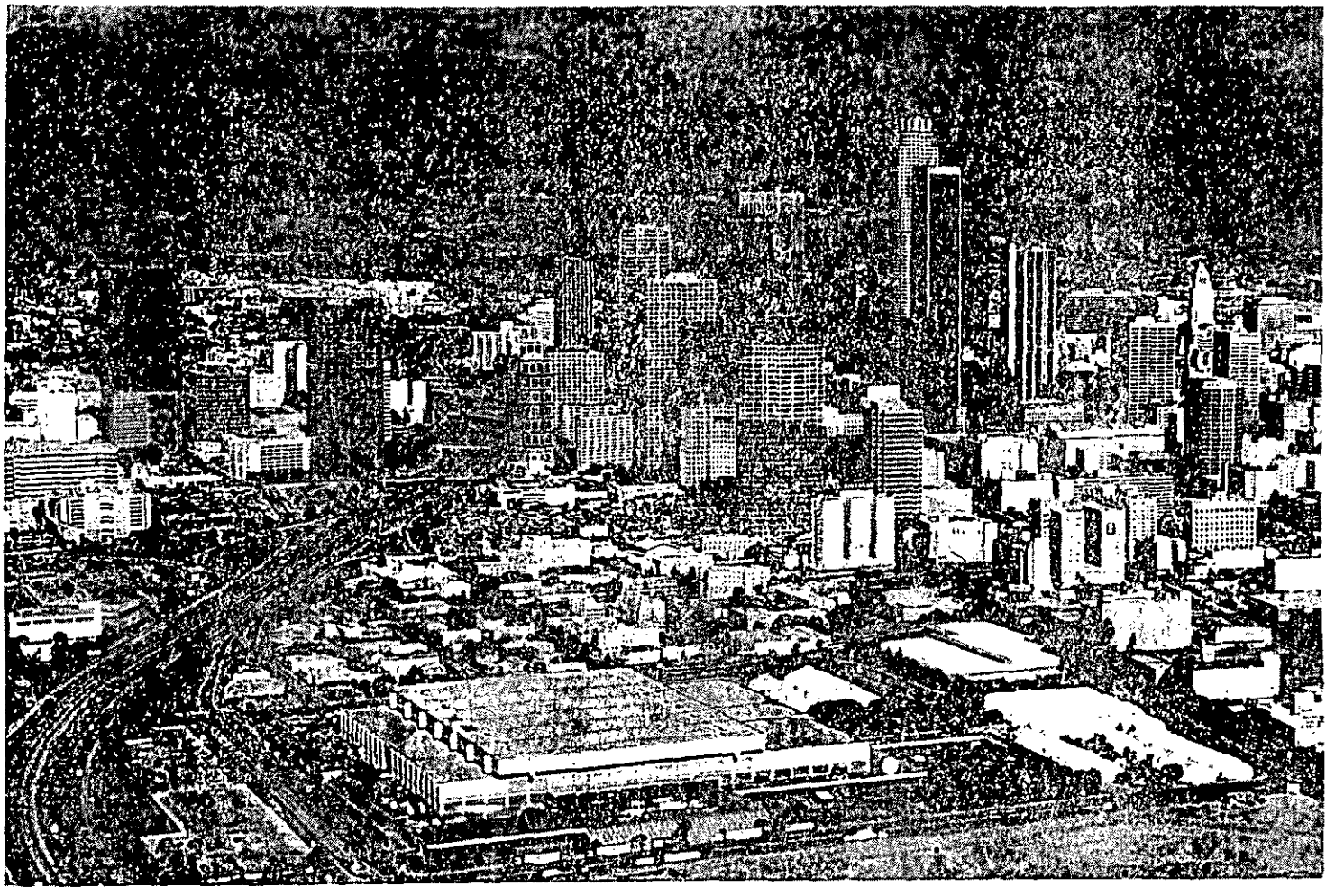
A PRELIMINARY DISCUSSION OF POSSIBLE OPTIONS FOR USE OF THE BUNKER HILL TRANSIT TUNNEL



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

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

March 1990

WHITE PAPER

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WHITE PAPER
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INTRODUCTION

BUNKER HILL TRANSIT TUNNEL STUDY AND THIS "WHITE PAPER"

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 (Figure 1). In view of the intensity of existing and future development in downtown, and the corresponding demand for transportation generated by that development, the BHTT is potentially a highly valuable element of the transportation infrastructure serving the area. The current BHTT Study is designed to consider ways to effectively use this untapped resource.

This white paper, and the more extensive report it summarizes, represent the completion of the first phase or milestone of the four-phase study. The phases are described as follows:

- **PHASE 1: 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 2: First-Level Screening of Generalized Scenarios** -- 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.

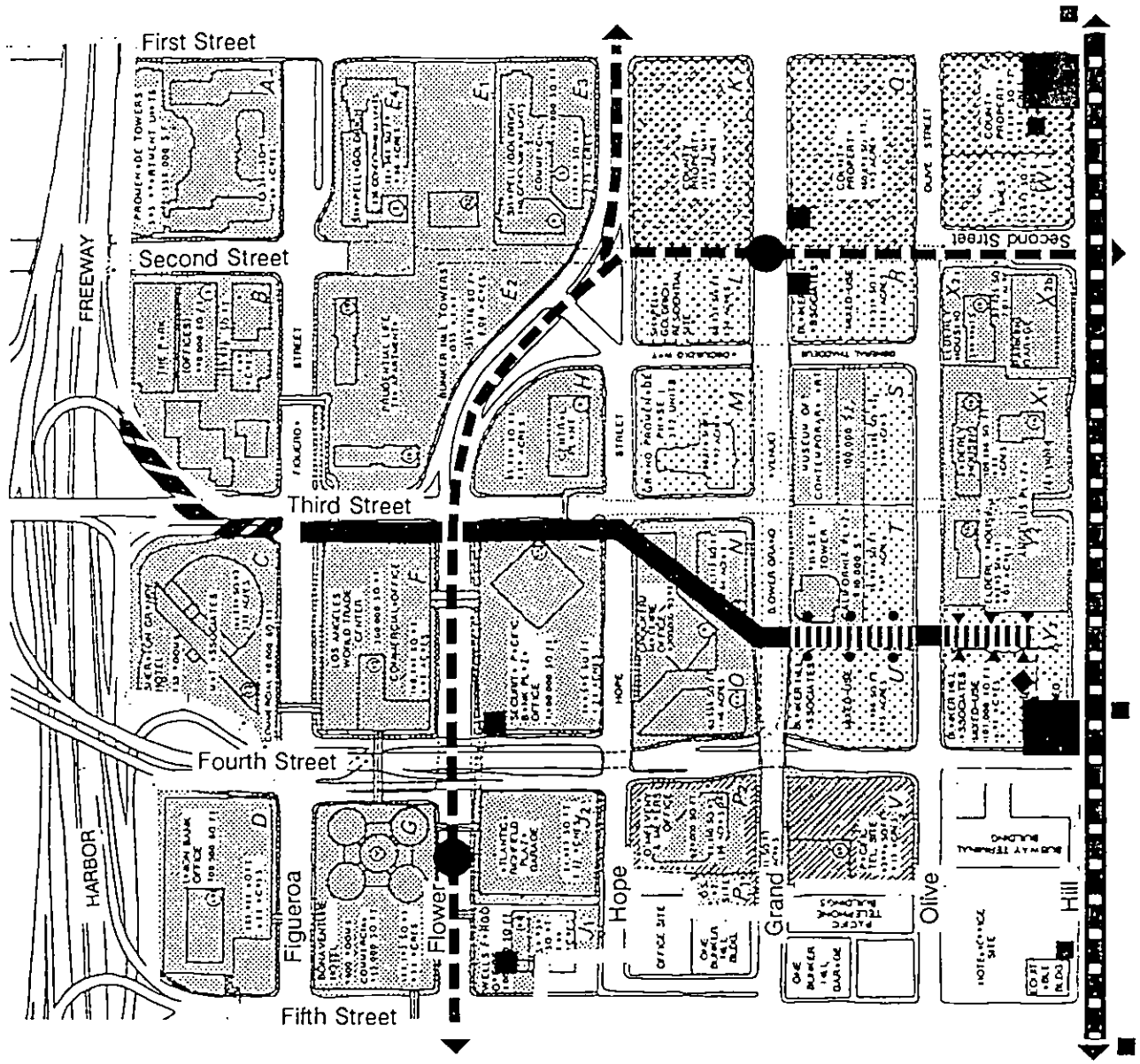
- **PHASE 3: Second-Level Screening of Specific Alternatives** -- Compare specific alternatives in terms of patronage (detailed modeling), environmental concerns, cost and cost-benefit, the ability to be financed, institutional arrangements, and implementation strategies. Formulate recommendations.

