with the thickest section occurring at near station 268+80. This section corresponds to a deep channel of soft clays that can be identified on U.S.G.S. maps prepared in the early 1900s, when the lake was known as West Lake.

Bedrock. This bedrock is primarily siltstone and claystone with clayey sandstone interbeds. Due to the lake waters, the upper 3 to 7 feet of bedrock are soft, brown, and deeply weathered. Below the upper 7 feet the bedrock grades into a blue-gray, fresh, friable moderately hard bedrock. The unconfined compressive strength of the unweathered bedrock is generally above 5000 psi, except along the bedding where the unconfined compressive strength is as low as 200 psi. The slope of the rock bedding requires that the excavation cut slope on the north side of the alignment be 2 feet horizontal for each 1 foot vertical. On the south side the cut slope can be 1/2 foot horizontal for each 1 foot vertical (see Figure 19).



Approved for publication 6/15/89 by

TEMPORARY SLOPE DESIGN

MACARTHUR PARK LAKE STUDY
Southern California Rapid Transit District
METRO RAIL PROJECT

Project No
83-1140

Converse Consultants Geotechnical Engineering and Applied Sciences

FIGURE 19

IV. CONSTRUCTION ALTERNATIVES

A. Tunnel Construction

1. Alternative A (Figures 2 through 6)

- Construction

With the deep channel of soft clays that runs through the area shown in Figure 3, excavation under MacArthur lake by tunneling presents special challenges.

First, to assure the safety of the workers and the tunnel it is mandatory that tunneling be done with the lake drained. There will be a great difference in consistency and behavior between the soft clay, the weathered bedrock, and the bedrock. Therefore, it will be extremely difficult to assure safe completion of the soft ground portion of tunnel using the same tunnel shield as in the bedrock. A machine (shield) that has cutters and face support systems set up for the majority of the tunnel will be ill equipped to support and excavate the soft ground. With the undrained lake overhead, a failure that would be minor under most circumstances could easily lead to complete (and rapid) flooding of the tunnel and adjacent unprotected work such as Alvarado Station. Therefore, the lake must be drained and the lake area fenced to prevent the general public from wandering onto the lake and work area.

Second, extraordinary means must be used to stabilize the soft silt and clay portion of the tunnel reach before tunneling. A preliminary study indicates three possible means: grouting, freezing, or replacement of materials. Further study, primarily review of the soil conditions, indicates that grouting is not feasible because the fines content of the soils (generally 50 to 98 percent passing the #200) makes grouting impossible.

Thus, based on this preliminary evaluation, it is concluded that the two acceptable methods of completing tunnel excavations across the soft clay fill zone are to solidify that zone by freezing before the tunnels are excavated, or to remove the soft zone and replace it with competent material before tunneling.

Third, special provisions may need to be made to keep the tunnels from "floating" when the lake is refilled. Depending upon the actual conditions encountered by the tunnels, it is probable that the soils around and above the tunnel crown cannot resist the buoyancy of the completed tunnels. Neither the soft clayey soils nor the weathered bedrock above and around the crown may have enough consistency or frictional resistance to resist this buoyancy.

Therefore, final evaluation and design may find it necessary to add a massive concrete slab over the tunnels, or to find another way to add sufficient mass to the tunnels to overcome their buoyancy.

It is recognized that further study of these issues will occur during detailed design, but for this study the following construction procedures have been assumed:

The lake will be drained before any tunnel work is initiated and will remain drained until the cast-in-place final tunnel lining is completed. The Contractor will use portions of the lake bed for staging.

To eliminate the soft ground in the tunnel (and the resulting mixed face tunneling conditions), and to prevent the completed tunnel from floating, the soft ground will be removed and replaced with lean concrete before tunneling. This lean concrete will be unreinforced and will extend approximately 5 feet above the tunnel crown to provide the mass required for prevention of flotation. Aggregate size will be limited so that a machine set up for tunneling in the Puente formation will be able also to excavate the lean concrete. A study of freezing the soft ground has indicated this alternative to be more expensive than the replacement of materials, thus freezing was dropped.

As with other sections of the Metro Rail Project, a hydrocarbon resistant membrane of high density polyethylene (HDPE) will be installed between the initial tunnel support and the cast-in-place final lining. This HDPE will assure that the final lining is both gas and water tight.

- Schedule

  According to the construction schedule prepared by SCRTD (Figure 27), the tunnel construction through the park impacts the lake for approximately 20 months.

- Cost

  The cost of tunneling (Alternative A) is shown below:

  Estimated Construction Costs (in millions)

Tunneling	$18.7
Add pocket track in Wilshire Blvd.	9.2
TOTAL	$27.9

- Impact of Construction on the Park

  (1) Area Required for Construction:

  The construction of tunnels through the park will involve the lake and some of the park land. A lake bed access road will cross the east side of the park on a strip of land 50 feet wide by 230 feet long from Alvarado Street sidewalk into the lake. A portion of the east shore of the lake south of the boathouse will be excavated to remove soft soil from the alignment. A piling support structure will be placed on the west and south sides of the boathouse to prevent its foundation from being undermined. Total area required for construction activities is less than 1/2 acre of the 21 acres of park land, or about 2.4 percent.

  (2) Effects on Park Facilities

  The boating concession would be closed for the 20-month duration of construction, resulting in a loss of $2,200 in revenues to the City Department of Recreation and Parks, and a loss of $16,100 to the concessionaire.

