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# 1.0 INTRODUCTION

[Note: this chapter is a summary of a previous Milestone report submitted earlier. More details on the information contained in this chapter are included in Milestone Report 1: Project Management Plan, April 2001]

## INTRODUCTION

Transportation planners throughout the Southern California region have long been concerned about mobility and ground access impacts to regional airports given the area's enormous growth in population and jobs. For example, in 1980 Southern California had a population of slightly less than 13 million; it is now anticipated that by the year 2020 the regional population will exceed 22 million. In addition, between now and 2020, the number of people using Los Angeles International Airport (LAX) will grow from 65 million a year to 86 million. That magnitude of growth will affect every Southern California resident and visitor as they attempt to move around the region on the ground or move into and out of the area by air.

To help deal with mobility issues associated with that type of growth, the Southern California Association of Governments (SCAG) has adopted a Regional Transportation Plan that includes a strategy for managing airport demand through maximizing the use of all existing airports and airfields in the region. The successful implementation of that strategy requires the development and deployment of one or more high-speed transportation systems connecting regional airports to substantially reduce airport ground access by single-occupant vehicles (SOVs).

In 1999, SCAG secured funding from the Federal Railroad Administration (FRA) and the Federal Aviation Administration (FAA) to begin planning high-speed ground access projects in three of the region's most heavily congested corridors to link many of the area's major airports. Those three corridors are:

- LAX to March AFB;
- LAX to Palmdale; and
- LAX to Orange County.

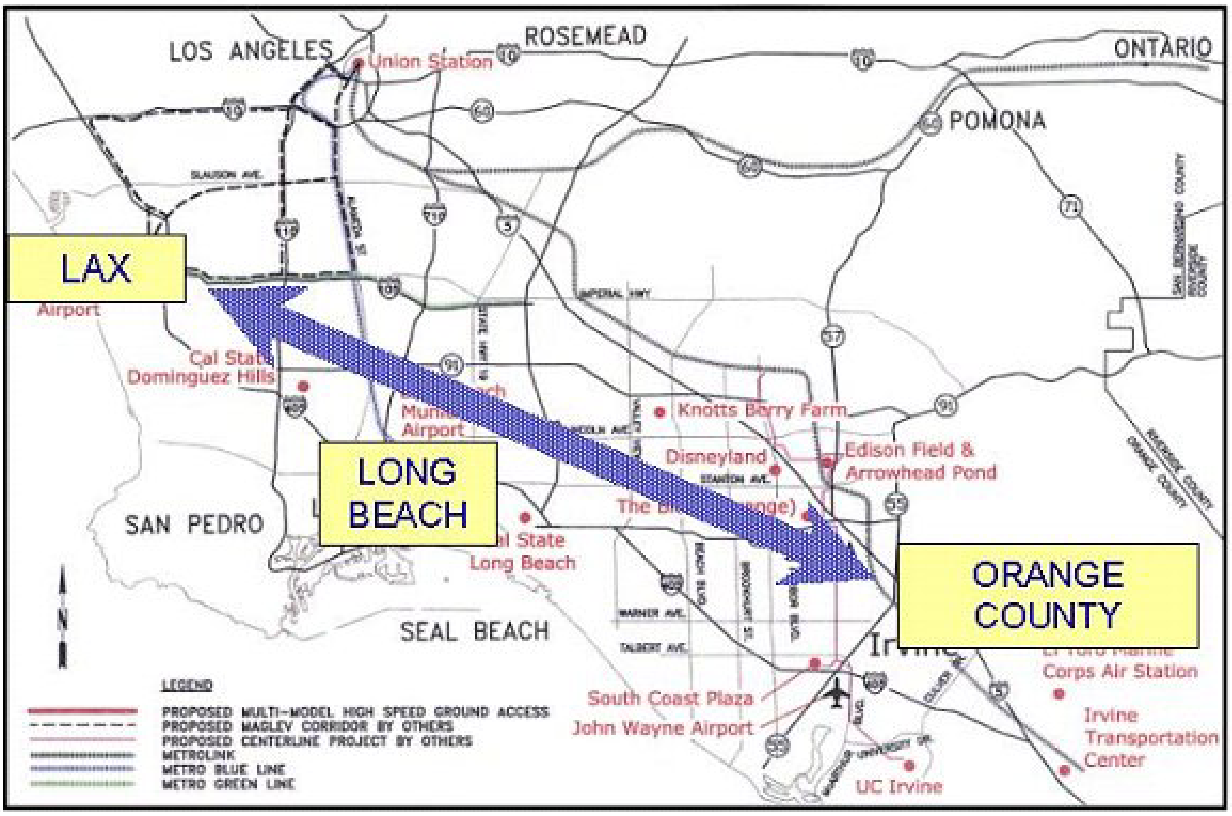
This study represents the third in that series.

## PURPOSE OF THIS STUDY

A regional multi-modal high-speed ground access (HSGA) system has been identified as a principal means of connecting major regional activity and transportation centers and supporting passenger and cargo demands associated with anticipated growth in Los Angeles, Orange, Riverside, and San Bernardino Counties. The development of regional multi-modal HSGA system alignment alternatives for this study will focus on the LAX/South (Orange County) Corridor, with a potential terminal station at John Wayne Airport (JWA), Long Beach Airport (LBA), the Irvine Ground Transportation Center (ITC), as well as other possible intermediary stations. This project is a key component of the 1998 Regional Transportation Plan (RTP) strategy of managing airport demand through maximized use of existing airports via high-speed transportation system connections.   This project's study area is shown in **Figure 1-1.**

The growth in air passenger and air cargo demand requires a multifaceted approach of expanding existing commercial airports and converting available military bases. The potential for adverse impacts associated with airport expansion has required development of regional strategies to manage demand and promote use of outlying airports while reducing regional trip making and community impacts. The use of high-speed links to connect airports throughout the region is a key element of this regional strategy.

*Figure 1-1: Study Area*




The analysis of the LAX/South (Orange County) Corridor follows two similar HSGA studies (LAX/March Inland Port and LAX/Palmdale) that, when viewed collectively, have the potential to redefine and implement a new vision for the SCAG region. This vision stems from the SCAG's Regional Council's adopted strategy to manage airport demand through maximized use of all existing airports and implementation of high-speed transportation connections. This study was designed to determine the feasibility of potential technologies and corridor connections, with feasibility determined in part by how effectively and efficiently the project could identify and resolve a variety of issues related to ground and air transportation, environmental impacts, growth and development patterns, local and regional mobility, and economic impacts.

The purpose of this study was to analyze high-speed access and interconnectivity between Los Angeles International Airport (LAX), Long Beach Airport, John

Wayne Airport, the Irvine Ground Transportation Center (ITC). The study was aimed at addressing the following issues:

- Mode alternatives;
- Alternative alignments;
- Station location, right-of-way (ROW) and urban design;
- Technology options;
- Shorter-range multi-modal options;
- Airport access/interconnection impacts;
- Investment quality ridership demand analysis;
- Conceptual engineering and design;
- Environmental analysis;
- Capital and operating cost estimates;
- Revenue generation (from ridership, joint development, and other sources); and
- Agency and public review/coordination.

The system concept and criteria on which the specific technology and alignment options were based were developed with close coordination and consideration of findings of the two other SCAG high speed ground access studies. This study also required coordination with the LAX Master Plan, airport planning in Orange County, the California High-Speed Rail Program, AMTRAK, and local and regional transit agencies.

This study was intended to accomplish a number of major goals, all of which are described in "milestone" format in this and earlier reports. Key elements and principles of the project's approach included:

- Development of a Project Management Plan (PMP) and definition of the general system concept and criteria consistent with other similar SCAG studies.

- Development of feasible routing options based upon the project team's knowledge of corridor conditions and what will work.
- Consideration of all multi-modal possibilities and applicability of all relevant technologies, including creating interface opportunities with existing transit modes to provide the maximum level of airport and commuter access.
- Use of an efficient and effective screening process early in the study to narrow potential alignment options to a reasonable set of alternatives for further evaluation and study.
- An assessment of design and right-of-way needs. The assessment included examining station needs, airport interface requirements, capital and operating costs and environmental issues.
- Examination of potential incremental improvements that enhance airport ground access and support the longer-range deployment of the selected system.
- Facilitation of agency review and coordination through use of the SCAG Maglev Task Force. Key stakeholder input from local jurisdictions and other organizations also was incorporated in the process.

# 2.0 SYSTEM CONCEPTS AND GOALS

[Note: this chapter is a summary of a previous Milestone report submitted earlier. More details on the information contained in this chapter are included in Milestone Report 2: System Concepts and Goals, June 2001]

## SYSTEM GUIDING PRINCIPLES, GOALS, AND OBJECTIVES

Guiding principles provide the overall framework of the project, providing a "big-picture" context for all decisions related to alignment, station, and technology choices. These are issues that have been expressed as important by stakeholders in the study corridor and by SCAG as an organization; they comprise the foundation for every decision made during the course of the project.

### Guiding Principle 1: Anticipate Future Needs

The issues that resulted in this project getting under way are mainly related to mobility. Transportation planners throughout the Southern California region have long been concerned about mobility and ground access impacts to regional airports given the areas enormous growth in population and jobs. For example, in 1980 Southern California had a population of slightly less than 13 million; it is now anticipated that by the year 2020 the regional population will exceed 22 million. That magnitude of growth will affect every Southern California resident and visitor as they attempt to move around the region on the ground or move into and out of the area by air. This project must be planned and designed with future capacity requirements in mind. Major transportation investments of this type generally take many years to implement; in the meantime, the problems that inspired the project in the first place continue to get worse. Therefore, to ensure that this project is not obsolete before it is built, its design guidelines must anticipate the population and mobility patterns and needs of the region at least 20 years from now, with the added requirement for flexibility for expansion beyond the 20-year horizon.

## Guiding Principle 2: Promote Positive Land Use and Environmental Impacts

The linkage between transportation and land use is often a double-edged sword. On the one hand, a transportation project should be located in areas that have the highest potential for ridership through appropriate adjacent land use. On the other hand, any major transportation investment – highway or rail – has the potential to drastically revise land use patterns along its right-of-way and particularly near its passenger areas or stations. To encourage orderly growth along the alignment that both benefits the community and promotes system ridership, this project will attempt to encourage local communities to work toward adopting policies and procedures that promote sound land use decisions.

## Guiding Principle 3: Minimize Public Investment and Maximize Private Investment

Few if any public transportation systems are operated on a pay-as-you-go basis; virtually every system requires some sort of public subsidy to cover ongoing operational costs. However, the emphasis on the high-speed ground access projects being developed in the SCAG region has been on the idea of designing, building, and operating a system that pays for itself and requires no ongoing public subsidies. This project will develop capital and operating cost estimates for one or more preferred alternatives without regard to funding sources. The larger challenge will be to develop a financial pro forma that anticipates all potential realistic sources of revenue and to develop innovative financing alternatives that minimize public investment and maximize private investment in the system to absorb any forecast shortfall in revenues.

## Guiding Principle 4: Focus on Implementation

The corridor's mobility problems and issues between now and 2020 are so acute that the region must find ways to improve ground and air capacity that do not involve continually increasing highway capacity. This project will always be aimed at developing alignments, station locations, and technology choices that are practical, reliable, and implementable in light of those mobility issues.

## System Goals

With these basic guiding principles in mind, the project team developed three major goals (and related objectives) to help guide project decision-making. This project is aimed at helping improve a variety of mobility issues in the Southern California region. Therefore, the project's goals must focus on a variety of solutions.

### Goal 1: Improve Regional Mobility and Connectivity

***Objective 1:*** *Provide a transportation alternative to residents in the study corridor other than the existing highway system.*

***Objective 2:*** *Improve access to major activity centers in the study corridor.*

***Objective 3:*** *Improve the safety of the existing transportation systems in the corridor.*

***Objective 4:*** *Limit the need to continue to expand freeways in the study corridor.*

***Objective 5:*** *Improve linkages and access to other transit modes in the corridor.*

***Objective 6:*** *Improve ground access, congestion mitigation, and air quality around airports in the study corridor by limiting the need for private auto access to those airports.*

***Objective 7:*** *Improve the efficiency of the movement of goods in the corridor.*

### Goal 2: Improve the Efficiency of the Corridor's Airports

***Objective 1:*** *Provide for convenient linkages for passengers between and among major airports in the study corridor.*

***Objective 2:*** *Provide the opportunity for more efficient use of the corridor's airport system.*

***Objective 3:*** *Improve the efficiency of the movement of goods between and among airports in the study corridor.*

***Objective 4:*** *Provide the opportunity for the airport system in the corridor to continue to meet future demand.*

### Goal 3: Improve the Corridor's Quality of Life

***Objective 1:*** *Improve linkages between residences and employment centers.*

***Objective 2:*** *Promote continued economic growth for the corridor.*

***Objective 3:*** *Promote focused development along major transportation corridors, particularly near major transportation nodes.*

***Objective 4:*** *Improve regional air quality.*

## SYSTEM ROLES

As the other two SCAG high-speed ground studies have evolved, a consensus has emerged among the projects as to the key roles the projects can play in improving mobility and access in the region.

### Role 1: Airport Connector and Feeder

Under this role, the system would serve two functions: it would first act as a quick, limited-access shuttle connection linking LAX to Long Beach Airport and John Wayne Airport; and it would help relieve ground access congestion at LAX by providing a quick and convenient connection to LAX, LBA, and JWA from population and employment centers throughout the study area.

The intent of the airport connector function is to relieve ground and air congestion at LAX by using a "networked airport" whereby passengers and baggage would, for example, arrive on an international flight at LAX, board the system to LBA or JWA, and board a connecting regional flight there. The intent is to provide a seamless connection between airports using the high-speed ground access system that would be comparable to gate-to-gate transfers in terms of time for the passenger.

While few if any cities in the world operate in this manner, the advent of high-speed ground access technologies has made the idea of direct airport-to-airport connections more attractive and is one of the major themes of this study. If this concept is to succeed, several issues will need to be addressed, including:

- airport competition and routing;
- flight routing/scheduling;
- air passenger airport processing;
- fares;
- passenger information;
- transfers at intervening stations;
- security;
- baggage handling; and
- airport station access (particularly related to placement of stations).

The second function under this role – airport feeder – has the system helping relieve ground access congestion at LAX by providing a quick and convenient connection to LAX, LBA, and JWA from population and employment centers throughout the study area. Similar to the current Flyaway service offered at Van Nuys, passengers could check in at a station, then ride to their selected airport. However, several issues are involved with this function, including:

- system reliability;
- station amenities;
- security; and
- baggage handling.

## Role 2: Multi-Modal Connector

This role is aimed at reducing non-airport related congestion within the study area by providing high-speed ground access between and among corridor population, employment, and activity centers. This means that the system must be designed to encourage the maximum non-airport ridership possible to reduce the increase in auto traffic and its related congestion and air pollution in the corridor.

Commuters would access the system using their own cars (traveling to park-and-ride lots), bus or rail transit service, or other modes (such as taxis or shuttles) for a non-congested ride to their destinations. Although primarily aimed at providing congestion relief, this role provides an alternative mode of travel for many trips within and between Los Angeles County and Orange County. There are several issues associated with this role that are aimed at promoting maximum non-airport ridership, including:

- speed and travel time;
- station spacing and location;
- station amenities;
- intermodal linkages;
- vehicle design and capacity;
- reliability;
- frequency; and
- fares.

## Role 3: Activity Center Connector

This is a longer-term role, which begins to recognize the relationship between access to transportation systems and the land uses along the transportation corridors. Intra-regional connections are more viable with a high-speed ground access system, since by providing a high-speed connection, places that many consider to be “outside” the traditional commuter area begin to be seen as seamlessly connected to the rest of the urbanized area (especially if this project is considered in relationship to other SCAG high-speed ground access projects and the system being developed by the California High-Speed Rail Authority). In addition, rapid access to and from major activity centers within more localized areas becomes available. In both cases, the development of a major transportation system provides the opportunity for jurisdictions along the system's right-of-way to begin rethinking their previous land use patterns and decisions.

If the system is successfully able to fulfill this intra-regional activity center connector role, the effects on the region could be significant, particularly in the area of land use. Several factors can contribute to the system's viability in fulfilling that role, including:

- travel time;
- reliability;
- spontaneity;
- fare structure; and
- capacity.

If the system can indeed meet these demands and serve as a true inter-regional activity center connector, the region has the opportunity to begin focusing development toward passenger stations to allow employees and employers to begin taking advantage of the huge potential for inter-regional commutes without further contributing to sprawl.

This project will need to be cognizant of the wide range of transportation improvements planned for the study area. Each of these improvements will be analyzed further during the alignment development and evaluation process to determine their potential impacts on and interfaces with those alignments.

### Role 4: Freight Carrier

The system can be designed to have the capacity and ability to incorporate cars or compartments designed to carry freight between and among major activity centers in the corridor. Ideally, such freight would be carried in freight containers for easy handling and boarding, and that such containers could be loaded concurrent with passenger boarding. The inclusion of freight service as a role for this project should be examined for two reasons:

1. Freight service is a potential source of revenue for the project; and
2. Including freight service as a service of the high-speed ground access project helps reduce roadway freight traffic, thereby potentially improving congestion and air quality.

This study will include an assessment of the potential market for airfreight service. The project's research may show that, unless there is clearly a strong market, adding such a major additional service to the system may be inadvisable. In the short term, however, if baggage is handled on the passenger system, limited high-value packages may be included and sent to or from the passenger stations with processing at the airline ticket counters at those locations. This and other freight-related issues will be studied in more depth during the project.

