BUNKER HILL TRANSIT TUNNEL STUDY
PHASE II

INITIAL EVALUATION / SCREENING OF ALTERNATIVE USES FOR THE BUNKER HILL TRANSIT TUNNEL

Prepared for:
City of Los Angeles Department of Transportation
Los Angeles Community Redevelopment Agency

Prepared by the Joint Venture of:
Schimpeler·Corradino Associates / Delon Hampton & Associates, Chartered

In Association with:
Myra L. Frank & Associates / KDG Development and Consulting

June 1990

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

I. INTRODUCTION

BUNKER HILL TRANSIT TUNNEL STUDY AND THIS "PHASE II REPORT"

This introductory chapter defines a dramatically expanding downtown Los Angeles along with the land development objectives driving the expansion. This chapter also defines adopted transportation policies designed to reduce CBD street congestion and air pollution while at the same time producing an efficient, cost effective downtown circulation capability -- capability needed to compliment the regional rail infrastructure feeding the expanding Los Angeles CBD. In this land use, transportation, major public policy and major public investment context, the BHTT Study is being conducted and documented.

This Phase II Report presents the incremental and logical development of an advanced technology system to increase mobility in downtown Los Angeles, specifically in Bunker Hill, Central City West, Financial Core, Little Tokyo, Civic Center, South Park, Convention Center, and other important downtown activity centers. The systems described herein interconnect and extend fixed guideway mobility now being put in place by extensive investment of public funds in the Metro Red Line and Metro Blue Line transit systems -- providing a high-coverage network of exclusive guideway, free-flowing, non-polluting transportation infrastructure to serve the downtown of what will soon be this nations largest metropolitan area.

The systems described herein further support the major public policy initiatives designed to reduce the cost of roadway congestion and auto emissions related environmental pollution by serving Los Angeles' proposed peripheral parking sites to be located and built at the fringe of the CBD. The downtown mobility systems proposed herein serve the region's objectives (objectives expressed by the Southern California Rapid Transit District) to intercept CBD-destined buses at selected points outside of the downtown (permitting these buses to return in relatively free-flow traffic conditions to provide neighborhood collector/distributor service while permitting an advanced technology automated guideway system to perform that function, separated from street traffic, in the CBD core). The Automated Guideway Downtown Circulation System described herein will enhance public investment in commuter rail services, HOV and busway transportation, and municipally operated and other non-SCRTD bus services.

The City of Los Angeles is reviewing opportunities for fully utilizing the Bunker Hill Transit Tunnel (BHTT). The BHTT consists of easements and actual tunnel segments that bisect some of the most attractive office, retail, residential and entertainment-related space in downtown Los Angeles (see reference map 1 in Appendix A). In view of the intensity of existing and anticipated future land development in downtown, and in view of the corresponding demand for transportation generated by that land development, the BHTT is potentially a highly valuable element of transportation infrastructure serving the Central

Business District (CBD) area. The current BHTT Study is designed to consider ways to effectively use this potential resource.

The first milestone, A Preliminary Discussion of Possible Options For Use of the Bunker Hill Transit Tunnel, documenting Phase I of this four-phase study, identified (on a preliminary basis) various potentially feasible opportunities for, along with issues and constraints associated with use of the BHTT.

This Phase II report --- Initial Evaluation/Screening of Alternative Uses For the Bunker Hill Transit Tunnel --- documents the study of six (6) alternative scenarios for use of the BHTT and represents the completion of the second phase or milestone of the four (4) phase BHTT study. The phases are described as follows:

- **PHASE I: White Paper** -- Identify, on a preliminary basis and in broad terms, potentially attractive and feasible opportunities, along with the issues and constraints associated with uses for the BHTT. The paper is to serve as a springboard for discussion among local public and private sector decision-makers, and other parties potentially key to the implementation feasibility of any resulting plan for the BHTT.

- **PHASE II: Initial Evaluation/Screening of Alternative Uses For the Bunker Hill Transit Tunnel** -- Compare up to six scenarios for use of the BHTT, in terms of physical feasibility, patronage (in orders of magnitude), connectivity to existing and planned transportation facilities, and consistency with City goals and policies. Select specific alternatives to explore further.

- **PHASE III: Second-Level Screening of Specific Alternatives** -- Compare specific alternatives in terms of patronage (more detailed manual sketch planning), environmental concerns, cost and cost-benefit, the ability to be financed, institutional arrangements, and implementation strategies; formulate recommendations.

- **PHASE IV: Disseminate Study Findings** -- Prepare a summary report, and make verbal presentations of the study findings.

Public input including the review of interested and affected public agencies is sought at each phase of the study.

LAND USE CONDITIONS AND GOALS/POLICIES

The greater downtown area today includes more than 80 million square feet of office, retail, institutional, residential, cultural and industrial land uses[1] with a population of about 30,000, and an employment of approximately 264,000 persons; major short term growth is planned. The brief discussion of land use conditions and growth policies in the downtown area is organized by subareas of:

- Bunker Hill;
- the CBD Redevelopment Area (including the Financial Core, Civic Center, South Park, Eastside Industrial, and Broadway/Spring Districts);
- Little Tokyo;
- Chinatown and City North;
- Central City West; and
- Alameda Corridor.

This summary presents the land use objectives context in which the BHTT may logically be required as a part of the development of CBD transportation infrastructure; Figure 1 is a graphical presentation of this land use context.

Bunker Hill Area

"Bunker Hill" or "the Bunker Hill area" is defined to be the area bounded by First Street, Hill Street, Fifth Street, and the Harbor Freeway (see reference map 1, Appendix A); the 133-acre Bunker Hill Redevelopment Project is the oldest redevelopment project downtown, formally created in 1959. Among the goals that were established for the area at the time of its creation, the one that is still most relevant is: "The improvement of Bunker Hill's tax base through mixed-use development, including commercial, residential and public services."[2]

Existing development and planned improvements in the Bunker Hill area are summarized below in Table 1.

---

[1] According to the 1985 Tax Assessor's Data Base for the Metro Rail Phase 1 Benefit Assessment District.

[2] **Bunker Hill Redevelopment Project Biennial Report, 1986-1988.** CRA/LA, November 1988, p.2.

TABLE 1

TOTAL EXISTING AND PLANNED DEVELOPMENT IN BUNKER HILL

Land Use	Existing	Planned	Total	% Increase
Office square feet	6,900,000	6,812,755	13,712,755	98.7
Retail square feet	391,625	503,800	895,425	128.6
Hotel rooms	2,029	1,400	3,429	69.0
Dwelling units	2,988	1,350	4,338	45.2
Parking spaces	17,069	8,700	25,769	51.0

Bunker Hill is among the most densely developed sectors of the Los Angeles Central Business District. Downtown as a whole averages 2.3 square feet of development (excluding parking but including residential) per square foot of land. The Bunker Hill area is nearly twice that density, with 4.2 square feet of development per square foot of land.

CBD Redevelopment Area

With an ordinance adopted in 1975, a major portion of downtown Los Angeles became the CBD Redevelopment Area. According to the Redevelopment Plan, "The basic objective of the Project is the eradication of blighting influences within the Project area and the prevention of their reoccurrence through the redevelopment of land uses consistent with the environmental, economic and social goals of the community."[3] The CBD Redevelopment Area contains a variety of subareas (each with a different character, but whose boundaries in a practical sense overlap): the Financial Core, the Civic Center, South Park, the Eastside Industrial Areas, and the Broadway/Spring Historic Core.

[3] **Redevelopment Plan: Central Business District Redevelopment Project**, Community Redevelopment Agency, City of Los Angeles, 1975, p. 14.

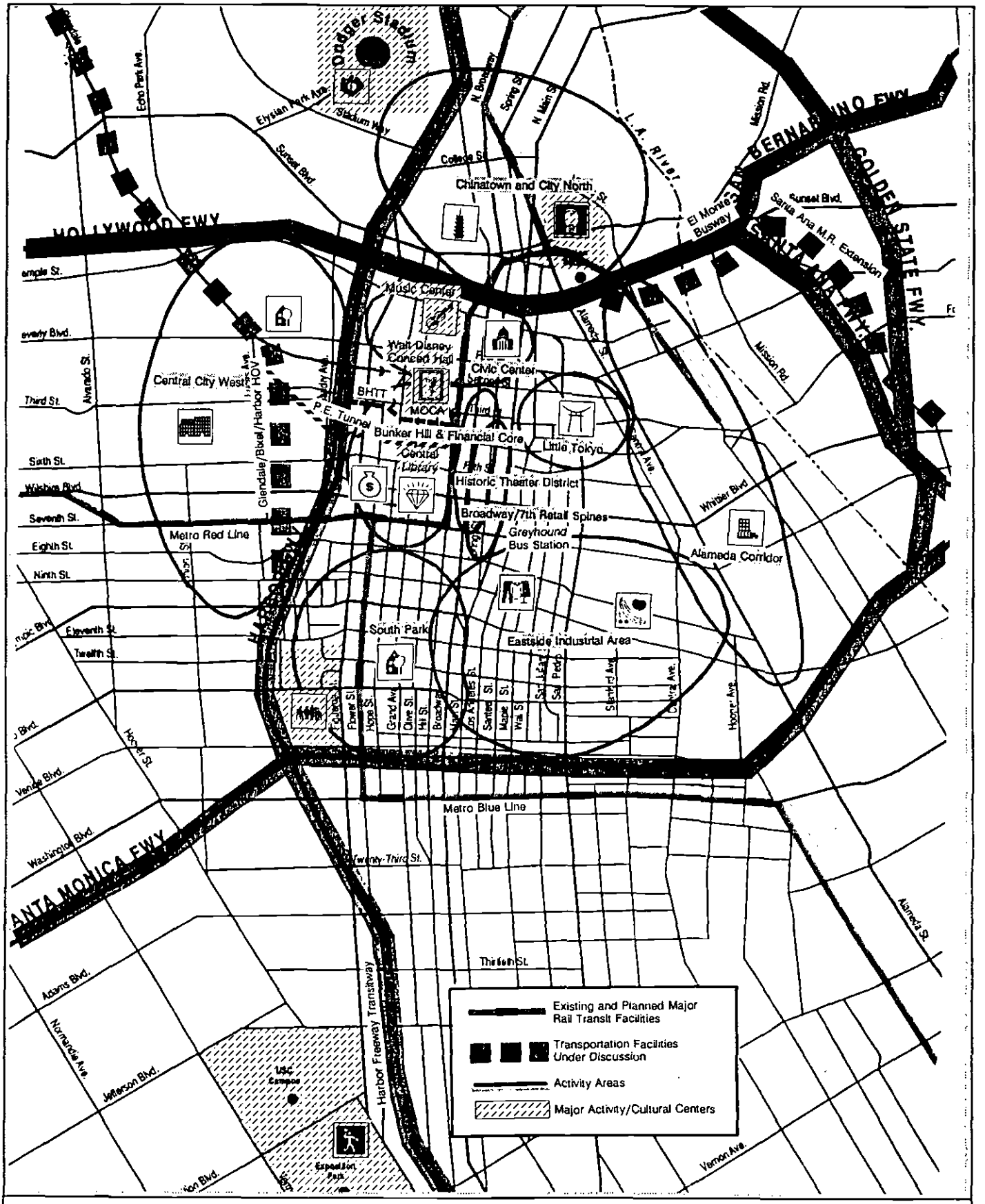


Figure 1

Station

North

DOWNTOWN LOS ANGELES CONTEXT

- The **Financial Core** is the heart of banking and other financial activity for the region. It is also the most densely developed portion of downtown, with about 14 million square feet of office space and 2.6 million square feet of retail in the area bounded by Fifth, Hill, Eighth, and the Harbor Freeway.

- The **Civic Center** contains a high concentration of Federal, State, County, and City employees and facilities. Many major public buildings are found within the area bounded approximately by the 101 Freeway, Alameda Street, First Street, and the I-110 Freeway.

- In addition to the 650,000 square foot, 35-story building currently under construction at 865 South Figueroa, several major commercial developments have been proposed for **South Park**. These and other planned developments would more than triple the office space in South Park, from 3.2 million to 12 million square feet. The South Park is also intended to provide some residential balance to the job-rich Central Business District. South Park is eventually envisioned to include up to 15,000 dwelling units.

- The **Eastside Industrial Area** is in the southeast quadrant of downtown, including large sections which are not part of any redevelopment area. It is characterized by light industrial activity and is home to the produce, flower, and garment industry.

- **Spring Street** was formerly the financial hub of downtown Los Angeles and **Broadway** was the entertainment center of the city. Broadway is an active retail-oriented corridor, anchored in the north by the Grand Central Market, and in the south by apparel industry activity.

The CBD Redevelopment Area is anticipated to experience substantial office development, with existing office square feet increasing from 29.9 million square feet to approximately 47.2 million square feet in the future. Proposed retail development is projected to grow from 4.6 million square feet today to 6.1 million square feet in the future.

Little Tokyo

Little Tokyo Redevelopment Area was established in 1970 and today is characterized by medium-density mixed-use development, including: office (about 350,000 square feet); retail (half a million square feet); hotel (the 448-room New Otani and the 174-room Hotel Tokyo); residential (568 dwelling units in several developments); and cultural (the Higashi Hongwanji Buddhist Temple, the Union Church, the Japan American Theatre, the Japanese American Cultural Center, the Centinela Methodish Church, and the Yaohan Honda Plaza). In addition to today's 2.3 million square feet, at least 1.2 million square feet of new development are planned for Little Tokyo. Several proposed major facilities are being discussed but are not yet well-defined.

Chinatown and City North

The Chinatown/City North area is approximately bounded by the Pasadena Freeway on the north and west, the Golden State Freeway on the east, and the Hollywood Freeway on the south. Dodger Stadium lies just to the west. The area has three distinct zones: (a) Chinatown, with medium-density mixed-use development, (b) Olvera Street/El Pueblo, now serving as a cultural and tourist attraction, and the (c) predominantly industrial and vacant area along the Los Angeles River. City North area was recently the subject of a brainstorming planning session sponsored by the City Planning Department. The proposal which was the outcome of that session included replacing the railyards area with a major housing and open space development (up to 15,000 dwelling units), to be called the River Park Area. The proposal also emphasized pedestrian links among the three zones and between Olvera Street and the Civic Center.

Central City West

The Harbor Freeway has served as a physical and psychological western boundary to downtown Los Angeles. In recent years, a consortium of property owners and developers, in coordination with the City of Los Angeles, has spearheaded the preparation of a Transportation/Land Use Specific Plan for the Central City West area, roughly bounded by Temple Street to the north, Glendale/Witmer/Union to the west, Olympic Boulevard to the south, and the Harbor Freeway to the east. The Plan analyzes the transportation impacts of two levels of development. In the first scenario, office development is assumed to nearly quadruple, from 5.2 million square feet today, to 21 million square feet in the future. Other land uses would bring total commercial development to about 25 million square feet. The second scenario assumes a 36 million square feet level of total commercial development. For both scenarios, housing is assumed to increase by 177% from 4,300 today to 11,900 in the future. These two levels of development are approximately 138% and 154%, respectively, higher than the current size of the CBD proper.

Alameda Corridor

The Alameda Corridor is currently characterized by warehousing and other light industrial activities. There are scattered proposals for large commercial and mixed-use developments in the corridor; these depend on whether the area is rezoned to permit higher densities.