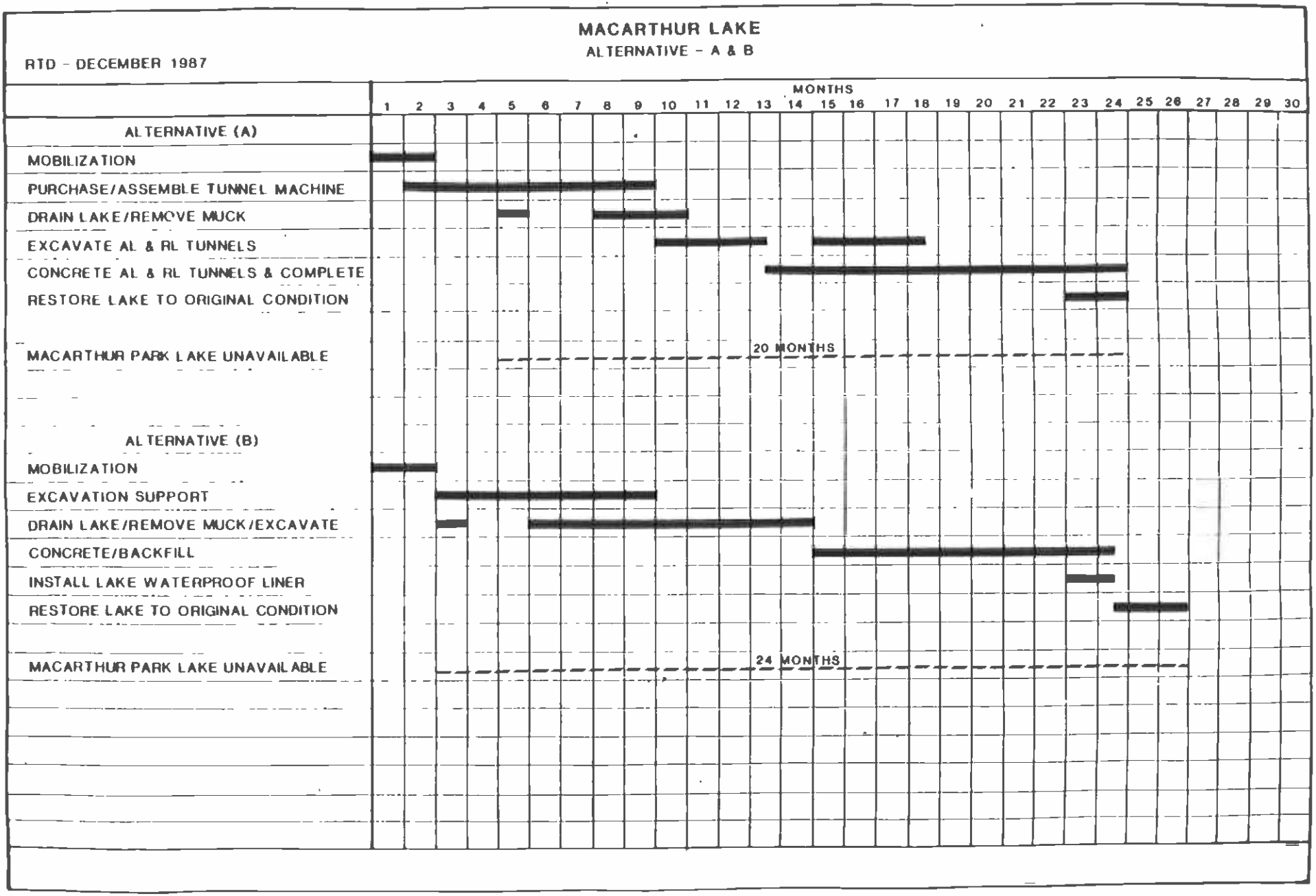


FIGURE 27

The food concession in the boathouse, if reopened before construction, would probably lose all its business during the construction period. The amount of loss depends on the level of operation the concession achieves before beginning of construction.

Several trees and other landscaping would be removed to accommodate the construction cut-and-cover through the lake bed and the access roadway. These would be replaced with like trees and landscape material upon completion of the construction.

Some furniture such as electroliers, benches, tables, and trash cans would be removed and stored during construction.

(3) Park Improvements

The lake bed will be restored and back-filled. The tunnel alternative does not include any improvements to the lake or park as the impact is minimal.

o Impact on the Community

Almost all (approximately 97 percent) of the usable land area of the park would remain open for public use during construction. The major impact on the public would be that the lake would be drained for the 20-month duration of construction. No boating would be available nor would lake fountains be operating.

Public information activities begun under construction of MOS-1 will be continued for the construction of the next segment, and will include meetings with the MacArthur Park Community Council, individual meetings with merchants, dissemination of Metrogram publications by targeted mailing lists and personal deliveries, and communication with Councilwoman Molina and her staff.

o Impact on Traffic and Circulation

Several walkways would be removed or interrupted during construction. These include the walk from the Alvarado and 7th Streets entrance to the boathouse, and the lake shore walk on the east side of the lake. The sidewalk along Alvarado Street would remain open to pedestrian traffic,

affording a convenient bypass to reach the food concession in the boathouse and the underpass to the north section of the park.

The lake access roadway would cross the Alvarado Street sidewalk. The construction contractor would be required to ensure pedestrian safety by providing a flag person to control traffic and pedestrians at the crossing.

2. Alternative A-1 (Figures 7 through 9)

o Construction

Construction steps are as follows:

-- Construct earth dike on south side of proposed Metro Rail structure.

-- Dewater the lake on the north side of the dam.

-- Install sheet pile wall cofferdam around the area to be excavated.

-- Excavate the alluvium soils and soft rock from the lake bottom down to approximately five feet into the sound rock.

-- Fill excavation within cofferdam with unreinforced lean concrete up to 5 feet above the tunnel crown to provide the mass required for prevention of flotation of tunnel.

-- Install 3-foot-thick regular concrete seal over lean concrete fill.

-- Complete backfilling up to the originall lake bed level.

-- During all this construction time the south side of the earth dike shall remain available for public use.

-- Remove earth dike and refill the lake to its original level.

-- The park and lake return to normal service to the public.

Concurrent with the works described above, a 88-foot-long structure for a pocket track will be constructed along Wilshire Boulevard.

Tunnel digging machines starting at that pocket track will build the tunnels passing under the lake to reach Alvarado Station. Operations will be performed completely underground.

This alternative will have limited adverse impact on the park because the construction is limited within the lake area.

- Schedule

The construction schedule (Figure 28) prepared by MRTC shows that this construction technique will impact half the lake for approximately 18.5 months.

- Cost

The cost of tunneling using this construction technique is shown below:

Estimated Construction Costs (in millions)

Tunneling	$18.7
Pocket track in Wilshire Blvd.	13.1
TOTAL	$31.8

- Impact of Construction on the Park, Community, Traffic and Circulation

The construction of an earth dike in the lake will involve importing earth fill. Excavated material within the limits of coffer dam will be stored on the north side of the alignment. The south side of the lake can be used by the public. Fencing will be installed along the alignment on the earth dike. No additional fill material will be required to regrade the lake bottom to its original contours. Approximately 30 percent of the lake will be available for public use most of the time. The park can be restored for public use prior to tunneling within 18.5 months.

Impact on the community and traffic circulation will essentially remain same as described for Alternative A.

Alternative A-1 will have less impact on lake use but will cost an additional $3.9 million.