## PROJECT EVALUATION CRITERIA

### Alignment Evaluation Criteria

As part of its proposal for this project, the consultant team proposed an initial set of six alignment alternatives for a high-speed ground access connection between LAX and various locations in Orange County. Those six alternatives will be examined and refined in a workshop format early in the project to define the best segments for further study. Those initial alignments and their refinements will be subjected to six categories of subjective screening or "fatal flaw" criteria:

1. System Role (related to the four roles described above);
2. Technical Capability (an alignment's ability to use a variety of modes,

especially given this study's requirements to develop short-term incremental improvements);

3. Revenue Potential;
4. Ridership Potential;
5. Cost; and
6. Environmental and Community Impacts.

After the short list of alignment alternatives and packages is developed, those alignments will be subjected to a more detailed evaluation process using a combination of quantitative and qualitative evaluation criteria and methodologies. Twelve initial categories of short list criteria have been developed and were adapted from the Federal Railroad Administration and other Maglev studies. However, the project team may choose to modify or adapt these criteria once more is known about the corridor and its alignment alternatives. The categories of criteria are:

- safety;
- ridership and travel;
- regulatory/permitting;
- construction;
- operations;
- environmental/physical;
- connectivity;
- community acceptance/economic potential;
- personal traveler access;
- job creation and project benefits;
- implementation; and
- financial and partnering potential.

## Technology Evaluation Criteria

The LAX/South study has as its charge to examine the whole range of potential passenger rail technologies that can provide high-speed ground access between and among the major activity centers in the study area. In addition, the study is to develop a series of incremental or short-term improvements that can begin to fulfill many of the proposed system roles on an interim basis before the implementation of a major transportation investment in the corridor. This means that a wider range of passenger transportation technologies will be examined in this study than were considered in LAX-March Inland Port or LAX-Palmdale studies.

Three sets of criteria will be used for the purposes of screening the range of transit technologies being considered by this study. These were obtained and adapted from other ongoing Maglev studies, but as with alignment criteria, these initial criteria may be adapted and modified as the project team continues to explore the technologies under consideration and their potential alignments.

The three categories of technology criteria are:

1. System Performance (including capacity, trip times, trip time reliability, headways, speed/acceleration/deceleration, safety, passenger comfort/accessibility, availability and reliability, image, geometric/configuration constraints, expandability, energy type of use, capital cost, and operations and maintenance cost);
2. Technology Performance and History (including technology maturity and stability, competition, California PUC requirements, and federal vehicle/system codes and standards); and
3. Project Physical and Operational Criteria (including exclusive right-of-way use, baggage handling, cargo/freight capability, community acceptance, acceptance by related service providers, area and development fit, noise and visual impacts, and other community and environmental impacts).

## CORRIDOR OPPORTUNITIES AND CONSTRAINTS

The purpose of this section is to examine both the opportunities and constraints that faced the project team as it developed and evaluated alignment and technology alternatives in the study corridor. Opportunities are issues that provide impetus or incentives for the project to move forward and are discussed in the context of the project being able to take advantage of those issues to succeed. Constraints are issues that could provide potential obstacles for the project's implementation and are discussed in the context of how the project team sees those issues being mitigated or overcome to result in successful project implementation.

### Market Opportunities

- ***Air Travel Market:*** The system is to provide convenient linkages for passengers between and among major airports in the study corridor and should be designed to provide fast, convenient, and easy-to-use linkages between and among the major airports in the study area. This would include airport-to-airport connections and access to airports from major activity centers throughout the corridor.
- ***Transit Market:*** This project provides the opportunity to substantially increase the use of transit in the study corridor by providing a high-speed long-haul service between and among major activity centers and by promoting intermodal connections to other transportation facilities and networks.

### Land Use Opportunities

- ***Coordinated Land Use Approach in Corridor Communities:*** This project provides the first major opportunity for communities and local jurisdictions within the study corridor to begin developing a systematic, coordinated approach to land use along the length of the alignment.

- ***Positive Land Use Influence along Alignments and Near Stations:*** One of this project's charges was to develop a set of guidelines for "smart" growth and development along the recommended alignment and particularly near stations.  These guidelines will be made available to all jurisdictions in the study area in the hope that they will be considered (as part of the coordinated approach mentioned above).

## Transportation Opportunities

- ***Regional Mobility:*** This project has the opportunity to substantially improve mobility in the study area and the entire region by providing alternatives to long-haul travel in highly congested corridors and improving travel times between and among major activity centers in the corridor.
- ***Ground Access to Airports:*** The project has the opportunity to substantially improve ground access to airports in the study area by providing alternative means of mobility to and from those airports.
- ***Regional Airport Growth and Usage:*** The project has the opportunity to help balance airport demand by spreading passenger activity among airports in the region and reducing the regional focus on LAX.

## Economic Development Opportunities

- ***Regional Employment Growth:*** The project has the opportunity to continue to improve regional employment growth through direct means (through construction and operations) and indirect means (by promoting ancillary economic activity along and near alignments and stations.
- ***Regional Economic Growth:*** The project can help sustain and improve the region's economic growth by providing tremendous incentives for spin-off development and economic activity.  A number of national studies have shown the economic benefits of transit investments.

## Market Constraints

- ***Air Travel Market:*** While the project is aimed at benefiting the air travel market, it could result in some inconveniences for air travelers. The system will need to establish a proven record of reliability if it is to be truly functional as an air travel connector.
- ***Transit Market:*** While ridership forecasts of other studies show a potentially significant transit (non-airport) market, the one-way fares of the system as envisioned (in the range of $10 or so) could make the system unattractive from an everyday, long-haul commuter system.

## Land Use Constraints

- ***Lack of Regional Coordination:*** While a goal of the project is to promote regional land use and development coordination, the danger exists that each individual community along the alignment will make its own independent decisions regarding development and land use, further exacerbating the jobs-housing imbalance in the region.
- ***Potential for Uncontrolled Development:*** The potential exists for development along alignments and around stations to occur in an unplanned way if developers leap ahead of local jurisdictions in purchasing land and securing development rights.

## Transportation Constraints

- ***Disruption to Existing Facilities During Construction:*** While the long-range benefits of the system will be substantial, the potential exists for significant disruption to existing transportation facilities during construction of the system.
- ***Induced Ground Access Demand at Airports:*** While the system is envisioned as reducing private auto traffic near local airports, that aim could have the opposite effect by increasing capacity of local roadways, freeing up capacity

for local private autos and resulting in no net change (or even a worsening) of local roadway demand around airports.

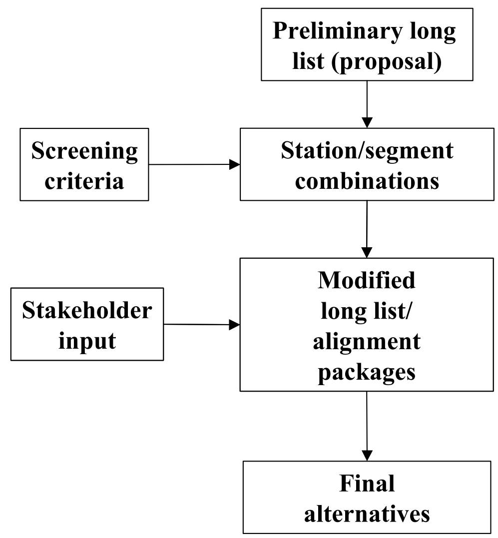
## Economic Development Constraints

- ***Continued Jobs/Housing Imbalance Potential:*** As with many long-distance transportation proposals, this project has the potential of further exacerbating the region's jobs-housing imbalance by providing quick and convenient transportation to commuters making long trips to their jobs.

# 3.0 ALIGNMENT AND TECHNOLOGY SCREENING

[Note: this chapter is a summary of a previous Milestone report submitted earlier. More details on the information contained in this chapter are included in Milestone Report 3: Alignment and Technology Screening, September 2001]

## ALIGNMENT DEVELOPMENT AND SCREENING PROCESS




The alignment development and evaluation process for this project consisted of two steps: development of a long list of alignment possibilities with a screening or "fatal flaw" analysis; and development of a short list of alignments with more detailed evaluation criteria. The intent of this process was to, first, examine all potential alignment segments and combinations in an effort to find the most logical alignment packages, and, second, to examine those packages and segments in greater detail with the ultimate aim of determining a single preferred alignment alternative. This section will deal only with the long list of alignments and its screening process that leads to the short list.

An initial set of six alignment alternatives was included in the project team's proposal to SCAG. Those initial alignments were refined into station/segment combinations in three geographic segments of the study area. Those combinations were then subjected to a screening using the long list of criteria (described below). Those combinations were then arranged into distinct packages of alignments serving the entire study area, and after modifications that took into account comments from stakeholders throughout the corridor, the project team developed a final short list of alternatives to take to more detailed evaluation in future milestones.

### Long List of Criteria

As part of its proposal for this project, the consultant team proposed an initial set of six alignment alternatives for a high-speed ground access connection between LAX and various locations in Orange County. Those six alternatives were examined and refined in a workshop format early in the project to define the best segments for further study. Those initial alignments and their refinements were subjected to six categories of subjective screening or "fatal flaw" criteria:

1. System Role;
2. Technical Capability;
3. Revenue Potential;
4. Ridership Potential;
5. Cost; and
6. Environmental and Community Impacts.

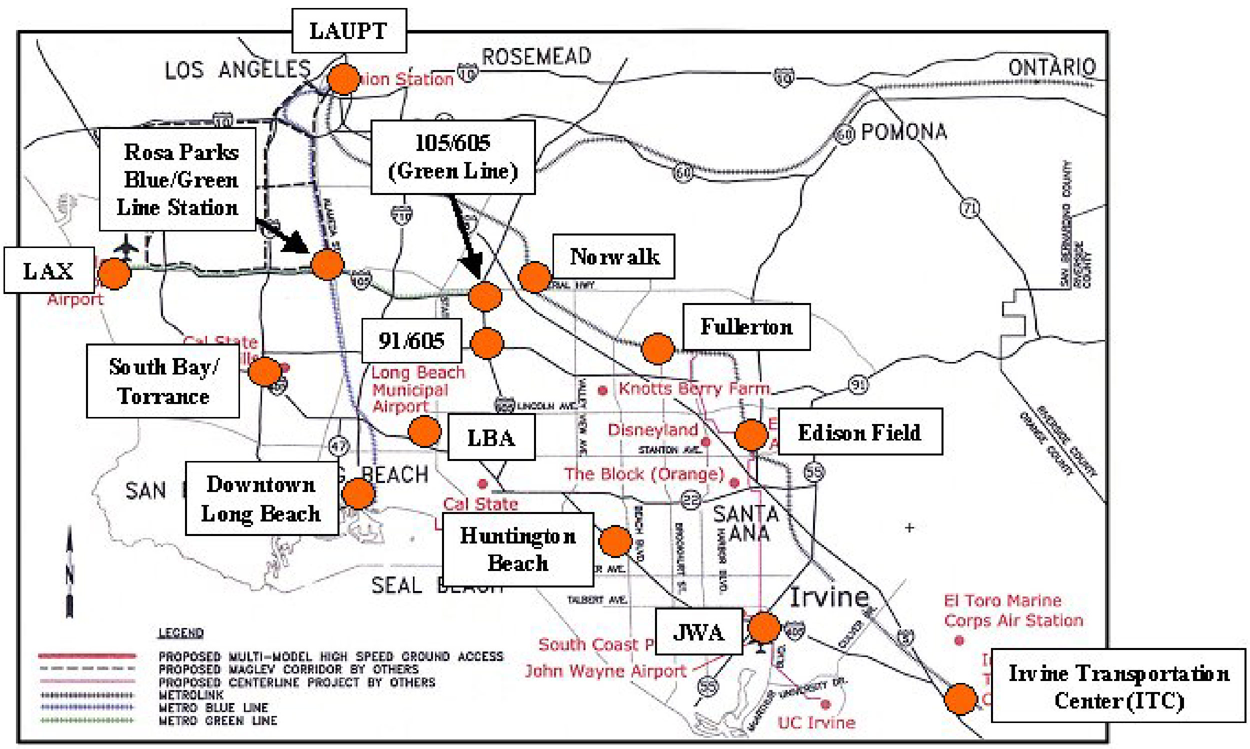
## MODIFIED LONG LIST OF ALIGNMENTS

To initiate the screening process, the project team held an all-day workshop to refine the preliminary long list of alignments and to begin applying the screening criteria to those alignments. The first activity was to segment the study area into three sections: a western section (roughly equal to the geographic area between LAX and Long Beach, including the linkage between LAX and LAUPT); a central section (Long Beach to Orange County); and an Orange County section (focusing on the southern terminus). The preliminary long list of alignments was then re-evaluated to ensure that the most logical and practical elements of each were retained and incorporated into the modified list on a segment-by-segment basis.

### Preliminary Stations and Route Segments

This activity represented the initial specification of potential activity centers, airports, and station sites, and determined the potential route segments that could link them (euphemistically known as "connecting the dots"). Based on the project team's background knowledge of the study area (including the major activity center areas reviewed in *Milestone 2: System Concepts and Goals*), and a review of the preliminary long list of alignment segments and their evaluation, a range of potential station sites was identified by the project team. **Figure 3-1** shows the preliminary stations and activity centers identified as key connection points for this analysis.

***Figure 3-1: Preliminary Station Sites/Activity Centers***




## Alignment Group 1: Western Segment

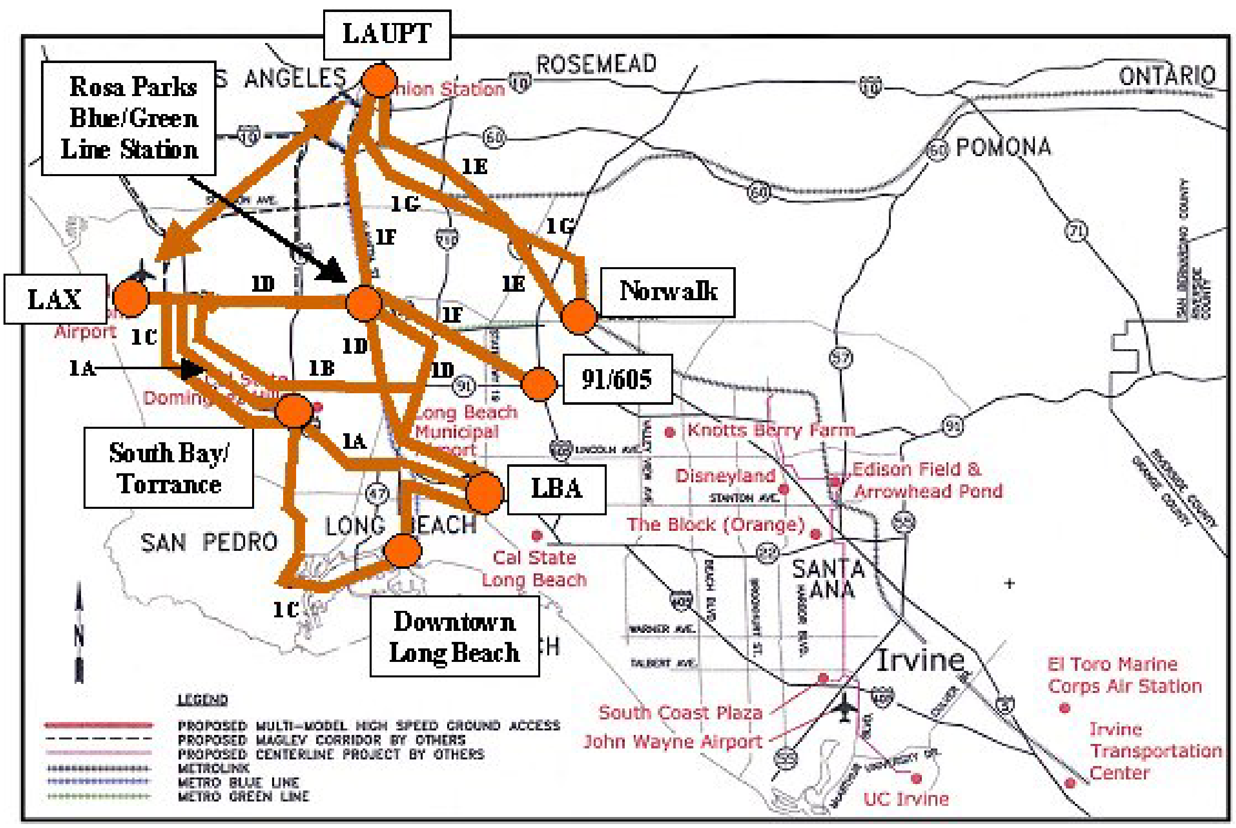
Seven alignments were developed for the western segment from Los Angeles International Airport to the Long Beach/I-605 corridor. Those segments are:

- Segment 1A, focused on the I-405 corridor;
- Segment 1B, using I-405, SR-91, and the Blue Line or I-710;
- Segment 1C, serving downtown Long Beach;

- Segment 1D, using I-105 and the Blue Line or I-710;
- Segment 1E, using I-5 from LAUPT to Norwalk;
- Segment 1F, using the proposed Orange Line alignment from LAUPT to the intersection of SR-91 and I-605; and
- Segment 1G, using the Metrolink alignment from LAUPT to Norwalk.

(Note: the segment from LAX to LAUPT in downtown Los Angeles is not included in this analysis; that segment is assumed to be the same alignment selected for the LAX-March study.) **Figure 3-2** shows the alignments analyzed in the western segment of the study area.