TRANSPORTATION POLICIES AND INVESTMENTS

Traffic Impact Zone/Peripheral Parking

The City of Los Angeles has defined the Traffic Impact Zone (TIZ) as the specific part of downtown that experiences the highest levels of roadway congestion now and will continue to do so in the future. This zone is bounded by the Harbor (110) and Santa Ana (101) Freeways, Broadway Street, and Olympic Boulevard. A policy priority is to reduce the number of vehicles entering the TIZ and the Harbor Freeway "slot". In April 1987, the Los

Angeles Community Redevelopment Agency adopted a Peripheral Parking Program for new developments within the TIZ that exceed 100,000 leasable square feet. The program requires developers to substitute between 25% and 40% of code-required parking downtown with an equal number of spaces in certain designated peripheral parking areas.

TRIP Ordinance

The Los Angeles City Council adopted the Transportation Reduction and Improvement Program (TRIP) Ordinance in 1987. The TRIP Ordinance explicitly recognizes the link between land use development and traffic. It permits new development to be assessed a fee for each new peak-hour vehicle trip created, with the money to be used for transportation improvements. At the present time the City Council has directed the preparation of a Transportation Interim Control Ordinance for the initial step in developing a final TRIP ordinance for downtown.

Existing and Committed Investments in CBD Transportation Infrastructure

Numerous commitments to the Metro Red Line, Metro Blue Line, future Commuter rail, HOV systems and Bus system development suggest opportunities (when taken with rapidly expanding CBD land use) for further study of BHTT uses to integrate and maximize the effectiveness of Los Angeles's transportation investments so as to facilitate economic development and reduce roadway congestion cost.

II. SYSTEM ALTERNATIVES OF FIRST-LEVEL SCREENING

The Bunker Hill Transit Tunnel Study to date has formulated a range of alternatives for future use of the Bunker Hill Transit Tunnel facility. That range of alternatives could potentially allow the facility to serve the following functions:

- o non-transit or pedestrian concourse type utilization (principally for the purpose of serving immediately contiguous buildings);
- o as an exclusive busway (for DASH bus service);
- o as the principal enclosure for various shuttle systems within Bunker Hill; and,
- o as a significant component of a comprehensive circulator for downtown, a service much as that provided by the Downtown People Mover Program developed in the late 1970's (see reference map 2 in Appendix A).

A comprehensive downtown circulator (as well as the incremental systems building up to the comprehensive downtown circulator) would have as their principal purpose the collection and distribution of person trips in downtown Los Angeles -- complimenting the region's investment in fixed guideway systems and complimenting regional bus services. The circulator service provided by facilities which utilize the Bunker Hill Transit Tunnel as an essential component would: (a) further the city's objective of enhancing connectivity among committed regional systems; (b) provide increased mobility for those people utilizing the downtown land uses; (c) reduce congestion and pollution by the elimination of buses and other motor vehicles from downtown Los Angeles; and, (d) create an efficient hierarchical system of public transportation wherein buses provide that function which they provide most effectively (neighborhood collection and distribution linking to line haul or fixed guideway circulator systems).

GUIDING FACTORS CONSIDERED IN SELECTING SYSTEM ALTERNATIVES

In developing potential transportation uses of the BHTT, several general, partially overlapping, goals have been considered:

1. Fill in gaps between existing or proposed fixed guideway transit or highway systems.
2. Support areas of major existing and future land use development.
3. Serve potential peripheral parking and bus intercept areas.
4. Serve cultural, entertainment, and sports facilities.
6. Provide additional transportation interchanges/linkages.

For the comprehensive systems two additional factors need to be considered:

1. Distribution to and from bus/regional rail transit systems in the Downtown.
2. Circulation within Downtown.

SYSTEM ALTERNATIVES

Several kinds of transportation alternatives discussed in the first level screening of this study appeared to warrant further study. The six alternatives discussed on the following pages are organized in an ascending degree of size, complexity, and area of service. The alternatives are as follows:

- o Alternative # 1: Use of the tunnel as a pedestrian concourse for circulation within Bunker Hill.
- o Alternative # 2: Use of the tunnel as an exclusive busway for part of a new DASH route serving Bunker Hill.
- o Alternative # 3: Provide a shuttle service within the Bunker Hill tunnel with an Automated Guideway Transit system.
- o Alternative # 4: Extend Alternative # 3 to provide Automated Guideway Transit connections to Central City West and Little Tokyo.
- o Alternative # 5: Extend Alternative # 4 into a loop system providing Automated Guideway Transit connections to the whole of the central core of downtown.
- o Alternative # 6: Further extend Alternative # 5 in phases to provide comprehensive Automated Guideway Transit coverage to the whole downtown area.

Each alternative is discussed in a fixed format to facilitate direct comparison between the various alternatives. Each of the alternatives being considered will be described under the following format.

Concept

This section describes any assumptions made in the selection of the route and any areas that could be environmentally sensitive or technically marginal. Please note that all routes shown extending beyond the existing tunnel confines are conceptual suggestions and are for discussion purposes; they do not represent a final alignment.

Primary Functions/Limitations

This section delineates the prime attributes of the system suggested, and equally important, any limitations on its utility or attractiveness. The major items discussed in this section include:

- o system coverage;
- o system linkage with other transportation systems; and
- o negative elements.

Key Features

This section lists the key physical attributes of the alternatives being discussed. The major items discussed include:

- o potential technology to be used;
- o length of the system;
- o capacity of the system;
- o build out requirements;
- o maintenance yard requirements; and
- o connections to other transportation systems.

These key features are synthesis of the studies performed for the alternatives under discussion and do not include every minor factor which may be inherent in the discussed alternative.

Systems and Related Structures Cost

The costs shown for each alternative are broad "order of magnitude" estimates for system hardware and related physical structures to allow comparisons of one system alternative to another. Costs estimates include:

- o Technology: Generally includes all of the costs associated with the technology including rolling stock, track, stations, maintenance facilities and control systems.
- o Tunnel Build-Out: Includes all costs relating to build out of the existing BHTT such as removal of temporary construction and enclosed walls, ventilation systems, lighting, escalators and stairs, and others.
- o System Features: Includes special bridges over freeways or other elements not specifically included in the first two categories.
- o Contingency: A 20 % contingency has been added.

Costs estimates do not include:

- o Right of Way Acquisition: It is assumed that the systems discussed will run within existing street right of way. Right of way acquisition cost will be determined at a later time when the alternative concepts advance further into preliminary engineering. Acquisition costs for potential maintenance yards will also need to be determined at a later time.
- o Utility Relocation: It is assumed at this stage that these cost will be minimal, based on the technologies choices suggested.
- o Mobilization: Mobilization, training and system start up.
- o Design/Engineering: Costs incurred by the client agency overseeing the design/engineering of the alternatives.

Urban Design Considerations

This section indicates factors which could be of concern in the context of urban design and highlights elements which could help to resolve these concerns.

The factors considered are historic areas, buildings of importance, new buildings adjacent to the proposed alignments, and others. Elements considered within the systems are size of vehicles, the track and the track support size and spacing, as well as station type size and location.

ALTERNATIVE # 1
PEDESTRIAN CONCOURSE

Concept

The BHTT could be finished out as a pedestrian concourse linking the escalators from the Fourth St./Hill St. Metro Rail Station through Bunker Hill to the World Trade Center. Moving sidewalks, although not essential for this option, could be installed to help speed the system and to increase its capacity and utility. Concession stands or other attractions could be included in the wider tunnel sections to help offset costs and to help increase patronage. The entire alignment of the alternative is contained within the existing tunnel and its extension at the north end of the World Trade Center.

Primary Functions/Limitations

1. Provide pedestrian connections within Bunker Hill.
2. Basement location not regarded as attractive or welcoming attribute.
3. Vertical distance to main floors of buildings not attractive for this type of system.

Key Features

1.	Technology	-	none or moving sidewalk
2.	Length of system	-	2200 ft.
3.	Capacity of system	-	3000-10,000 people per hour
4.	Build out requirements	-	existing tunnel build-out finishes & utilities; and bridge to World Trade Center
5.	Connection to	-	Cal Plaza III escalator system to Red Line at Fourth St./Hill St.

Systems and Related Structures Costs (rough order of magnitude)

			(Millions of Dollars)
1.	Technology		$ 0 - $ 8
2.	Tunnel Build out		$13
3.	Bridge to World Trade Center & Connection at Cal Plaza II		$ 4
		Sub-Total	$25
4.	20% contingency		$ 5
		Total	$22 - $30

Urban Design Considerations:

A new bridge would be built across Flower St. to connect from the end of the tunnel in the Security Pacific building across to the World Trade Center. This alternative would have minimal impact in terms of urban design. There are no discernible negative impacts to historical buildings, significant structures, or new buildings.

Note: Although this alternative is technically possible, it is not desirable based on the ultimate plans for Bunker Hill.

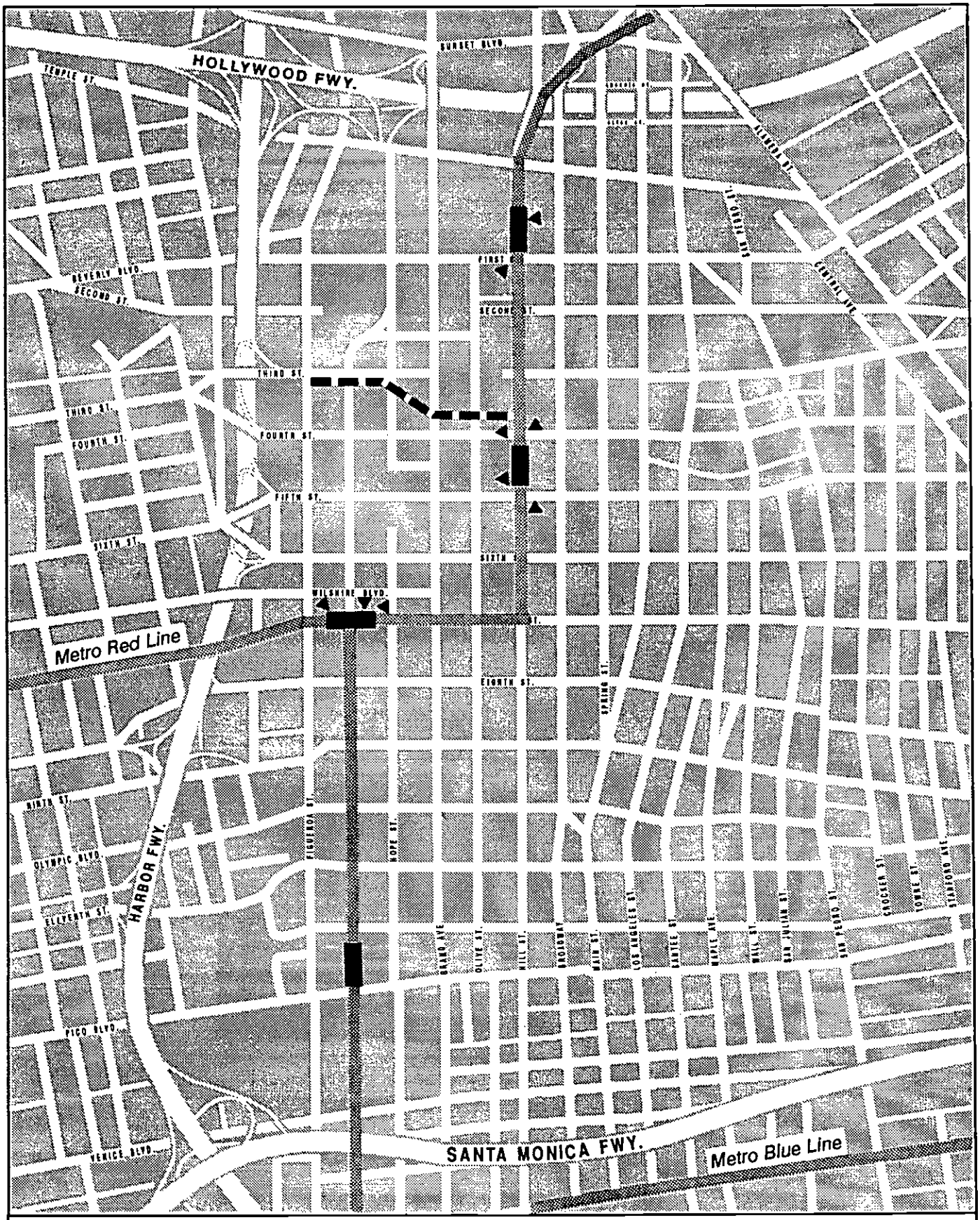


Figure 2

ALTERNATIVE # 1
PEDESTRIAN CONCOURSE

Station ▲ Portal

0 1000 Feet

North

SCRTD/DHA Bunker Hill Transit Tunnel Study

ALTERNATIVE # 2
EXCLUSIVE BUSWAY

Concept

This option uses all of the existing tunnel for an exclusive busway and provides a drop off for patrons in two of the major buildings in Bunker Hill, Cal Plaza and Security Pacific. This option would form a part of an extended DASH system and would preferably have all electric or dual powered buses for the buses using the tunnel. The existing DASH buses could be utilized if a suitable ventilation system can be incorporated into the existing tunnel. This alternative is contained within the existing tunnel except for the proposed on ramp at Hill St. and the off ramp at 3rd St. between Flower St. and Figueroa Street. It is anticipated that buses would pass in one direction only from Hill St. to Figueroa Street.

Primary Functions/Limitations

1. Provides better DASH service link for Bunker Hill to the rest of downtown.
2. Two-way service through BHTT not possible unless alternate one-way service is used through the Wells Fargo Building.
3. Requires buses to travel on Figueroa which is further west than current DASH service provides.
4. DASH system now constrained by street traffic, and not expected to improve in the future.

Key Features

1.	Technology	-	Dual powered or electric bus with charging systems in tunnel sections.
2.	Length of system	-	2200 ft.
3.	Capacity of system	-	3000 passengers per hour.
4.	Build out requirements	-	existing tunnel build out finishes & utilities, and on ramp at Hill St. off ramp at 3rd and Figueroa.
5.	Connection to Red Line at 4th St./Hill St.		

System and Related Structures Costs (rough order of magnitude)

		(Millions of Dollars)
1.	Technology	$ 6
2.	Tunnel Build out	$13
3.	On and off ramps	$ 4
	Sub-Total	$23
4.	20% Contingency	$ 5
	Total	$28

Urban Design Considerations:

The key elements of concern would be the construction of on and off ramps at Hill St. and 3rd St. and 3rd St. and Figueroa Street. The ramps would introduce a potentially negative visual element to the environment.