- **PHASE 4: Disseminate Study Findings** -- Prepare a written report, and make verbal presentations of the study findings.

Public input is sought at each phase of the study.

CURRENT DOWNTOWN DECISION-MAKING CONTEXT

Downtown Los Angeles is in a period of perhaps unprecedented volatility; the term "renaissance" is often applied. Its form is rapidly being redefined through a series of decisions regarding large transportation and land use investments.



Easement for Right-of-Way

Reserved Tunnel Easement

Tunnel Under Construction

Tunnel or Deck Related Construction Completed

Tunnel to be Constructed

Light Rail Alignment Under Study

Metro Rail

Metro Rail Station

Portal

LRT Station

Figure WP-1

Bunker Hill Area and Tunnel

The Land Use Context

The downtown Los Angeles skyline is literally changing daily. Seven million square feet of office space are currently under construction in the core area. In the Bunker Hill, Central Business District (CBD), and Little Tokyo redevelopment areas, 38 million square feet of new development is projected to occur over the next 10 to 15 years. Los Angeles has overtaken San Francisco as the financial center of the western United States, and as the gateway to the Pacific Rim.

In Central City West, just west of the Harbor Freeway, a proposal for building up to 25 million square feet of commercial development, plus up to 12,000 dwelling units, would bring that area to a density comparable to that of the CBD proper. To the north and east, futures for City North and the Alameda Corridor are under study, amid considerable private sector investment activity. To the south, the mixed-use South Park area is planned eventually to include up to 15,000 dwelling units and about 10 million square feet of commercial space. Further south, development stretching down the Figueroa Street corridor will ultimately link downtown to the University of Southern California (USC)/Coliseum area and beyond.

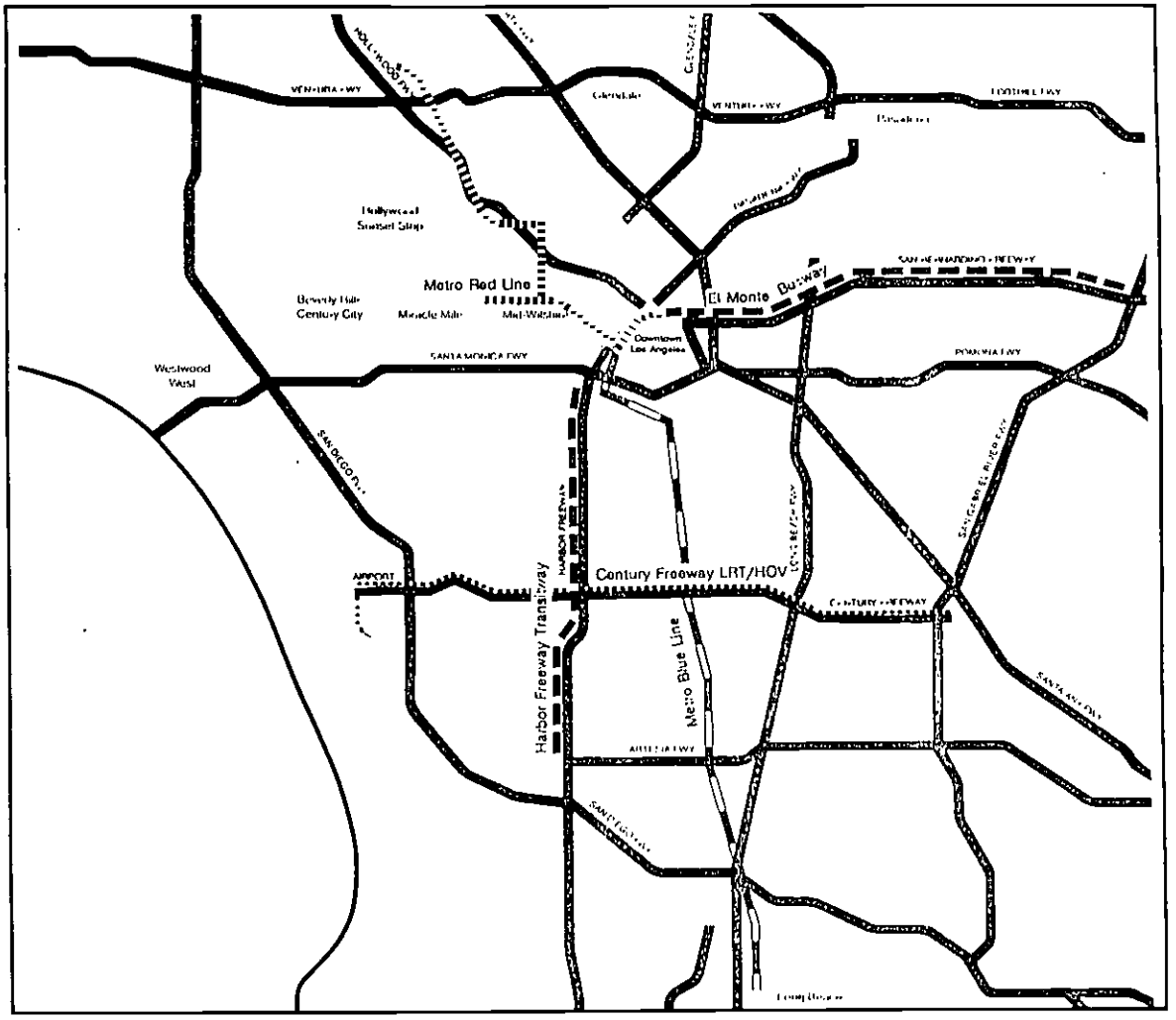
Downtown is home to multi-billion dollar retail and wholesale trades in jewelry, apparel, and produce. The approximately 42,000 Federal, State, and local government employees in the Civic Center area represent one of the largest concentrations of public employees west of the Mississippi.

Several major activity centers in downtown are currently undergoing development. The Convention Center has just broken ground on a $390 million expansion from 28 to 63 acres, including a 350,000 square foot exhibition hall. The 63-year-old Los Angeles Central Library is in the midst of a complete rehabilitation and expansion. And the proposed 2,500-seat Walt Disney Concert Hall would join with the 6,000 seats of the three major performance areas of the Music Center across the street, to create a world-class performing arts complex.

The Transportation Context

Figure 2 illustrates major existing and planned transportation facilities in the region (Los Angeles County) and downtown. Two new regional facilities are already under construction in downtown: the heavy rail transit (HRT) Metro Red Line, initially running from Union Station to Wilshire at Alvarado, with a second-phase extension to North Hollywood; and the light rail transit (LRT) Metro Blue Line from Long Beach to Seventh and Flower Streets in downtown L. A. The existing El Monte Busway will soon be extended into Union Station, with buses ultimately feeding in to Metro Rail rather than continuing downtown.