***Figure 3-2: Alignment Group 1/Western Segment***



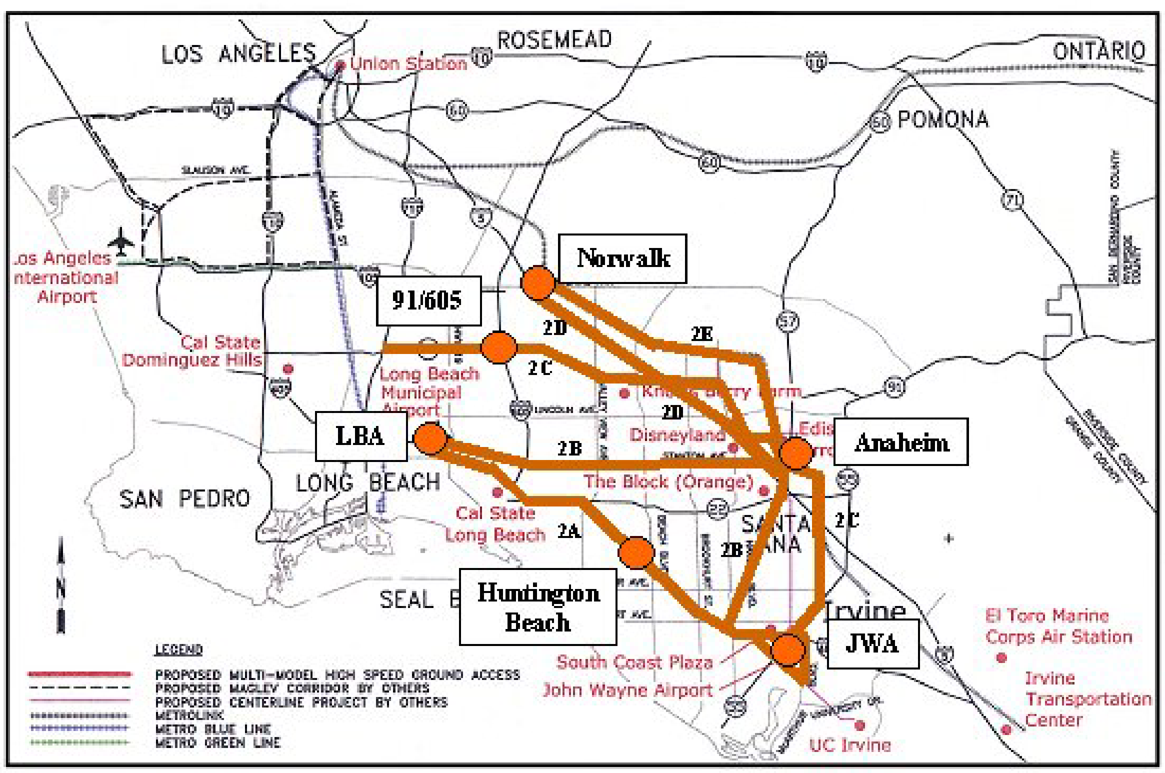
## Alignment Group 2: Central Segment

Five alignments were developed for the central segment of the study area from roughly the I-605 corridor and Long Beach Airport to Orange County. Those alignments are:

- Segment 2A, using the I-405 corridor;
- Segment 2B, linking LBA and Anaheim by the Willow/Katella corridor, then linking JWA with the Metrolink/LOSSAN alignment and the Santa Ana River;
- Segment 2C, using SR-91 and the LOSSAN corridor;
- Segment 2D, using I-5 from Norwalk to Anaheim; and
- Segment 2E, using the Metrolink corridor from Norwalk to Anaheim.

**Figure 3-3** shows the Central Segment alignments.

*Figure 3-3: Alignment Group 2/Central Segment*



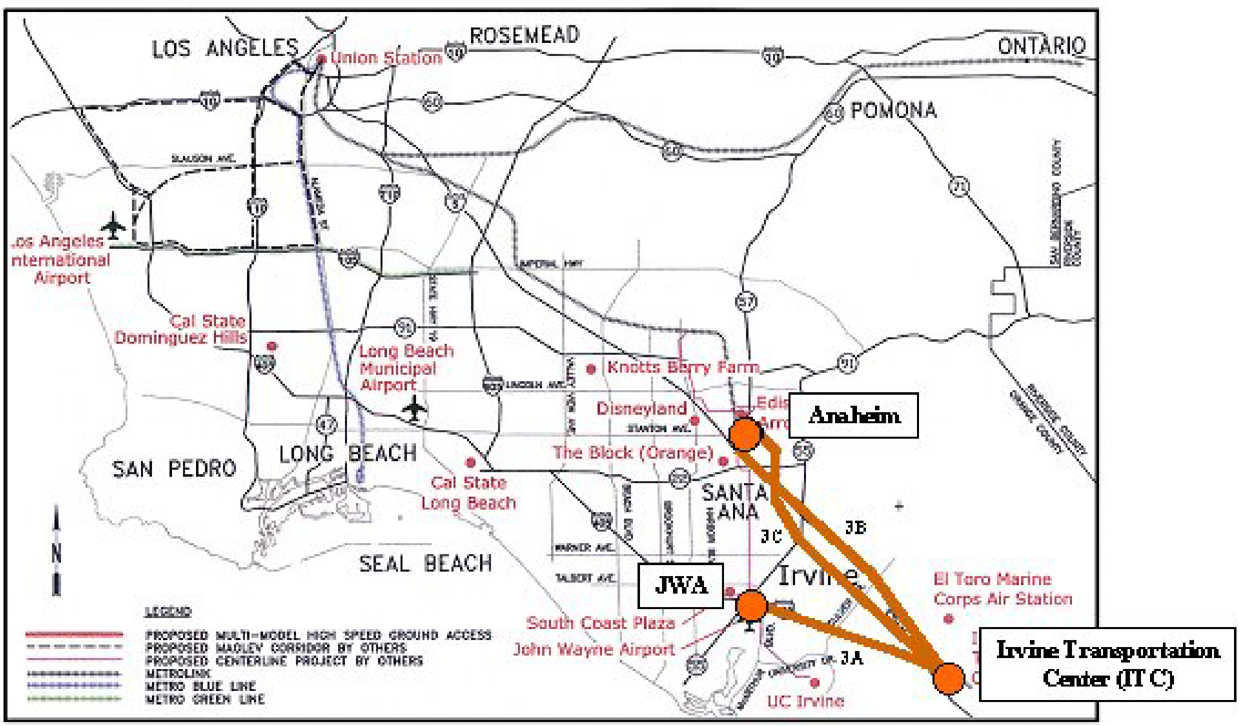
## Alignment Group 3: Orange County

Three alignments were studied for the Orange County segment from Anaheim or John Wayne Airport to the Irvine Transportation Center:

- Segment 3A uses I-405 from JWA to ITC;
- Segment 3B uses I-5 from Anaheim to ITC; and
- Segment 3C uses the Metrolink corridor from Anaheim to ITC.

**Figure 3-4** shows these alignments.

***Figure 3-4: Alignment Group 3/Orange County Segment***



## Screening of Modified Long List

On March 14, 2001, the LAX-South Project Team conducted a daylong workshop to screen each of the modified long list segments, using the six categories of criteria described earlier (System Role, Technical Capability, Ridership Potential, Revenue Potential, Cost, and Environmental and Community Impacts). The ranking system used for measuring these variables was qualitative based on the team's knowledge of the corridor. Each segment was evaluated and ranked according to how it met each of the criteria: very good/very high (++), good/high (+), neutral (0), some challenges (-) and many challenges (--), each of which was converted to a numerical scale. **Table 3-1** shows the final results of the screening process for each segment.

**Table 3-1: Results of Modified Short List Segment Screening Process**

| Segment | System Role | Revenue & Ridership Potential | Costs | Environmental and Community Impacts | Total Score | Rankings within each Alignment Grouping |
|---|---|---|---|---|---|---|
| *Western* | | | | | | |
| Segment 1A | 6 | -1 | 1 | 0 | 6 | 5 |
| Segment 1B | 4 | 0 | 2 | 0 | 6 | 5 |
| Segment 1C | -2 | 4 | 0 | -1 | 1 | 7 |
| Segment 1D | 10 | 0 | 0 | 2 | 12 | 1 |
| Segment 1E | 2 | 3 | 2 | 1 | 8 | 2 |
| Segment 1F | 4 | 2 | 1 | 1 | 8 | 2 |
| Segment 1G | 3 | 2 | 1 | 1 | 7 | 4 |
| *Central* | | | | | | |
| Segment 2A | 5 | 6 | 1 | 1 | 13 | 3 |
| Segment 2B | 6 | 10 | 0 | -1 | 15 | 1 |
| Segment 2C | 1 | 8 | 0 | 2 | 11 | 4 |
| Segment 2D | 3 | 4 | 2 | 1 | 10 | 5 |
| Segment 2E | 5 | 5 | 2 | 2 | 14 | 2 |
| Orange County | | | | | | |
| *Segment 3A* | 4 | 9 | 2 | 1 | 16 | 1 |
| *Segment 3B* | 4 | 9 | 0 | 1 | 14 | 3 |
| *Segment 3C* | 5 | 9 | 0 | 2 | 16 | 1 |

Source: URS Corp., September 2001

## ALIGNMENT PACKAGING PROCESS

### Alignment Package Refinements

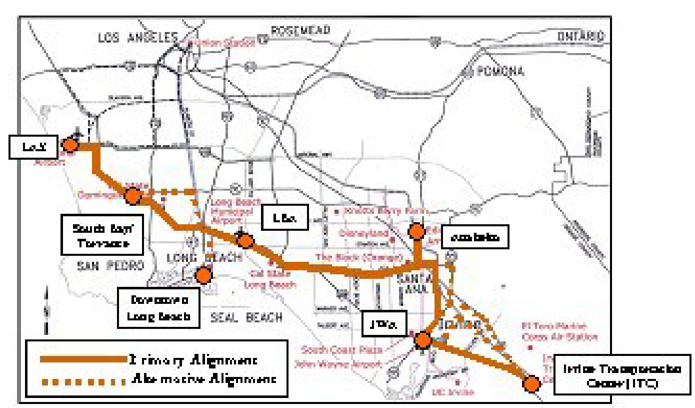
After development of the initial alignment packages, the project team held a series of discussions with stakeholders throughout the study area to gauge their reactions to the potential alignments and to ensure that all major destinations were being taken into consideration.

Based on those comments and others, the project team began refining the alignment packages even further. The primary issue in system continuity is that connecting both the Long Beach Airport area and the Anaheim/Disney/Edison Field area would be problematic because of the existing freeway, railroad, river, and utility corridors in the area. To help resolve that and other issues, several alignment principles and concepts were discussed in the package refinement.

Based on these issues and suggested alignment concepts, the project team developed a series of alignment package refinements to try to accommodate as many suggestions as possible. Three sets of packages were developed, serving the southern, central, and northern parts of the study area. In addition, the alignments were developed with the idea of fulfilling one of the three system goals: airport connector and feeder; activity center connector; and multi-modal connector.

### Southern Alignment Packages

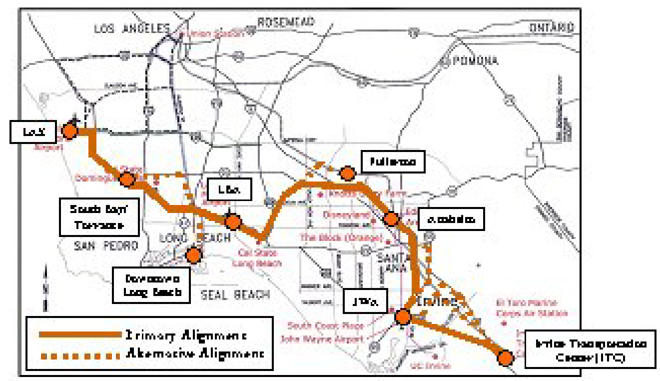
South-1




Alignment package **South-1** focuses on the I-405 corridor in the western half of the study area and connects LAX with Central Orange County and the resort area along SR-22 in the eastern half. From LAX, the alignment follows I-105 east, and I-405 south to Long Beach Airport (with an optional spur line along the Los Angeles River to downtown Long Beach). An alternative alignment would follow SR-91 east from I-405, turning south into the Metro Blue Line/Alameda Corridor to I-405.

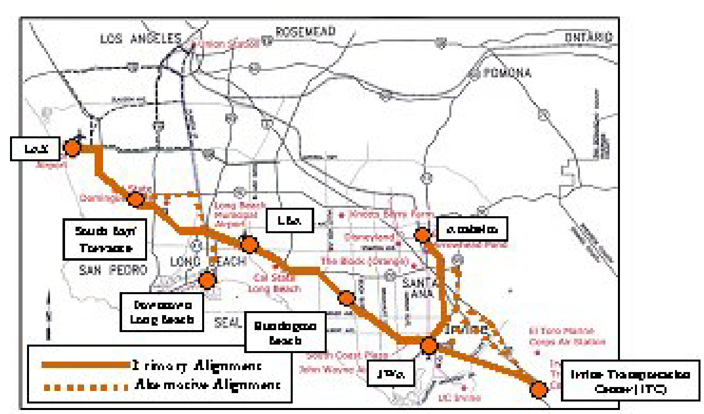
Alignment package **South-2** links the I-405 corridor with the resort area by way of the industrial portion of Coyote Creek. It follows I-105 from LAX, and runs south and southeast on I-405 to Long Beach Airport (with an optional spur to downtown Long Beach). An alternative in this vicinity would use SR-91 east from I-405, turning south into the Blue Line/Alameda Corridor right-of-way to I-405. Continuing southeast on I-405 from Long Beach Airport, the line briefly follows I-605 northeast, transitioning into Coyote Creek to its intersection with SR-91. It then follows that highway east into the Metrolink track to the Edison Field area (with an alternative following the Metrolink tracks to serve the Fullerton area), continuing south in the railroad right-of-way to SR-55 and I-405 and John Wayne Airport. From there, it continues southeast to the ITC area (with the same alternatives as described in South-1). The primary alignment is approximately 62.5 miles long.

South-2



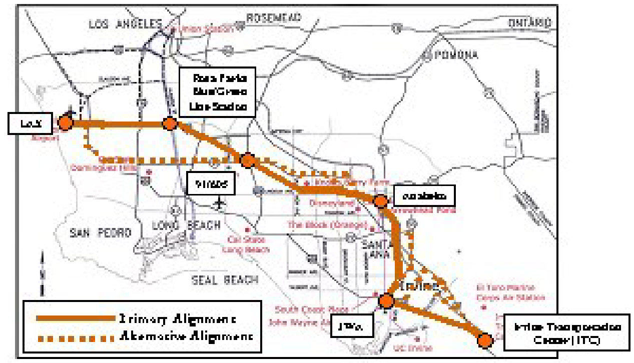

Alignment **South-3** focuses on he I-405 corridor (with an optional spur to downtown Long Beach), with a long spur connecting the John Wayne Airport area with the Edison Field/resort area. Counting the two spur lines, it is approximately 67.8 miles long.

South-3



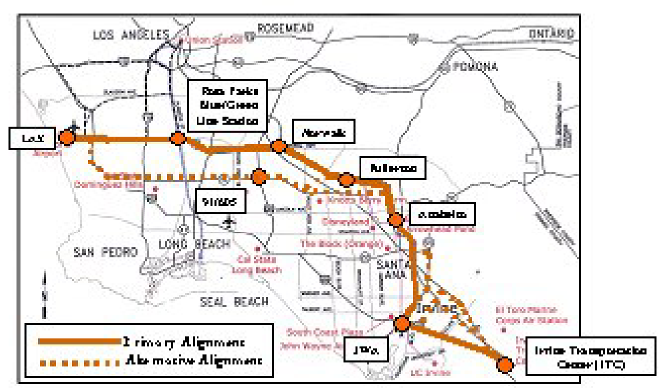
## Central Alignment Packages

Central-1




Alignment package **Central-1** focuses on the I-105 and the Pacific Electric right-of-way to link the major activity centers, bypassing Long Beach Airport. From LAX, the line follows I-105, transitioning southeast into the Pacific Electric (future MTA Orange Line) corridor at the combined Blue/Green Line Rosa Parks Station at Imperial and Wilmington. The alignment follows that rail corridor, turning east along the railroad corridor just north of Katella Avenue, curving north across the I-5 and following the railroad corridor to the Edison Field area. From that point, it follows the Metrolink alignment south into SR-55 and turns east on I-405, with a spur serving John Wayne Airport. The line then continues southeast on I-405 to the ITC area. The alignment is approximately 53.5 miles long. Several alternatives exist for serving the same area, including the I-405/SR-91 combination eastward from LAX, the railroad and Metrolink tracks north of Edison Field, and the other alternatives south from "Bid Ed" as described in the southern alignment packages.

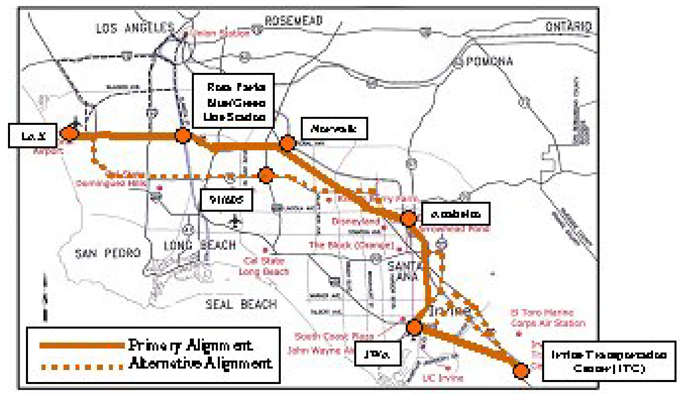
Central-2




Alignment package **Central-2** uses the I-105 corridor east from LAX, using the Imperial Highway to cross I-5 and enter the Metrolink tracks to the Edison Field area. From that point south, the alignment and alternatives are the same as in previous alignment packages (including a spur to John Wayne Airport). The primary alignment is approximately 52 miles long. An east-west alternative would be to use the I-405/SR-91 combination to the Metrolink tracks north of Edison Field.

Alignment package **Central-3** follows the I-105 alignment east from LAX, transitioning southeast into the I-5 or its parallel railroad alignment until moving into the Metrolink alignment to reach the Edison Field area. The alignment south from that point is the same as previous alternatives. Again, an east-west alternative would be to use the I-405/SR-91 combination. The primary alignment is approximately 50.5 miles long.