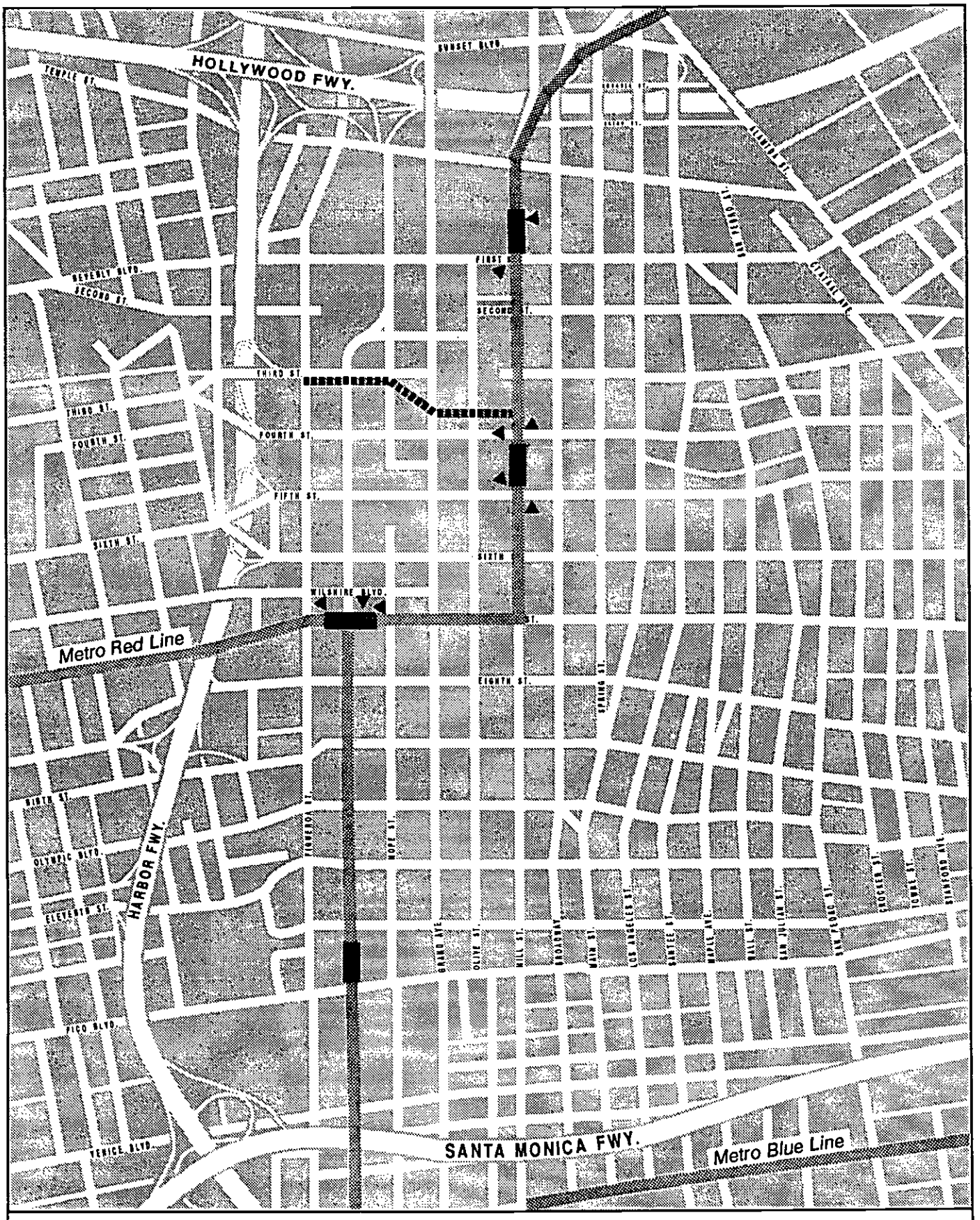


Figure 3

ALTERNATIVE # 2
EXCLUSIVE BUSWAY ▪▪▪▪▪▪▪▪▪▪

■ Station ▲ Portal

North

0 1000 Feet

ALTERNATIVE # 3
BUNKER HILL SHUTTLE

Concept

The tunnel could be used as a shuttle for the Bunker Hill area utilizing an automated guideway system. The system would go from Cal Plaza III to the World Trade Center and would utilize one of the currently available small cable driven circulator systems, such as the Soule system. This alternative is also contained within the existing tunnel except for the bridge connection to the World Trade Center.

Primary Functions/Limitations

1. Provides circulation within Bunker Hill.
2. Capable of limited extensions beyond Bunker Hill in the future.
3. Can be operated 2-way within the confines of the existing tunnel, including system maintenance.

Key Features

1.	Technology	-	Cable driven.
2.	Length of system	-	2200 ft.
3.	Capacity of system	-	5,000 people per hour.
4.	Build out requirements	-	existing tunnel build out finishes & utilities.
		-	Bridge to WTC & build out at WTC.
		-	Connection to Cal Plaza III escalator system.
5.	Connection to Red Line at Fourth St./Hill St.		

Systems and Related Structures Costs (rough order of magnitude)

			(Million of Dollars)
1.	Technology		$ 8
2.	Tunnel Build out		$13
3.	Bridge to WTC & other Construction build out		$ 6
		Sub-Total	$27
4.	20% Contingency		$ 6
		Total	$33

Urban Design Considerations

Urban Design impacts would be minimal because the shuttle system would operate exclusively within the existing tunnel envelope, and, aside from the bridge to the World Trade Center, no other new structures are contemplated.

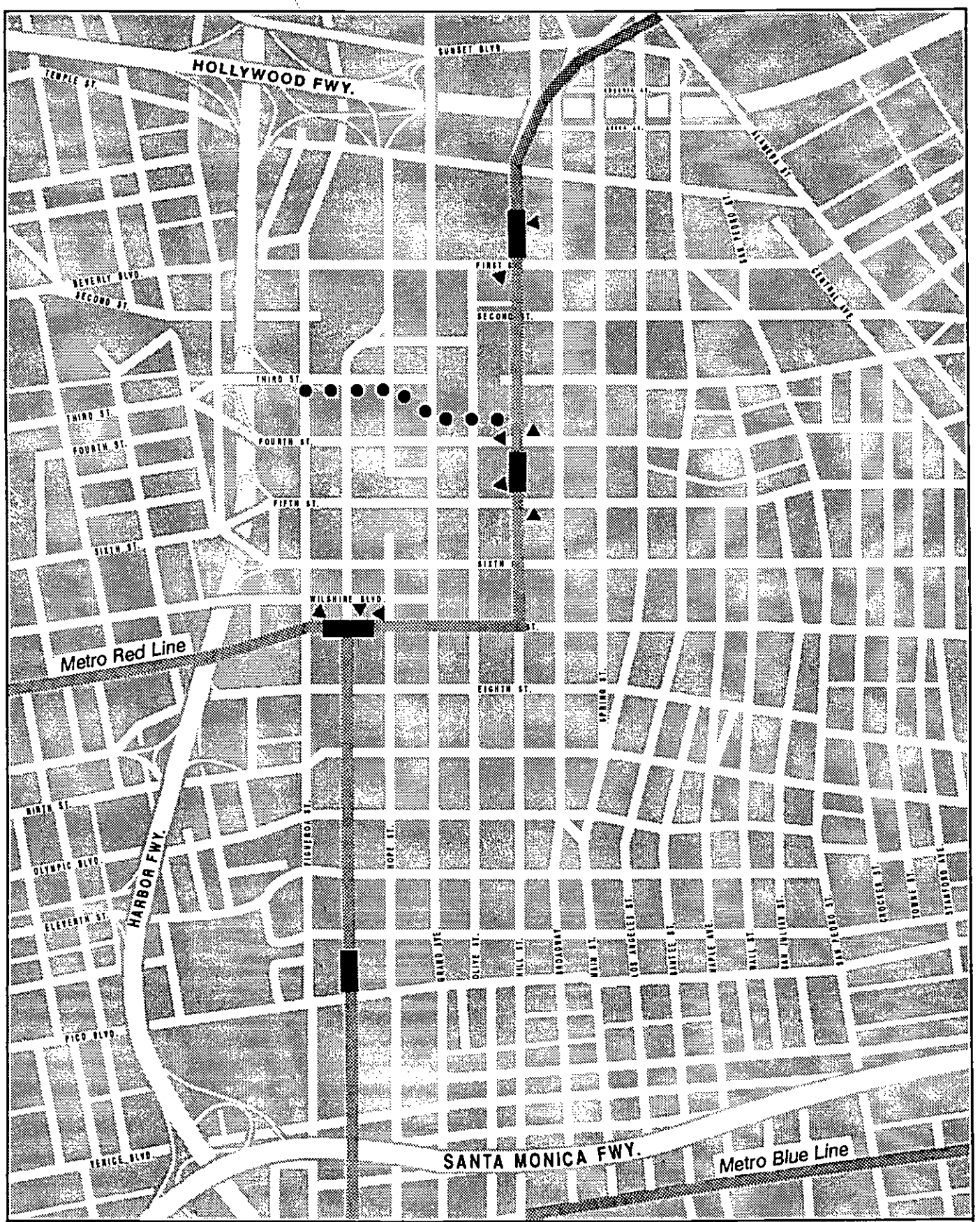


Figure 4

ALTERNATIVE # 3
BUNKER HILL SHUTTLE • • • • •

■ Station ▲ Portal

North

0 1000 Feet

ALTERNATIVE # 4
EXTENDED BUNKER HILL SHUTTLE

Concept

The shuttle system described in Alternative 3 could be extended eastward into Little Tokyo and westwards into Central City West to provide additional connectivity to other areas. The eastward extension would be with an overhead trackway on 4th St. to Los Angeles St. where it would turn north and then head easterly on 3rd Street. The westward extension would consists of an above grade trackway to the west along 3rd St., crossing the Harbor Freeway and turning southward along the proposed Bixel Street Transit Mall to 8th Street. The small cable driven systems would be suitable for this type of alignment depending on the length of the system. For longer systems a light monorail would be more suitable.

Primary Functions/Limitations

1. Extends system coverage to Central City West and Little Tokyo.
2. Increases demand for system use by connecting to other activity areas.
3. Links Bunker Hill and Central City West to possible peripheral parking locations in the Alameda area.
4. Provides link to Metro Red Line at Fourth St./Hill St. station.
5. Possible Bus intercepts in Central City West and East Side areas.

Key Factor

1.	Technology	- Cable driven or light monorail.
2.	Length of System	- 2.1 miles
3.	Capacity of System	- Cable driven - 5,000 people per hour per track. - Monorail - 10,000 people per hour per track.
4.	Build out requirements	- Existing tunnel build out. - Eastward extension track thru Little Tokyo to Alameda including track support columns stations etc. - Westward extension over Harbor Freeway to and along Bixel Transit Mall including track support columns station etc
5.	If the monorail system is selected a maintenance yard will be required; maintenance for the cable system can be accomplished on a small track extension.	

Systems and Related Structures Costs (rough order of magnitude)

			(Millions of Dollars)	
1.	Technology (including new tracks, rolling stock & stations, with support posts for overhead installation).			
		Cable driven	$25	
		Monorail		$42
2.	Build out of existing tunnel.		$13	$13
3.	Additional construction items (bridge over freeway etc.).		$ 5	$ 5
4.	Maintenance yard.		$ 1	$ 5
		Sub-Total	$44	$65
5.	20% contingency.		$ 9	$13
		Total	$53	$78

Urban Design Considerations

The proposed extensions of an elevated guideway from the tunnel right of way would pass through very different areas of Downtown. To the west , the existing buildings are fairly new, and an elevated guideway could possibly be mitigated fairly easily in the design of the new facilities. To the east, the route concept passes through a sensitive, historic area of Los Angeles and then into the Little Tokyo area. The route then passes through a less sensitive environment around Alameda Street.

The technologies for this alternative do impose a new visual element in the environment. A cable driven system guideway has a 3 foot wide rail track supported on a concrete bed spanning approximately 70 feet between columns. The light monorail system guideway has a 17 foot wide double track spanning 70 feet supported by 3 foot diameter "T" top columns.

The station mass and bulking for the light monorail system would be larger than the cable driven system. It is possible, through advance planning, joint development, and design coordination, to mitigate the visual impacts that this alternative may create (this also applies to Alternatives 5 and 6).

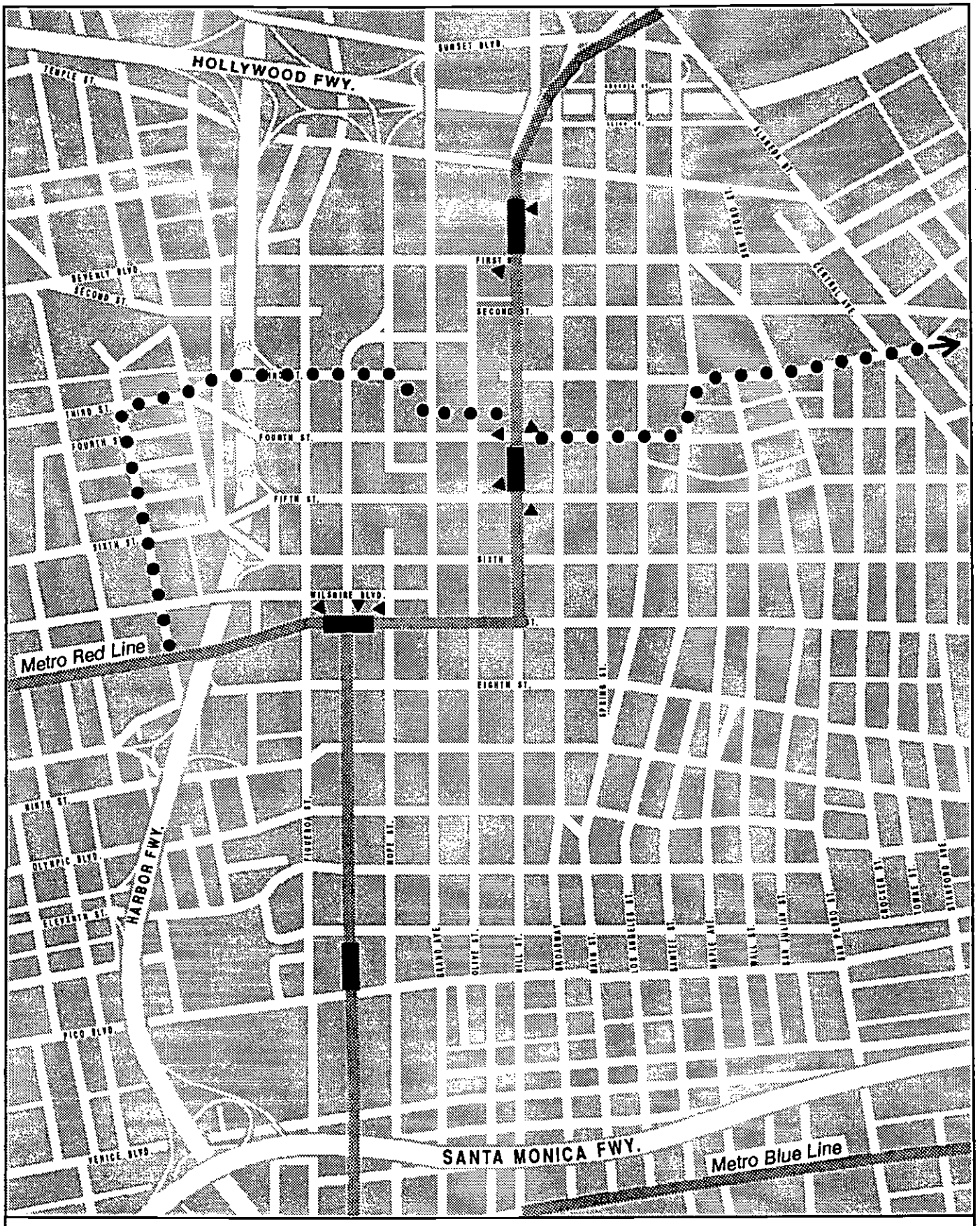


Figure 5

Station ▲ Portal

ALTERNATIVE # 4
EXTENDED BUNKER HILL SHUTTLE • • • • •

SCRTD / DHA Bunker Hill Transit Tunnel Study

ALTERNATIVE # 5
CENTRAL CORE CIRCULATION/DISTRIBUTION SYSTEM

Concept

The system described in Alternative 4 (Extended Bunker Hill Shuttle) could be further extended to provide a complete loop through Bunker Hill, the Financial Core of Downtown and Central City West. By continuing from Little Tokyo southward along Main Street and then turning west along 8th St. and crossing the 110 Freeway to join at Bixel a complete loop is formed in the densest populated area of downtown. Two alternative lines have been identified that could provide service to Little Tokyo and access to a maintenance facility. The first alternative line (A) would extend along Los Angeles Street to the north to Union Station area and the second alternative line (B) would extend from Little Tokyo easterly on 3rd St. towards the Los Angeles River. This system concept is too long for cable driven technology and the only other suitable existing system that will fit 2-way into BHTT is a light monorail.