Two other regional fixed-guideway facilities related to downtown are also under construction: a light rail line and high-occupancy vehicle (HOV) lanes in the median of the Century Freeway; and the 20-mile Harbor Freeway Transitway. In addition, a number of other potential regional transportation facilities directly affecting downtown are under study. Decisions on the alignment of the light rail extension to Pasadena will be made within the next three months. Other facilities being discussed for future implementation include:



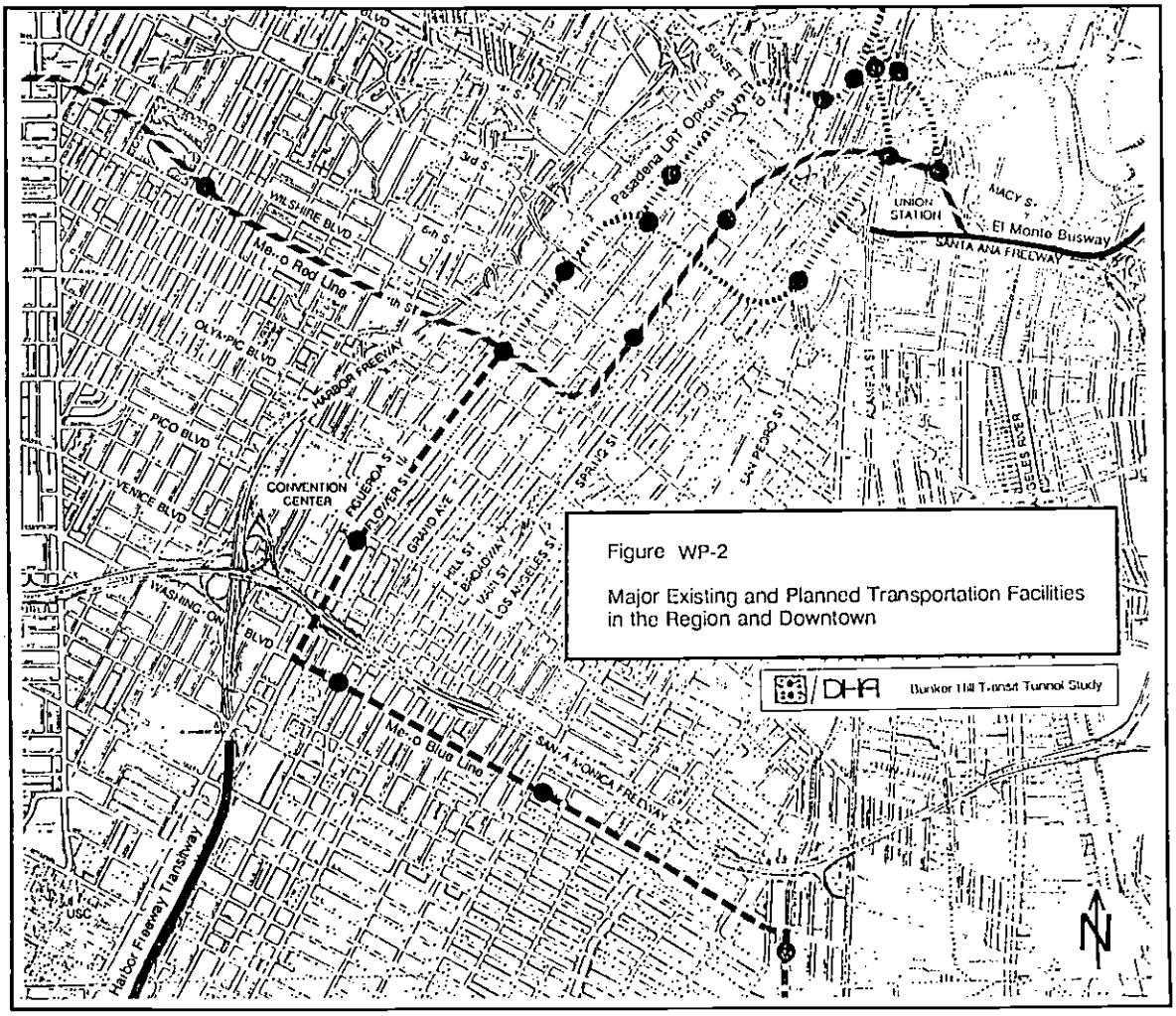


Figure WP-2

Major Existing and Planned Transportation Facilities in the Region and Downtown

- o the eastern extension of Metro Rail into the Santa Ana Corridor;
- o western extensions of Metro Rail to Santa Monica and through the San Fernando Valley;
- o extended and new transitways along the Harbor Freeway, Bixel Street, and Glendale Boulevard, creating a continuous north-south corridor from the Artesia (91) Freeway to the City of Glendale;
- o a transitway down the concrete-lined bed of the Los Angeles River from the San Fernando Valley to Union Station; and
- o new and expanded commuter rail service between Union Station and San Bernardino, Ventura, and Orange/San Diego Counties.

The considerable investment in fixed-guideway transit facilities represents one form of transportation policy for downtown. Other, more intangible policies are also part of the transportation context. These policies include:

- o the peripheral parking program of the Community Redevelopment Agency, which mandates, for new developments within the most congested zone of downtown, substituting a portion of code-required on-site parking with parking in specially-designated areas on the periphery of downtown; and
- o Regulation XV of the Air Quality Management District, which requires medium and large downtown employers to develop plans for achieving an average occupancy of 1.75 persons per vehicle for peak period commute trips.

Downtown Transportation Issues

With the land use and transportation activities sketched above, Los Angeles is being transformed into what is by nearly any standard a world-class city. However, the new downtown will retain and create some transportation problems that are not fully addressed by the facilities currently existing and under consideration.

The two rail lines being built will function as a regional transportation system bringing trips into downtown, but will be of limited value for serving mid-day circulation within downtown. The two lines have a pronounced north - south orientation; east - west linkages are needed to balance the system. The two lines meet at only one point (Seventh and Flower); it is desirable to increase the connectivity of the rail system. Union Station will become a major interceptor for downtown-oriented trips, with the single Metro Red Line potentially the only fixed-guideway distribution mechanism within downtown.

Finally, there are some notable gaps in the fixed-guideway transportation system that is emerging for downtown -- that is, there are a number of activity areas not well-served by existing and proposed facilities. Equity issues are raised by a multi-billion dollar rail system that almost exclusively serves the white-collar employment base on the north and west sides of downtown. In downtown itself, un- or under-served areas include Little Tokyo and the

eastern half of the Civic Center area, the southern half of the Broadway/Spring Theater District, the 55,000 employees of the Eastside Industrial Area, and the eastern half of South Park. There are other potentially underserved sectors in the greater downtown area. The BHTT, with its east - west alignment through high-density development, may be a building block in an integrated, systemic solution to some of these problems.