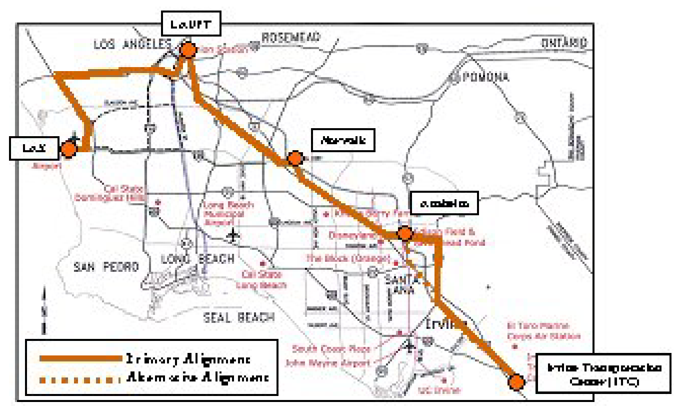
Central-3




## Northern Alignment Package

Only one alignment package was developed to serve the northern portion of the study area. Alignment package **North-1** is a combination of railroad and highway alignments that links LAUPT with the Irvine Transportation Center in Orange County. From LAUPT, the alignment runs south in the Union Pacific Rail Road (UPRR) railroad right-of-way on the east side of the river, runs briefly in the I-710 right-of-way, then turns southeastward into the Union Pacific (UP) Santa Ana branch. The line then transitions eastward into Imperial Highway to the Norwalk Transportation Center, briefly entering the LOSSAN/Metrolink railroad alignment and then turning southward along Coyote Creek, where the line re-enters the UP alignment that parallels I-5. The line then enters I-5 and turns eastward into a utility corridor

North-1



near Anaheim Blvd. north of Katella, and then turns eastward into the UP line that enters downtown Anaheim and serves the Edison Field area, turning south at the stadium and then eastward to SR-55. The alignment then turns south on SR-55 and then southeast on I-5, re-entering the LOSSAN corridor to access the Irvine Transportation Center. This alignment is approximately 48 miles long from LAUPT to the ITC, with an additional 15 miles from LAUPT to LAX using the LAX-March recommended alignment. This alignment was designed primarily to avoid the right-of-way issues associated with I-5 and the Metrolink line that serve the same general corridor.

## Preliminary Ridership Analysis

Planning-level ridership estimates were developed for each of the alignment packages developed for the study. Initial ridership forecasts were developed to provide a basis for comparison among the alignment packages. Ridership estimates were developed based on corridor socio-economic variables, including population and employment along the alignments and on existing information related to airport access and inter-airport flows. The initial estimates were developed using trip tables (commute-to-work trips and resident-based non-work trips) obtained from the SCAG model and market shares for the 'High Speed" mode that are consistent with SCAG Phase I California Maglev Deployment Project forecasts. In addition, preliminary inter-airport traffic estimates were assumed from air passenger data generated previously by the Regional Airport Demand Allocation Model (RADAM).

The ridership estimates were developed using spreadsheets that detail each component of the initial estimates, including estimated air passenger traffic. This process is consistent with the methodology used in developing preliminary ridership estimates for previous SCAG Maglev corridor studies. **Table 3-2** presents the preliminary ridership estimates for the six alignment packages assuming Maglev technology. The table includes work trips, non-work trips, airport trips, and special event trips. The variance in ridership for each alternative is based on potential station locations and estimated travel times (assuming Maglev technology) of each of the proposed segments. It should be emphasized that these ridership projections constitute initial sketch-planning level estimates and should be used for comparison purposes only.

| Alignment Packages | Initial Estimated Daily Ridership Range |
|---|---|
| *Southern Alignment Packages* | |
| South-1 (I-405/SR-22/Metrolink/I-405, Long Beach Spur) | 118,300-129,200 |
| South-2 (I-405/ Coyote Creek/SR-91/Metrolink I-405, Long Beach Spur) | 111,100-120,900 |
| South-3 (I-405 with Long Beach, Edison Field Spurs) | 113,600-121,800 |
| *Central Alignment Packages* | |
| Central-1 (I-105/PE/Metrolink/I-405) | 106,200-113,100 |
| Central-2 (I-105/Metrolink/I-405) | 104,800-111,200 |
| Central-3 (I-105/I-5 or railroad/Metrolink/I-405) | 101,900-109,700 |
| *Northern Alignment Package* | |
| North-1 (UPRR/I-5/Metrolink/SR-55/I-405) | 79,000-131,000 |

Source: Meyer, Mohaddes Associates, Inc., using SCAG Model, September 2001

The table shows that the South-1 alignment package, focused on I-405, has the highest conceptual daily ridership level of all southern alternatives, and the Central-1 package, focused on I-105 and the PE corridor, has the highest ridership of all central alternatives. The North-1 alignment has the largest range of all alternatives but has the highest upper end of potential ridership.

## System Role Analysis

The project team then conducted one final analysis of the alignment packages to determine the alignments that best fulfilled each of the three major system roles established for this study: airport connector and feeder; multi-modal connector; and activity center connector. **Table 3-3** shows the results of that analysis

| Table 3-3: System Role Analysis of Alignment Packages | | | |
|---|---|---|---|
| **Alignment Package** | **Airport Connector and Feeder** | **Multi-Modal Connector** | **Activity Center Connector** |
| *Southern Alignments* | | | |
| South-1 | Good | Fair | Good |
| South-2 | Good | Good | Fair |
| South-3 | Excellent | Fair | Fair |
| *Central Alignments* | | | |
| Central-1 | Fair | Good | Good |
| Central-2 | Fair | Excellent | Excellent |
| Central-3 | Fair | Good | Excellent |
| *Northern Alignment* | | | |
| North-1 | Fair | Excellent | Good |

Source: URS Corp., September 2001

The table shows that the South-3 package best fulfills the role of airport connector and feeder, as it provides the most direct connections between all the major airports in the study area. The Central-2 and North-1 alignments were rated best as multi-modal connectors, as they provide direct links between and among the major existing transportation systems in the region (including the Green and Blue Lines, Metrolink, and in the case of the North-1 alignment, LAUPT). The Central-2 and Central-3 alignments were rated best as activity center connectors, as they provide the most direct links between the airports at the end of the study area with the major activity centers (particularly tourist destinations) in between.

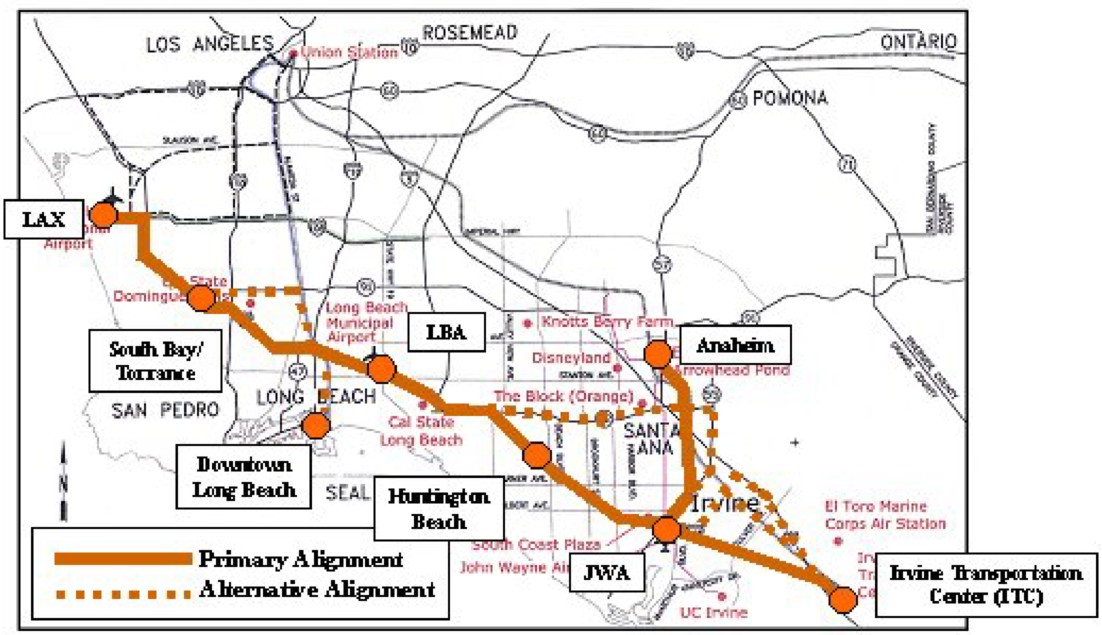
## FINAL RECOMMENDED ALIGNMENT ALTERNATIVES

After reviewing the preliminary ridership analysis, system role analysis, and other factors (including stakeholder comments), the project team agreed on three final recommended alignment alternatives, each of which wais aimed at fulfilling one of the three major system roles developed for this project.

## Initial Recommended Alternatives

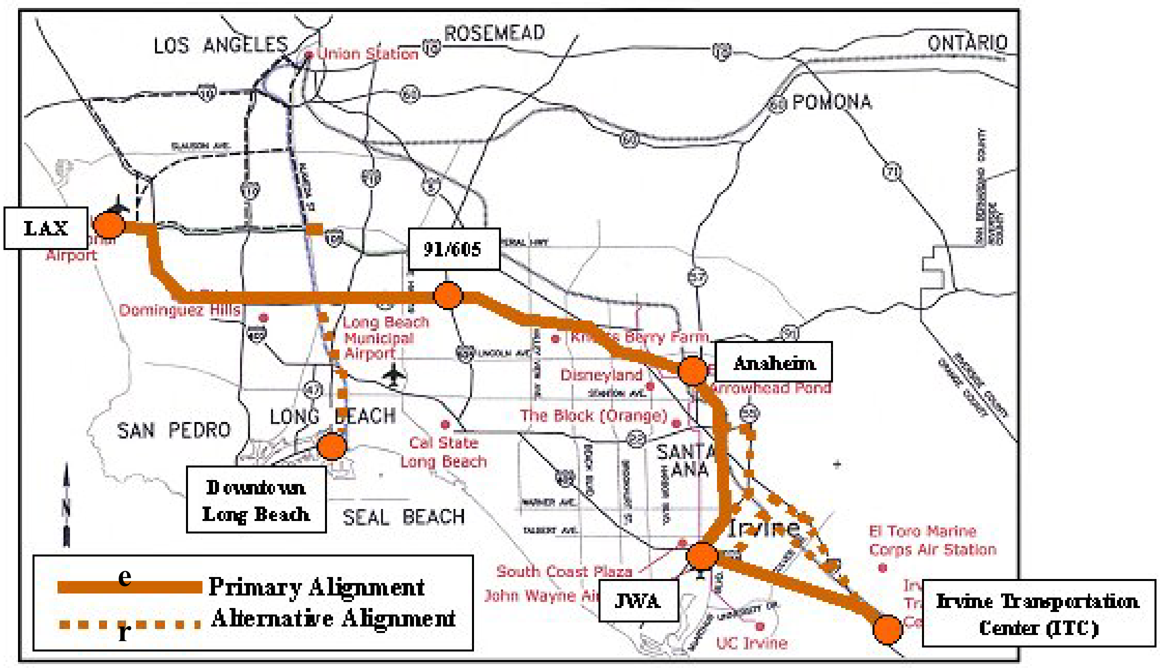
The **Southern Alignment** (see **Figure 3-5**) fulfills the primary system role of **Airport Connector and Feeder** by providing the quickest, most direct connections to all airports in the study area. It is most similar to Refined Alignment Package South-3. From LAX, it stays almost entirely within the I-405 corridor from I-105 to the ITC, with a stub track north from the JWA area to Anaheim. Options include the use of SR-91 on the western end for connections to the Alameda Corridor, a line to downtown Long Beach along the river, the use of SR-22 to serve Anaheim directly, and various options between Edison Field, JWA, and the ITC. The primary alignment using I-405 (and including the stub line to Anaheim) is approximately 58 miles long.

***Figure 3-5: Initial Recommended Southern Alignment/Airport Connector and Feeder***



The **Central Alignment** (see **Figure 3-6**) focuses on the SR-91 corridor as the primary means to connect the two ends of the study area, and is most similar to Refined Alignment Package Central-3. It best fulfills the system role of **Activity Center Connector** by linking the major destinations in the Orange County area. It also includes an optional stub line to Long Beach by way of I-710 and the river, with several variations between Anaheim, JWA, and the ITC. The primary alignment is approximately 52 miles long.

***Figure 3-6: Initial Recommended Central Alignment/Activity Center Connector***

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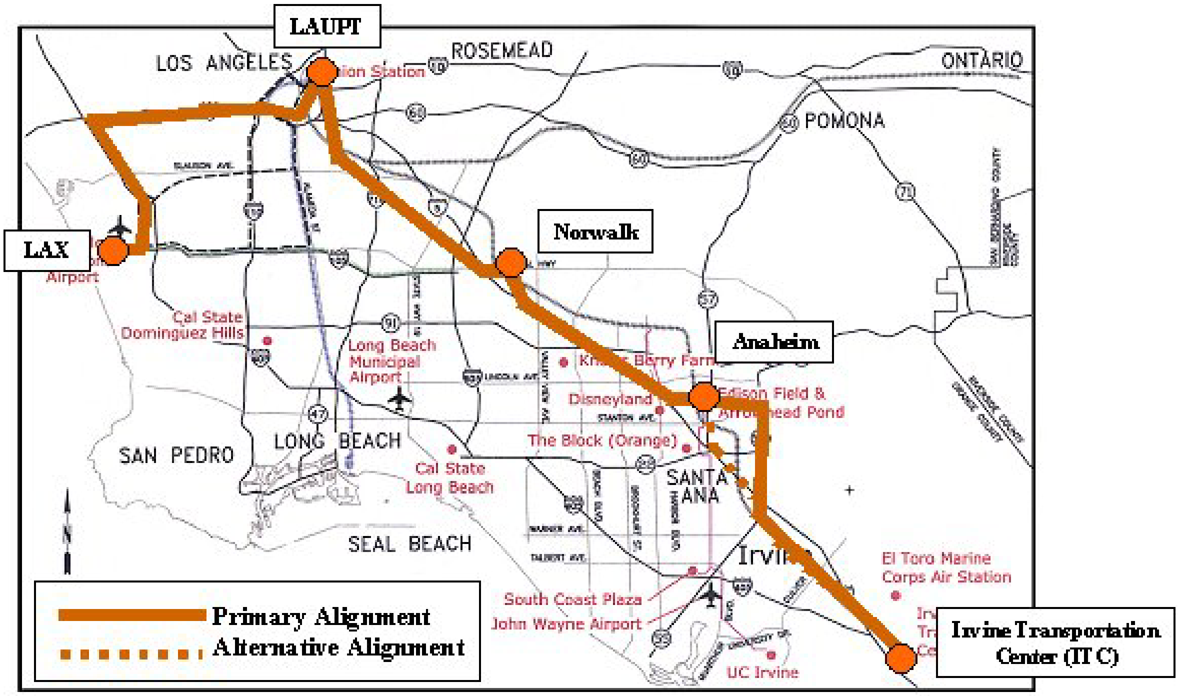
**Alignment** (see **Figure 3-7**) is identical to Refined Alignment Package North-1 and is focused on the UP railroad branch that parallels I-5, with the use of various railroad and roadway alignments to link LAUPT (and LAX) with Orange County. It best fulfills the role of **Multi-Modal Connector**, and the primary alignment is approximately 63 miles long counting the LAX-March recommended alignment between LAX and LAUPT. This alignment would not serve LBA or JWA.

*Figure 3-7: Initial Recommended Northern Alignment/Multi-Modal Connector*




## Preliminary Ridership of Initial Recommended Final Alternatives

Planning-level ridership estimates were developed for each of the initial alignment packages developed for the study. As with earlier preliminary ridership estimation, ridership estimates for the final alternatives were developed based on corridor socio-economic variables, including population and employment along the alignments and on existing information related to airport access and inter-airport flows. These preliminary estimates were developed using trip tables (commute-to-work trips and resident-based non-work trips) obtained from the SCAG model and market shares for the 'High Speed" mode that are consistent with SCAG Phase I California Maglev Deployment Project forecasts. In addition, preliminary inter-airport traffic estimates were assumed from air passenger data generated previously by the Regional Airport Demand Allocation Model (RADAM). **Table 3-4** shows the results of the preliminary ridership estimates for the three recommended final alignment alternatives.

| Table 3-4: Initial Estimate of Daily Ridership for Initial Recommended Alignment Alternatives | |
|---|---|
| **Recommended Final Alignments** | **Initial Estimated Daily Ridership Range** |
| Southern Alignment/Airport Connector and Feeder | 113,600-129,200 |
| Central Alignment/Activity Center Connector | 104,800-113,100 |
| Northern Alignment/Multi-Modal Connector | 79,000-131,000 |

Source: Meyer, Modaddes Associates, Inc., using SCAG Model, September 2001

## TECHNOLOGY SCREENING

This section details a long list of technology alternatives that include bus, fixed guideway and high-tech transit alternatives for consideration for use in the LAX/South project. A wide variety of alternatives was included in the long list in order to consider incremental improvements as well as long-term major investments for the project corridor. The transit alternatives considered included:

**BUS**
- Conventional bus
- Bus/HOV Lanes
- High-speed, high-quality express bus

**FIXED GUIDEWAY**
- Light rail
- Commuter rail (conventional and DMU/regional rail) / Intercity rail
- Heavy rail
- Automated Guideway Transit / People Movers
- Monorail
- High Speed / Very-high-speed rail

**HIGH-TECH**
- Low-Speed Maglev
- High-Speed Maglev

### Initial Technology Screening

**Table 3-5** reflects the results of the initial technology screening process. The table uses the categories and screening criteria noted in *Milestone 2: System Concepts and Goals*.