Primary Functions/Limitations

1. Provides circulation to Bunker Hill, Central City West, the Financial Core and Little Tokyo.
2. Provides connectivity to possible peripheral/remote parking sites.
3. Provides the possibility of bus intercepts for riders coming into the downtown area from any direction.
4. Provides possible connections to commuter rail, El Monte Busway, and future Blue Line extensions.
5. Provides improved distribution in the Central Core for passengers from Metro Red Line.

Key Factors

1. Technology - Light monorail
2. Length of system - 4 miles
3. Capacity of system - 10,000 people per hour per track
4. Build out requirements - Existing tunnel build out
   - New overhead track and supports complete with all new stations and access.
5. A maintenance yard is required
6. Connection to Red Line at 4th St./Hill St. and also the Blue Line at 7th & Flower

Systems and Related Structures Costs (rough order of magnitude)

		(Millions of Dollars)
1.	Technology (including track stations, rolling stock overhead supports etc.	$ 80
2.	Build out of existing tunnel	$ 13
3.	Freeway Bridges	$ 2
4.	Maintenance yard	$ 6
	Total	$101
5.	20% contingency	$ 20
	Total	$121

Urban Design Considerations

The 8th Street alignment was suggested to avoid impacts on the historic buildings on 7th Street and also to avoid construction conflicts with the Metro Red Line. New development along 8th Street is anticipated and could be designed to include this proposal. One disadvantage is that an 8th Street connection to the 7th St. and Flower St. Metro Rail Station may not be as convenient.

The Main Street section of this proposal passes through an area which, while somewhat blighted now, will hopefully be improved in future years. The Los Angeles St./Union Station alternative route presents significant urban design challenges , but appears feasible given the opportunities to incorporate design into future development plans.

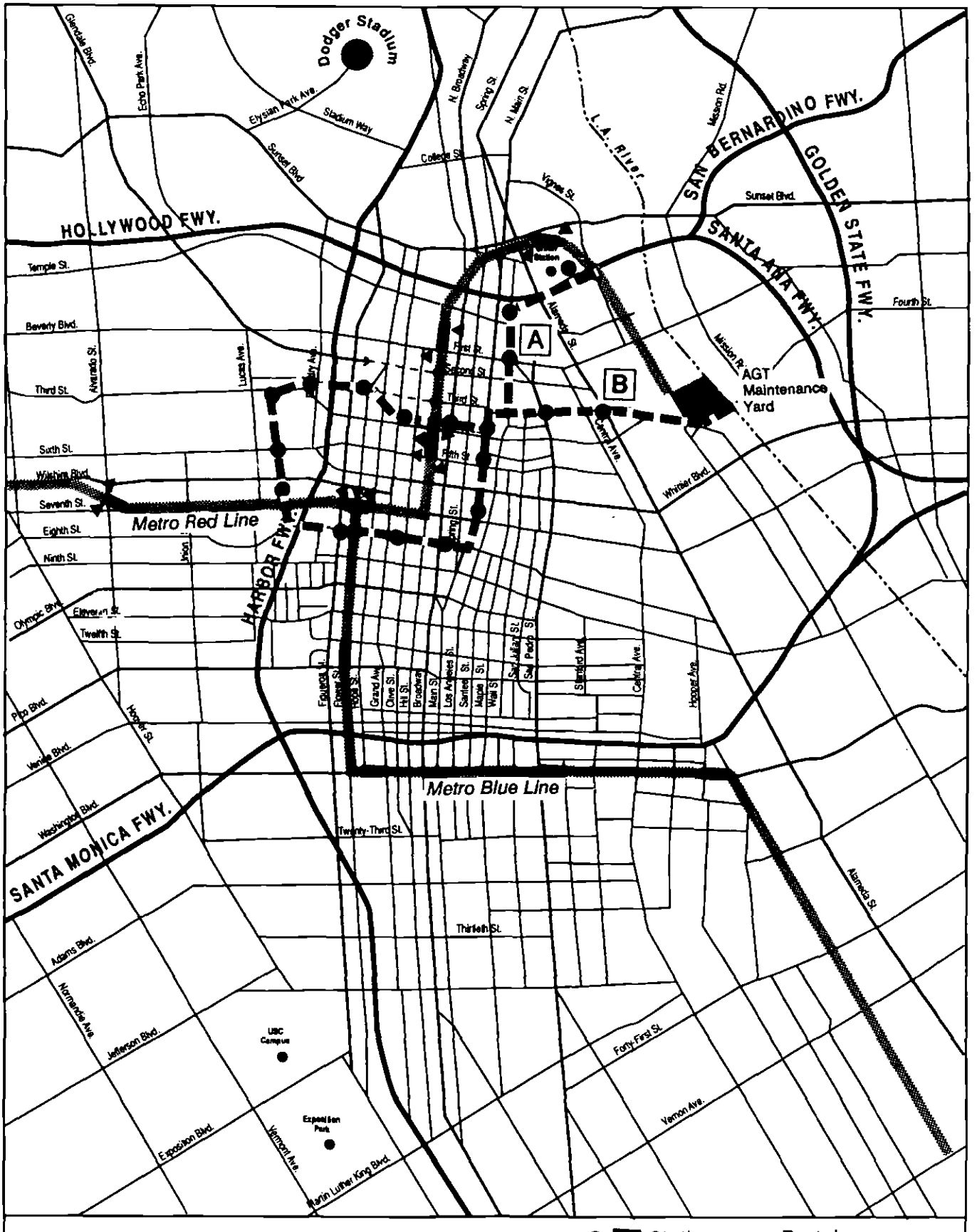


Figure 6

ALTERNATIVE # 5
CENTRAL CORE CIRCULATION / DISTRIBUTION SYSTEM

● ■ Station ▲ Portal

0 1/2 Mile North

ALTERNATIVE # 6
GREATER DOWNTOWN CIRCULATION/DISTRIBUTION SYSTEM

Concept

The Central Core Circulator could be further extended in several phases to a give fully integrated system serving Greater Downtown. The system could consist of multiple phases, built over time, running from Dodger Stadium in the North to USC and the Coliseum in the south and stretching from Central City West and the Convention Center in the west to Main Street in the east.

The alignment suggested under Alternative # 5 is further extended by creating a loop to the south proceeding from 8th St. southward along Figueroa St. to the Santa Monica Freeway. The alignment then proceeds easterly on 17th St. and north on Main St. to join the original loop at 8th Street. A third loop is created to the north by linking to the Union Station leg at Temple St. then proceeding west to Boylston in Central City West, then south to 3rd St. to again link to the first loop. Further extensions are proposed linking to USC and the Coliseum in the south along Flower Street, and to Chinatown and Dodger Stadium to the north.

Primary Functions/Limitations

In addition to those listed under the other 5 alternatives:

1. Serves Government Center, South Park, the Convention Center, Garment District, Chinatown, USC/Coliseum and Dodger Stadium.
2. Increased value for integration with bus intercept locations and for providing access to peripheral/remote parking sites.
3. Provides additional connectivity to the Blue Line at Pico/Flower and Washington/Hope stations.

Key Factors

1. Technology - Light monorail
2. Length of system - 12.2 miles (Phases 1 - 4 only)
3. Capacity of system - 10,000 people per hour per track
4. Build out requirements - Existing tunnel
   - New overhead track complete with all new stations and access
5. A maintenance yard is required
6. Connection with the Red Line at 7th and Flower, 4th and Hill and Union Station and to the Blue Line at 7th and Flower, Pico and Flower, and Washington and Grand.

Systems and Related Structures Costs (rough order of magnitude)

		(Millions of Dollars)
1.	Technology (including track stations, rolling stock and overhead supports).	$244
2.	BHTT build out	$ 13
3.	Freeway bridges	$ 5
4.	Maintenance yard	$ 8
	Total	$270
5.	20% contingency	$ 54
	Total	$324

Costs do not include Phase 5 costs.

Urban Design Considerations

The proposed loop through South Park would present urban design challenges along Figueroa Street and at the Convention Center. Connections across the Harbor Freeway could also pose challenges. The remaining portions of the South Park extension seem to pose minimal urban design impacts. However, it must be noted that the elevated guideway, in all phases, would introduce a new visual element into the environment.

The northern extension (Phase 3) in the Civic Center could create urban design concerns along Temple St. in the vicinity of the City and County Buildings as well as the Music Center. However, there appears to be sufficient space to accommodate the suggested light monorail guideway within the existing public right of way. Outer extensions described in Phases 4 and 5 are not yet defined in sufficient detail to comment on at this time.

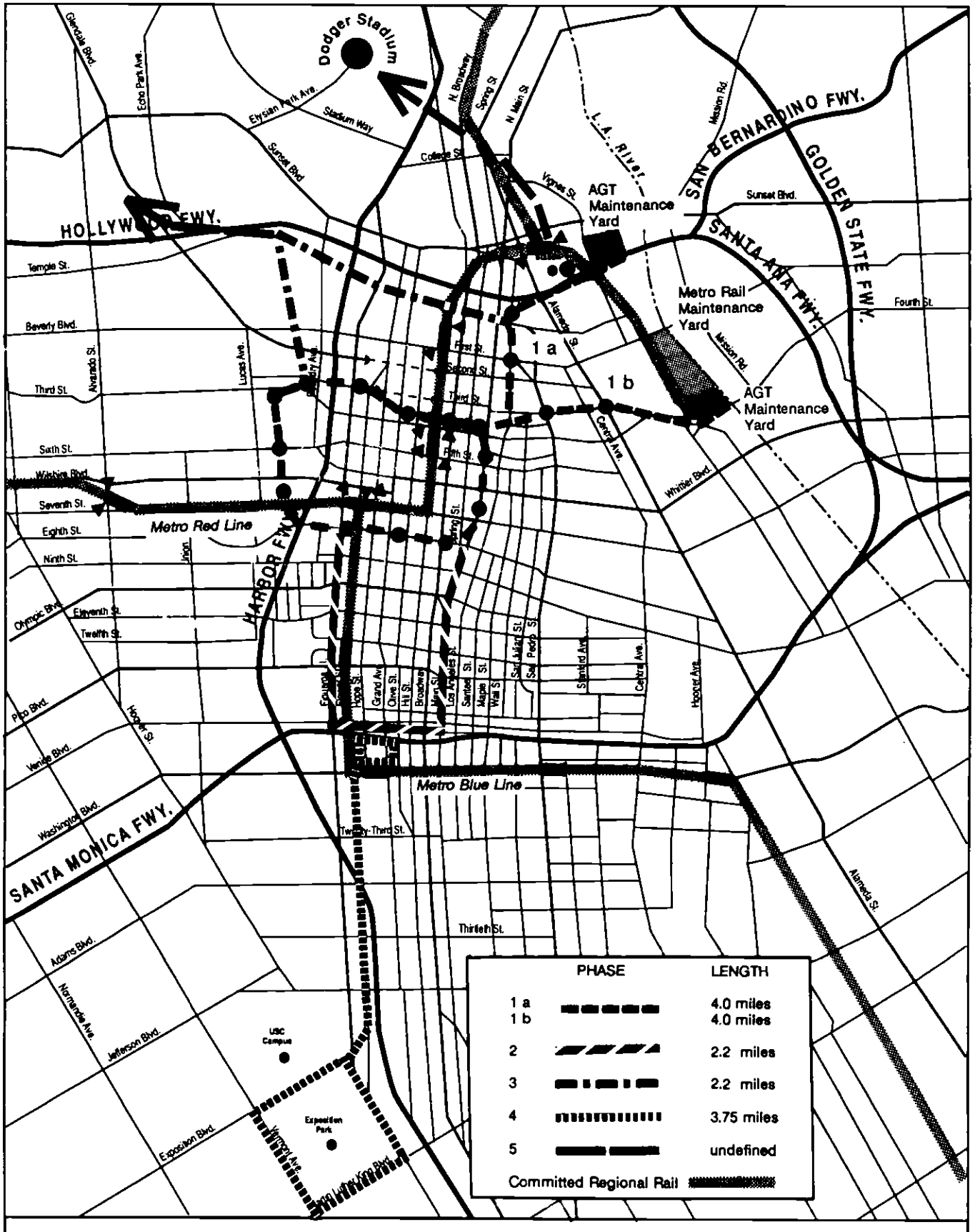


Figure 7

ALTERNATIVE # 6
GREATER DOWNTOWN CIRCULATION / DISTRIBUTION SYSTEM

III. TECHNOLOGY ASSESSMENT

Assuming that the analyses documented in the previous chapter confirms the need for increased downtown mobility (mobility to maximize the effectiveness of existing regional fixed guideway investment, mobility to support land use objectives and significant anticipated land use growth, mobility to minimize the cost of roadway congestion), a range of candidate technologies must be considered. That range of technologies begins on the low end of the continuum with simple sidewalk and moving sidewalk facilities, ranging upward through the simple cable driven technologies, rubber tired automated systems (as have been successfully used in major airports), steel wheeled systems and advanced technology systems such as the proven monorail systems and dual mode systems in use around the world).

The data in this technology assessment chapter is presented in a matrix form listing the attributes as well as the drawbacks of the various candidate technologies. These materials will be presented in narrative as well as in tabular form leading to an evaluation of the performance capabilities of each alternative technology.

POTENTIALLY APPLICABLE TECHNOLOGIES

This section contains a short, non-technical overview of each of seven types of technologies. The textual descriptions below are followed by a summary in Table 2. More detailed comparison charts on the various technologies are included in Appendix B, for all system manufacturers from which information was available at this time. No single system is intrinsically superior; the best technology depends on a number of factors, including:

- o whether or not the right-of-way is extended beyond Bunker Hill; i.e. eventual length of the system.
- o the importance of being able to physically link to other systems (such as Metro Rail);
- o the maturity and reliability of the technology;
- o physical constraints of the Bunker Hill Transit Tunnel (see Appendix C);
- o cost/engineering feasibility; and
- o projected patronage.

These factors will be analyzed in greater depth throughout this study, eventually leading to a recommended system.

Moving sidewalk

Moving sidewalks are employed at most larger airports to convey passengers between the terminal and boarding gates. They operate continuously at about 2 miles per hour; because of their continuous operation, they can carry large numbers of people. The actual capacity depends on the width of the walkway installed but ranges between 3,000 and 10,000 people per hour.

Two-way service can fit into the existing tunnel, but numerous walkway segments will be needed to serve the full length of the guideway. The horizontal curves will require a series of short walkways set on the tangents of the curves. Access can be provided to all buildings along the tunnel right-of-way.

Rubber-tired

A typical rubber-tired system involves vehicles which are roughly a cross between a streetcar and a bus, running on a dedicated right-of-way (usually concrete), with an automatic guidance system (either from a center or side rail), and either on automatic control or with a driver. The vehicles range in size from a small minibus to streetcar size and can usually be linked into trains of several cars to increase passenger capacity. Capacity ranges from 3,000 to 15,000 passengers per hour; the system runs at speeds of between 30 and 50 miles per hour.