DEVELOPMENT OF THE BUNKER HILL TRANSIT TUNNEL

Initial Impetus – Peripheral Parking for Bunker Hill

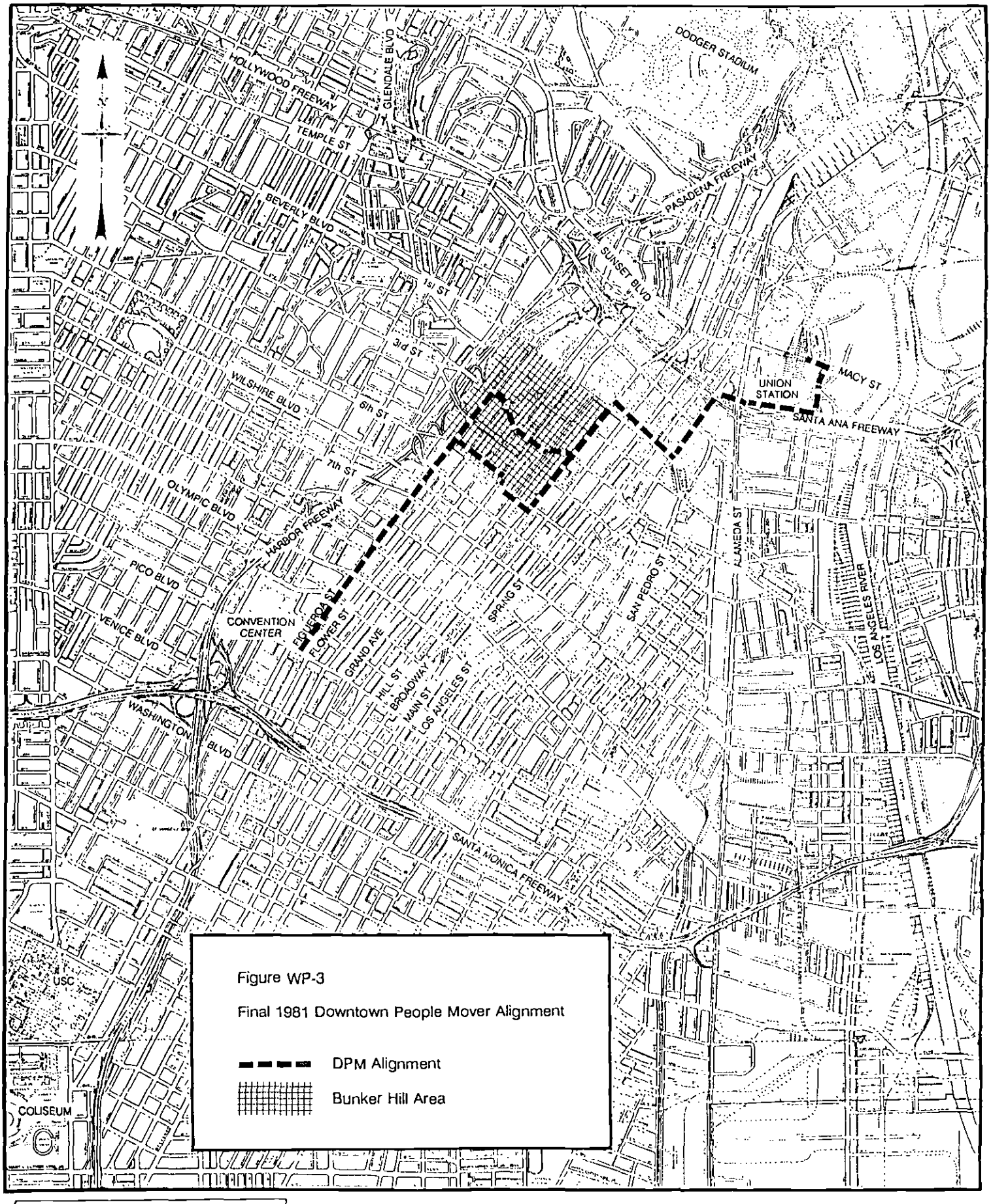
In 1969, a study commissioned by the Los Angeles Community Redevelopment Agency noted that "an essential element of the total Bunker Hill renewal program is a 'people mover' system linking the various developments within Bunker Hill to satellite parking concentrations." The need for such a satellite parking concept was described as an outgrowth of the inability of the street network surrounding Bunker Hill to accommodate all of the traffic generated by the total proposed developments. The Central City East area was identified as providing the best opportunity for developing a parking program which could fulfill the needs of Bunker Hill. Because of the distance between Bunker Hill and possible satellite parking facilities, and because of the extensive elevation differentials, a circulation system was thought to be necessary to link the two areas.

Downtown People Mover

This original people mover concept serving Bunker Hill evolved over a period of years into the proposed Downtown People Mover (DPM) System. Figure 3 shows the alignment that was eventually identified in the 1980 Final Environmental Impact Statement for a Los Angeles DPM System. The alignment would have joined Union Station northeast of downtown to the Convention Center southwest of downtown, with a one-way circulation loop within the Bunker Hill area. The Federal Urban Mass Transportation Administration (UMTA) awarded $125 million to Los Angeles for design and construction of the system, but the DPM was then defunded in 1981. Sufficient funding was obtained, however, to finish construction of the tunnel through the Bunker Hill area.

As part of the transition process, UMTA agreed to fund 80% of the remaining cost of completing the tunnel through Bunker Hill. That completion cost is estimated at $3.8 million, which includes $760,000 in Bunker Hill tax increment funds. A condition of the agreement was that the BHTT be placed into mass transit operation (a) within one year after the opening of Metro Rail to revenue service, or (b) within one year after the completion of California Plaza Phase IIA, whichever comes first. Failure to meet that implementation deadline could necessitate the return of $3 million from the City of Los Angeles to UMTA.

A number of things have changed since 1981. For one thing, employment in the downtown core has already exceeded the 1990 forecast on which DPM patronage estimates were based. Further, the DPM analysis did not take into account the growth that is now developing in the greater downtown area -- Central City West and elsewhere. The Metro Red Line has shifted alignment slightly, largely in response to the defunding of the DPM. The Metro Blue Line was not taken into account at the time.


HOLLYWOOD FREEWAY
GLENDALE BLVD
DODGER STADIUM
TEMPLE ST
BEVERLY BLVD
PASADENA FREEWAY
SUNSET BLVD
1st ST
3rd ST
WILSHIRE BLVD
5th ST
7th ST
UNION STATION
MACY ST
SANTA ANA FREEWAY
OLYMPIC BLVD
HARBOR FREEWAY
PICO BLVD
VENICE BLVD
FIGUEROA ST
FLOWER ST
GRAND AVE
HILL ST
BROADWAY
MAIN ST
LOS ANGELES ST
SPRING ST
SAN PEDRO ST
ALAMEDA ST
LOS ANGELES RIVER
CONVENTION CENTER
WASHINGTON BLVD
SANTA MONICA FREEWAY
USC
COLISEUM
Figure WP-3
Final 1981 Downtown People Mover Alignment
DPM Alignment
Bunker Hill Area

Collectively, these things suggest that: (i) the patronage-related justification for a DPM concept may be as strong as ever; but that (ii) the justification for the original DPM route, with its predominantly north - south orientation, has been made obsolete with the current configuration of the Metro heavy rail transit and light rail transit systems downtown. Rather than unnecessarily duplicating service provided by the Red and Blue Lines, it may be possible to use the BHTT to complement the regional rail system, resulting in a carefully integrated DPM/HRT/LRT service for the growing and congested Los Angeles urban core.

PRELIMINARY INTERVIEWS

To initiate this study, a series of interviews was held with individuals who had participated in the development of the original Downtown People Mover System, and with officials affecting transportation systems in the Central Business District of Los Angeles. Their recommendations were followed in developing and guiding the study scope and issues related to the BHTT and its possible uses. Those recommendations may be loosely organized as relating to land use, transportation, and implementation of a BHTT-based service.

Land use-related recommendations included admonitions to: (1) Keep the long-range future (say, 50 years from now) of downtown in mind (that time frame will see a good deal of infill development and expansion that is not yet planned); and (2) Focus attention on currently unserved markets, such as Central City West, Little Tokyo, and potential peripheral parking facilities.

Specifically transportation-related recommendations included suggestions to: (1) Investigate in detail potential linkages of the BHTT to existing/planned transportation facilities such as Metro Rail, the Pasadena LRT, the Glendale Transitway, and DASH lines; and (2) Focus attention on east - west connections across downtown.

Finally, implementation-related recommendations included the following advice: (1) Begin political consensus-building early; (2) Pursue private-sector financing as an essential ingredient to the economic viability of a BHTT-based system; (3) Plan for phased implementation of the ultimately-desired system, considering, e.g., preliminary use of the tunnel for DASH buses or for a moving sidewalk; and (4) Conduct early right-of-way protection through tying developer agreements to dedication of transit easements.

DESCRIPTION OF THE TUNNEL AND OF POTENTIALLY APPLICABLE TECHNOLOGIES

DESCRIPTION OF THE EXISTING BUNKER HILL TRANSIT TUNNEL AND EASEMENTS

Tunnel Profile

Vertical and horizontal cross-sections of the BHTT and surrounding areas are shown in Figure 4. The "tunnel" actually consists of three types of facility:

(1) Sections of building basements set aside for use by a people mover system (1,346 feet). These are either built, under construction, or planned for construction in the future.

(2) Sections of already-constructed tunnel beneath streets (266 feet). This includes Hope Street, Grand Avenue, and Olive Street.

(3) Rights-of-way for an aerial system from the locations where the tunnel breaks grade (about 1300 feet). To the west, the right-of-way continues across the World Trade Center, whose deck (currently in use as a tennis court) has been structurally reinforced to support a people mover station. There is an easement across Figueroa and curving northward to the Harbor Freeway. To the east, the right-of-way continues to Hill Street and turns north along Hill Street to Third Street.