The table shows that the higher-speed technologies (such as high-speed rail and Maglev) are rated high on capacities, trip time, reliability, speeds, passenger comfort, and other criteria related to performance. Lower-speed technologies (such as light rail, commuter rail, and heavy rail) are rated high in system maturity and stability primarily due to their widespread use in the U.S. and elsewhere.

**Table 3-5: Initial Technology Screening**

| Evaluation Criteria | Bus/ HOV | High-Speed Bus | Light Rail | Comm. Rail | Heavy Rail | High-Speed Rail | Maglev |
|---|---|---|---|---|---|---|---|
| **Performance Criteria** | | | | | | | |
| Capacity | Poor | Poor | Fair | Good | Good | Good | Good |
| Trip Time | Poor | Poor | Fair | Fair | Fair | Good | Good |
| Trip Time Reliability | Poor | Poor | Fair | Fair | Fair | Good | Good |
| Headway | Fair | Fair | Good | Fair | Good | Good | Good |
| Speed/Accel/Decel | Poor | Poor | Fair | Poor | Fair | Good | Good |
| Safety | Poor | Poor | Fair | Fair | Fair | Good | Good |
| Passenger Comfort/Accessibility | Fair | Fair | Fair | Fair | Fair | Good | Good |
| Availability / Reliability | Fair | Fair | Fair | Fair | Fair | Good | Good |
| Image | Poor | Poor | Fair | Fair | Fair | Good | Good |
| Geometric Configuration Constraints | Good | Good | Fair | Fair | Fair | Poor | Poor |
| Expandability | Fair | Fair | Good | Good | Good | Good | Good |
| Energy Type & Use | Diesel/CNG | Diesel/CNG | Electric | Diesel | Electric | Electric/ Diesel | Electric |
| Capital Cost | Good | Good | Fair | Fair | Fair | Fair | Fair |
| O & M Cost | Good | Good | Fair | Fair | Fair | Poor | Poor |
| **Technology Criteria** | | | | | | | |
| Tech. Maturity | Good | Good | Good | Good | Good | Fair | Poor |
| Tech. Stability | Good | Good | Good | Good | Good | Fair | Poor |
| Competition | Good | Good | Good | Good | Good | Fair | Poor |
| Cal. PUC Requirements | Good | Good | Good | Good | Good | Poor | Poor |
| US Code/Standards | Good | Good | Good | Good | Good | Fair | Poor |
| **Project Criteria** | | | | | | | |
| Exclusive ROW | No | No | Yes | Yes – Shared | Yes | Yes | Yes |
| Integrated Baggage Handling | No – By passengers | No – By passengers | Possible | Possible | Possible | Yes | Yes |
| Cargo/Freight | Yes – limited | Yes – limited | No | No | No | Yes | Yes |
| Community Acceptance | Good | Good | Good | Good | Good | Unknown | Unknown |
| Acceptance by Related Providers | Good | Good | Good | Good | Good | Fair | Good |
| Fits Area/Developments | Good | Good | Good | Good | Good | Fair | Fair |
| Noise Impacts | Fair | Fair | Fair | Fair | Fair | Good | Good |
| Visual Impacts | Good | Good | Good | Good | Good | Poor | Poor |
| Other Impacts (including air quality) | Fair | Fair | Good | Fair | Good | Good | Good |

Source: URS Corp., September 2001

**Table 3-6** reflects the project team's initial analysis of technologies and their suitability for short-term incremental improvements and long-term major transportation investments that meet the system goals of this project.

| Table 3-6: Technology Screening/Applicability | | | |
|---|---|---|---|
| **Technology** | **Appropriate for Incremental Improvements** | **Appropriate for Major Investment** | **Comments** |
| *Bus* | | | |
| Conventional Bus | No | No | Could be used as support for major investment |
| Bus/HOV Lanes | Yes | No | Used as support for major investment |
| High-speed Express | Yes | No | Used as support for major investment |
| *Fixed Guideway* | | | |
| Light Rail | No | No | Non-exclusive guideway |
| Commuter Rail | No | No | Non-exclusive guideway |
| Heavy Rail | No | No | Guideway cannot be converted |
| AGT/People Mover | No | No | Not enough capacity |
| Monorail | No | No | Not enough capacity |
| High-Speed Rail | No | Yes | Long-term investment only |
| *High-Tech* | | | |
| Low-Speed Maglev | No | No | Cannot meet system roles |
| High-Speed Maglev | No | Yes | Long-term investment only |

Source: URS Corp., September 2001

Based on the project team's initial analysis, the following technologies were not carried forward:

- **Conventional Bus:** Adding a region-wide conventional bus system to already congested highways would not create a travel time advantage for commuters or airport passengers.

- **Light Rail, Commuter Rail, and Heavy Rail:** Not appropriate for either short-term incremental improvements or long-term major transportation investments. Light rail and commuter rail are often constructed in non-exclusive guideways, and upgrading a light rail or commuter rail line to a major investment serving the system roles of this project would be cost-prohibitive. Heavy rail is constructed in exclusive guideways, but again the cost of upgrading to a major investment to serve this project would be cost-prohibitive.

- **Automated Guideway Transit / People Movers**: These systems are most appropriate for short to medium distance travel, not appropriate for this project's setting and length. Speeds are very low compared to other rail and bus technologies. A totally new infrastructure would be required.

- **Monorail**: Typically, monorail has been implemented in recreational areas or amusement parks with short (1-2 mile) applications. Speeds are very low compared to other rail and bus technologies. A totally new infrastructure would be required.

- **Low-speed Maglev**: These systems, although proven, are capacity constrained and their cruise speeds are too slow considering the new infrastructure that is required.

The following technologies should be considered for incremental short-term improvements:

- **Bus/HOV Lanes, and High-Speed High-Quality Bus**: New Bus/HOV lanes and high-speed, high-quality bus service could serve as a connector or shuttle system between and among the major activity centers identified in this project (including to and from airports) until a major transportation investment is implemented.

The following technologies should be considered for long-term major transportation investments in the study area:

- **High-Speed/Very-High-Speed Rail:** This technology has top speeds approaching the system requirements for this study and is already under consideration for a statewide passenger rail network. If the state system is implemented, there is the opportunity for cost-sharing and coordinated service and schedules.

- **High-Speed Maglev:** This technology meets virtually all the system goals and requirements for this project, providing high-speed, high-quality premium service that can fulfill the role of airport connector and feeder, activity center connector, and multi-modal connector.

However, based on project team discussions and information from other similar high-speed ground access studies in the Southern California region, additional analysis was conducted to more thoroughly document the differences between high-speed rail and high-speed Maglev technologies. This effort was conducted to try to maintain consistency with the other high-speed studies for costing and operational analysis purposes in future milestones. Using analysis conducted by other Maglev studies as a guide, the characteristics where significant differences were noted included:

- **Top Speed:** According to the IBI analysis, high-speed rail could typically operate at a top speed of between 125 and 163 MPH, while high-speed Maglev operates at a top speed of approximately 215 MPH and also has significant abilities to accelerate faster than high-speed rail.
- **Average Speed:** High-speed Maglev typically is able to operate at an average operating speed of about 109 MPH, about 10% faster than high-speed rail (typically 97 to 99 MPH), subsequently resulting in faster travel times for users.
- **Grades:** High-speed Maglev can accommodate grades of 8-10%, while high-speed rail is limited to 2-6%.
- **Passenger Capacity:** According to IBI, a typical eight-car high-speed rail trainset (with seating four across) can carry approximately 450 passengers, while a typical six-car high-speed Maglev trainset (with seating six across) can carry approximately 600 passengers.

- **Safety:** High-speed rail, with its steel wheels on rail, has a higher potential for derailment than high-speed Maglev vehicles, which are designed with vehicle carriages that wrap around the Maglev guideway beam.
- **Energy Consumption:** According to IBI, high-speed rail would consume 74 watt-hours per seat mile at 150 MPH and 93 watt-hours per seat mile at 190 MPH. However, high-speed Maglev, due to its high efficiency propulsion system, low-friction guideway, and higher passenger capacity, would consume 58 watt-hours per seat mile at 150 MPH and 71 watt-hours per seat mile at 190 MPH.
- **Noise:** According to IBI, high-speed Maglev has considerably lower noise impacts than high-speed rail. High-speed Maglev is rated at 70.9 dBA at 150 MPH, while high-speed rail has higher noise impacts (73.4 dBA) at a much lower speed (50 MPH). This is a significant issue when consideration is given to neighborhood or community impacts.
- **Vibration:** High-speed Maglev (rated at 65 dB) has considerably lower vibration impacts than high-speed rail (rated at 81 dB), another significant neighborhood and community factor in favor of Maglev.
- **Visual Impacts:** High-speed Maglev would have less significant visual impacts than a high-speed rail system, which generally uses an overhead catenary propulsion system.
- **Station Size:** According to the IBI analysis, a prototypical passenger station for a high-speed Maglev system would require a platform 1,100 feet long, while a high-speed rail system would require a typical passenger platform that is 2,000 feet long. This disparity is a function of the passenger capacity mentioned above; high-speed Maglev, with its wider profile (six seats across) would require a six-car trainset instead of an eight-car trainset typically used by high-speed rail.
- **Maintenance Facility:** Due to its smaller fleet size requirements, high-speed Maglev would require a smaller maintenance facility than a high-speed rail system.

- **Costs:** While a high-speed Maglev would have higher initial capital costs than high-speed rail (primarily due to its more complex vehicles, guideways, and power distribution systems), operating costs for high-speed Maglev are anticipated to be significantly lower than those for high-speed rail. IBI estimated operating costs for high-speed Maglev to be approximately 30% lower than those for a high-speed rail system of similar length and complexity. According to IBI, high-speed Maglev has an advantage in this area due to its frictionless technology. High-speed rail has steel wheels on steel rails and more moving parts, and would therefore require more significant routine maintenance and parts replacement than high-speed Maglev. And the larger fleet requirements of high-speed rail would increase overall operating costs of that technology compared to the fleet size needed by high-speed Maglev.

For these reasons, the project team is recommending a primary focus on high-speed Maglev technology for the LAX/South study area.

# 4.0 STATION LOCATIONS, RIGHT-OF-WAY, AND URBAN DESIGN

[Note: this chapter is a summary of a previous Milestone report submitted earlier. More details on the information contained in this chapter are included in Milestone Report 4: Station Locations, Right-of-Way, and Urban Design, February 2002]

## INTRODUCTION

This chapter addresses the regional role of the stations, local role of the stations, and the design of the station and station areas. The milestone included the results of four subtasks:

- Station Site Criteria and Prototypical Design: This subtask established station prototype designs, including typical guideway section conditions and specific station design requirements.

- Station Location and Station Area Development Criteria: This subtask consisted of the preparation of technical design criteria related to station location and station areas. The criteria were written not as design guidelines, but as factors that will allow the study to evaluate alternate station site locations. The subtask also included preparing system-wide land use and urban design guidelines to promote transit-oriented development at station sites.
- Station Location Analysis: This subtask tested the station locations to accommodate station and related facilities, by applying the station prototypes to each candidate station to determine whether the station area can accommodate all needed facilities. This activity was aided by the use of station area "roundtables" in key jurisdictions throughout the study area to ensure that local preferences were included in the consideration of station sites.

- Finally, this task included a discussion on public policy issues related to station location and design that should be taken into account in future phases of this project.

## STATION STRUCTURE DESIGN GUIDELINES

The following guidelines were used to assure that the stations and station areas are developed with a high level of design quality.

- **Integration with Related Site Development:** The station should be designed to provide the most direct linkages to concurrent or future station area development.

- **Visual Character and Impacts*:*** The station should visually integrate and relate in terms of scale, material and visual appearance with present and planned development.

- **Design Continuity:** Elements of design continuity should be provided that are relatively uniform among all stations. These elements include the wayfinding and information systems, stairs and escalators, and basic platform design.

- **Level of Comfort and Luxury:** All facilities should be designed with a high level of design, amenity, comfort, convenience and attractiveness. Full enclosure and weather conditioning of ground, platform, mezzanine and bridge levels should be considered.

- **Related Amenities:** The station should provide amenities appropriate to the level of transit service provided. These amenities could include restrooms, comfortable seating, an excellent and extensive public information system, and convenience-commercial uses such as public phones, snack bars, restaurants, news stands, shoe shine stands, banking services and dry cleaning.

- **Linkages:** The station structure should be designed to provide the shortest, most direct and perceptually clear connection between the Maglev system and other transit modes serving the station.

- **Wayfinding Program:** A complete wayfinding system should be provided. Elements of this system should include full passenger information facilities such as system maps, area maps, and electronic changeable signs.

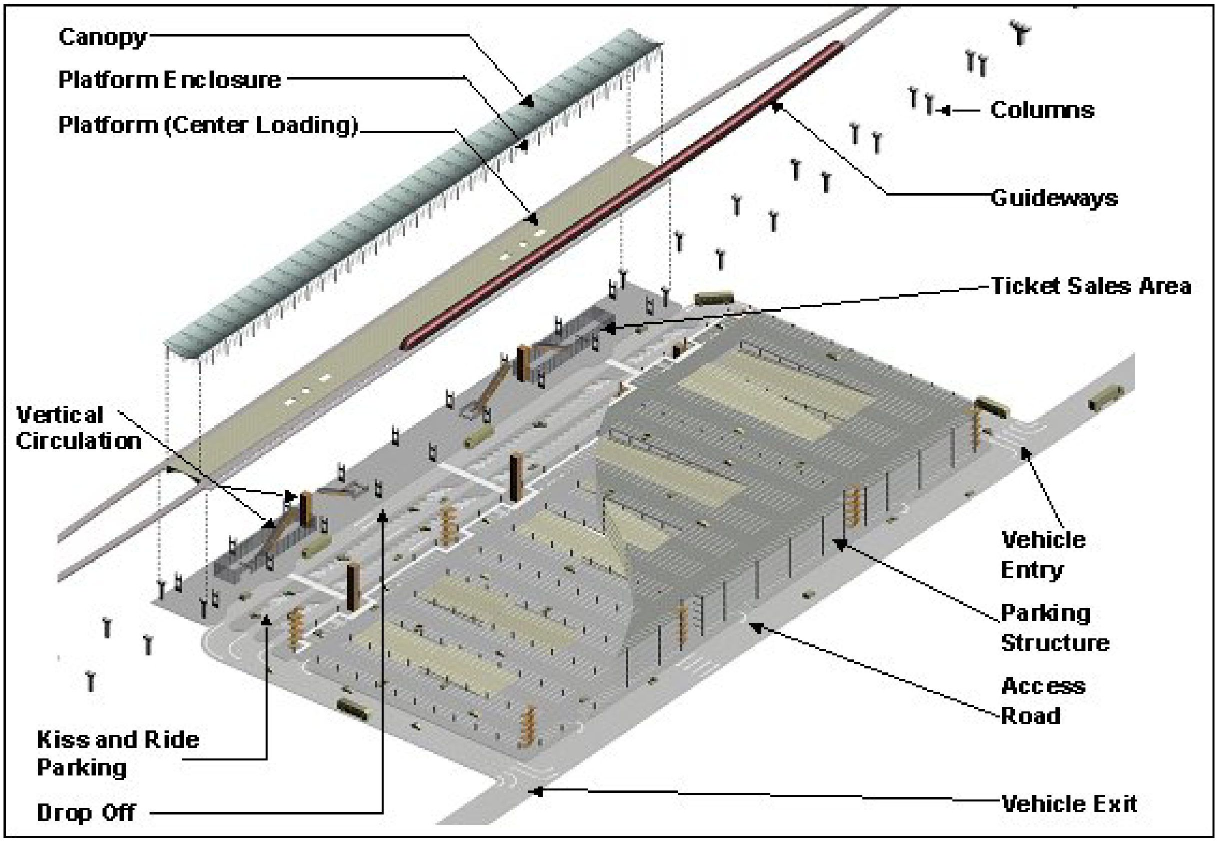
- **Safety and Security.** The station and station sites should be designed to maximize the safety and security of patrons and workers.

- **ADA Compliance:** The station should be designed in full compliance with ADA requirements.

- **Art Programs:** Art should be an integral part of the station and station site design. Artists should be included at the initiation of station design. A proportion of the construction budget should be allocated to public art.

**Figure 4-1** shows a prototypical Maglev station layout, incorporating many of the specific design features described in the following sections.

*Figure 4-1: Prototypical Maglev Station Elements*




Source: AC Martin Partners, February 2002

## Station Structure Design Parameters

To be consistent with the other two SCAG Maglev studies, the station structure design parameters are derived from Transrapid, the Maglev vehicle and equipment supplier. Variables that may affect the station design include: operational and ridership analysis that will affect train frequency and length; service analysis including the policy for accommodating baggage and cargo; the possible need for off-line stations; site-specific needs that will alter the prototype design; and economics.

### Platforms

- ***Platform Length:*** Platform length is assumed at a minimum of 843’ for a 10-car consist. The station track is assumed to be straight along the platform length, but a large radius curve may be used if necessary. The number of tracks at each station depends on the operations plan, but this study assumes two tracks at each station. The platform is a minimum of 16 feet above grade.

- ***Platform Type:*** Depending on the specific conditions at each station, the station may be center-loaded (see **Figure 4-2**) or side-loaded (see **Figure 4-3**), and with or without a mezzanine.
- ***Platform Width:*** For a side loaded station: assume a minimum of 25 feet wide per platform; a center-loaded station minimum platform width is 40 feet.