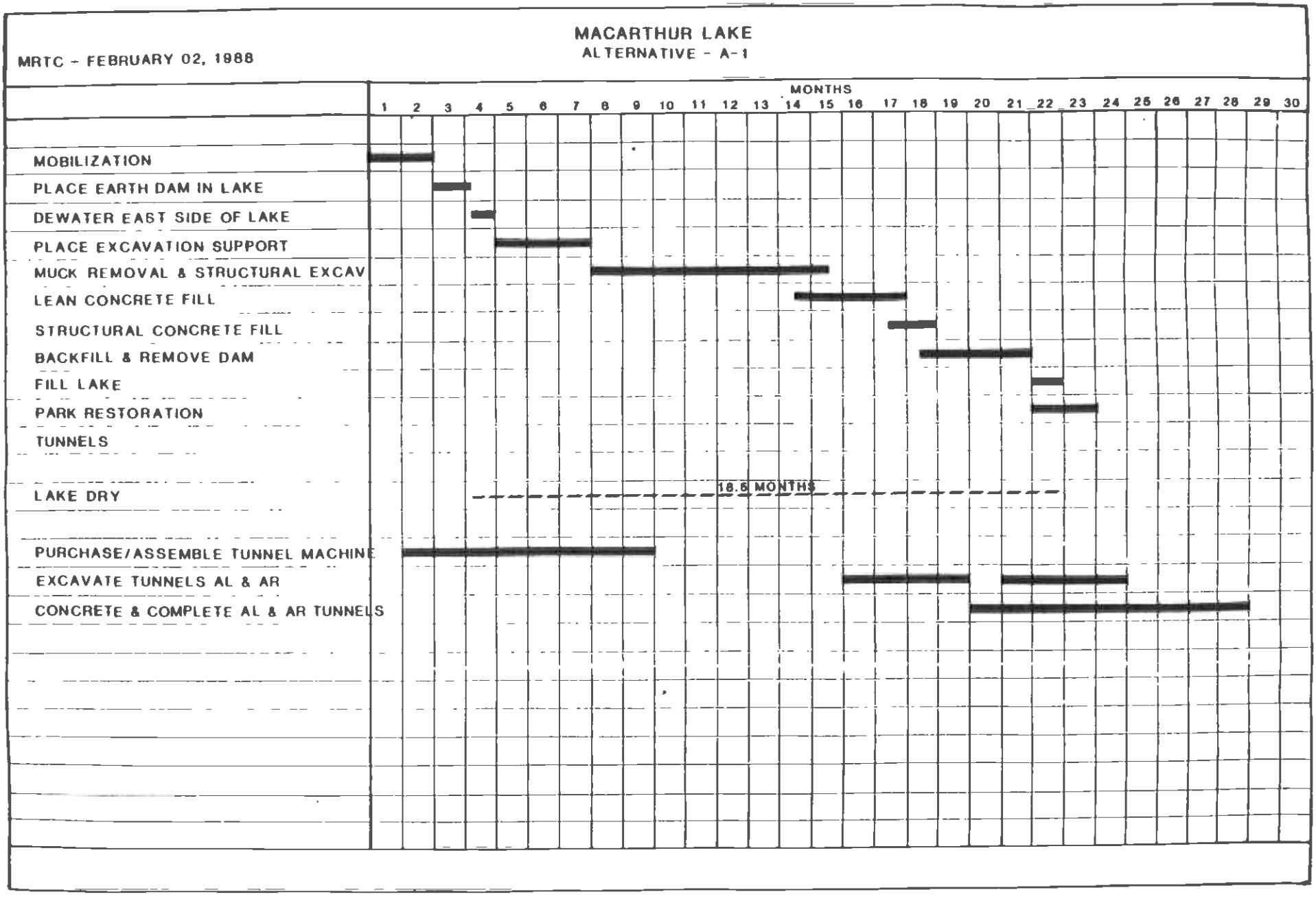

MACARTHUR LAKE
ALTERNATIVE - A-1
MRTC - FEBRUARY 02, 1988
MONTHS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
MOBILIZATION
PLACE EARTH DAM IN LAKE
DEWATER EAST SIDE OF LAKE
PLACE EXCAVATION SUPPORT
MUCK REMOVAL & STRUCTURAL EXCAV
LEAN CONCRETE FILL
STRUCTURAL CONCRETE FILL
BACKFILL & REMOVE DAM
FILL LAKE
PARK RESTORATION
TUNNELS
LAKE DRY
18.6 MONTHS
PURCHASE/ASSEMBLE TUNNEL MACHINE
EXCAVATE TUNNELS AL & AR
CONCRETE & COMPLETE AL & AR TUNNELS

FIGURE 28

3. Alternative A-2 (Figures 10 through 13)

o Construction

Construction steps are as follows:

-- Drain the lake completely.

-- Excavate from the lake bottom down up to approximately 5 feet into the sound rock in order to remove the unsuitable material. Use sloped side excavation through the lake bed. The excavation will extend for the full length of the lake from the east to the west bank. The excavation width will be approximately 160 feet.

-- Use a temporary support system to minimize excavation in the park outside the lake.

-- A ramp for trucks shall be constructed with access at Alvarado Street.

-- Back fill excavation with unreinforced lean concrete up to 5 feet above the tunnel crown.

-- Install a 3-foot thick regular concrete seal over lean concrete. Fill only in center 80-foot width of the excavation.

-- Back fill the lake, and regrade the lake bottom to its original contours.

-- Refill lake with fresh water and put lake back in service.

The construction of the pocket track and the tunnels also will be performed as described before.

o Schedule

The construction schedule (Figure 29) prepared by MRTC shows that the tunnel construction through the park will require closing of the park facility for 22 months.

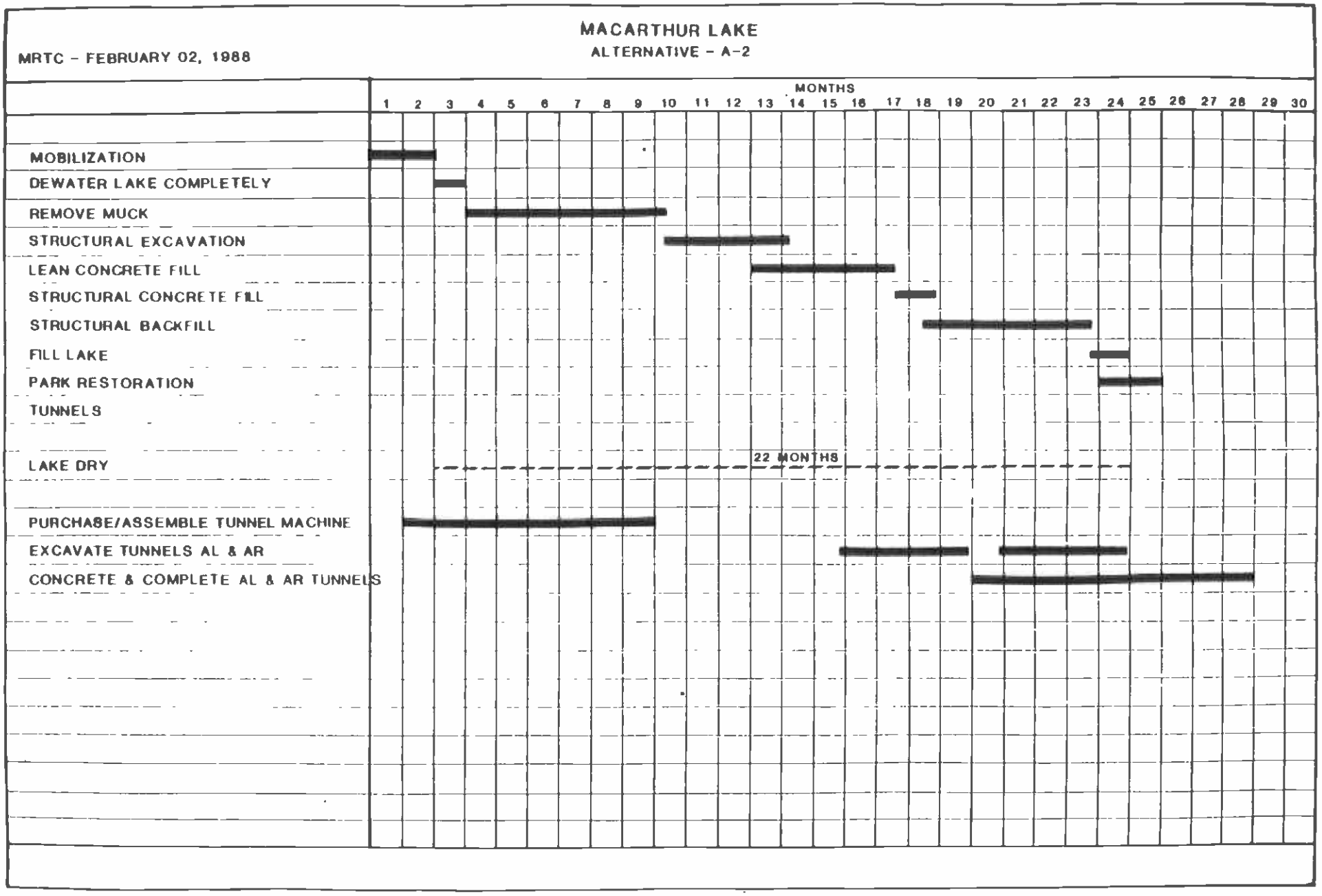


FIGURE 29

- o Cost

  The cost of tunneling using this alternate is shown below:

Estimated Construction Costs (in millions)

Tunneling	$18.7
Pocket track in Wilshire Blvd.	11.4
TOTAL	$30.1

- o Impact of Tunnel Construction on the Park, Community, Traffic and Circulation

  Impact of tunnel construction on the park by using these construction steps will be essentially the same as indicated above. Alternative A-2 will have less impact on lake use but cost an additional $2.2 million.

  Impact on the community and traffic circulation will be essentially the same as outlined above for Alternative A.

B. Cut-and-Cover Construction

1. Alternative B (Figures 14 through 19)

- o Construction:

  Construction steps are as follows:

  The construction of a three-cell subway box by cut-and-cover will actually require three types of excavation:

  --The Metro Rail crossing of Alvarado Street will be constructed by cut-and-cover with a temporary support system and decking for the street and adjacent sidwalks. Thus, flow of traffic on Alvarado will be maintained.