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

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

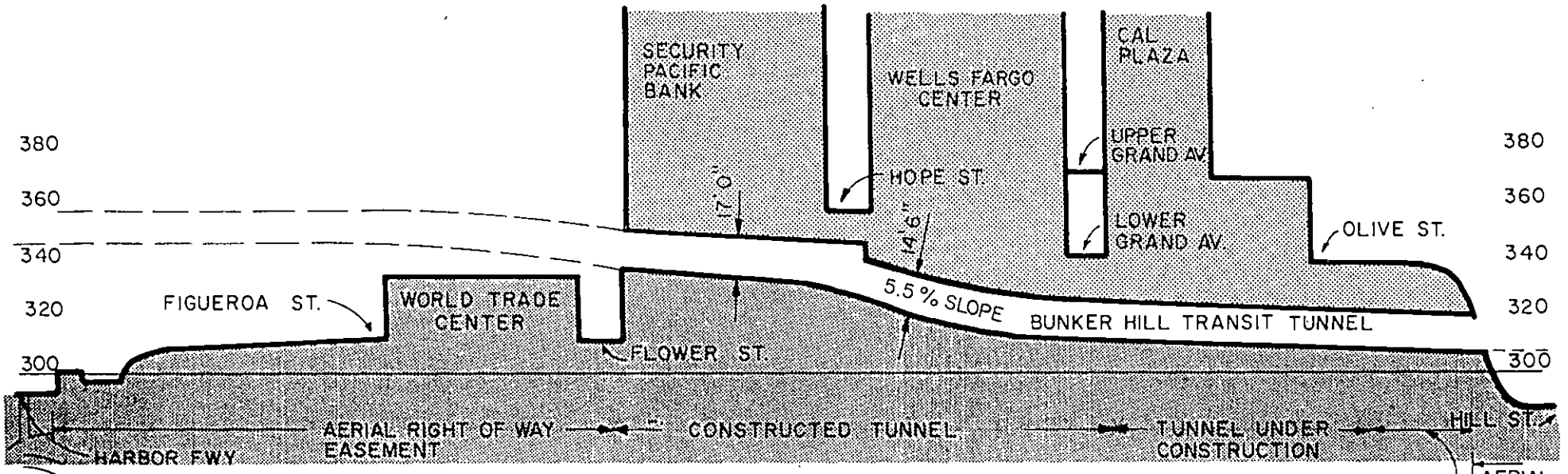
All of these restrictions are found in the tunnel segment below the Wells Fargo Center.

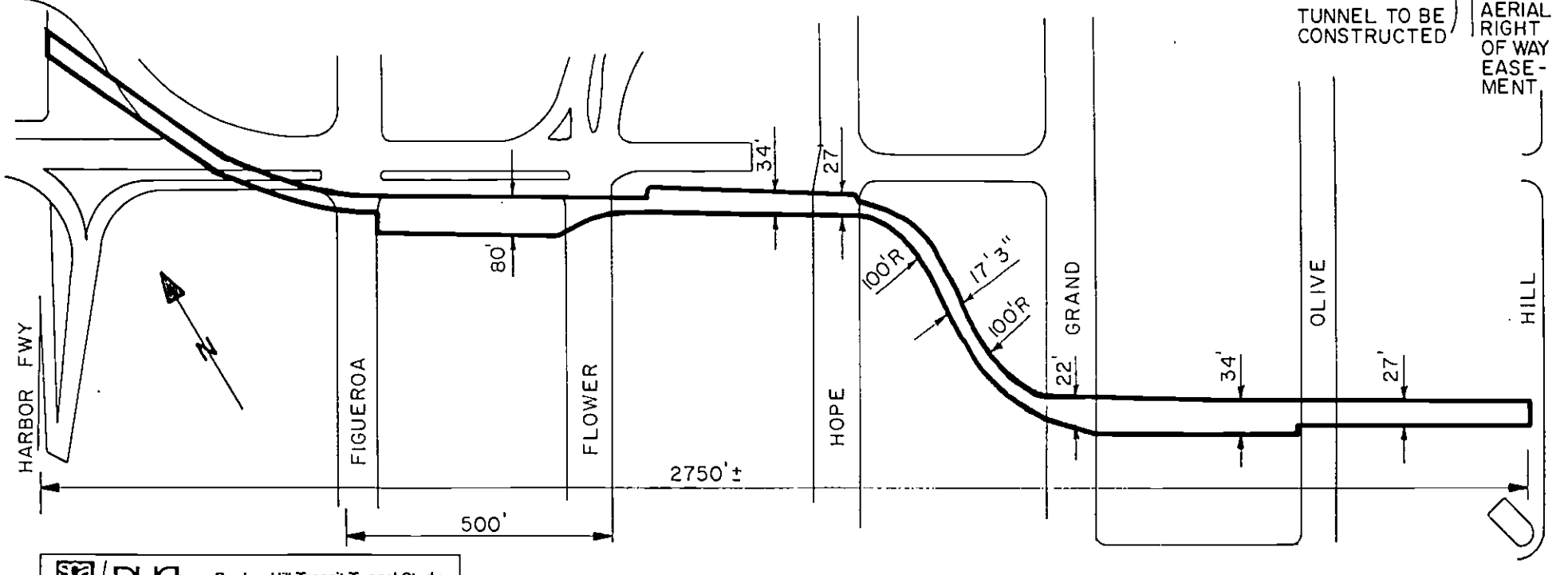
Engineering Constraints on Two-Way Service through the Tunnel

For most of its length, the existing sections of the BHTT are at least 32' wide. However, the usable portion of the tunnel narrows to 17'-3" under the Wells Fargo Building. This

Figure WP-4

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





SCRTD/DHA Bunker Hill Transit Tunnel Study

bottleneck imposes serious constraints on the ability to provide simultaneous two-way service within the tunnel envelope.

Potential options for dealing with this constraint include: (1) providing two-way service using technology that does fit within the existing width; (2) permitting two-way traffic, using larger vehicles, with switching safeguards to prevent collisions on the bottleneck portion of track; (3) widening the tunnel; (4) digging another tunnel underneath the existing one; and (5) using the tunnel as part of a one-way loop.

A BRIEF OVERVIEW OF POTENTIALLY APPLICABLE TECHNOLOGIES

If the BHTT is to be used for transportation purposes, a variety of technologies can be considered. At the low end (of cost, capacity, and speed), the simple moving sidewalk should not be overlooked. Beyond that, vehicular technologies can be broadly grouped into six categories, with wide variations within categories.

This section contains a short, non-technical overview of each of these seven types of technologies. The textual descriptions below are followed by a summary in Table 1. No single system is intrinsically superior; the best technology for the BHTT depends on a number of factors, including:

- o whether or not the right-of-way is extended beyond Bunker Hill;
- o the importance of being able to physically link to other systems (such as LRT);
- o the maturity and reliability of the technology;
- 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 the 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 automatic control or 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. 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 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 is generally about 20,000 per hour.

All 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 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.

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. 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 operation at this time (the M-bahn in Germany). 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.

The only maglev system in production has too wide a turning radius to accommodate the curves in the existing BHTT.

Cable-driven

Cable-driven systems can run on steel rails, rubber tires, or air cushion. 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 the cable drive are reliability and reduction of weight and complexity in the passenger cars. The 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 (i) by a diesel engine on normal streets with a human driver, or (ii) by an electric motor on a dedicated or shared guideway in automatic or manual modes. Two dual-mode systems are now in production. 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.

TABLE WP-1

KEY CHARACTERISTICS OF VARIOUS PEOPLE-MOVER TECHNOLOGIES

Technology	Typical Capacity[1] (Pax/hr)	Maximum Speed (mph)	Maximum Sys. Length (miles)	Construction Cost (millions per track mile)[2]	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	7-50,000	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

[1] 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.

[2] 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.

POTENTIAL USES FOR THE BHTT

The Bunker Hill Transit Tunnel may or may not be viable as a stand-alone facility, serving Bunker Hill only. However, this study is also intended to look more broadly at how the BHTT may function as a piece of a transportation system serving a larger area of downtown. In exploring transportation roles for the tunnel and possible extensions, it is useful to keep in mind the various potential markets for a downtown transportation system. Such a system could fulfill two important functions: circulation, and distribution.