Most of these systems are too wide to allow simultaneous two-way operation in the narrowest section of tunnel and will likely run at speeds below 30 miles per hour. Most of them can operate as a one-way loop or one-track shuttle system in the tunnel as constructed. These systems will typically require storage and maintenance yard space not available in the existing tunnel section and rights-of-way.

Steel Wheel/Light Rail

Urban rail systems are usually defined as heavy rail or light rail. Heavy rail systems, like the Metro Red Line under construction, have large, heavy vehicles running on full weight rails. Heavy rail systems are not considered suitable for use in the BHTT because of their size and weight, and the limitations of the tunnel's turning radii and slopes. Light rail systems have lighter vehicles and lighter-weight (but usually standard-gauge) tracks. They run at slower speeds, and are capable of negotiating tighter turns and steeper slopes than heavy rail systems. These are the systems described below as steel wheel systems.

Steel wheel systems, such as the Los Angeles - Long Beach Metro Blue Line, are the modern equivalent of the old Red Cars. They consist of steel wheeled vehicles running on steel tracks with either automatic or driver operation. Most of these systems are of similar size and capacity, roughly equivalent to the old streetcars. They generally operate at top speeds of approximately 50 miles per hour.

Steel wheel systems have a good reliability record and cost around $60 million per mile to construct, excluding purchase of right-of-way. Passenger capacity based on 3-minute headways is generally about 20,000 per hour.

TABLE 2

KEY CHARACTERISTICS OF VARIOUS PEOPLE-MOVER TECHNOLOGIES

Technology	Typical Capacity[4] (Pax/hr)	Maximum Speed (mph)	Maximum Sys. Length (miles)	Construction Cost (millions $ per track mile)[5]	BHTT Constraints
Moving sidewalk	3,000 - 10,000	2	0.1	8	length, curvature
Rubber-tired	3,000-15,000	30-50	N/A	30-60	width
Steel wheel/ light rail	20,000	50	N/A	60-80	width
Monorail:					
Top-riding	7,000-50,000	20-70	N/A	10-50	turning radii
Underslung	3,000	20	N/A	10-50	height
Magnetic levitation	9,000	50	N/A	30-50	turning radius
Cable-driven	100-20,000	15-20	5	10-50	width, length, curvature (for some)
Dual-mode	3,000 10,000	40+	N/A	10-60	width

[4] These capacities are generally based on 3-minute headways, which can be achieved by almost all systems. However, headway ranges vary within technologies: moving sidewalks have zero headways (continuous motion), most technologies have some systems which can operate at 2-minute headways, and at least one cable-driven system can achieve headways as low as 12 seconds.

[5] These figures do not include right-of-way acquisition, and are based on aerial or at-grade construction. Tunneling is an order of magnitude more costly.

Most of these systems are too wide to provide simultaneous two-way service in the tunnel bottleneck. Most of them can operate as a one-way loop or one-track shuttle in the existing tunnel. Some may need modified electrical collector systems. Maintenance and storage yards will be needed for a system of this type. With compatible vehicles and tracks, the possibility exists of connecting to the LA-LB or Pasadena light rail line to permit sharing maintenance and storage facilities.

Monorail

Monorails are split into two basic groups: top-riding, and underslung. Top-riding monorails usually utilize a concrete or steel box beam, with a rubber-tired vehicle riding on top and guide wheels at the sides. Vehicle size can range from small "personal" vehicles through streetcar up to heavy rail size. Train capacity ranges from 7,000 to 50,000 passengers per hour. Typical operating speeds vary from 20 to 70 miles per hour. The best-known examples of this type of system are the monorails at Disney amusement parks, with vehicles of approximately streetcar size.

This technology requires approximately 1/3 of the structure because of its relative light weight, for an elevated system, of comparable steel wheel or rubber tired systems and therefore gives a much lighter and less intrusive system in an urban area.

Underslung monorail systems are similar in appearance to ski resort cable cars, with vehicles suspended below a single slender steel track.

Only the smaller top-riding monorail systems will fit in the BHTT because of the restricted turning radius -- both vertical and horizontal -- of the larger systems and the smaller sizes can be operated two ways simultaneously. The underslung monorails tend to have excessive height requirements, which preclude their use in the BHTT. Maintenance and storage yards will be needed for any of these systems.

Magnetic Levitation

Only one "maglev" system is in day to day operation at this time (the M-bahn in Germany), although these systems have often been successfully demonstrated at exhibitions. Vehicle sizes for this system are roughly equivalent to those of the old streetcars. Magnetic levitation is used to hold the vehicle above the track, therefore reducing rolling resistance. The system in operation has a speed of 50 miles per hour and a capacity of 9,000 passengers per hour. Systems are often capable of higher capacity and speed.

The maglev system in public operation has too wide a turning radius to maneuver the tight curves in the existing BHTT, but some of the other systems, such as the HSST urban maglev system, have the ability to be used in one way operation in the tunnel section.

Cable-driven

Cable-driven systems again fall into two categories, the first type can run on steel rails, rubber tires, or air cushion and be pulled by cable; the second type is supported by an

overhead cable and also driven by cable. Only the supported systems are suitable for use in the BHTT because of the minimum height of the cable supported systems. They differ from other system types in that traction is supplied from a stationary motor driving a cable rather than being self-propelled by on-board motors. The chief advantages of a cable driven system are reliability and reduction of weight and complexity in the passenger cars. The chief disadvantage is that vehicles are restricted, in the distance they can run, to about a mile for a single-cable system, or about five miles for multiple-cable systems with change-over mechanisms.

These systems operate at relatively low speeds of 15 - 20 miles per hour, and capacities can range from a few hundred to 20,000 passengers per hour. Costs vary widely depending on the system chosen.

The cable-driven systems vary widely in their abilities and sizes. Most of them can fit in the tunnel as it exists, and some could provide simultaneous two-way operation. Most of the systems can operate over the full length of the existing tunnel. However, some systems are incapable of negotiating horizontal curves, and some are incapable of transitioning between level and sloping track. Maintenance and storage space will be needed for most of these systems, although for some, maintenance takes place directly on the tracks. In either case, the space requirements are generally smaller than for other technologies: they can usually be accommodated on a spur track or tunnel section behind the main traction motors.

Dual-mode (Electric/Conventional) Bus

The dual-mode bus is a recently-developed technology. The dual-mode vehicle is a bus which can be operated either (a) by a diesel engine on normal streets with a driver, or (b) by an electric motor on a dedicated or shared guideway in automatic or manual (with driver) modes. They can be operated at speeds of more than 40 miles per hour, and have capacities of between 3,000 and 10,000 passengers per hour.

These vehicles can operate within the tunnel as it exists, but only in one direction at a time in the narrow section. Maintenance and storage yards can be remotely located because of the ability to drive these vehicles on the street, and is therefore an advantage.

TECHNOLOGY EVALUATION/PERFORMANCE STANDARDS CRITERIA

The comparison of factors for choosing an applicable technology shown in Table 3 indicates that for a short run system the moving sidewalks is applicable, while cable driven and light monorail systems would all be viable for longer run systems. However, only the light monorail meets all of the evaluation criteria with a known technology in commercial operations. The UTDC L.C.T.S. system may be a viable alternative but has not yet been used in commercial operations and so is somewhat of an unknown quality as far as reliability and cost are concerned. The HSST urban maglev system may be capable of modification to run two-way in the BHTT, but again is not in commercial use at present and is therefore again somewhat of an unknown as far as costs are concerned; the maglev reliability is very good to date with its demonstration systems at various Expo's.

TABLE 3

TECHNOLOGY ASSESSMENT EVALUATION MATRIX

SYSTEM ALTERNATIVES	FACTORS: APPLICABLE TECHNOLOGY	MATURE TECHNOLOGY	2-WAY OPERATING POTENTIAL IN EXISTING TUNNEL	EXPANSION CAPACITY	DISRUPTIVE INSTALLATION	POTENTIAL ENVIRONMENTAL IMPACT: VISUAL	POTENTIAL ENVIRONMENTAL IMPACT: NOISE	OPERATIONAL RELIABILITY	COST (Millions $): CAPITAL (per mile)	COST (Millions $): O/M	MAXIMUM CAPACITY (Passengers per hour)
PEDESTRIAN CONCOURSE	PEDESTRIAN ONLY	Yes	Yes	No 1/2 mile max	Low/Med	Very low	Very low	Good	8	Low	2-5k
	MOVING SIDEWALK	Yes	Yes	No 1/2 mile max	Low/med	Very low	Very Low	Good	8	Low	3-10K
EXCLUSIVE BUSWAY	ELECTRIC	No	No	Yes	Med/ High	High	Med	Med	30-60 ③	High	3-10K
	DUAL-MODE	No	No	Yes	Med/High	High	Med	Med	30-60 ③	High	3-10K
BUNKER HILL CIRCULATOR	CABLE DRIVEN GROUND SUPPORTED	Yes	Some Systems	Yes 4 Mile Max	Low/Med	Very Low/ Med	Very Low/ Med	Good	10-15	Low	10-20k
EXTENDED BUNKER HILL CIRCULATOR	CABLE	Yes	Some Systems	Yes 4 mile max	Low/Med	Very Low/ Med	Very Low/ Med	Good	10-15	Low	10-20k
	MONORAIL LIGHT TOP RIDING	Yes	Yes	Yes	Low	Very Low	Low	Good	10-20	Low	3-10K
	OTHER	Yes	No	Yes	Low/Med	Very Low Med	Low	Good	10-50	Low/ Med	3-50k
CENTRAL CORE C/D SYSTEM	MONORAIL (LIGHT TOP RIDING	Yes	Yes	Yes	Low	Very Low	Low	Good	10-20	Low	3-10k
	OTHER	Yes	No	Yes	Low/Med	VL/Md	Low	Good	10-50	Low/Med	3-50k
GREATER DOWNTOWN C/D SYSTEM	MONORAIL	Yes	No	Yes	Low/Med	VL/Md	Low	Good	10-50	Low/Med	3-50k
	LIGHT RAIL	Yes	No ①	Yes Unlimited	Med/High	Med	Med/Hi	Good	30-80 ④	Low/Med	5-20K
	RUBBER TIRED	Yes	No	Yes Unlimited	Med/High	Med	Low	Good	40-60	Low/Med	3-15k
	MAG LEV	No	No	Yes	Low/Med	Low/Med	Low	Good ②	30-50 ④	Low	3-10K

1 UTDC have a new technology not yet in commercial operation which could fit in the tunnel for 2-way operation.
2 Operation on test tracks seem to indicate this will be a very reliable technology.
3 Based on construction of overhead dedicated right-of-way.
4 Additional cost of $30 million to $40 million for tunnel widening would be required.

IV. PATRONAGE FACTORS

A manual sketch planning procedure was applied to estimate patronage as a part of this study. The analysis approach is based upon the quantification of travel currently occurring in the Los Angeles CBD and makes assumptions as to the extent to which travel now utilizing bus, automobile, and walk modes may be diverted to a downtown circulator system. The patronage methodology additionally considers the significant growth in land use activity projected for downtown Los Angeles in the near term development horizon.

The major component of downtown circulator patronage is that component of travel logically diverted from the regional bus system. The regional buses do an excellent job of neighborhood collection and distribution outside of the CBD; unfortunately the same buses often do a very poor job in the highly congested roadway traffic of the CBD. The most efficient overall use of transportation in downtown Los Angeles would be to quickly free up buses for neighborhood collection and distribution -- freeing up these buses by turning them back as they intercept the downtown circulator system -- and returning these buses for operations of collecting and distributing people in the neighborhoods of the Los Angeles region.

OVERVIEW

Estimating patronage for downtown transit circulator systems requires specialized travel demand forecasting approaches. Few models have been developed and calibrated for this purpose. Since the complex analysis associated with mathematically modeling a downtown circulator system at a fine-grained-zone level was outside the scope of this project, a "manual sketch planning procedure" was used to develop preliminary order of magnitude estimates for the alternatives under study. The manual sketch planning procedure simply estimates the fraction of existing auto and transit trips that could potentially be captured by the six alternatives, and then factors these trips to 1990 and the horizon year (2000) using a demographic based growth factor. Since the estimates generated by the manual sketch planning procedure are preliminary and approximate, care must be taken while interpreting them.

MAJOR ASSUMPTIONS AND ANALYSIS APPROACH

The major assumptions associated with the manual sketch planning procedure are described in detail in Appendix D. These assumptions included, but was not limited to:

1. definition of the study area;
2. definition of the travel demand components;
3. definition of the variables used in the mode-choice models;
4. growth factors;
5. system connectivity; and
6. review of previous DPM patronage, bus/rail patronage, and peripheral parking studies.

The preliminary results of the level of magnitude patronage estimates are presented for the base year (1990) in Table 4 and for the horizon year (2000) in Table 5.

TABLE 4

DAILY PATRONAGE ESTIMATES, YEAR 1990

SYSTEM ALTERNATIVES	APPLICABLE TECHNOLOGY	CIRCULATION TRIPS AUTO(1)	CIRCULATION TRIPS TRANSIT(2)	DISTRIBUTION TRIPS AUTO(3)	DISTRIBUTION TRIPS TRANSIT(4)	TOTAL TRIPS (5)	NOTES
PEDESTRIAN	PEDESTRIAN ONLY	20	30	--	600	650	Derivation based on technology speed ratio to BH circulator system.
CONCOURSE	MOVING SIDEWALK	40	60	--	1,200	1,300	
EXCLUSIVE BUSWAY	ELECTRIC	100	200	--	8,200	8,500	Derived from existing RTD bus trips/ auto trips in BHTT TAZ & DASH trips.
	DUAL-MODE	100	200	--	8,200	8,500	
BUNKER HILL SHUTTLE	CABLE DRIVEN	100	200	--	4,000	4,300	Derived from existing RTD bus trips and auto trips in BHTT TAZ.
EXTENDED BUNKER HILL SHUTTLE	CABLE DRIVEN	800	800	--	29,500	31,000	Derived from existing RTD bus trips/ auto trips in BHTT, CCW, & LT TAZ's
	MONORAIL	800	800	--	29,500	31,000	
CENTRAL CORE CIRCULATOR	MONORAIL	11,000	1,700	--	66,400	79,100	Derived from existing RTD bus trips/ auto trips in CORE TAZ's + RRT/LRT transfers.
GREATER * DOWNTOWN CIRCULATOR	MONORAIL	21,400	2,300	1,700	89,200	114,600	Derived from existing RTD bus trips/ auto trips in D.T. TAZ's + RRT/LRT transfers.
	LIGHT RAIL	21,400	2,300	1,700	89,200	114,600	

* Patronage estimates for this alternative include Phase 1, Phase 2, and Phase 3.
Estimates for Phase 4 and Phase 5 are not included at this time because the alignments are at a very general level of detail.

Estimates for the Central Core Circulator reflect increased existing bus boardings/alightings accessed by this alternative vs. the Extended Bunker Hill Shuttle. The Central Core Circulator 1990 estimates of 79,100 are very comparable to the late 1970's DPM Program estimates of approximately 72,500 daily riders. Bus to Circulator transfers are based on behavioral modeling, not on forced bus turn backs at intercept points. A policy decision to turn back buses as they intercept the circulator could result in greater volumes of patronage. Behavioral modeling which produces these mode splits is based in part on congested CBD travel speeds for bus and auto vs. unrestricted flow speeds for the circulator.