  -- The reaches from Alvarado Street to the east lake shore and from the west lake shore to station 275+75 are outside the lake bed but within the park. To minimize the width of excavation a temporary support system without decking will be used for each of these reaches.

-- The excavation under the lake will require draining and mucking the lake bed. The exact thickness of the muck is not known but is believed to vary from zero to approximately 10 feet. To facilitate construction and as a long-term improvement, all of the muck will be removed from the lake bottom as soon as the lake bed has dried sufficiently. This allows the contractor to regrade and use the south half of the lake bed for construction staging and storage, thereby minimizing the construction impacts on the surrounding park facilities.

The contractor will excavate to the bottom of the proposed subway structure using a single open trench. The three-cell box structure will be constructed in the trench and surrounded with a hydrocarbon resistant membrane of high density polyethylene (HDPE). This use of HDPE is typical of Metro Rail construction to assure that the structure is both gas and water tight.

When backfilling above the completed structure, the lake bed will be regraded and a water-proof liner installed. The liner will be protected with a covering of sand or asphalt paving.

o Schedule

The construction schedule (Figure 27) prepared by SCRTD shows that cut-and-cover construction through the park will impact the lake for approximately 24 months.

o Cost

The estimated cost of constructing the three-cell box through the park is shown below:

Estimated Construction Costs (in millions)

Three-cell box	$14.9
Park Improvements	2.0
Equivalent lengths of tunnels in Wilshire Blvd.	6.7
TOTAL	$23.6

- Impact of Construction on the Park

  (1) Area Required for Construction

  The construction of an open cut through the park will involve the lake and some of the park land. On the east side of the park a supported decked-over cut 70 feet wide will cross Alvarado Street and sidewalks from the Alvarado Station. At the edge of the park land a 70-foot wide supported, open cut will continue into the lake. To provide access to the lake bed construction site, one 35-foot-wide roadway will parallel each side of the open cut from Alvarado Street into the lake bed, taking a strip of land roughly 140 feet by 230 feet, or just under three-quarters of an acre. On the west side of the lake a supported cut 70 feet by 100 feet will be needed to complete the pocket track structure. An additional 10 feet will be needed around the supported cut to allow installation of the support system and fencing, for a total of nearly one-quarter acre. The total park land occupied by construction would be approximately one acre out of the net land area of 21 acres, or 4.7 percent.

  (2) Effects on Park Facilities

  The boating concession would be closed for the 24-month duration of construction, resulting in a loss of $2,600 revenues to the City Department of Recreation and Parks and a loss of $19,400 to the concessionaire.

  The food concession in the boathouse, if reopened before construction, would probably lose all its business during the construction period. The amount of loss depends on the level of operation the concession achieves before beginning of construction.

  Several trees and other landscaping would be removed to accommodate the construction cut and lake bed access roadway. These

would be replaced with like trees and landscape material upon completion of the construction.

The lake aeration system would be removed during construction and restored upon completion.

Some furniture such as electroliers, benches, tables, and trash cans would be removed and stored during construction.

(3) Park Improvements

The lake bed will be completely mucked for this construction alternative. Upon completion of construction, the lake bed will be backfilled and regraded to its original contours. An impermeable lining will then be installed on the lake bed and protected with a covering of gravel or asphalt. Finally, the lake will be refilled with fresh water. These improvements to the lake will make it more enjoyable and will assist City Department of Recreation and Parks in future maintenance activities in the lake.

o Impact on the Community

A large percentage (about 95 percent) of the usable land area of the park will remain open for public use during construction. The major impact on the public would be that the lake would be drained for the 24-month duration of construction. No boating or fountains would be available.

Public information is same as described under tunneling above.

o Impact on Traffic and Circulation

Several walkways would be removed or interrupted during construction. These include the lake shore walk on the west side of the lake, the walk from the Park View and 7th Streets entrance to the western passenger viaduct under Wilshire Boulevard, the walk from Alvarado and 7th Street entrance to the boathouse, the walk from mid-block on Alvarado Street between Wilshire Boulevard and 7th Streets to the boat house, and the lake shore walk on the east side of the lake. The sidewalk along Alvarado Street would remain

open to pedestrian traffic, affording a convenient bypass to reach the food concessionin the boat house, and the underpass to the north section of the park.

The lake access roadway would cross the sidewalk of Alvarado Street. The construction contractor would ensure pedestrian safety by providing a flag person to control traffic and pedestrians at the crossing.

Access to other parks and recreation areas is available through the excellent network of bus service in the area. Some nearby parks are Lafayette Park (¼ mile), Harold Henry Park (3 miles), L.A. High Memorial Park (3-1/4 miles), and Barnsdall Park (3-1/2 miles). All can be reached by a single bus ride and walk of less than 1/4 mile or a bus ride and transfer.

Alternative B provides major long-term improvements to MacArthur Park Lake:

-- Complete removal of muck on lake bottom

-- Regrading of the lake bottom

-- Installation of a water-proof lining

-- Placement of gravel or asphalt cover over lining

-- Refilling of the lake with clean water.

These improvements will enhance the overall quality of the lake and assist in and improve the efficiency of any future maintenance activities in the lake.

2. Alternative B-1 (Figures 20 through 22)

o Construction

Construction steps are as follows:

-- Build earth dike south side of proposed Metro Rail structure.

-- Dewater the lake on north side of dike.

-- Install sheet pile wall cofferdam as indicated in plan and section (Figure 20 and 22)

-- Excavate from lake bottom down to 3 feet below the invert elevation of cut-and-cover structure.

-- Install gravel fill and tremie concrete to have dry base for construction of grade slab.

-- Install sump to prevent any heaving.

-- Construct a system of vertical drains and trenches to collect seepage water in sump.

-- In place of steel sheet pile wall cofferdam, a structural slurry cut-off wall could be used.

-- Install a hydrocarbon-resistant membrane of high-density pedyethylene (HDPE) on top of tremie concrete and along sheet pile walls.

-- Construct grade slab using cast-in-place concrete.

-- Precast concrete elements could be used to build walls and roof slab to expedite construction of cut-and-cover structure between the banks of MacArthur Lake.

-- Use of cast-in-place concrete for the subway box structure inside banks will be preferable to save cost and to facilitate structural framing in the switch area.

-- Keep the lake on the south side of the earth dike available for public use while building coffer dam, excavating, and constructing cut-and-cover structure.

-- Excavated material can be stored on the north side of the Metro Rail Structure.

-- Dewater remainder of lake completely.

-- Pull secondary sheet pile wall retaining earth dam.

-- Break the earth dike and regrade lake bottom to its original contours, using excavated and earth dike material.

-- Install an impermeable water-proof lining on the lake bed protected with a covering of sand or asphalt paving.

-- Refill lake with fresh water and put lake back in service.

- Schedule

  The construction schedule (Figure 30) prepared by MRTC shows that by using precast element and following the construction steps outlined above, the park will be impacted for approximately 25 months.

- Cost

  The estimated cost of constructing the three-cell cut-and-cover box structure through the park is shown below.

  Estimated Construction Costs (In Millions)

Three-Cell Box Structure	$15.6
Park Improvement	2.0
Equivalent lengths of tunnels in Wilshire	6.7
TOTAL	$24.3

- Impact of Construction on the Park, Community, Traffic, and Circulation

  This alternative will provide partial use of lake except during lake lining installation. Half of the lake could be used by public at all times.

  The impact of Metro Rail construction on the park facilities, Park improvement, community, and traffic circulation will remain essentially the same as indicated for alternative B.

3. Alternative B-2 (Figures 23 through 26)

   - Construction

     This construction alternate is based upon first completing cut-and-cover structure up to the banks of the lake and then building the middle three-cell box structure by using cast-in-place concrete or precast elements. The lake remains in full operation during construction of the structure at Alvarado Street (east bank) and at Wilshire Boulevard (west bank).