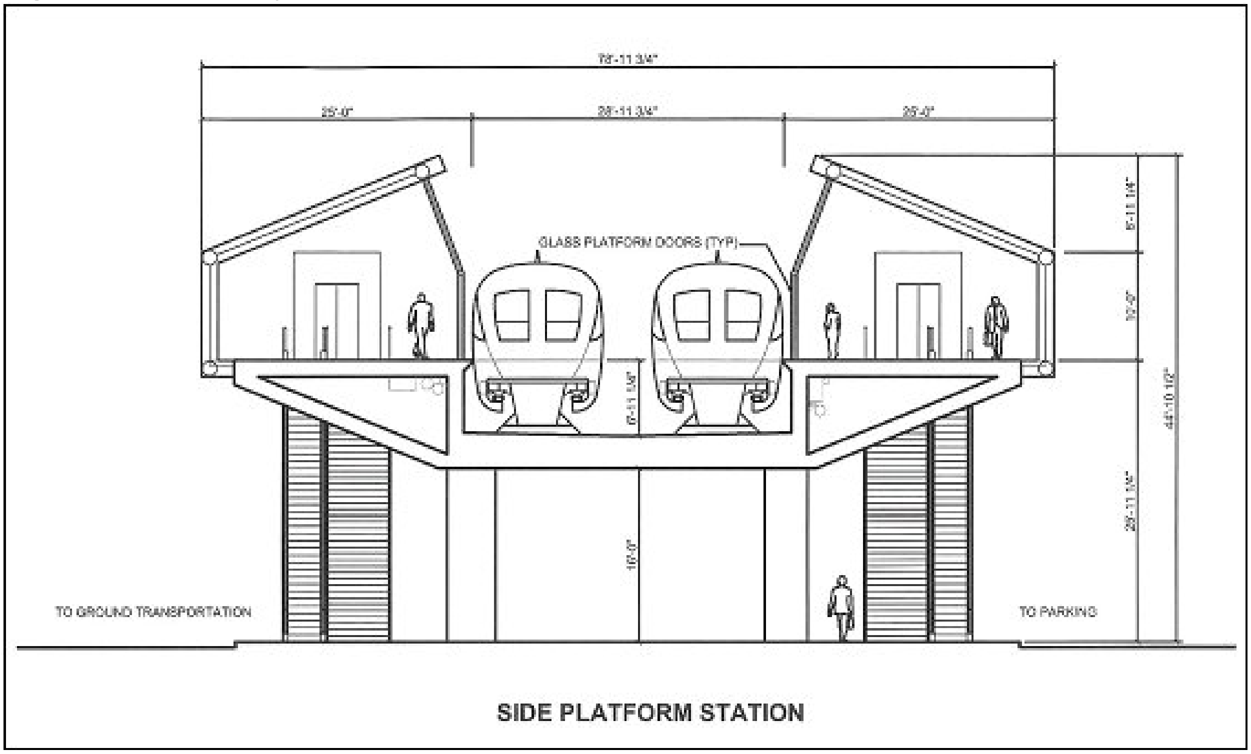
## Station and Guideway Width

- ***Overall Station Width:*** Assume 70 feet for a center platform station (one 40-foot-wide center platform with two 15-foot-wide guideways, and 80 feet for a side platform station with two 25-foot side platforms and two 15-foot guideways).

## Other Station Structure Elements

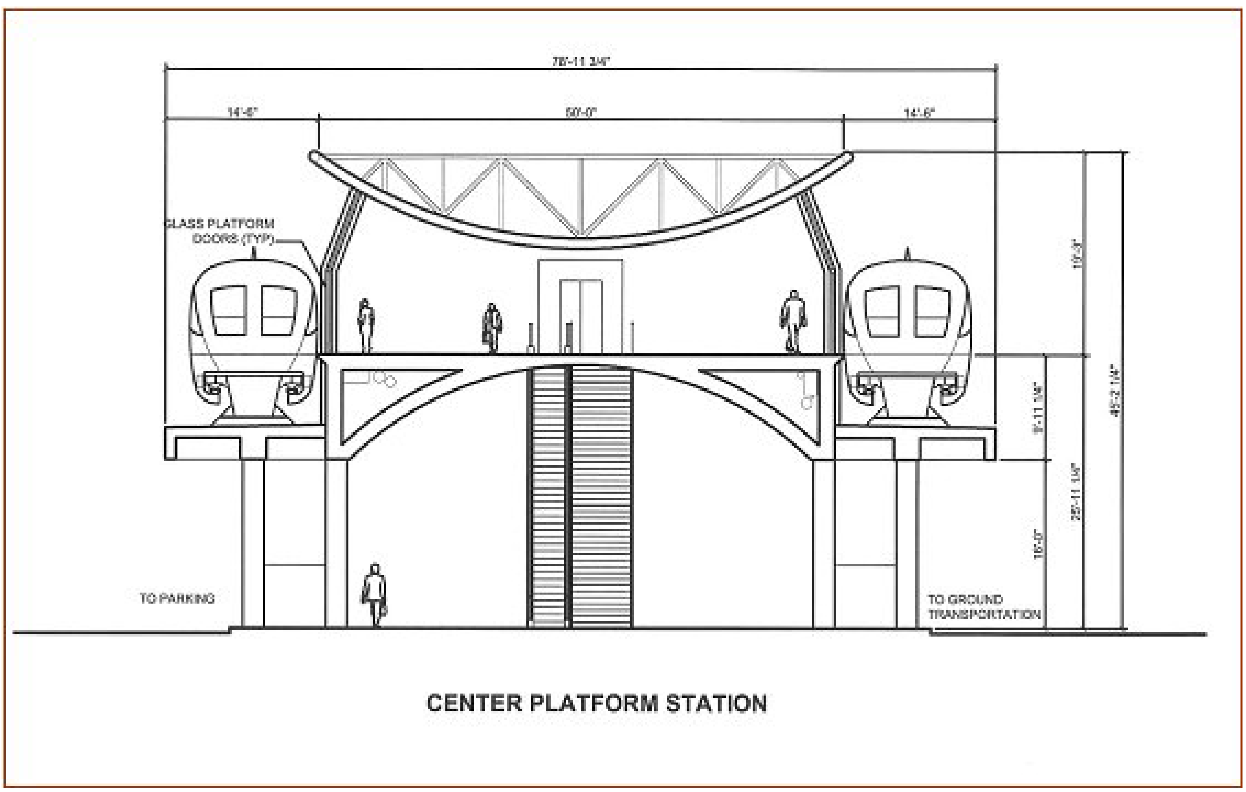
- ***Canopy***
- ***Platform Enclosure***
- ***Retail Concessions***
- ***Restrooms***
- ***Vertical Circulation Elements (Escalators, Elevators)***
- ***Safety and Security Equipment***
- ***Information Devices***
- ***Airline Functions***

*Figure 4-2: Side Platform Station without Mezzanine*




Source: Transrapid

*Figure 4-3: Center Platform Station without Mezzanine*




Source: Transrapid

## Station Site Design Criteria

### General

- All site areas should be landscaped to provide an attractive and comfortable environment.
- The station facility itself should be treated as an important civic structure, a focus of the site design.
- All sites should accommodate the maximum amount of station-related development that the sites can sustain, consistent with regional and local community goals.

### Access

- Pedestrian and vehicular traffic should be separated to the extent possible to avoid pedestrian/vehicular conflicts.
- Bus and auto traffic should be separated to the extent possible to avoid bus/auto conflicts.
- Handicapped facilities should be located as close as possible to the station entrance.
- All pedestrian and vehicular access points should be linked as directly as possible to the existing pattern of urban development.
- Onsite roadways should be designed to slow traffic and create an environment conducive to pedestrian use.
- Bicycle pathways should be developed from most major access roads or nearby or adjacent bike paths.

### Parking

- ***Parking elements:*** Station parking elements shall include, where required, a) Park-and-Ride; b) bus bays; and c) Kiss-and-Ride/taxi/van drop-off.

- ***Ground level uses in parking structures:*** Retail, other commercial and/or community uses.

- ***Location of parking structures:*** Where possible and appropriate, parking structures shall not obstruct direct vision of and access to the station structures and station entrances.
- ***Shared parking:*** Where possible, surface and ground parking should be made available for nearby businesses, special event, and other non-commuter parking purposes.
- ***Landscaping and lighting of open lots***
- ***Expansion and conversion:*** Sites should be designed to allow for expansion of parking capacity if needed, and for the conversion of parking areas into joint/collateral development sites.
- ***Attached uses:*** "Laminating" parking structures, or attaching commercial and/or residential uses to the face of parking structures, should be utilized where feasible.

## Relation to adjacent development

- Wherever possible, sites should be located adjacent to or within existing development and road networks so that they can become extensions of existing urbanization.

## Overall Station Footprints

**Table 4-1** shows the estimated land area needed for stations with different types of parking facilities.

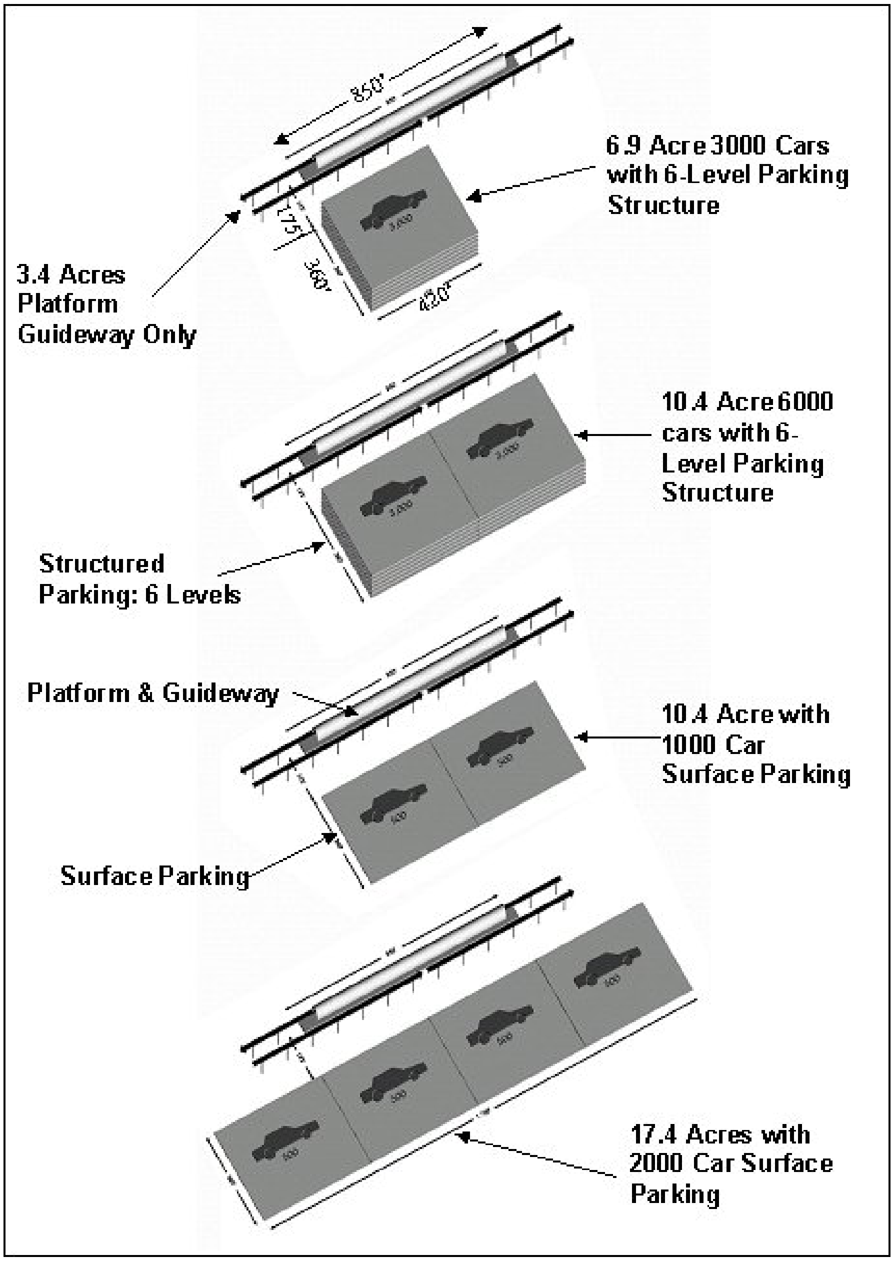
**Table 4-1: Land Area Required for Stations and Parking**

| Facilities | Acreage |
|---|---|
| Station and access with no long-term parking | 3.4 acres |
| Station, access and 500 cars in surface parking lot | 6.9 acres |
| Station, access and 1000 cars in surface parking lot | 10.4 acres |
| Station, access and 2000 cars in surface parking lot | 17.4 acres |
| Station, access and 3000 cars in a 6 level parking structure (500 cars per level) | 6.9 acres |
| Station, access and 6000 cars in a 6 level parking structure (1000 cars per level) | 17.4 acres |

Source: AC Martin Partners, February 2002

**Figure 4-4** illustrates the land area requirements related to parking.

*Figure 4-4: Minimum Station Site Area*




Source: AC Martin Partners, February 2002

## Station structure prototypes within alternate rights-of-way

Station design and access is in part a function of the guideway's location, whether within a rail or highway right-of-way.

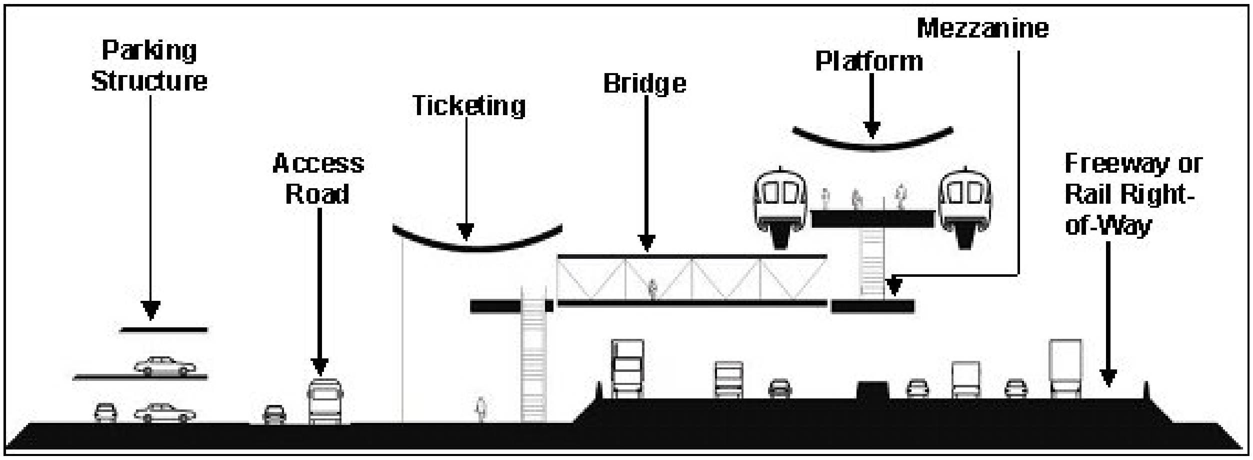
- Stations within rail rights-of-way could be located to the side of existing tracks, or in the space formerly occupied by tracks. The station and its support columns must avoid conflicts with the existing track and its clearance envelope.

- Within freeways, stations could be located in the median between opposing lanes of traffic, or along one of the two sides of the freeway.

- Other structural potentials are placing the station on top of a structural span, and crossing above, through or below freeway ramps and interchanges.

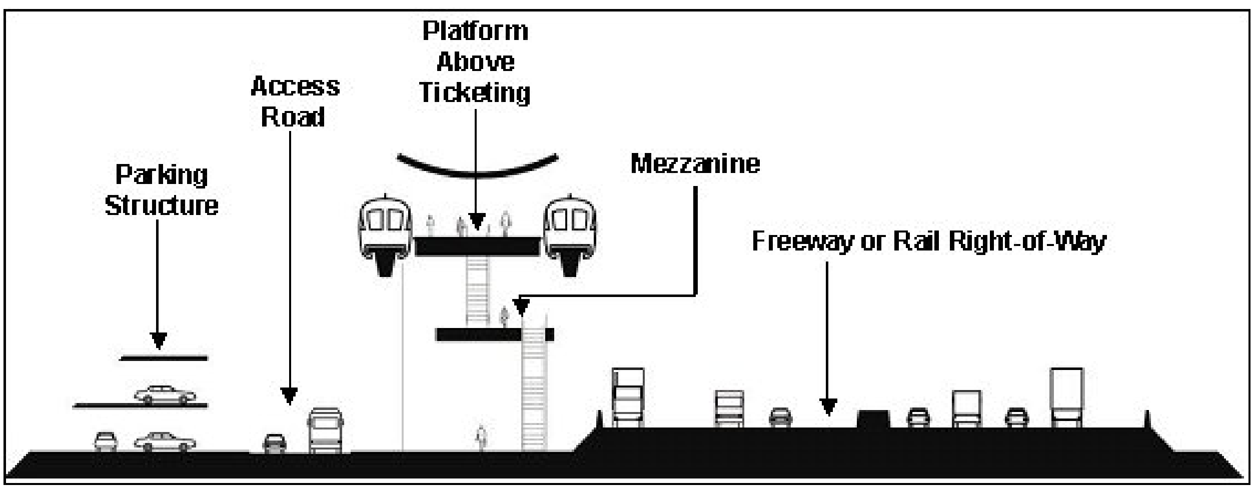
Three exhibits illustrate potential station locations within rights-of-way. **Figure 4-5** illustrates a center-platform and mezzanine within a freeway right-of-way, with a bridge linking the mezzanine to a ticketing structure to the side of the right-of-way. **Figure 4-6** shows a freeway right-of-way with the center-platform and mezzanine located above ticketing to the side of the freeway. **Figure 4-7** shows a center platform with mezzanine above ticketing, directly adjacent to a parking, commercial and/or residential mixed-use building. The mezzanine connection to the adjacent building is a linkage facilitated by joint development.