Notes:
(1) Mode Split Applied to CBD Zone to CBD Zone Auto Trip Interchanges.
(2) Mode Split Applied to CBD Zone to CBD Zone Bus Trip Interchanges.
(3) Auto Passengers Arriving at Three (3) Peripheral Parking Lots.
(4) Mode Split Applied to CBD Zone to Non-CBD Zone RTD Bus Trip Interchanges and Metro Red Line and Blue Line Transfers.
(5) Trip Types Not Estimated in this Table Include:
- o Walk only trips.
- o Transfers from other than RTD buses.
- o Transfers from commuter rail transit.
- o Transit trips induced by the introduction of a high level CBD Circulator transit service.
- o Park-and-Ride trips from other than the three (3) proposed peripheral parking lots.

TABLE 5

DAILY PATRONAGE ESTIMATES, YEAR 2000

SYSTEM ALTERNATIVES	APPLICABLE TECHNOLOGY	CIRCULATION TRIPS AUTO(1)	CIRCULATION TRIPS TRANSIT(2)	DISTRIBUTION TRIPS AUTO(3)	DISTRIBUTION TRIPS TRANSIT(4)	TOTAL TRIPS (5)	NOTES
PEDESTRIAN CONCOURSE	PEDESTRIAN ONLY	25	40	--	775	840	Derivation based on technology speed ratio to BH circulator system.
	MOVING SIDEWALK	50	80	--	1,570	1,700	
EXCLUSIVE BUSWAY	ELECTRIC	130	260	--	10,610	11,000	Derived from existing RTD bus trips/ auto trips in BHTT TAZ & DASH trips.
	DUAL-MODE	130	260	--	10,610	11,000	
BUNKER HILL SHUTTLE	CABLE DRIVEN	130	260	--	5,210	5,600	Derived from existing RTD bus trips and auto trips in BHTT TAZ.
EXTENDED BUNKER HILL SHUTTLE	CABLE DRIVEN	1,040	1,040	--	41,720	43,800	Dervied from existing RTD bus trips/ auto trips in BHTT, CCW, & LT TAZ's
	MONORAIL	1,040	1,040	--	41,720	43,800	
CENTRAL CORE CIRCULATOR	MONORAIL	14,300	2,200	--	103,000	119,500	Dervied from existing RTD bus trips/ auto trips in CORE TAZ's + RRT/LRT transfers.
GREATER * DOWNTOWN CIRCULATOR	MONORAIL	27,800	3,000	8,100	132,700	171,600	Dervied from existing RTD bus trips/ auto trips in D.T. TAZ's + RRT/LRT transfers.
	LIGHT RAIL	27,800	3,000	8,100	132,700	171,600	

* Patronage estimates for this alternative include Phase 1, Phase 2, and Phase 3.
Estimates for Phase 4 and Phase 5 are not included at this time because the alignments are at a very general level of detail.

Estimates for the Central Core Circulator reflect increased existing bus boardings/alightings accessed by this alternative vs. the Extended Bunker Hill Shuttle. The Central Core Circulator 1990 estimates of 79,100 are very comparable to the late 1970's DPM Program estimates of approximately 72,500 daily riders. Bus to Circulator transfers are based on behavioral modeling, not on forced bus turn backs at intercept points. A policy decision to turn back buses as they intercept the circulator could result in greater volumes of patronage. Behavioral modeling which produces these mode splits is based in part on congested CBD travel speeds for bus and auto vs. unrestricted flow speeds for the circulator.

Notes:
(1) Mode Split Applied to CBD Zone to CBD Zone Auto Trip Interchanges.
(2) Mode Split Applied to CBD Zone to CBD Zone Bus Trip Interchanges.
(3) Auto Passengers Arriving at Three (3) Peripheral Parking Lots.
(4) Mode Split Applied to CBD Zone to Non-CBD Zone RTD Bus Trip Interchanges and Metro Red Line and Blue Line Transfers.
(5) Trip Types Not Estimated in this Table Include:
- o Walk only trips.
- o Transfers from other than RTD buses.
- o Transfers from commuter rail transit.
- o Transit trips induced by the introduction of a high level CBD Circulator transit service.
- o Park-and-Ride trips from other than the three (3) proposed peripheral parking lots.

V. COST FACTORS

Order of magnitude cost information is provided for those technologies for downtown circulation which may be of practical value as a decision is made with respect to ultimate utilization of the Bunker Hill Transit Tunnel. Capital costs are presented as are operating cost. As with the patronage information presented in the previous chapter, cost information is provided for significant components (or modules) of possible downtown circulator systems so that those reviewing this report may make an assessment as to the generalized cost-effectiveness of alternative courses of action. The analysis will provide for a generalized assessment of the level of mobility which may be provided for given alternative levels of investment.

ORDER OF MAGNITUDE COST FACTORS

The costs shown for each alternative are broad "order of magnitude" estimates for system hardware and related physical structures to allow comparisons of one system alternative to another. Costs estimates include:

- o Technology: Generally includes all of the costs associated with the technology including rolling stock, track, stations, maintenance facilities and control systems.
- o Tunnel Build-Out: Includes all costs relating to build out of the existing BHTT such as removal of temporary construction and enclosed walls, ventilation systems, lighting, escalators and stairs, and others.
- o System Features: Includes special bridges over freeways or other elements not specifically included in the first two categories.
- o Contingency: A 20 % contingency has been added.

Costs estimates do not include:

- o Right of Way Acquisition: It is assumed that the systems discussed will run within existing street right of way. Right of way acquisition cost will be determined at a later time when the alternative concepts advance further into preliminary engineering. Acquisition costs for potential maintenance yards will also need to be determined at a later time.

- o Utility Relocation: It is assumed at this stage that these cost will be minimal, based on the technologies choices suggested.
- o Mobilization: Mobilization, training and system start up.
- o Design/Engineering: Costs incurred by the client agency overseeing the design/engineering of the alternatives.

Cost of providing transit services is a critical element in the decision process and can be divided into two costs categories: capital (investment) costs and operating costs. Capital cost are those that are required to construct the system (cost of the system). Operating costs are those costs incurred by running and maintaining regular operation of the system. Table 6 contains the order of magnitude capital and operating cost information by system alternative and potentially applicable technology. Capital costs per daily rider for each of the six system alternatives and potentially applicable technology are presented in Table 7.

TABLE 6

CAPITAL AND OPERATING COST ESTIMATE MATRIX

(in millions of dollars)

SYSTEM	TECHNOLOGY CHOICE	BUILD OUT OF EXISITING TUNNEL	TECHNOLOGY COST INCLUDING TRAINS, TRACKS, STATIONS TSD STRUCTURES	SPECIAL STRUCTURES	RIGHT-OF-WAY ACQUISITION ①	UTILITY RELOCATION ②	CONTINGENCY (20%)	TOTAL CAPITAL COST	O&M COSTS (PER VEHICLE MILE)
PEDESTRIAN CONCOURSE	PEDESTRIAN ONLY	13	4	4	--	--	3.4	20	NO DATA
	MOVING SIDEWALK	13	8	4	--	--	5.0	30	NO DATA
EXCLUSIVE BUSWAY	ELECTRIC	13	6	4	--	.5	5.0	29	NO DATA
	DUAL MODE	13	6	4	--	.5	5.0	29	2.2
BUNKER HILL CIRCULATOR	CABLE	13	8	6	--	--	5.5	33	1.50-3.50
EXTENDED CIRCULATOR	CABLE	13	25	6	--	6	10	60	1.50-3.50
	MONORAIL	13	42	10	--	6	14	85	2.50-5.50
CENTRAL CORE CIRCULATOR/ DISTRIBUTOR	MONORAIL	13	80	13	--	8	20	121	2.50-5.50
GREATER DOWNTOWN CIRCULATOR DISTRIBUTOR	MONORAIL	13	244	--	--	24	56	337	2.50-5.50
	LIGHTRAIL	13	990	--	--	48	210	1261	2.50-5.50
	RUBBER TIRED	13	725	--	--	48	157	943	2.50-5.50
	MAG. LEV	13	610	--	--	48	134	805	NO DATA

Footnotes:

1 *It is assumed that the systems discussed will run within existing street right of way. Right of way acquisition cost will be determined at a later time when the alternative concepts advance further into preliminary engineering. Acquisition costs for potential maintenance yards will also need to be determined at a later time.*

2 *An allowance of $2 million per mile has been made for utility diversion for all of the overhead track systems.*

* *Note: The numbers are preliminary and rounded to the nearest million.*

TABLE 7

CAPTITAL COST PER DAILY RIDER
(in 1990 constant dollars)

SYSTEM	TECHNOLOGY CHOICE	CURRENT YEAR (1990) ($)	HORIZON YEAR (2000) ($)
PEDESTRIAN CONCOURSE	PEDESTRIAN ONLY	31,400	24,300
	MOVING SIDEWALK	23,100	17,600
EXCLUSIVE BUSWAY	ELECTRIC	3,400	2,600
	DUAL MODE	3,400	2,600
BUNKER HILL SHUTTLE	CABLE	7,600	5,800
EXTENDED SHUTTLE	CABLE	1,900	1,400
	MONORAIL	2,700	1,900
CENTRAL CORE CIRCULATOR/DISTRIBUTOR	MONORAIL	1,500	1,000
GREATER DOWNTOWN CIRCULATOR/DISTRIBUTOR	MONORAIL	2,900	2,000
	LIGHTRAIL	11,000	7,300
	RUBBER TIRED	8,200	5,500
	MAG. LEV.	7,000	4,700

VI. SYSTEM ALTERNATIVES RECOMMENDED FOR SECOND-LEVEL SCREENING

Based on a careful review of the goals for development for downtown Los Angeles, the need to address roadway congestion in downtown Los Angeles, the need to maximize the effectiveness of a multi-billion dollar investment in regional rail transit, and on the need to be responsive to current legislation regulating air pollution, this study provides a structured evaluation of alternative urban mobility technologies. This systems evaluation leads to the technical and economic tradeoff which may form the basis for a recommended approach for enhanced mobility in downtown Los Angeles. Similarly, these analyses provide the rationale for eliminating route configurations for downtown mobility systems as well as eliminating those technologies which are not suited to transportation, land use and environmental objectives of this community.

ALTERNATIVES FOR SECOND-LEVEL SCREENING

System alternatives recommended for second-level evaluation screening include: more detailed study of alternatives to the Greater Downtown Circulation/Distribution System, more detailed study of the Central Core Circulation/Distribution System, more detailed study of the Pedestrian Concourse System and potential non-transportation uses of the BHTT.

The Greater Downtown Circulation/Distribution System is ubiquitous in its coverage of the Los Angeles Central Business District -- of the Los Angeles CBD as it exists today and as the CBD is anticipated to expand in the next decade. The ubiquitous coverage of the Greater Downtown Circulation/Distribution System provides for walk access links to a station generally no greater than 3-1/2 blocks (approximately 1,500 feet) while providing coverage to projected growth areas such as Central City West, the Figueroa Corridor, Chinatown/City North, Little Tokyo, and South Park. Coverage of emerging land use objectives (objectives which create growth at centers such as those just mentioned) is coupled with the same level of coverage of established growth concentrations such as the Financial Core, Bunker Hill, and the Civic Center. Support of defined land use objectives is coupled with the provision of fixed guideway circulation service in the CBD in predominantly east-west corridors. The proposed CBD Circulator provides collector-distributor service for the north-south orientated Metro Red Line and Metro Blue Line. Based on this system's potential to serve downtown travel demand, its ubiquitous coverage, and the system's cost-effectiveness, this alternative should be examined further in Phase 3 of this study.

The Central Core Circulation/Distribution System provides direct service to an area of downtown Los Angeles where congestion is at its greatest. Coverage of land use activities in Bunker Hill, Central City West, Little Tokyo and the Financial Core are served. More

detailed study of this alternative or variations of this alternative are recommended based on the service it will provide for relieving roadway congestion and its cost-effectiveness in comparison to the other alternatives.

The Pedestrian Concourse alternative (simple sidewalk or moving sidewalk technology) should also be studied further as a potential use for the BHTT. If it is decided upon that a circulation/distribution system is not the best use for the BHTT, this alternative offers an opportunity to serve pedestrian trips generated by land uses contiguous to the BHTT. Additionally, this alternative provides the opportunity for a pedestrian mall to enhance or compliment BHTT development within the confines of the tunnel as it is currently constructed and is better than using the tunnel as storage, as it is currently being utilized.

Non-transportation alternatives should not be ruled out at this stage, although further work would be needed to identify a comprehensive range of options, applicable legal restrictions, as well as evaluation criteria. In view of the UMTA restriction on uses of the BHTT and the need for improved CBD circulation and congestion relief, perhaps it is appropriate to view non-transportation uses as a last-resort option, to be studied more extensively if it appears that transportation uses will not be possible. The most promising alternatives at this point are the transportation-related ones.

The four alternatives recommended above provide significant variations in coverage and provide significant variations in capital investment.

TECHNOLOGIES ELIMINATED AND WHY

During the course of this preliminary study, a number of technologies have been discussed and some have been suggested for the various conceptual options. The general discussion following will endeavor to illustrate why various technologies are suited to one type of alternative and not to another.

- Constraints within the BHTT itself preclude further consideration of at least three classes of technology: heavy rail transit like the Metro Red Line, suspended monorail, and suspended cable systems. The larger monorail systems and some light rail & maglev systems are also excluded.

- The least costly transportation alternative, the internal circulator, falls under the category of very short run (one mile and less) high capacity multiple stop systems. Because of the short length, high capacity and relatively slow speed necessitated by many stops, moving walkways and cable shuttle systems are suitable. Larger, high-speed systems such as light rail and the larger rubber tired systems are not well-suited because of the extensive maintenance facilities required, the more expensive infrastructure required and the inefficiency of starting and stopping the trains.

- The fourth alternative proposed (extended BHTT circulator) can be classified under high-capacity, multiple-stop, short-run (up to four miles) systems. These alignments are suitable for the larger rail guided cable traction systems and for some of the

smaller rubber tired and monorail systems. Both of these technologies require more infrastructure and support systems than the very short-run systems, but less than the large rubber tired systems and light rail systems. Moving walkways are not suitable for distances of more than one mile because of their very slow speed.

- The fifth and sixth alternatives (central core and greater downtown systems) are classified as longer systems (over four miles). Four miles is about the limit for cable systems even with multiple loops and changeovers, so they are virtually eliminated from this group of alignments. The small monorail and small rubber-tired systems can still be used and may be the best choice for these alignments, the decision points being the capacity required for the system and speed at which it is desired to operate the system. The smaller systems are capable of speeds of 20 mph and capacities of 6,000-10,000 people per hour. The larger systems operate at speeds of 30-50 mph and have capacities of up to 20,000 people per hour.

- The dual-power systems could be used for any of the alternatives discussed, but they suffer from the same problems as all-street systems to the extent that for part of their routing they have to contend with street traffic. If used exclusively in automated mode they are less efficient than a totally dedicated (single-power) system, and therefore they should be regarded as a stop-gap or compromise solution. They are also less reliable than a dedicated automated guideway transit system.

VII. NEXT STEPS

The final technical phase of work (Phase III Analysis) will involve a rigorous screening of those system alternatives considered to be realistic and responsive to the transportation and land use objectives of downtown Los Angeles. In addition to producing a second-level screening of viable alternatives (and their associated technologies) the Phase III effort will address such other considerations essential to successful implementation of a program for increased downtown mobility. Considerations such as the institutional framework under which a downtown mobility system would be deployed (who would build?, who would operate?), how a downtown mobility system would be financed, the environmental impact of alternative systems on downtown, generalized cash flow analysis of conventional and new approaches to financing (treatments of potential revenue streams, bonding, turnkey operations, privatization, etc.), as well as a refinement of the patronage anticipated for an enhanced system for downtown mobility.