Circulation refers to serving midday, non-commute trips within the downtown area. Distribution refers to delivering a commute trip to its final downtown destination. A distribution mechanism would be needed for auto trips being intercepted at a peripheral parking lot, and for regional trips whose final line-haul stop (e.g., at Union Station or at the Pershing Square Metro Station) were some distance away from the desired destination. With the current emphasis on job-housing balance, wherein housing opportunities are increasingly being provided near the CBD, a distribution system could also serve the entire commute trip from those nearby residential centers to the CBD workplace.

POTENTIAL STAND-ALONE USES OF THE BHTT

Several potential stand-alone uses for the BHTT may be identified. Each of those uses can be viewed not only as a permanently stand-alone option, but also as a potential interim use of the tunnel -- a stage on the way to full implementation for some of the expanded options discussed in later sections.

Non-Transportation Uses

Opportunities

Several potential non-transportation uses of the BHTT may be appropriate. One such use is simply to allow the building owners to obtain the tunnel segments and easements for private use. Portions of the tunnel are currently being used for recreation, storage, and parking. The value of this tunnel and easements in terms of square feet of space on Bunker Hill is estimated at $25 million.

Another suggestion is to use the space for emergency storage (food, medical supplies) and/or communication. Alternatively, either independently of or in conjunction with transportation uses of the tunnel, the BHTT could be developed as an activity center in its own right: as a retail mall, for example -- a kind of mini-"Underground Atlanta".

Issues/Constraints

Any option other than permitting the continued use of existing tunnel segments by the affected building owners would require a financial analysis. Use of the tunnel as a retail mall raises the questions of whether development would be in private hands or (as in the case of the Los Angeles Mall next to City Hall) public, and whether the projected cash flow would justify the investment.

Another important issue is that the UMTA agreement associated with defunding the old DPM system stipulated that the tunnel be placed into "mass transit operation". Use of the tunnel for non-transportation purposes could necessitate the return of $3 million to UMTA. There may also be legal issues involved if the original easements negotiated for the DPM were specifically tied to transportation uses.

Perhaps the overriding issue to be considered for non-transportation uses of the tunnel is the opportunity cost of not using it for transportation purposes. The tunnel represents a nearly ready-made channel through one of the most densely developed parts of downtown. Providing a completely new transportation facility or service with equivalent capacity would be extremely costly.

Exclusive Guideway for DASH

Opportunities

The BHTT could serve as an exclusive guideway for a re-routed and/or enhanced DASH shuttle bus system. While a DASH route using the BHTT would serve a larger area than Bunker Hill only, this option is classified as stand-alone in the sense that the exclusive guideway portion of the route would not be expanded beyond the existing BHTT right of way, except for on- and off-ramp access to the existing street system.

This option would provide downtown circulation through Bunker Hill on a guideway that would avoid surface congestion. For electrically-propelled buses, the tunnel would provide adequate length for recharging batteries outside of mixed-flow traffic.

Issues/Constraints

Use of a conventional diesel bus would necessitate a ventilation system for the full length of the tunnel. Thus, electric buses should be considered in exploring this option. Also, the section of tunnel through the Wells Fargo Building is only wide enough for one-way traffic using this system. This suggests that a DASH route using the tunnel take the form of a one-way loop, with the remainder of the route traversing existing surface streets in mixed traffic.

This alternative would require construction of ramps connecting each end of the tunnel (above-grade at the west end) to the at-grade street system.

Internal Circulator

Opportunities

Table 2 summarizes existing development and planned improvements in the Bunker Hill area. Bunker Hill is already among the most densely developed sectors of the Los Angeles Central Business District, second only to the Financial Core area to the south. New development is projected to increase office space by 79%, adding nearly 7 million square feet to an existing 9 million. Retail/restaurant/service space will nearly double, to 1.1

million square feet. Hotel rooms will increase by 69%, and dwelling units by 45%. Existing development represents approximately 32,000 employees and some 6,000 residents. It is anticipated that, upon buildout, the Bunker Hill area will contain around 59,000 employees and 9,000 residents.

The steep gradients of the Bunker Hill area make some kind of internal circulation system desirable, while at the same time precluding the use of conventional buses in some areas. In particular, there is no through east-west transit service for Bunker Hill; stand-alone development of the BHTT could provide exactly that, at least in a local sense.

Of the 27 million existing and planned square feet of development in the Bunker Hill area, about 12 million square feet are contiguous to the BHTT. This represents an estimated total potential weekday market of at least 32,000 patrons. It is also relatively inexpensive to provide pedestrian linkages from the BHTT to the Metro Red Line on the eastern end, and to the proposed Pasadena Blue Line extension on the western end. This would increase the connectivity of the rail system downtown, and partially serve east-west demand patterns.

TABLE WP-2

TOTAL EXISTING AND PLANNED DEVELOPMENT IN BUNKER HILL

Land Use	Existing	Planned	Total	% Increase
Office square feet	8,672,000	6,812,755	15,484,755	78.6
Retail square feet	586,000	503,800	1,089,800	86.0
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

Issues/Constraints

One issue concerning a stand-alone Bunker Hill shuttle is that of user acceptance: will a user want to take a basement-level shuttle -- as opposed to using the existing (or future enhanced) aerial or ground-level walkway system? What is the difference in travel time among these alternatives?

Another issue is the ease with which a stand-alone system can later be extended to serve a larger area. Finally, there are certain engineering issues associated with this option.

POTENTIAL WESTERN LINKAGES

Opportunities

Potential Demand

Linking the BHTT to Central City West (CCW) could benefit several groups of people. As a **circulator**, the tunnel could provide CCW employees (about 26,500 today; potentially 79,000 under the proposed Specific Plan) easy access to CBD activity centers for mid-day work and non-work travel. Similar access would be provided for CBD employees to CCW. As a **distributor**, the BHTT could serve CBD-destined commuters parking at a peripheral lot at Crown Hill, transit users of the proposed Glendale/Bixel/Harbor transitway, and CCW residents (about 13,000 today; potentially 31,000 under the proposed Plan).

Pacific Electric Tunnel

The P.E. Tunnel can relate to the BHTT in two different ways. On one hand, reactivating the P.E. Tunnel, especially if it is reconnected around the blockage between Figueroa and Hope Streets, could provide service between the Central City West area and the CBD roughly comparable to that of the BHTT. This would suggest an either-or analysis of the two tunnels. On the other hand, there may be some synergies to be derived from connecting the two tunnels in some way.

Issues/Constraints

Any major extensions of the BHTT immediately raise questions about engineering and financial feasibility. One issue specific to western extensions is that the densest commercial development in CCW will take place in the southern end, while both a simple linear extension of the BHTT and the P.E. Tunnel would be most accessible to the residential northern end. Integrating service through the Bixel transit mall with the BHTT would need careful attention.

POTENTIAL EASTERN LINKAGES

Opportunities

Several important activity centers on the east side of downtown will not be directly served by the Metro Red Line, including the new, 825,000 square-foot State Office Building at Third and Spring; and Little Tokyo. An eastern extension of the BHTT, especially given the connections to the Red and Blue Lines discussed above, could serve this area in lieu of the Second Street alternative alignment of the Pasadena LRT.

Once the BHTT reaches Little Tokyo, it is perhaps natural to consider extending it further north to Union Station. That would provide for direct transfer capabilities to/from commuter trains, the El Monte busway, the Metro Red Line, the Santa Ana extension of the Metro Red Line, and peripheral parking.

Issues/Constraints

One concern with an extension to Union Station is that, between that point and Fifth and Hill, the Bunker Hill line will provide service partly competing with the Metro Red Line. For this reason, a Union Station connection should perhaps be considered a longer-term option, to be explored when it appears that demand would support two rail choices within the northeast sector of downtown. On the other hand, the possibility of using an area around Union Station for a storage and maintenance yard may make it a logical segment to include early on.