*Figure 4-5: Station Location within Right-of-Way: Platform in Median, Ticketing on Side*



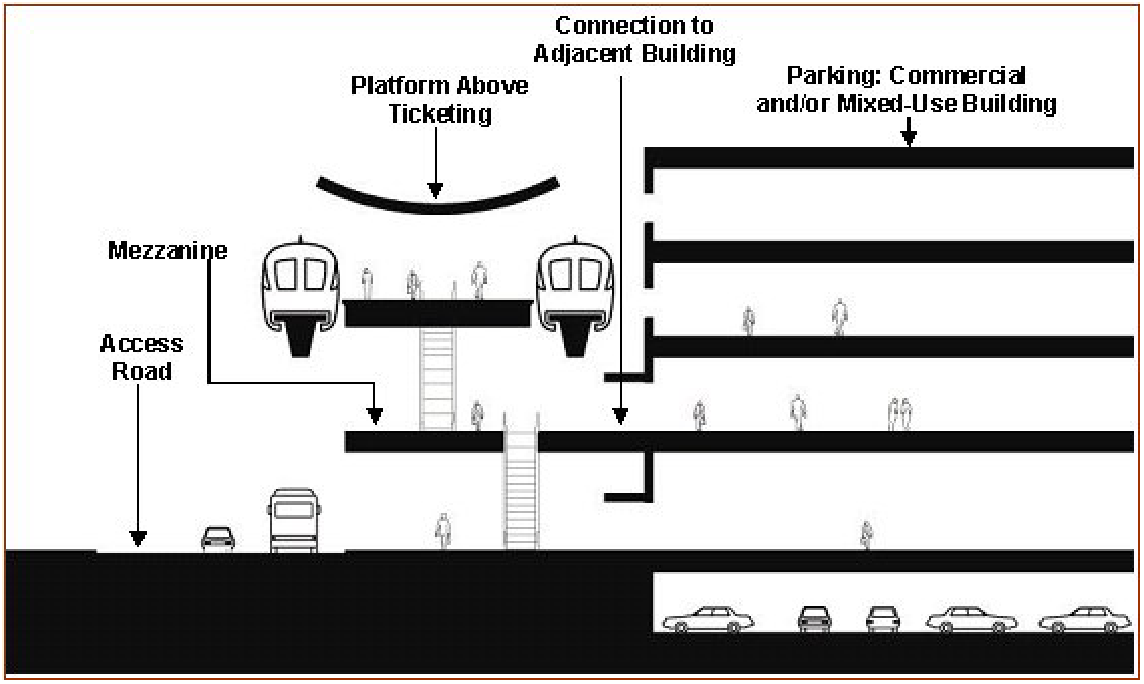

Source: AC Martin Partners, February 2002

*Figure 4-6: Station Location within Right-of-Way: Platform and Ticketing on Side*




Source: AC Martin Partners, February 2002

*Figure 4-7: Station Location within Right-of-Way: Platform and Ticketing Adjacent to Building*




Source: AC Martin Partners, February 2002

## STATION LOCATION CRITERIA

### Location Criteria

This section describes the criteria used to determine station locations with an "ideal" number of factors that are goals for each station to potentially meet.

- ***Station Spacing:*** Station site location at 10 to 15 miles between stations, to allow efficient speeds and minimal travel times.
- ***Land and Location:*** Sufficient land area to accommodate all station facilities independent of station area development.

- ***Land Availability:***
  - Sufficient land available for the station, whether vacant, cleared, or with existing development that it is cost-effective to remove.
  - Adjoining land that could be available for future station or station area expansion.

- ***Local Stakeholder Support:*** A series of workshops was held throughout the study area in November 2001 to identify key issues and local preferences related to stations on the three alignments.

- ***Land Use Compatibility:*** Close proximity of station related to key activity, population and employment centers.

- ***Intermodal Connectivity:***
  - Existing or potential public transit that could serve the station.
  - Opportunities to share station areas with other modes, such as bus, high-speed rail, Metrolink, Amtrak and light rail.
  - Location available to achieve the most direct access possible to airport terminals.

- ***Impacts:*** Level and type of economic, traffic, air quality, neighborhood and other impacts.

- ***Sufficient Road Access***

- ***Sufficient Land for Parking***

- ***Ridership Potential:*** Adequate local population and employment "catchment" area that supports the maximum ridership possible as determined through preliminary ridership analysis.

- ***Pedestrian/Bicycle Access***

- ***Capital Costs***

## Station Area Development Prototypes

SCAG has asked that this study closely examine the potential link between the Maglev system and its stations, with land use and development. This Milestone identified five prototypes of station-area development that could be associated with the Maglev system. Each station area was evaluated as to the prototype most appropriate for that specific area.

### Prototype Descriptions

**Prototype 1:** **No station or station-area uses:** Station facilities are limited to access, parking, and multi-modal transfer facilities. No commercial, residential or mixed-use facilities are provided.

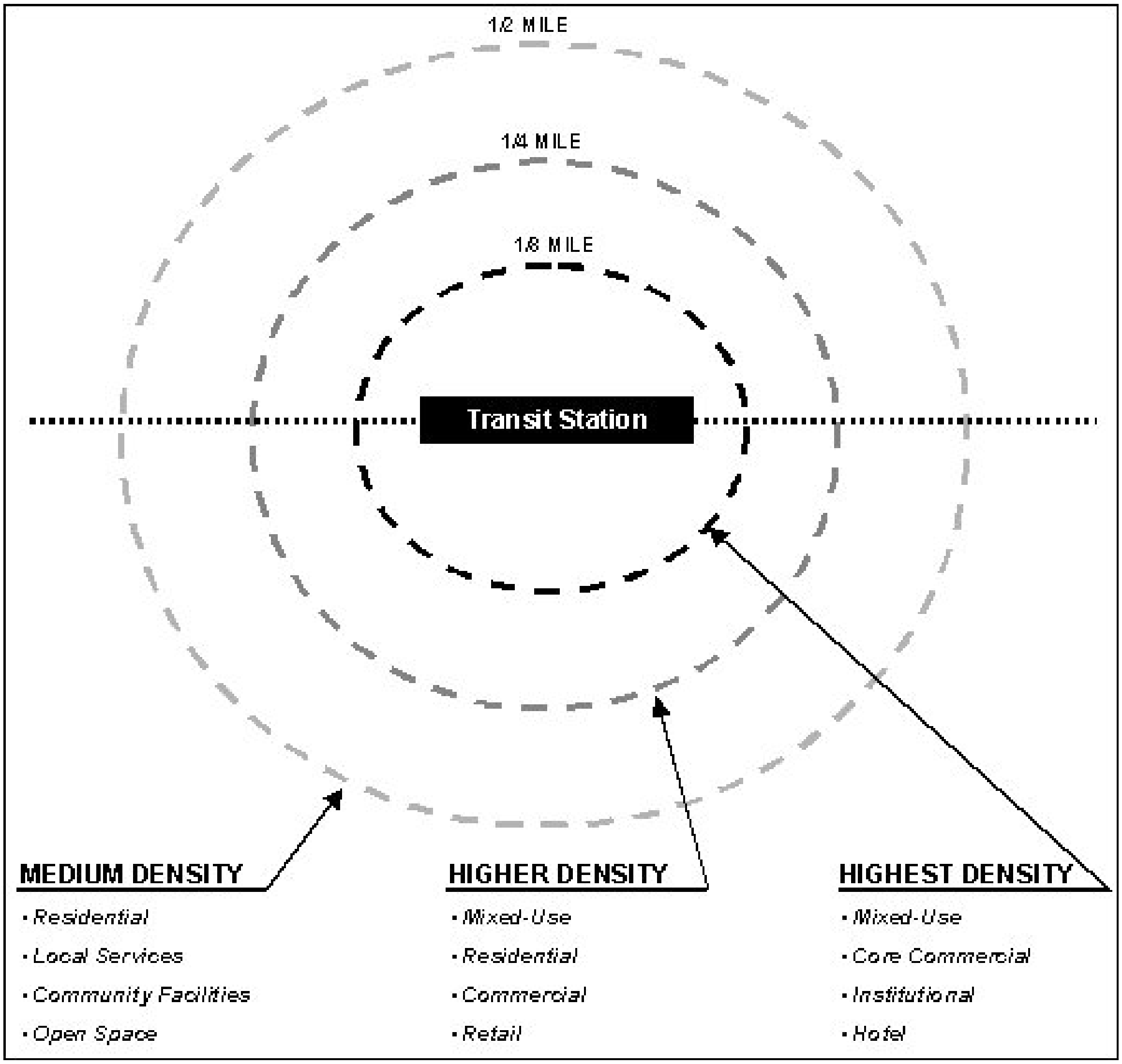
**Prototype 2:** **Convenience/commercial for transit patrons:** This Prototype is the same as Prototype 1, with the addition of patron-related commercial services at the station site alone. Such commercial services act as an amenity for passengers but bring minor if any income to offset system expenses and, again, forego all or most of the advantages that capitalizing on the transportation investment can bring.

**Prototype 3:** **Single-use residential or community-serving commercial:** This prototype incorporates primarily residential or commercial uses oriented not only to the Maglev patron but to commercial users from outside the site. The residential uses could range from attached townhouses or multifloor apartments to high density towers. Commercial uses would be oriented to serve station patrons and the retail/office/service and entertainment markets in the station's area of influence.

**Prototype 4:** **Conventional Mixed Use:** Conventional mixed use is a significant step towards a Transit-Oriented District. Not intended to link with adjacent urban areas, it could be an isolated development, complete within itself. Yet this prototype could still have a level of vitality due to the interaction of residential and commercial uses, and the involvement of commercial patrons from a larger market area than the station area itself.

**Prototype 5:** **Transit-Oriented District:** The Transit-Oriented District (TOD) is an innovation in land use and community planning. Its fundamental purpose is to create a land use pattern that supports, is focused on, served by and maximizes the benefits of the interaction of transit and land use. TODs are designed to encourage transit use and pedestrianization, while reducing auto dependence and environmental degradation. TODs encourage pedestrian access, and through its compact form create the physical framework for social community that has been lacking in most postwar suburban development. **Figure 4-8** illustrates these types of development traditionally found in and around TODs.

*Figure 4-8: Prototype 5 – Transit Oriented Development Area of Influence*




Source: A.C. Martin Partners, February 2002

### Evaluation Categories

Two categories were used to reflect the overall potential for development at each station:

- **Development Potential:** Low, Medium, High.

  This is an overall assessment of the potential station area's ability to absorb regional growth within a station-oriented or station-served development of single or mixed uses.

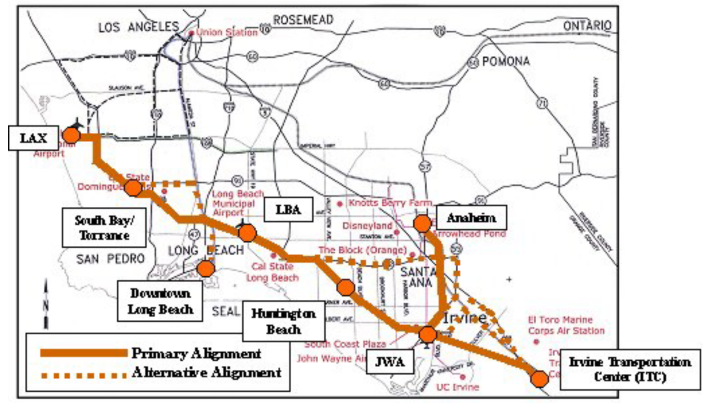
- **Highest Development Type:** Station-oriented commercial; commercial; mixed use, TOD.

  This category utilizes each of the development prototypes. These represent a scale of development ranging from commercial uses primarily serving Maglev passengers (such as a newsstand, snack shop, or dry cleaners) to a complete Transit-Oriented District. Each development type reflects the highest level of station-related development that, in the project team's judgment, could be attracted at a station.

## CANDIDATE STATIONS AND SCREENING

Chapter 3 identified three initial alignment alternatives to be subjected to additional analysis. The project team developed several potential station areas on each alignment. In some cases, more than one site was identified as a candidate to serve a particular area. These sites were subjected to a screening process taking into account preliminary ridership and traffic figures along with comments from stakeholders gathered at station area roundtable meetings in November 2001.

## Southern Alignment




The Southern Alignment fulfills the primary system role of Airport Connector and Feeder by providing the quickest, most direct connections to all airports in the study area. From LAX, it stays almost entirely within the I-405 corridor from I-105 to the ITC, with a stub track north from the JWA area to Anaheim. Options include the use of SR-91 on the western end for connections to the Alameda Corridor, a line to downtown Long Beach along the river, the use of SR-22 to serve Anaheim directly, and various options between Edison Field, JWA, and the ITC. The primary alignment using I-405 (and including the stub line to Anaheim) is approximately 58 miles long.

### Proposed Station Locations

- Los Angeles International Airport:
  - Marine Avenue/Redondo Beach Avenue Metro Rail Green Line Station
  - Aviation Blvd/Imperial Hwy Green Line Station
  - Aviation Blvd/Arbor Vitae Street Station
- Carson
- Long Beach:
  - I-405/Wardlow Road Metro Rail Blue Line Station
  - Airport Passenger Terminal
  - Downtown CBD/Port
- Seal Beach – Huntington Beach Area:
  - Seal Beach West
  - Seal Beach East
  - Huntington Beach

- Anaheim
- John Wayne Airport:
  - Passenger Terminal
  - SR 73/SR 55
  - South Coast Plaza/Metro
  - Hutton Centre/Imperial Promenade
- Irvine Transportation Center

## Southern Alignment Evaluation

**Table 4-2** summarizes the evaluation of stations on the Southern Alignment.

**Table 4-2: Evaluation of Southern Alignment Stations**

| Station | Comments | Development Evaluation |
|---|---|---|
| **Los Angeles International Airport** | | |
| Marine/Redondo Green Line Station | Little room for expansion, but already serves as transit center | High/TOD |
| Aviation/Imperial Green Line Station | Little room for expansion; high traffic impacts; access limited; highest ridership of any LAX station | Low/Station-serving commercial only |
| Aviation/Arbor Vitae | Moderate impacts but moderate ridership as well, though could share with another Maglev line | High/TOD |
| **Carson** | Relatively close to Long Beach stations; high traffic impacts and parking demand, good ridership | High/TOD |
| **Long Beach** | | |
| I-405/Wardlow Road Metro Blue Line Station | Additional ROW needed; good intermodal connections; moderate parking and ridership | Low/Commercial |
| Airport Passenger Terminal | Limited ROW, low ridership and parking demand | Low/TOD |
| (Option: Downtown CBD/Port) | Moderately high ridership and parking demand, good activity center location, but local support is uncertain | High/TOD |
| **Seal Beach – Huntington Beach Area** | | |
| Seal Beach – West | Good station spacing; location on Navy facility may be a problem; moderate ridership and parking demand | Low/Station Facilities Only if on Navy Base; High/TOD if on alternate site |
| Seal Beach – East | Good station spacing; location on Navy facility may be a problem; moderate to high ridership and parking demand | Medium/Mixed Use |
| Huntington Beach | Good station spacing; mall site provides good opportunity; high ridership and parking demand | Medium/Commercial |
| **Anaheim** | Good station spacing; high ridership and parking demand; major traffic impacts in already congested area | High/TOD |
| **John Wayne Airport** | | |
| Passenger Terminal | Low to moderate ridership potential; limited land area | Medium/TOD |
| SR73-SR55 | Good station spacing; major traffic impacts; moderate ridership and parking demand | Low/Station-Area Commercial |
| South Coast Plaza/Metro | High ridership and parking demand; major traffic impacts | Medium/Mixed Use |
| Hutton Centre/Imperial Promenade | Moderately high ridership and parking demand; high traffic impacts | High/TOD |
| **Irvine Transportation Center** | Good station spacing and intermodal access; moderate to high ridership and moderate parking demand | High/TOD |

Source: URS Corp., February 2002

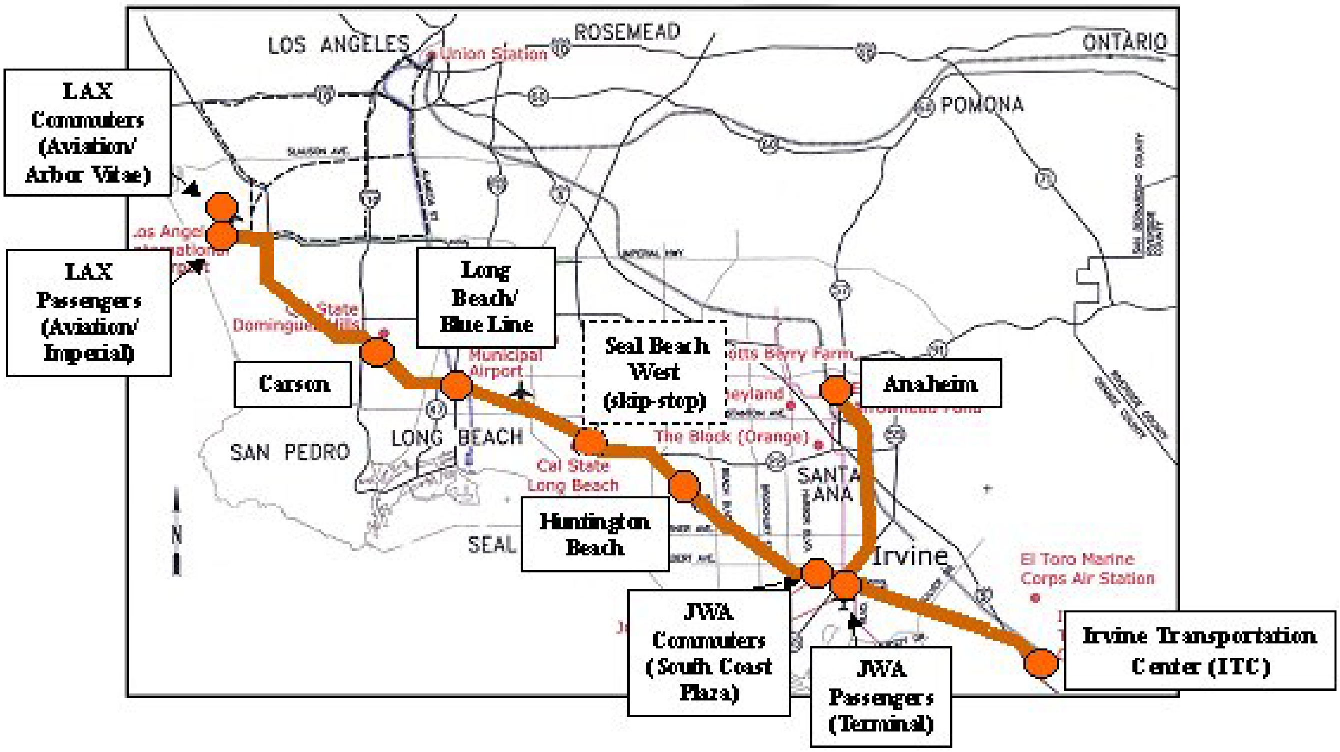
The table allows the project team to draw the following conclusions as to station preference:

- **LAX Area:** In the absence of an on-airport station, it appears that two station sites are most preferable: the Aviation/Imperial Highway Green Line Station (even though it has relatively low development potential, it has the highest ridership and intermodal capability) and the Aviation/Arbor Vitae Station (due to its development potential and its linkages to the other Maglev systems). It may be preferable to focus commuter parking at the Aviation/Arboe Vitae station and use the Aviation/Imperial Highway Station as an employee/passenger station, pending a final decision on internal circulation by the LAX Master Plan.