The three recommended alternatives for detailed (second-level screening) study outlined in the previous chapter of this report will be analyzed in Phase 3 of this study. These three alternatives will be studied with respect to the tasks that follow:

LEGAL AND INSTITUTIONAL

Implementation of any of the alternative uses for the Bunker Hill Transit Tunnel discussed in the previous chapters will likely require development of new institutional and organizational structures. This task will examine alternative institutional arrangements to address the two key issues associated with development of a transit system in the BHTT: 1) identification of the agency (or agencies) to be responsible for constructing and operating the system; and 2) identification of the agency to be responsible for developing agreements with property owners to integrate the system into existing and future properties. In addition, institutional structures to implement non-transportation uses of the BHTT will be examined.

FINANCING MECHANISMS

Funds for transit operating and capital expenses are derived from traditional and innovative funding sources. Traditional funds are available from federal, state and local agencies which administer funds to operators of public transit facilities. Innovative funding sources to be studied include such mechanisms as: access, development, and parking fees; tax increment financing; benefit assessment districts; cost sharing; and joint development.

ENVIRONMENTAL IMPACTS

Environmental impacts associated with the use of the Bunker Hill Transit Tunnel would vary according to the types of uses developed. A precise description of the environmental impacts of various tunnel uses will be developed. This task will review major environmental issues typically associated with the tunnel uses currently under study. Impacts such as those associated with the systems physical structures, safety and aesthetics, among others will be assessed.

PATRONAGE

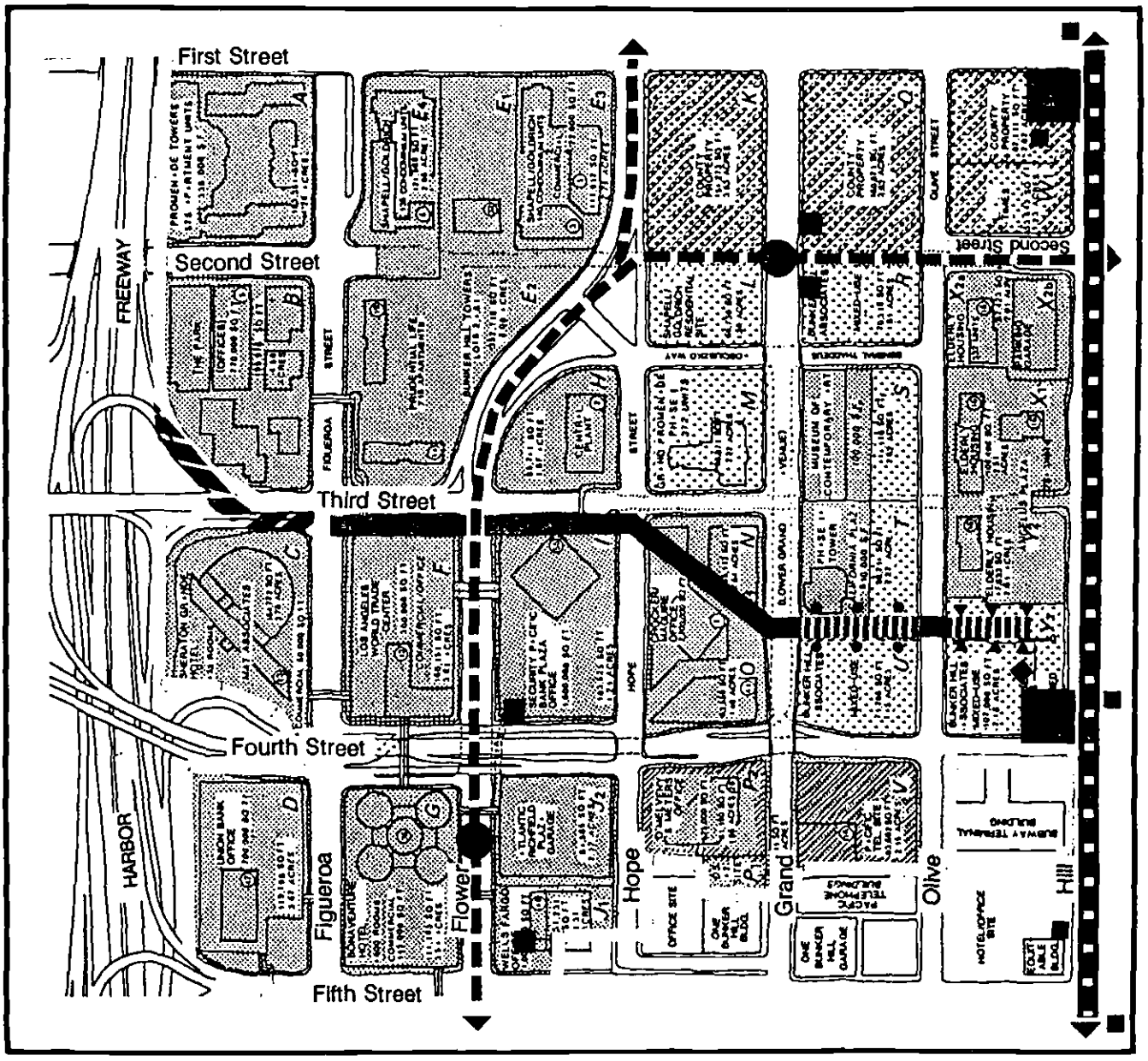
A more detailed, but similar patronage estimation procedure will be applied for developing ridership forecasts for the four suggested alternatives for detailed study in Phase 3.

FORMULATE RECOMMENDATIONS

Based on the study findings, recommendations on a specific alternative and technology for the BHTT will be formulated. The recommendations will be based on the analyses and findings of the first three phases of this study.

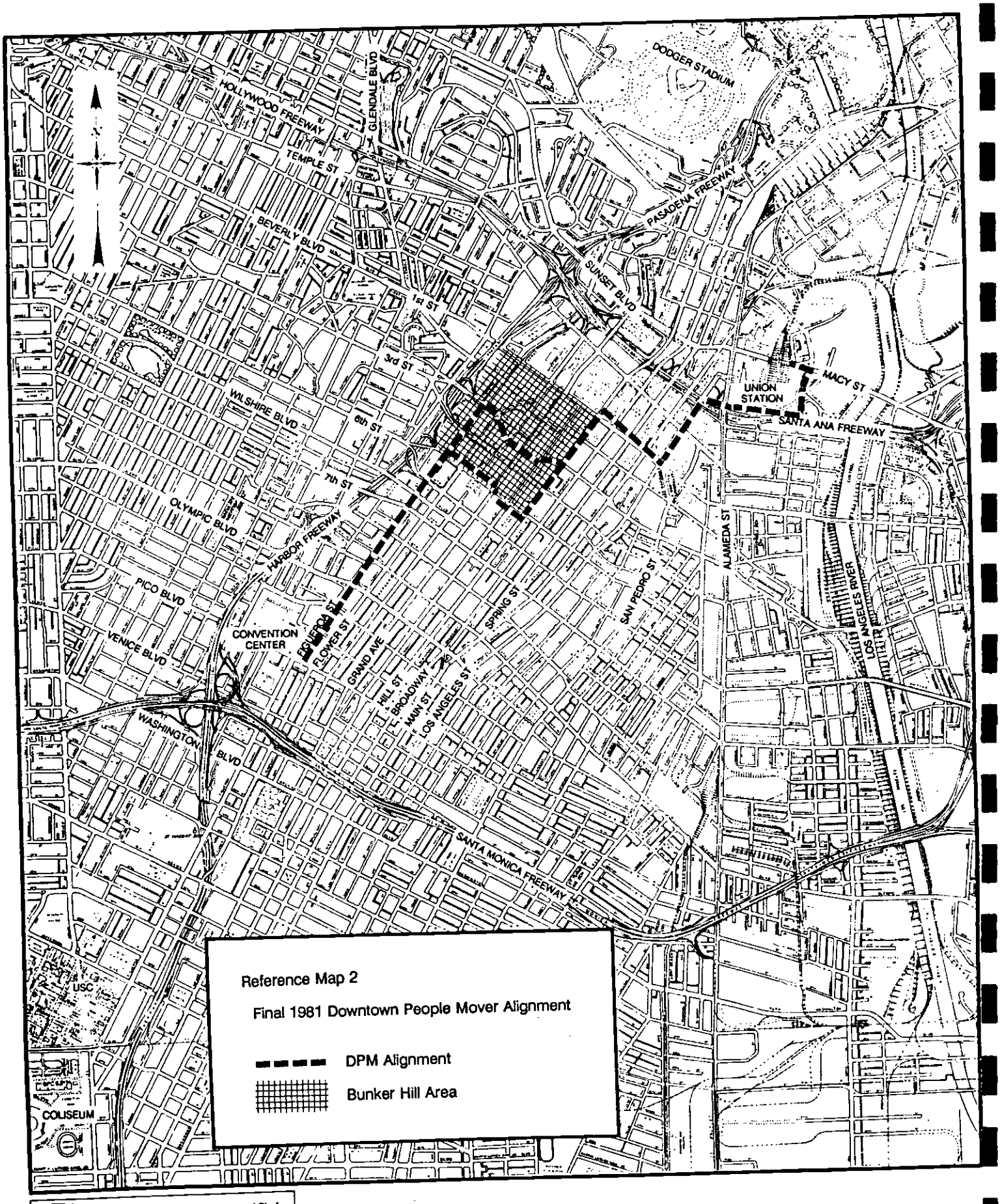
APPENDIX A

REFERENCE MAPS



Reference Map 1

Bunker Hill Area and Tunnel



SCRTD/DHA Bunker Hill Transit Tunnel Study

* : Will fit 2-way in existing tunnel
** : Will fit 1-way in existing tunnel
*** : Will fit 1-way with modifications to existing tunnel
□ : Will not fit in existing tunnel
○ : Insufficient information to make a judgement

AVAILABLE CIRCULATOR SYSTEMS AND THEIR CHARACTERISTICS

SYSTEM TYPE	RUBBER TIRED AUTOMATIC GUIDED SYSTEMS													
MANUFACTURER	WESTINGHOUSE	WESTINGHOUSE	MATRA/VAL	NEWTRAM (VOUGHT)	VONA	MITSUBISHI HEAVY INDUSTRIES	MITSUBISHI HEAVY INDUSTRIES	NIIGATA ENG CO	PARA TRAM. TOKYO CAR CO	KAWASAKI HEAVY INDUSTRIES	KRT KOBE STEEL LTD	KRT KOBE STEEL LTD	FAST FUJI CAR MFG	FAST FUJI CAR MFG
MODEL	** C100	** C45	*** 256	○	**	**	**	**	**	**	**	**	**	**
HEIGHT CAR TOTAL	11'-1" 13'-0"	10'-2" 11'-11"	10'-10"		11'-0" 12'-0"	9'-8"	10'-10"	10'-2"	10'-7"	10'-6"	8'-11"	10'-7"	10'-3"	10'-6"
WIDTH CAR TOTAL	9'-4" 12'-5"	8'-5½" 10'-0"	6'-10"		8'-0" 10'-0"	7'-4"	8'-2½"	7'-6"	8'-0"	7'-10"	6'-9"	7'-8"	7'-6"	8'-2"
LENGTH	33'-8" 41'-10"	22'-0" 26'-5"	87'-0"		25'-4"	19'-0"	29'-4"	26'-8"	26'-8"	21'-6" 30'-4"	19'-0"	26'-8"	21'-4" 29'-4"	43'-4"
MAXIMUM GRADE	10%	10%	10%		6%	10%	10%	10%	7%	10%	10%	9%	10%	10%
MINIMUM HORIZONTAL CURVE RADIUS (FT)	75'-0" @ 13 MPH	75'-0" @ 13 MPH	135'		50'-0"	50'-0"	50'-0"	66'-0"	100'-0"	66'-0"	31'-0"	50'-0"	76'-0"	76'-0"
MINIMUM VERTICAL CURVE 1% CHANGE			3300'R 31'-0"											
MAXIMUM CARS PER TRAIN	3	3	4	4 STD 6 MAX	3	6	6	6	6	6	6	6	6	6
CAR CAPACITY DESIGN CRUSH	100 150	45 68	160		70 75	32	75	75	75	30 75	30	75	50/75	130
TRAIN CAPACITY PASS./HR. 3 MIN HDWY	9,000	4,000	10,000	7,200	4,500	4,000	9,000	9,000	9,000	9,000	3,600	9,000	6,000/9,000	15,600
SPEED MAXIMUM OPERATING	30 MPH	30 MPH	50 MPH	38 MPH	38 MPH									

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AVAILABLE CIRCULATOR SYSTEMS AND THEIR CHARACTERISTICS

SYSTEM TYPE	STEEL WHEEL SYSTEMS												
MANUFACTURER	UTDC	UTDC	UTDC	UTDC	UTDC	TGI / BOMBARDIER	TAU/BN/ BOMBARDIER	AEROMOVEL RADSCO	GEC / MOWLEM	UTDC LCTS			
MODEL	** TORONTO LRV	** TORONTO ALRV	** DETROIT ALRTV	** VANCOUVER ALRTV	** SANTA CLARA ALRTV	**	○	□		*			
HEIGHT CAR TOTAL	11'-0"	11'-0"	10'-3"	10'-3"	11'-2½" 13'-0"	11'-1¾" 12'-8¾"		15'-6"		7'-4" ±			
WIDTH CAR TOTAL	8'-4"	8'-6"	8'-2½"	8'-2½"	8'-8½"	8'-8½"		9'-3"		6'-8" ±			
LENGTH	52'-7"	75'-1"	41'-8"	41'-8"	88'-6"	89'-2"		43' ±		25'-2" ±			
MAXIMUM GRADE	8%	8%	6%	6%	6.4%	6%	6%	4-10%		10%			
MINIMUM HORIZONTAL CURVE RADIUS(FT)	36'-0"	36'-0"	60'-0"	60'-0"	82'-0"	82'-0"	32'-0"	85' ±		100'-0"			
MINIMUM VERTICAL CURVE 1% CHANGE	460' R 4'-7"	800' R 8'-0"	1000' R 10'-0"	1000' R 10'-0"	1660' R 16'-6"	1150' R 11.5'		340' 3.4'					
MAXIMUM CARS PER TRAIN	6	4	2	6	4	4		4	2 OR MORE	1			
CAR CAPACITY DESIGN CRUSH	94 142	159 257	73 112	73 107	166 257	211 256	115 130	150		36			
TRAIN CAPACITY PASS./HR. 3 MIN HDWY	17,000	20,000	4,480	12,840	20,000	20,000	20,000	12,000	8,000	5,000			
SPEED MAXIMUM OPERATING	58 MPH 50 MPH	56 MPH 50 MPH	62 MPH 56 MPH	62 MPH 56 MPH	65 MPH 56 MPH	55 MPH	36 MPH	47 MPH 28 MPH	50 MPH	25 MPH			

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○ : Insufficient information to make a judgement