     Construction steps are as follows:

     -- Build earth dike on east bank of lake as indicated.

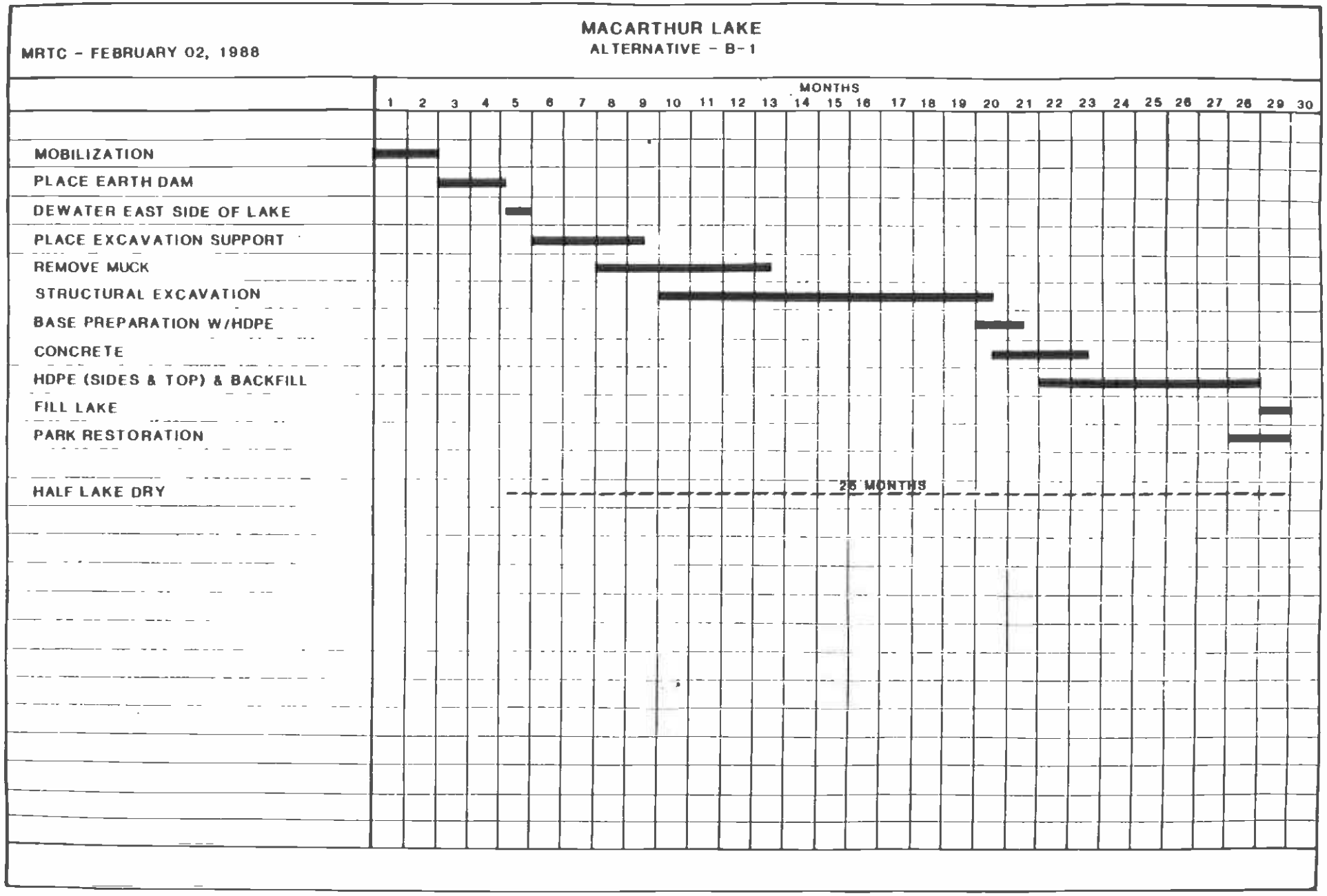

MACARTHUR LAKE
ALTERNATIVE - B-1
MRTC - FEBRUARY 02, 1988
MONTHS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
MOBILIZATION
PLACE EARTH DAM
DEWATER EAST SIDE OF LAKE
PLACE EXCAVATION SUPPORT
REMOVE MUCK
STRUCTURAL EXCAVATION
BASE PREPARATION W/HDPE
CONCRETE
HDPE (SIDES & TOP) & BACKFILL
FILL LAKE
PARK RESTORATION
HALF LAKE DRY
25 MONTHS

FIGURE 30

-- Install support of excavation for cut-and-cover structure from Alvarado Street to east bank of the lake.

-- Deck over the construction in Alvarado Street.

-- Complete cut-and-cover box structure from the existing Wilshire Alvarado Station to east bank of lake using conventional cast-in-place concrete construction.

-- Build earth dike on west bank of lake as indicated.

-- Install support of excavation for cut-and-cover structure from west bank of the lake to a point east of Parkview Street (station 275+25).

-- Complete cut-and-cover box structure using conventional cast-in-place concrete construction.

-- Drain the lake completely.

-- Remove soft sediments (mud) in the vicinity of Metro Rail structure.

-- Use sloped side excavation through the lake bed.

-- Excavate for the three-cell subway box structure.

-- Store excavated material in the remaining area of lake.

-- Install hydrocarbon resistant membrane of high density polyethylene (HDPE) for grade slab.

-- Construct grade slab using cast-in-place concrete.

-- Construct walls and roof slab using precast concrete elements or cast-in-place concrete for the three-cell subway box structure in the lake.

-- Install hydrocarbon resistant membrane around the walls and top of roof.

-- Backfill around box to original lake bottom elevation.

-- Regrade the lake bed to its original contours.

-- Install an impermeable water-proof lining on the lake bed, protected with a covering of sand or asphalt paving.

-- Refill the lake with fresh water and put lake back in service.

-- Reconstruct those facilities affected by this work.

o Schedule

The construction schedule (Figure 31) prepared by MRTC shows that cut-and-cover construction through the park will impact the lake for approximately 15 months.

o Cost

The estimated cost of constructing the three-cell box through the park is shown below:

Estimated Construction Costs (in millions)

Three-cell box	$17.4
Park improvements	2.0
Equivalent lengths of tunnel in Wilshire Blvd.	6.0
TOTAL	$ 25.4

o Impact of Cut-and-Cover Construction on the Park, Community, Traffic and Circulation

This alternative will also have a temporary adverse impact on the park. (The lake will remain out of public use for a very limited time). Construction time will be significantly cut down by building the structure in three segments and by using precast concrete elements for walls and roof.

Impact of construction on the park, park facilities, community, and traffic circulation will remain essentially the same as indicated for Alternative B.