POTENTIAL ADDITIONAL LINKAGES

Opportunities

An extended BHTT could serve as the backbone for a larger loop system connecting a number of activity centers surrounding and within downtown. Such a system could provide new and/or improved service to major areas of existing and future development, including: South Park and the Convention Center, the Alameda Corridor and City North, and the Greyhound Bus Terminal and the garment/produce districts.

Issues/Constraints

Again, financial, engineering, environmental, and political feasibility are major questions. Such a system would be costly, but its costs -- and its benefits -- would be shared over a larger base of development.

PROMISING ALTERNATIVES FOR FURTHER STUDY

GUIDING FACTORS CONSIDERED THROUGHOUT THIS STUDY

In developing potential transportation uses of the BHTT, six general, partially overlapping, goals were considered. These same goals will be important throughout this study:

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

SPECIFIC PROMISING ALTERNATIVES FOR FURTHER STUDY

Non-transportation alternatives should not be ruled out at this early stage, although further work would be needed to identify a comprehensive range of options, as well as evaluation criteria. In view of the UMTA restriction on uses of the BHTT, 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 cost-effective. The most promising alternatives at this point are the transportation-related ones.

Several kinds of transportation alternatives appear to warrant further study. Each of them is discussed further below. All except the comprehensive alternative are illustrated together in Figure 5.

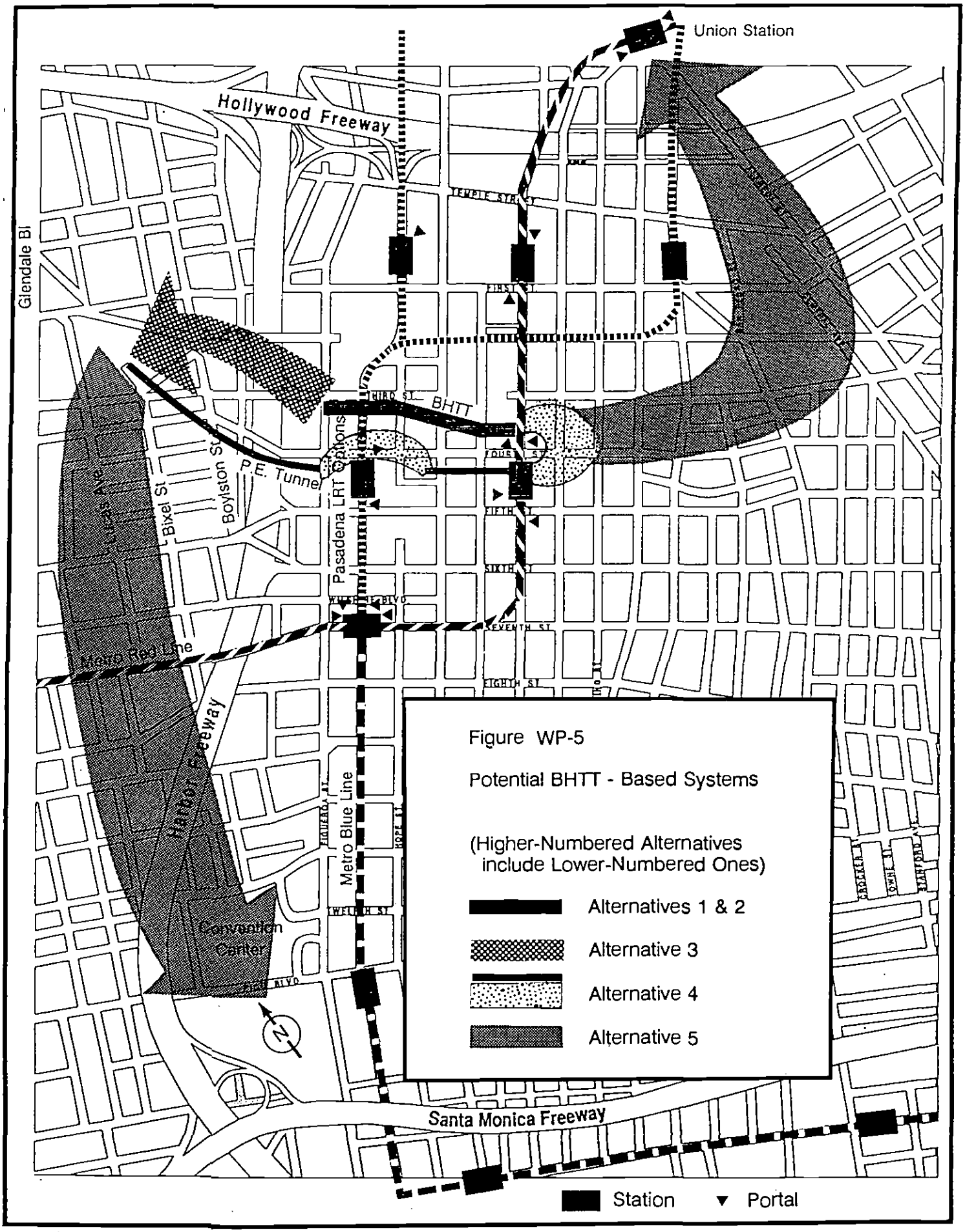
1. Internal Circulator

The existing Bunker Hill Transit Tunnel could be used as a two-way shuttle system to serve the Bunker Hill area, to transport people between buildings, and to serve as a link from the northwest entrance of the Metro Red Line Fifth and Hill Station into Bunker Hill. A connection could also be made via escalator and moving sidewalk to the proposed Pasadena Light Rail station at Fourth and Flower. This alignment would require the construction of a bridge across Flower Street to serve the World Trade Center, and construction of stations or drop offs within the various buildings served.

Technologies suitable to this short-run system might include moving sidewalks or some of the smaller cable driven systems such as the SOULE System. Maintenance areas for these technologies could be provided in areas of the existing tunnel which are wider than the minimum 17'3" section below the Wells Fargo building.

Pedestrian Linkages to Metro Red and Blue Lines

The Pershing Square (Fifth and Hill) Station of the Metro Red Line will run the length of the block between Fourth and Fifth Streets. The northwest portal of the station is nearly a block away from the planned California Plaza Station of the BHTT, and 60 - 70 feet


Union Station
Hollywood Freeway
Glendale Bl
BHTT
P.E. Tunnel Options
Pasadena LRT
Bixel St
Boylston St
Broadway
Metro Red Line
Harbor Freeway
Metro Blue Line
Convention Center
Santa Monica Freeway
Alameda St
TEMPLE STREET
FIRST ST
THIRD ST
FOURTH ST
FIFTH ST
SIXTH ST
SEVENTH ST
EIGHTH ST
WILSHIRE BLVD
FIGUEROA ST
HOPE ST
OLYMPIC BLVD
Figure WP-5
Potential BHTT - Based Systems
(Higher-Numbered Alternatives include Lower-Numbered Ones)
Alternatives 1 & 2
Alternative 3
Alternative 4
Alternative 5
Station
Portal

lower. The proposed Cal Plaza Phase III building is planned to have a set of retail terraces joined by escalators that will link the Metro Station to the Cal Plaza development. This escalator system can serve to connect the BHTT to Metro Rail.

As for the Blue Line extension, the proposed station at Fourth and Flower would have an entrance just north of Fourth Street, less than a block from the Security Pacific / World Trade Center sections of the BHTT at Third and Flower. The Bunker Hill "tunnel" is actually some 30 feet above ground level at the intersection of Third and Flower, while the LRT tunnel will be about 20 feet underground. Nevertheless, it is entirely feasible to connect the BHTT to the north entrance (at ground level) of the LRT station, by a moving walkway and escalators. The moving walkway could proceed south on Flower alongside the Security Pacific Building at third-story level, then join an escalator down to the station entrance.

2. Guideway for Electrified DASH

This alignment could also be used for a dedicated DASH bus route with a linear induction charging system for electric buses within the tunnel section. This would require construction of on- and off-ramps to link the tunnel to the existing street system. Buses would enter the tunnel via a ramp from Hill Street, would have stops at the California Plaza and Security Pacific Buildings and would descend to the present grassy median in Third Street via a ramp from the west side of the Security Pacific Building bridging over Flower Street. The DASH bus would then join the surface street traffic on Figueroa Street. Some modifications to the street traffic system at Figueroa such as a dedicated bus lane and separate traffic lights may be required.