AVAILABLE CIRCULATOR SYSTEMS AND THEIR CHARACTERISTICS

SYSTEM TYPE	MONORAIL SYSTEMS													
MANUFACTURER	TGI/ BOMBARDIER	TGI/ BOMBARDIER	TGI/ BOMBARDIER	ASTROGLIDE TITAN PRT SYSTEMS	VON ROLL/ VSL CORP	SIEMENS AG	ALWEG	HITACHI						
MODEL	* UMI	□ M	○ XM	○	*	○ H. BAHN.	○	□						
HEIGHT CAR TOTAL	8'-11" 10'-3"	10'-5½" 15'-0"			8'-6¾" 11-0"									
WIDTH CAR TOTAL	6'-6" 8'-0"	8'-4½" 10'-0"			6'-9" 8'-1"			10'-0"						
LENGTH	22'-1" 17'-4"	41'-5" 30'-2"						50'-0"						
MAXIMUM GRADE	12%	12%			6%	7.5%		3% (STEEPER WITH SPECIAL TRACK)						
MINIMUM HORIZONTAL CURVE RADIUS (FT)	100'-0"	175'-0"			65'-0"									
MINIMUM VERTICAL CURVE 1% CHANGE	600' R 6'	1000' R 10'												
MAXIMUM CARS PER TRAIN	6 STD 10 MAX	6 STD 10 MAX	6 STD 10 MAX		10 MAX	1		4						
CAR CAPACITY DESIGN CRUSH	21 34	46 76	250	20-50	23	42		120 250						
TRAIN CAPACITY PASS./HR. 3 MIN HDWY	6,800	15,200	50,000		5,000	3,780		20,000						
SPEED MAXIMUM OPERATING	30 MPH	55 MPH	70 MPH		30 MPH									

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AVAILABLE CIRCULATOR SYSTEMS AND THEIR CHARACTERISTICS

SYSTEM TYPE	CABLE SYSTEMS								MAGNETIC SYSTEMS			DUAL MODE STREET + AGT		
MANUFACTURER	OTIS	SOULE	POMA	MITSUBISHI	SKIRAIL	FUJI TEC (INCLINED ELEVATOR SYSTEMS)	METROSHUTTLE 2000 VSL CORP		MAGNETIC TRANSIT	HSST		BN/ BOMBARDIER	AEG/ WESTINGHOUSE	
MODEL	* *	*	○ 2000	* SKY CABLE	* *	□	○		□ M-BAHN	** 100		* *	* *	
HEIGHT CAR TOTAL	9'-10" 10'-9"	7'-6" 9'-11¼"		11'-0"	13'-0"	20'-6"			9'-7" 11'-5"	10'-4"		11'-7"		
WIDTH CAR TOTAL	7'-4"/9'-10" 9'-10"	5'-0"		6'-0"	9'-0"	6'-5"/11'-4"			8'-2" 9'-7"	9'-10"		8'-1½"		
LENGTH	15'-0" 27'-0" 39'-0" 51'-0"	10'-0"		9'-0"		6'-0"			37'-10"	35'-7" 26'-3"		82'-2"		
MAXIMUM GRADE	8%	10%/12%	13%	30%	34%	20-50%				8%		15%	18%	
MINIMUM HORIZONTAL CURVE RADIUS (FT)	60'-0"	48'-0" (100'-0" NORMAL)		70'-0"		STRAIGHT ONLY			166'-0"	80'-0"		40'-0" (47'-0" AGT)		
MINIMUM VERTICAL CURVE 1% CHANGE	3,000' R 30'-0"	400'-0" 4'-0"				STRAIGHT ONLY			2000' 20'-0"					
MAXIMUM CARS PER TRAIN	2 OR MORE			1		1			4'	4 OR MORE		2-3 IN AGT ONLY	1	
CAR CAPACITY DESIGN CRUSH	23-187	12-20		15		8 20			83 115	40		94 157		
TRAIN CAPACITY PASS./HR. 3 MIN HDWY	11,000	5,000	20,000	(20 SEC HDWY) 3,000	3,000				9,000	3,200 OR MORE		3000 9000 (AGT)		
SPEED MAXIMUM OPERATING	25 MPH	12.5 MPH	22 MPH	13 MPH 8.5 MPH	22 MPH	2 MPH			50 MPH	60 MPH		44 MPH		

APPENDIX C

PHYSICAL FEASIBILITY OF THE BHTT

PHYSICAL FEASIBILITY OF THE BHTT

The vertical and horizontal cross-sections of the existing BHTT and surrounding areas are shown in Figure C-1. For the BHTT to be used for accommodating travel demand in the downtown area, alterations to the existing cross-sections may be necessary. The portions of the tunnel within building basements will need some additional construction work to separate the tunnel from building uses.

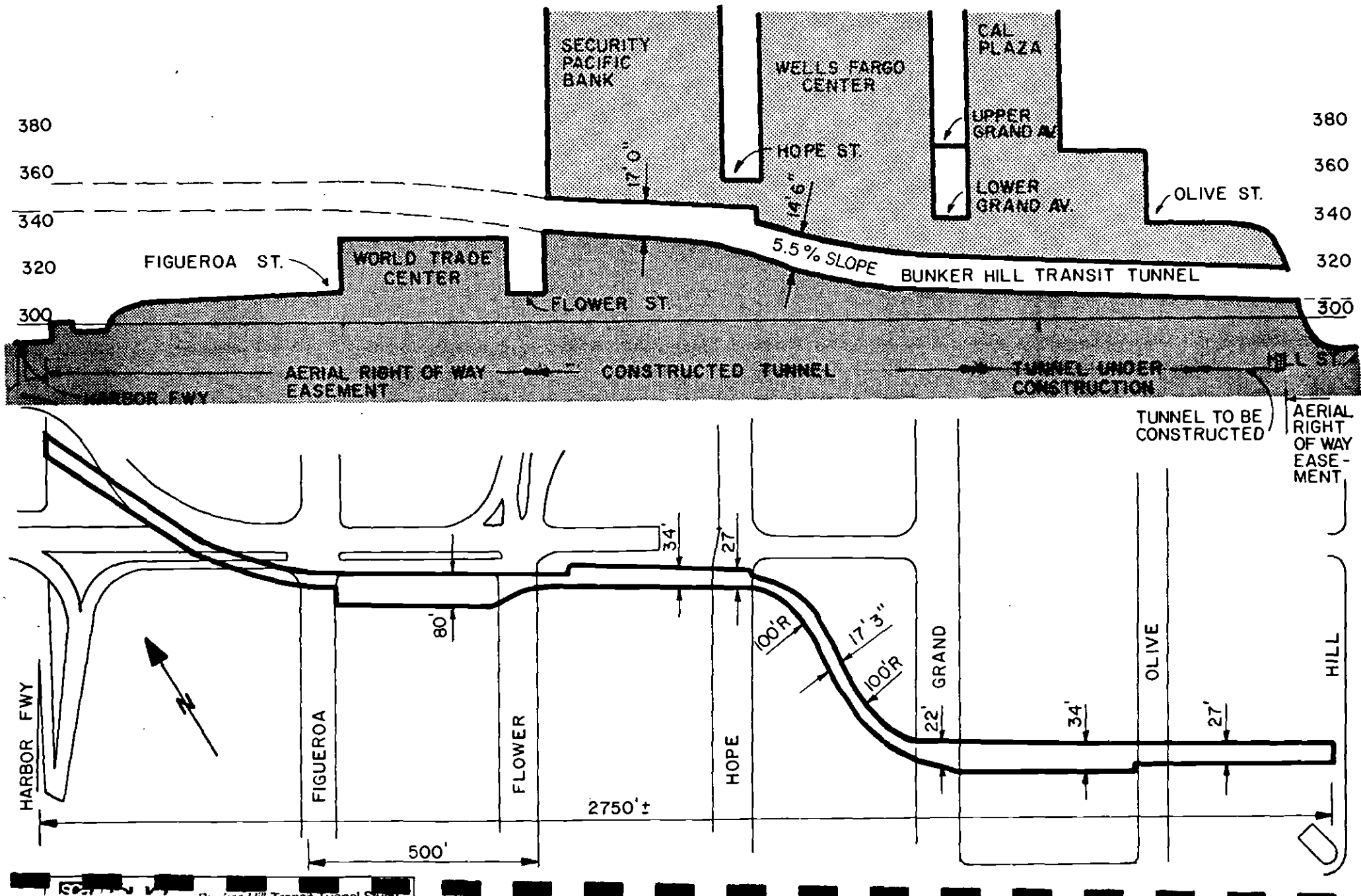
Several dimensions could restrict the kinds of systems that could operate in the tunnel as it is presently constructed. These include:

- o height (minimum 14'-6") -- some vehicles are too high to fit;
- o width (minimum 17'-3") -- for most systems, two vehicles could not pass each other in this section;
- o horizontal curve (minimum 100' radius) -- some systems require a larger turning radius;
- o grade (maximum 5.5%) -- some systems require shallower slopes; and
- o vertical curve (maximum 20' per 1% change in slope) -- some systems require a slower change in grade.

All of these restrictions are found in the tunnel segment below the Wells Fargo Center. The most important of these constraints is width.

Figure C - 1

B.H.T.T. PLAN & SECTION OF TUNNEL & EASEMENTS



APPENDIX D

SUPPLEMENTAL PATRONAGE ESTIMATION INFORMATION

PATRONAGE ESTIMATES

While considering alternative technologies for the BHTT, it is necessary to determine the potential travel demand that would be served (and street congestion alleviated) by use of the BHTT. The techniques used for estimating travel demand on the proposed alternatives/scenarios that would utilize the BHTT are intended to estimate potential patronage on an order of magnitude basis. These patronage estimates will be used in the evaluation process assessing the need of a CBD Circulator transit system that could utilize the BHTT and (if needed) the circulator technology with capability to address travel demand needs.

The following is an overview of the analysis approach, procedures and data analysis used, and major assumptions that were made in developing the patronage estimates on the various alternatives under study.

MANUAL SKETCH PLANNING PROCEDURE

Estimating patronage for downtown transit circulator systems requires specialized travel demand forecasting approaches. Few models have been developed and calibrated for this purpose. Since the complex analysis associated with mathematically modeling a downtown circulator system at a fine-grained-zone level was outside the scope of this project, a "manual sketch planning procedure" was used to develop preliminary order of magnitude estimates for the alternatives under study. The manual sketch planning procedure simply estimates the fraction of existing auto and transit trips that could potentially be captured by the six alternatives, and then factors these trips to 1990 and the horizon year (2000) using a land use development based growth factor. Since the estimates generated by the manual sketch planning procedure are approximate, care must be taken while interpreting them.

MAJOR ASSUMPTIONS AND ANALYSIS APPROACH

The purpose of this section is to document the major assumptions and analysis approach associated with the manual sketch planning technique. The analysis approach included, but was not limited to: 1) definition of the study area; 2) definition of the travel demand components; 3) definition of the variables used in the mode-choice models; 4) growth factors; 5) system connectivity; and 6) review of previous DPM patronage, bus/rail patronage, and peripheral parking studies.

1. Study Area

The study area for purposes of travel demand estimation is all of Downtown Los Angeles, bounded by Dodger Stadium on the North, the Coliseum to the South, Center City West, and the Los Angeles River to the east.

2. Travel Demand Components

a. Existing CBD Bus Ridership

The major component of downtown circulator potential patronage is that component of travel logically diverted from the regional bus system. Data for transit boardings and alightings was made available at the census tract level from the Southern California Rapid Transit District (SCRTD). SCRTD maintains an updated file of RTD bus boardings and alightings by census tract. Transit ridership was collected for census tracts that are within alternative CBD Circulator alignment loops and adjacent to alternative CBD Circulator alignment loops. In some instances, fractions (percent of the tract within walking distance of the alternative) of ridership from the census tracts were used. Bus ridership estimates are then multiplied by a bus/circulator mode-split factor to arrive at the fraction of bus trips that are captured by the circulator system.

b. Automobile Circulation trips

Data was compiled for automobile trips from traffic analysis zones (TAZ's) within the proposed alignments study area. The automobile trips are based on modal split trip tables developed at SCRTD. SCRTD trip tables are based on 1985 highway and transit levels of service. This data was collected by trip purpose to account for different trip characteristics among different trip purposes. These CBD auto circulation trips are then multiplied by the auto/circulator mode split factor to arrive at an estimate of auto circulation trips that will be captured by the circulator system.

c. Automobile Distribution Trips

Automobile distribution trips were estimated based on availability and capacity of peripheral parking facilities and their relative location to alternative CBD Circulator alignments. Data regarding peripheral parking was available from the CRA/LADOT Downtown Los Angeles Peripheral Parking Program report. The assumption was that no more automobile CBD distribution trips could be assigned than the capacity of the parking facility (as far as calculating the proportion of automobile trips that could be captured by the circulator system). An automobile occupancy rate of 1.44 (value used in the SCAG Travel Forecast Atlas) was used. It is assumed that most of these trips could potentially use the circulator system.

3. Mode Choice Equations

The base modal shares for the base year trips were estimated by way of mode choice models developed for home based work and non-work trips. The mode choice models were developed in order to logically divert a percentage of existing automobile trips to urban circulator trips and existing bus transit trips to urban circulator trips. The mode choice model was developed on a Lotus 123 spreadsheet to "split" automobile and urban circulator trips and to "split" bus transit and urban circulator trips. Utilities were used to express benefits, or negative costs to trip maker for making his/her choice between modes. Utility equations to estimate the attractiveness of an alternative based on various characteristics were developed. The basic components of the equations were In Vehicle Travel Time(IVTT), Out of Vehicle Travel Time(OVTT) and Cost to the trip maker. The coefficients used in the equations were taken from the Los Angeles mode choice models developed at SCRTD. Using these equations, the factors used to divert trips from bus and auto to the circulator system were calculated to be:

Modes	Home-Work	Non-Work
Bus/Circulator	0.42	0.38
Auto/Circulator	0.40	0.13

4. Growth Factor

In order to scale up the base year automobile and transit trips to the horizon year (2000), base year trips were multiplied by a growth factor that was computed base on projected office/retail development increases in the study area from base year(1990) to horizon year(2000). A growth rate from the base year to the horizon year of approximately 30 % was computed. This growth factor is based on the assumption that total office/retail development in the study area would not exceed 1.5 million square feet per year for the 10 year projection period. Trips by mode were assigned to the alternatives in the base year and scaled up to arrive at the estimated patronage in the horizon year.

5. System Connectivity

The assumptions used in system connectivity (projection of transfers) between the CBD circulator system and other fixed guideway systems serving the downtown area -- the Long Beach/Los Angeles Light Rail(Blue Line) and the Metro Rail Heavy Rail (Red Line) considered relative walk distances. The walk distance for the proposed circulator system is approximately .2 miles while the maximum walk distance for the other fixed guideway systems was assumed to be .5 miles. This ratio was applied to total alightings projected from the SCRTD/GPC Financial Operating Plan Networks Patronage Forecast Report.

6. Previous Studies

Previous studies which were used for reference to estimate patronage for a downtown circulator system include the following:

a. The Downtown Los Angeles Peripheral Parking Program report, LACRA/LADOT, 1986.
b. Final Environmental Impact Statement for the Los Angeles Downtown People Mover, USDOT/UMTA, 1980.
c. Models and Estimates of Los Angeles Downtown People Mover Demand, Cambridge Systematics, 1978.
d. Planning for Downtown Circulation Systems, Analysis Techniques, volume 2 & 3, USDOT/UMTA, 1983.

7. General Comments

The order of magnitude manual sketch planning forecasts developed here seems to be generally consistent with earlier DPM forecasts accomplished for the Los Angeles CBD. However, the next phase of this BHTT effort (the second-level screening) may result in major changes in the Table 3 patronage levels (as it may lead to a proposed detailed computer modeling to follow at a later date).

In the interest of not overstating projected circulator patronage, such trips as walk-only trips, transfers from other than RTD bus, regional rail transit transfers from other than the 7th/Flower station, possible transfer from commuter rail, trips induced by the introduction of circulator service and park-n-ride trips from other than peripheral parking lots have not been counted.