C. Other Construction Alternatives

This report discusses in detail six possible methods for crossing MacArthur Lake. As has been shown by this study, the number of possible methods for crossing the lake is much higher than six. Four other possibilities

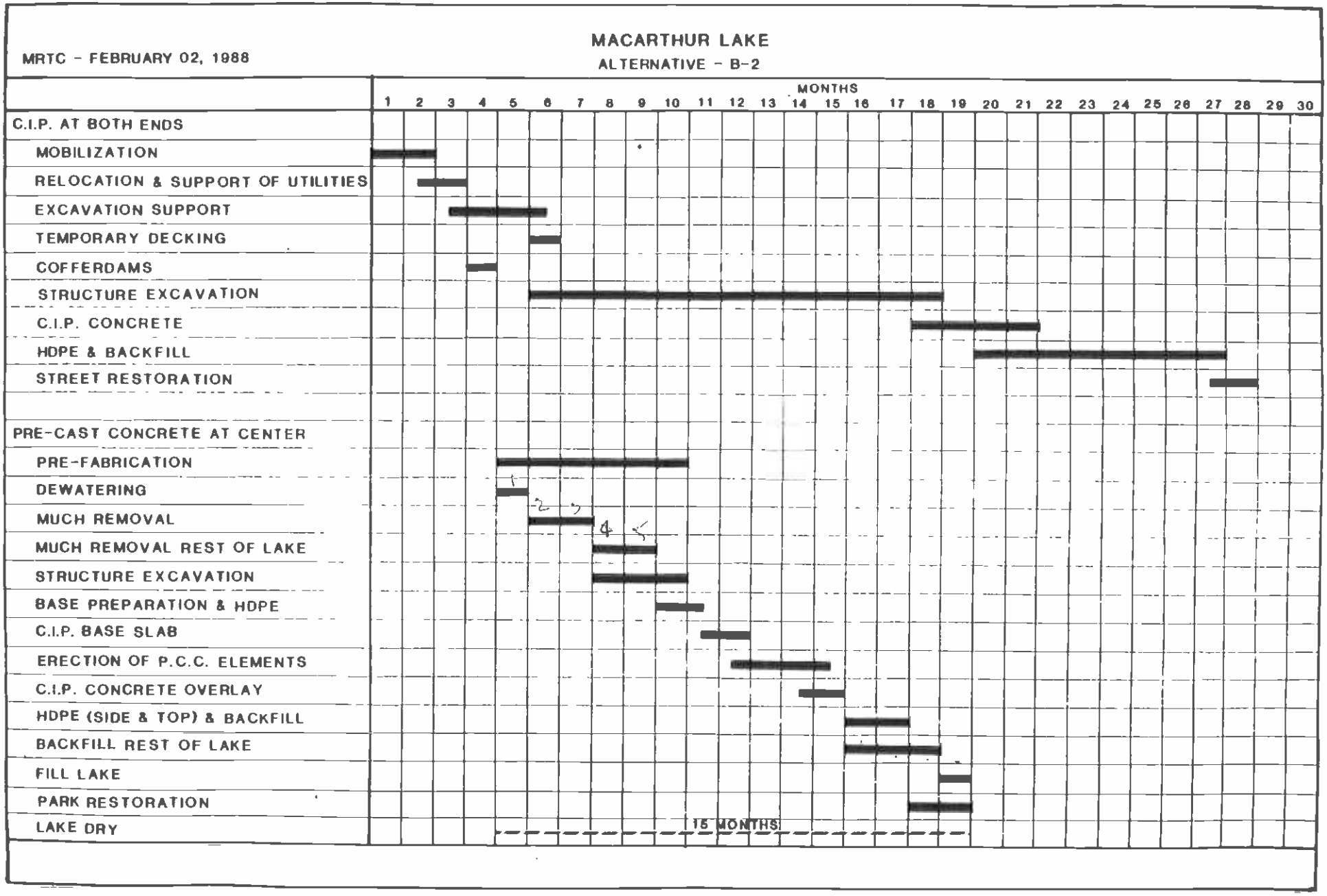

MRTC - FEBRUARY 02, 1988
MACARTHUR LAKE
ALTERNATIVE - B-2
MONTHS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
C.I.P. AT BOTH ENDS
MOBILIZATION
RELOCATION & SUPPORT OF UTILITIES
EXCAVATION SUPPORT
TEMPORARY DECKING
COFFERDAMS
STRUCTURE EXCAVATION
C.I.P. CONCRETE
HDPE & BACKFILL
STREET RESTORATION
PRE-CAST CONCRETE AT CENTER
PRE-FABRICATION
DEWATERING
MUCH REMOVAL
MUCH REMOVAL REST OF LAKE
STRUCTURE EXCAVATION
BASE PREPARATION & HDPE
C.I.P. BASE SLAB
ERECTION OF P.C.C. ELEMENTS
C.I.P. CONCRETE OVERLAY
HDPE (SIDE & TOP) & BACKFILL
BACKFILL REST OF LAKE
FILL LAKE
PARK RESTORATION
LAKE DRY
15 MONTHS

FIGURE 31

are outlined below. These four possibilities have not been studied to the same degree as the first six. It is believed, however, that these latter four possibilities are bracketed by the cost and schedule estimates generated for the initial six methods.

- o Jet Grouting (Figure 32)

  This method uses the relatively new technique of jet grouting from the face to form a canopy of grouted ground over the crown of the tunnel. The method works by displacement; thus the soils need not be groutable in the ordinary sense. It is believed that: 1) this method would not save time or costs compared to the first six methods, 2) using this unfamiliar technique in the soft lake bottom materials would present special challenges to U.S. contractors, and 3) additional provisions would have to be made to prevent the tunnels from floating.

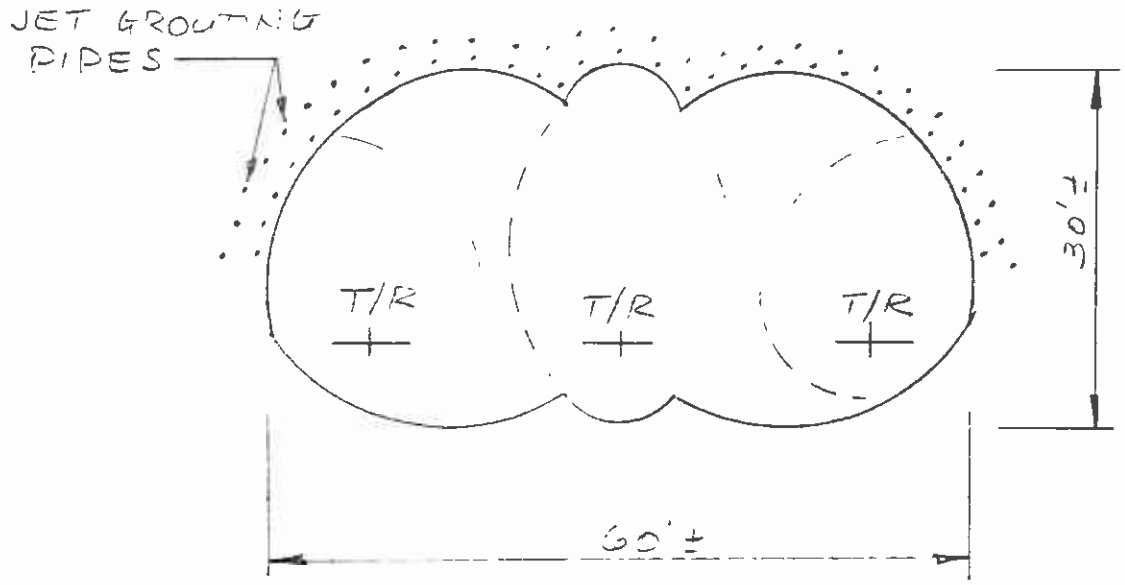
- o Diaphragm Wall Construction (Figure 33)

  This method requires draining the lake, replacement of uncompetent material in the lake with roller compacted concrete, construction of diaphragm walls in panels, placement of the roof slab, and then completion of the excavation and base slab from beneath the roof slab. The cost of this method is indicated to be very comparable to those of Alternatives B; preliminary indications are that the period for having the lake drained would be approximately 12 months.