3. Extended Shuttle

The internal circulator discussed above could be extended into Central City West. This would create east-west connectivity to this fast emerging development area, and could also help to alleviate traffic congestion in the Bunker Hill area by allowing easy access to Bunker Hill for people parking in peripheral lots to the west of the Harbor Freeway.

A cable shuttle system would be ideally suited to this type of application. Moving sidewalks would provide plenty of capacity but would be less suitable because of their slow speed. Maintenance areas could be provided within the wider tunnel sections or at the west end of the system in Central City West.

This option would require the construction of a bridge across Flower Street to the proposed World Trade Center station, and an aerial guideway from there across Figueroa Street and the Harbor Freeway and into Central City West. An additional station would be constructed in CCW, and possibly a maintenance and storage yard.

4. BHTT/P.E. Tunnel Loop

This one- or two-way loop system uses all of the currently existing but unused sections of tunnel formerly used or intended for use as transportation rights of way and connects them together with the minimum of additional construction.

The narrow section of tunnel under the Wells Fargo Building restricts the existing tunnel to a one-way system for most technologies. However, the total length of the system is within the maximum length range of one or two of the small cable shuttle systems which could be run as a two-way system in this narrow section.

Light rail and other automated guideway transit (AGT) systems could be run as a two-way loop. There would be a short one-way section within the Wells Fargo Building, with a sophisticated automatic control to allow passage of vehicles from opposite directions in this area. Alternately, a two-way loop system could be achieved by constructing space for a second track alongside or below the existing one in the Wells Fargo bank area.

On the other hand, the argument for a two-way system is less compelling for this particular alignment than it would be for larger loops, since the two tunnels are only about a block apart for most of their length.

A maintenance area for this system could be created in Central City West close to Beaudry and First Street, or if a compatible light rail technology were chosen, a connection could be made to the Pasadena Light Rail system so that its maintenance facilities could be utilized.

Construction for this option will be more extensive than for the preceding three suggestions. In addition to the aerial guideway described in the above alternative (which would join the BHTT to the P.E. Tunnel at Crown Hill to the west), major guideway construction associated with this alignment includes (i) a diversion tunnel to link the two pieces of the P.E. Tunnel, and (ii) an eastern loop to join the BHTT to the P.E. Tunnel.

The total length of existing tunnel is a little more than one mile. New guideway totals a little over one mile also, approximately 65% of which is tunnel, the remainder being elevated. Connections would be made to the Blue Line at Fourth and Flower and to the Red Line at Fourth and Hill Street, where a knock out panel exists for a new portal.

5. Loop with Extensions

A two-way shuttle system could be created from Union Station through Little Tokyo, Bunker Hill, Central City West and down to the Convention Center, using BHTT as the starter section. To accomplish this effectively, the BHTT would need to be widened to accommodate two-way traffic or the Pacific Electric Tunnel would have to be linked in to create the second track as described in the previous alternative. The sections of new guideway would be above grade.

This alternative is too long for cable driven systems but is suited for light top riding monorail, rubber tired or light rail technologies. A maintenance area for the system could be created at Union Station or in an area close to Venice or Washington to the west of the Harbor Freeway and north of the Santa Monica Freeway.

Construction for this option would again be extensive. The major guideway construction elements (in addition to widening the BHTT or joining it with the P.E. Tunnel as described

above) would be (i) an aerial guideway linking the eastern end of the BHTT to Union Station through Little Tokyo, and (ii) an aerial guideway proceeding south from Crown Hill, through CCW and over to the Convention Center.

The total length of existing tunnel used would be 1/3 mile if the BHTT alone were used or one mile if both the BHTT and the Pacific Electric Tunnel were used. The total length of the system would be about 4 miles (4-3/4 if the P. E. Tunnel is used). Connections would be made to the Red Line at Union Station and at Fourth and Hill, and to the Blue Line at Fourth and Flower and at Pico and Flower.

6. Phased Comprehensive Automated Downtown Circulator Systems

The systems described above are capable of being expanded to create a Comprehensive Downtown Circulator System. Naturally, technologies such as moving sidewalks and cable-driven vehicles are precluded in a comprehensive system. There are any number of potential alignments for such a comprehensive downtown circulator system, but most logical alternatives have a number of factors in common.

1. They have a starter section usually utilizing the BHTT (and possibly also the Pacific Electric Tunnel) as a minimum operable segment, which can be connected to an area where it is possible to create a maintenance and storage yard.

2. They provide east - west connectivity in the Bunker Hill area and in the South Park area. This is also possible in the Civic Center area as well.

3. They connect to the existing and proposed infrastructure of transportation systems, including the Red Line, the Blue Line, Union Station, the Greyhound Station, the Harbor/Glendale HOV lanes, and so on.

4. They provide service to areas of need that are served neither by existing nor by proposed transportation systems.

5. They are phased in three or four steps which are each capable of being engineered and constructed in a 3-5 year time frame.

6. The total length of each system is between 13 and 16 miles.

7. They are capable of using a variety of technologies from light top riding monorail though rubber tired to light rail. If it is decided to proceed with a comprehensive system, a full study will be required to decide the technology to use, the alignment, and the phasing.

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.

1. Constraints within the BHTT itself preclude further consideration of at least two classes of technology: heavy rail transit like the Metro Red Line, and maglev. The larger monorail systems are also excluded.

2. 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.

3. The third and fourth alternatives proposed (the BHTT extended west, and a BHTT/P.E. Tunnel loop) can be classified under high-capacity, multiple-stop, short-run (up to four miles) systems. These alignments are suitable for the larger rail girded 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.

4. The fifth and sixth alternatives (loop with extensions, and comprehensive 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 6-10,000 people per hour. The larger systems operate at speeds of 30-50 mph and have capacities of up to 20,000 people per hour.

5. 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.

DECISION POINTS AND WINDOWS OF OPPORTUNITY

It is clear that the set of reasonable options for use of the BHTT is affected by developments in other studies that are also underway. In particular, the following factors significantly impact BHTT options:

- which alignment of the Pasadena LRT is selected;
- how the Central City West plan shapes up; and

- what happens to the most recent proposals for use of the Pacific Electric Tunnel.

To a longer term, but not necessarily lesser, extent, future plans for areas such as City North, the Alameda Corridor, and the Figueroa Corridor could impact choices for the BHTT. At the same time, the impact should not all be in one direction. That is, the availability of the BHTT may generate opportunities that are superior from a system-wide standpoint to those proposed without consideration of the tunnel. Thus, discussions on the role of the BHTT need to be integrated with these and other relevant activities concerning downtown Los Angeles.

Also, the timing of key decisions can affect the costs associated with various BHTT options. For example, significant economies could be achieved by coordinating BHTT-related construction with construction on nearby projects. While it may be too late to modify activities related to the construction of the Metro Red Line tunnels at Fifth and Hill and the California Plaza Phase II building, coordination should be possible for the interface of the west end of the existing BHTT with the proposed Pasadena LRT line. Another example of the importance of timing is the opportunity afforded by the approval process for new developments to secure early preservation of rights of way and easements for an extended BHTT system.

SUMMARY AND NEXT STEPS

This white paper has identified some promising uses for the Bunker Hill Transit Tunnel, in the context of ongoing land-use and transportation activities in downtown Los Angeles. While it is too early to judge the ultimate feasibility of any of the options, it is easy some attractive possibilities for improving downtown circulation, providing better service to major activity areas, and linking together key elements of the downtown transportation infrastructure.

The remainder of this study will explore these options further. In particular, the various conceptual alternatives presented here will be compared in terms of projected patronage, engineering feasibility, cost-effectiveness, financing plans, and environmental concerns. Institutional and phased implementation questions will also be addressed by this study. The outcome will be a set of recommendations to the City of Los Angeles regarding the use of the Bunker Hill Transit Tunnel.