- o Bridge over MacArthur Lake (Figure 34)

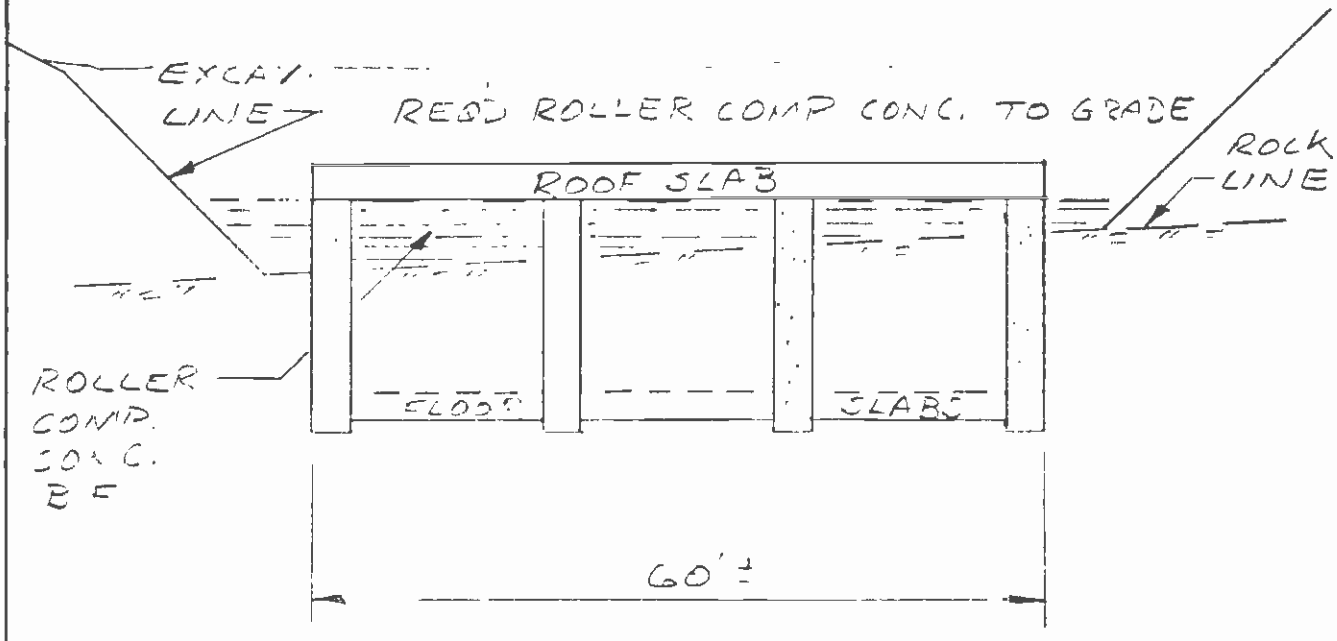
  This method uses a large trestle or bridge spanning the full length of the lake crossing. Incorporated in the trestle structure would be sheet pile cut-off walls driven into the rock of the lake bottom to stabilize the sides of the excavation and hold back the water. All excavation and construction would be by means of heavy equipment operating from deck of the trestle. If the sheet piles can be driven deep enough for anchorage and can be made satisfactorily watertight, this method would allow the lake to remain filled, though separated into two pieces by the construction.

MacARTHUR PARK LAKE	JOB No.	SHEET No
OTHER CONSTRUCTION ALTERNATIVES NO. 1	DESIGNED BY J. Monsees	DATE
JET GROUTING	APPROVED	2-5-88



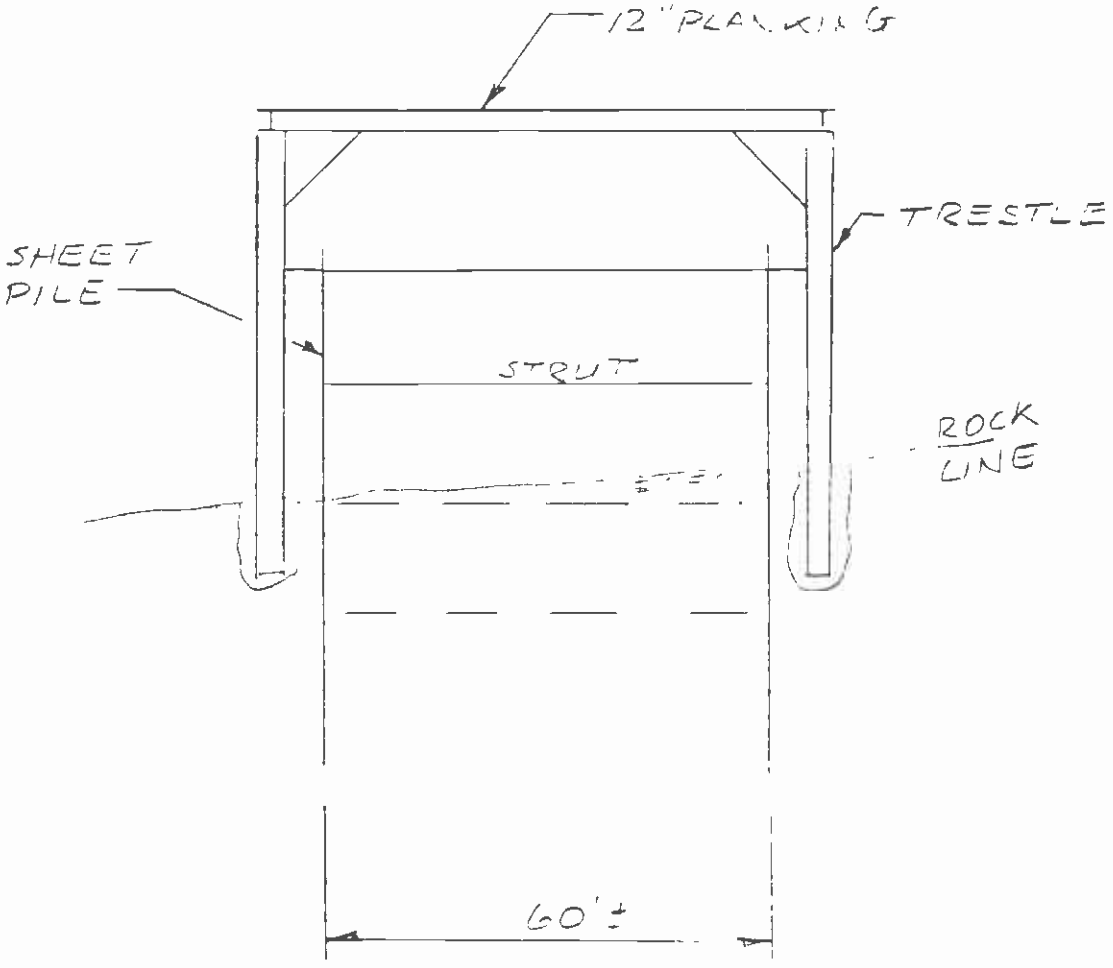
JET GROUTING SECTION

MacARTHUR PARK LAKE	JOB No	SHEET No.
OTHER CONSTRUCTION ALTERNATIVES NO.2	DESIGNED BY M. Monsees	DATE
DIAPHRAGM WALL CONSTRUCTION	APPROVED	2-5-88



DIAPHRAGM WALL CONSTRUCTION SECTION

MacARTHUR PARK LAKE	JOB No.	SHEET No.
OTHER CONSTRUCTION ALTERNATIVES NO.3	DESIGNED BY J. Monsees	DATE
BRIDGE OVER MacARTHUR PARK LAKE	APPROVED	2-5-88



BRIDGE OVER MacARTHUR PARK LAKE SECTION

Q001 018-T183

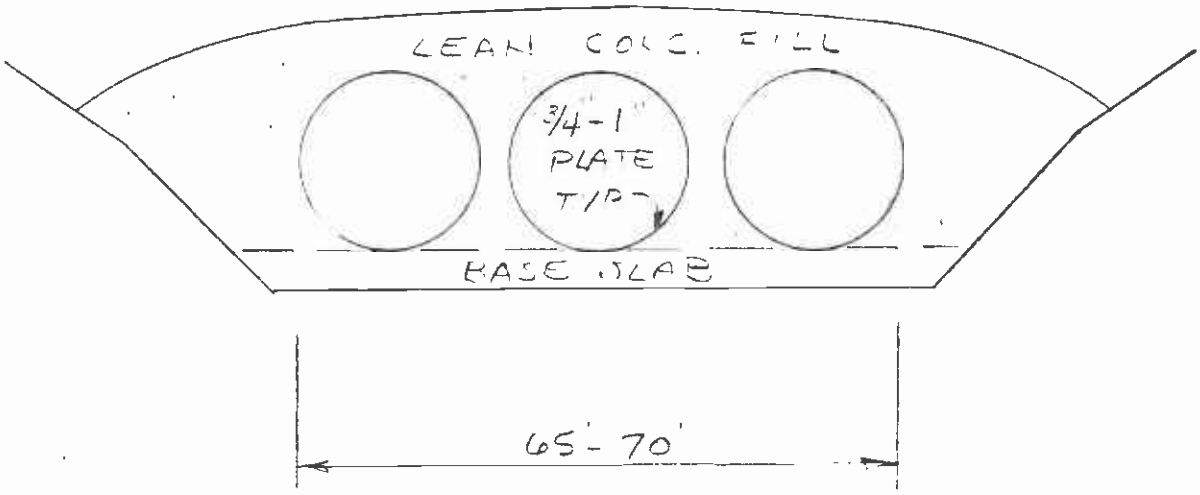
FIGURE 34

- Submerged Pipes (Figure 35)

  This method involves constructing crossovers at both ends of the lake within cofferdams in the undrained lake and then crossing the center of the lake by placing three rolled steel "cans" in an open cut in the drained lake. These cans would be backfilled by lean concrete to complete the composite structure and to provide mass to resist flotation. This method may require widening the track spacing to accommodate the three cans.

  It's estimated that none of the above four construction alternative would have advantages in either time or cost over alternative 'B' (cut-and-cover three cell subway box structure including pocket track); therefore these four construction alternatives are eliminated from further study.

MacARTHUR PARK LAKE	JOB No.	SHEET No.
OTHER CONSTRUCTION ALTERNATIVES NO.4	DESIGNED BY J. Monsees	DATE
SUBMERGED PIPES	APPROVED	2-5-88



SUBMERGED PIPES SECTIONS

V. ANALYSIS OF OPTIONS

A. Operational Impact

The three-cell cut-and-cover box structure at Wilshire/Alvarado enables the installation of a pocket track strategically located to accommodate failed trains on the trunk and branch lines near the Wilshire/Vermont junction station. The operational importance of a pocket track has already been shown. To summarize, the important benefits are as follows:

- Expedite removal of failed train from revenue trackage
- Store gap train for revenue service
- Act as staging area for work train
- Turn trains (reverse direction) without interfering with revenue trackage.

A pocket track at Wilshire/Alvarado provides convenient access between the station and the stored train. Locating a pocket track further away from the station makes access more difficult, due to safety precautions that must be followed for worker safety, and portable equipment that may require transport.

The tunnel alternative includes a pocket track under Wilshire Boulevard between Alvarado and Vermont. This alternative does not meet the operational requirements to the extent that the cut-and-cover alternative does, primarily because the location is not optimum. For safety considerations, trains must operate at much slower speeds than normal when employees are walking between the pocket track and the adjacent station. In addition, the transport of portable repair equipment to the stored train will be very time consuming. Train headway capacity will be impaired especially during the peak rush hour. Thus, a pocket track under Wilshire is an acceptable alternative only when compared with having no pocket track at all.

An alternative to locating a pocket track on the trunk is to provide one at Wilshire/Normandie on the west branch and one at Vermont/Beverly on the north branch. This configuration does not perform as well since both pocket-tracks are poorly situated to accommodate train failures on the critical segment, the trunk line. Trains operating on the branch would likely be turned at these stations prior to entering the trunk. This results in a reduction in service to Wilshire/Vermont, through the maximum load point between Wilshire/Alvarado and Wilshire/Vermont.

An alternative that does not provide for either a pocket track on the trunk line or on each of the branches near the junction station is unacceptable.

B. Impact on Public

The impacts of each alternative on the public have been detailed in Sections II.F.1 and II.F.2. Those impacts are summarized as follows:

o Tunnel Alternative

Positive Impacts:
-- shorter construction period required with drained lake.

-- No decking of Alvarado Street.

Negative Impacts:
-- Requires cut-and-cover construction of pocket track elsewhere on Wilshire Boulevard with longer construction and traffic disruption.

-- Higher cost

-- No improvement to lake

-- Non-optimal location for pocket track.

o Cut-and-Cover Alternative

Positive Impacts:
-- Lower cost

-- No disruption elsewhere on Wilshire

-- Major long-term improvements to lake

-- Optimal location for pocket track.

Negative Impacts:
-- Slightly longer construction period required with drained lake

-- Construction activity on park land

C. Costs

See Table 2, Summary of Cost.

TABLE 2.

Summary of Cost

ALT.	DESCRIPTION	CUT & COVER LENGTH	CUT & COVER COST	TUNNELING LENGTH	TUNNELING COST	TOTAL LENGTH	TOTAL COST	SCHEDULE LAKE DRY
(Pocket Track Under Wilshire)								
A	Twin Tunnels/ Replace Loose Soil W/Lean Concrete/Dewater Lake Completely	1035RF	18.7	1105RF	9.2	2140RF	27.9	20 MO.
A-1	Twin Tunnels/ Earth Dike & Sheet Piling W/Conc. Fill/ Dewater 1/2 Lake	1035RF	18.7	1105RF	13.1	2140RF	31.8	18.5 MO. (1/2 Lake Only)
A-2	Twin Tunnels/ Open Cut/ W/Conc. Back-fill/Dewater Lake Completely	1035RF	18.7	1105RF	11.4	2140RF	30.1	22 MO.
(Pocket Track In the Park)								
B	Open Cut/CIP/ Dewater Lake Completely	1105RF	$14.9	1035RF	$6.7	2140RF	$21.6*	24 MO.
B-1	Open Cut/CIP Earth Dike/ Dewater 1/2 Lake	1105RF	$15.6	1035RF	6.7	2140RF	22.3*	25 MO. (1/2 Lake Only)
B-2	Open Cut/CIP & PCC/Cofferdams/ Dewater Lake Completely	1120RF	17.4	920RF	6.0	2140RF	23.4*	15 MO.

* Cost does not include $2M for park improvements.

VI. SUMMARY AND CONCLUSION

A. Operational Requirement

SCRTD has determined that a pocket track is required in the vicinity of Wilshire/Alvarado. This requirement can be met in two ways depending upon the method of construction used at MacArthur Park Lake: 1) If construction at MacArthur Park Lake is by tunnel, a pocket track will be built by cut-and-cover nearby under Wilshire Boulevard; or, 2) If construction at MacArthur Park Lake is by cut-and-cover, the pocket track can be included as part of that construction.

B. Impact on Public

This study indicates that construction by the cut-and-cover alternative, including the pocket track, is preferred at MacArthur Park. This alternative costs less, provides major park improvement, meets operational requirements optimally, and reduces disruption elsewhere on Wilshire; it also requires four months longer and requires decking of Alvarado. For the tunnel alternative these positives and negatives are reversed.

C. Recommended Solution

This evaluation leads to the recommendation that the cut-and-cover alternative B be adopted, based on the total differential cost of $4.3 million, permanent and long-term improvement to the lake, the optimal operationally efficient location for the pocket track, and the minimization of disruption to heavily-traveled streets during pocket track construction. If the objective of minimizing the impact on lake use is of prime concern, the cut-and-cover Alternative B-2 could be adopted at an additional cost of approximately $1.8 million.

It is recommended that the District adopt construction of pocket track under MacArthur Park by cut-and-cover and authorize design for that alternative.