- **Long Beach:** The I-405/Wardlow Road Blue Line Station is preferable after initial analysis, primarily due to the problematic physical constraints of entering the Long Beach Airport property and the high intermodal capability of the Blue Line Station. Even though this station is relatively close to the Carson Station, its importance as an intermodal transfer center to the Blue Line (and downtown Long Beach) makes it an important station for the system. It could also serve as a transfer point for a shuttle serving Long Beach Airport, increasing its utility as an airport passenger station.
- **Seal Beach-Huntington Beach:** The Huntington Beach Station seems to provide the best opportunity in this area primarily due to its land availability. The alternative site near Seal Beach West might be retained as a skip-stop future station.
- **John Wayne Airport:** The South Coast Plaza Metro Station is a mainline station that has high ridership and probably should be the focus for commuters; the Airport station should also be included to serve airport passengers and employees if physical constraints can be overcome. The Hutton Centre/Imperial Promenade on the spur line to Anaheim has the highest development potential of any station in the area but may be too close to the mainline to include in the system.

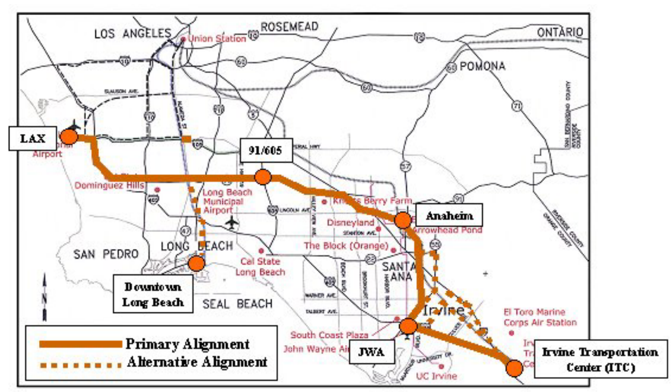
**Figure 4-9** shows the initial stations recommended for the Southern Alignment.

*Figure 4-9: Initial Stations Recommended for Southern Alignment*




## Central Alignment

The **Central Alignment** focuses on the SR-91 corridor as the primary means to connect the two ends of the study area. It best fulfills the system role of **Activity Center Connector** by linking the major destinations in the Orange County area. It also includes an optional stub line to Long Beach by way of I-710 and the river, with several variations between Anaheim, JWA, and the ITC. The primary alignment is approximately 52 miles long.



### Proposed Station Locations

- Los Angeles International Airport:
  - Marine Avenue/Redondo Beach Avenue Metro Rail Green Line Station
  - Aviation Blvd/Imperial Hwy Green Line Station
  - Aviation Blvd./Arbor Vitae St. Station
- South Bay
  - Torrance
  - Compton
- Long Beach CBD/Port (Optional)
- Cerritos:
  - SR91/I-605
  - Towne Center
- Fullerton
- Anaheim
- John Wayne Airport:
  - Passenger Terminal
  - Hutton Centre/Imperial Promenade
- Irvine Transportation Center

### Central Alignment Evaluation

**Table 4-3** summarizes the evaluation of stations on the Central Alignment.

| Table 4-3: Evaluation of Central Alignment Stations | | |
|---|---|---|
| **Station** | **Comments** | **Development Evaluation** |
| **Los Angeles International Airport** | | |
| Marine/Redondo Green Line Station | Little room for expansion, but already serves as transit center | High/TOD |
| Aviation/Imperial Green Line Station | Little room for expansion; high traffic impacts; access limited; highest ridership of any LAX station | Low/Station-serving commercial only |
| Aviation/Arbor Vitae | Moderate impacts but moderate ridership as well, though could share with another Maglev line | High/TOD |
| **South Bay** | | |
| Torrance | Good station spacing; moderate ridership and parking demand; difficult access | Medium/TOD |
| Compton | Good station spacing to west but not to east; low ridership and parking demand | Low/Commercial |
| **Cerritos** | | |
| SR91/I-605 | Fair station spacing; low to moderate ridership and parking demand; high traffic impacts | Medium/Mixed Use |
| Towne Center | Good station spacing; moderate ridership and parking demand | High/TOD |
| **Fullerton** | Poor station spacing; low to moderate ridership and parking demand | Low/Mixed Use |
| **Anaheim** | Good station spacing; high ridership and parking demand; major traffic impacts in already congested area | High/TOD |
| **John Wayne Airport** | | |
| Passenger Terminal | Low to moderate ridership potential; limited land area | Medium/TOD |
| Hutton Centre/Imperial Promenade | Moderately high ridership and parking demand; high traffic impacts | High/TOD |
| **Irvine Transportation Center** | Good station spacing and intermodal access; moderate to high ridership and moderate parking demand | High/TOD |

Source: URS Corp., February 2002

The table allows the project team to draw the following conclusions as to station preference:

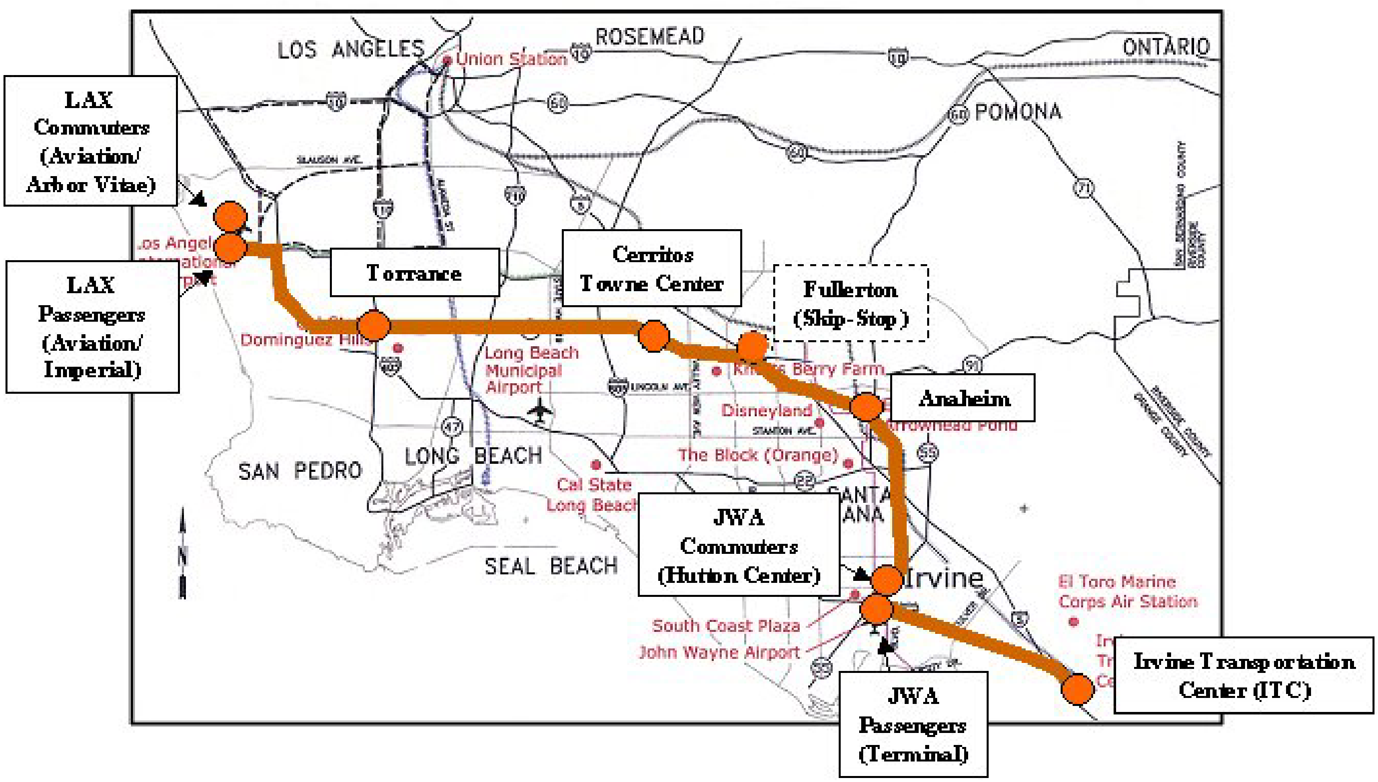
- **LAX:** As with the Southern Alignment, the Aviation/Arbor Vitae station should be the focus for commuters, with the Aviation/Imperial Green Line Station being the focus for airport passengers and employees.
- **South Bay:** The Torrance Station has the best station spacing and highest development potential of the two station sites under consideration in this area.
- **Cerritos:** The Towne Center Station has the best station spacing and highest development potential of the two sites under consideration in this area.
- **Fullerton:** This station's proximity to Cerritos and Anaheim make it an initial poor candidate for a Maglev station, as its close station spacing would

tend to make the Maglev operations inefficient. However, it may need to be retained as a skip-stop station (for example, operating during peak periods only, or at periodic intervals in combination with through service) due to its strategic location as a multi-modal transit regional transit center.

- **John Wayne Airport**: Both the Hutton Centre/Imperial Promenade station (for commuters) and the Airport Terminal station (for airport employees and passengers) should be retained on this alignment.

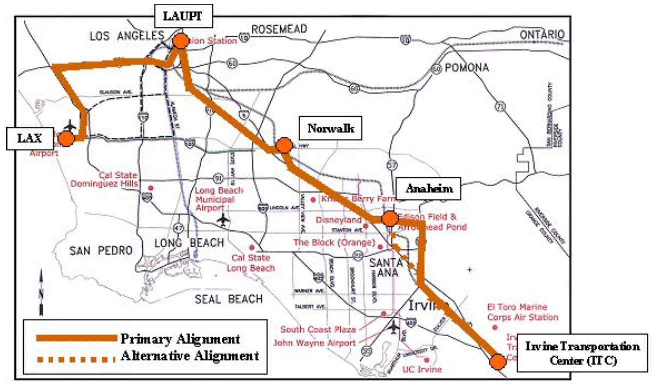
**Figure 4-10** shows the initial list of stations recommended for the Central Alignment.

***Figure 4-10: Initial Stations Recommended for Central Alignment***



## Northern Alignment

The **Northern Alignment** is focused on the UP railroad branch that parallels I-5, with the use of various railroad and roadway alignments to link LAUPT (and LAX) with Orange County. It best fulfills the role of **Multi-Modal Connector**, and the primary alignment is approximately 63 miles long counting the LAX-March recommended alignment between LAX and LAUPT. This alignment would not serve LBA or JWA.




### Proposed Station Locations

- Los Angeles International Airport
  - Aviation Blvd./Arbor Vitae St.
  - Aviation Blvd./Imperial Highway
- West Los Angeles
- Los Angeles Union Station
- Norwalk Transportation Center
- Fullerton
- Anaheim
- Irvine Transportation Center

### Northern Alignment Evaluation

**Table 4-4** summarizes the evaluation of stations on the Northern Alignment.

| Table 4-4: Evaluation of Northern Alignment Stations | | |
|---|---|---|
| **Station** | **Comments** | **Development Evaluation** |
| **Los Angeles International Airport** | | |
| Aviation/Imperial Green Line Station | Little room for expansion; high traffic impacts; access limited; highest ridership of any LAX station | Low/Station-serving commercial only |
| Aviation/Arbor Vitae | Moderate impacts but moderate ridership as well, though could share with another Maglev line | High/TOD |
| **LA West** | Assumed to be part of the LAX-March and LAX-Palmdale studies | N/A |
| **Los Angeles Union Station** | Good station spacing; regional intermodal hub | High/TOD |
| **Norwalk Transportation Center** | Good to fair station spacing; low to moderate ridership and parking demand; good intermodal access | Low/Commercial |
| **Fullerton** | Poor station spacing; low to moderate ridership and parking demand | Low/Mixed Use |
| **Anaheim** | Good station spacing; high ridership and parking demand; major traffic impacts in already congested area | High/TOD |
| **Irvine Transportation Center** | Good station spacing and intermodal access; moderate to high ridership and moderate parking demand | High/TOD |

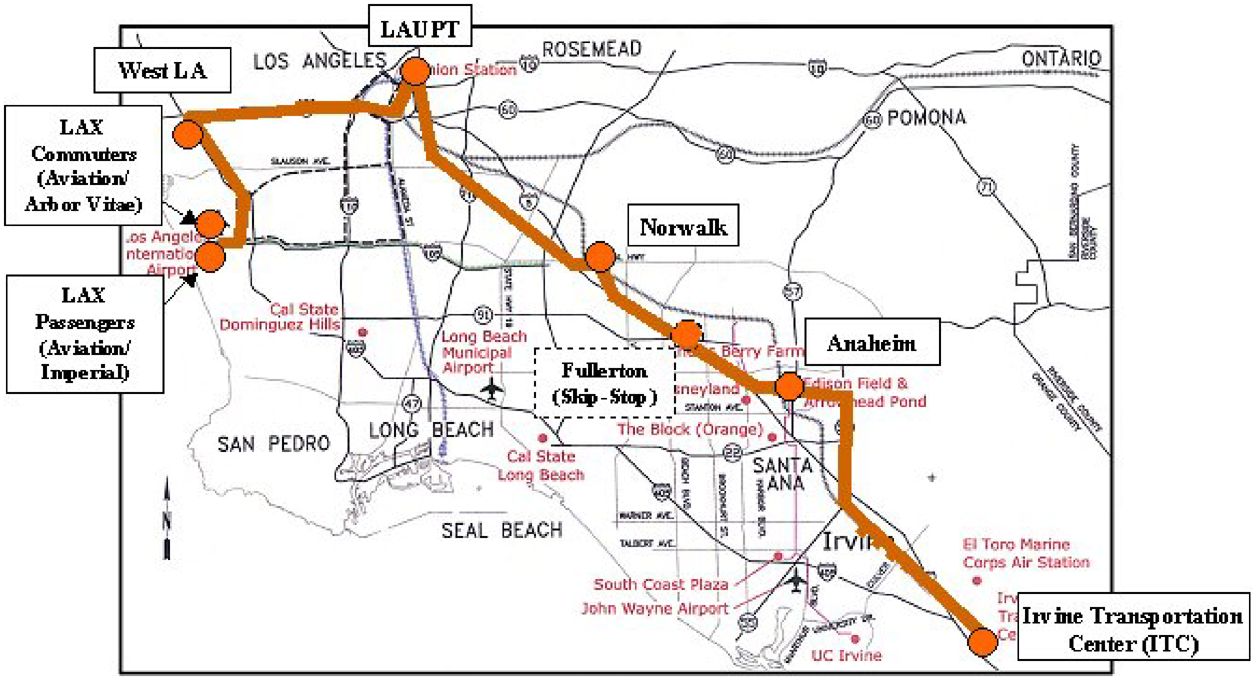
Source: URS Corp., February 2002

The table allows the project team to draw the following conclusions as to station preference:

- **LAX:** As with the Southern and Central Alignments, the Aviation/Arbor Vitae station should be the focus for commuters, with the Aviation/Imperial Green Line Station being the focus for airport passengers and employees.
- **Fullerton:** This station's proximity to Norwalk and Anaheim make it an initial poor candidate for a Maglev station, as its close station spacing would tend to make the Maglev operations inefficient. However, it may need to be retained as a skip-stop station (for example, operating during peak periods only, or at periodic intervals in combination with through service) due to its strategic location as a multi-modal transit regional transit center.

**Figure 4-11** shows the initial stations recommended for the Northern Alignment.

*Figure 4-11: Initial Stations Recommended for Northern Alignment*




## Development Evaluation Summary

A review of the development potential of the three alignments allows the project team to draw the following conclusions:

- The Central Alignment has the largest number of station sites with high development potential (5), followed by the Southern and Northern Alignments with four each.
- The Central Alignment also has the largest number of stations with Transit Oriented Development potential (7) followed by the Southern Alignment with five and the Northern Alignment with four.

# 5.0 ENVIRONMENTAL ASSESSMENT

[Note: this chapter is a summary of a previous Milestone report submitted earlier. More details on the information contained in this chapter are included in Milestone Report 7: Preliminary EA: Existing Conditions, April 2002]

## INTRODUCTION

The purpose of this chapter is to document existing environmental conditions along the study corridors related to public resources, land use, cultural resources, and biological resources.

This environmental conditions report utilizes three primary regulatory frameworks for documenting environmental conditions in the study corridors:

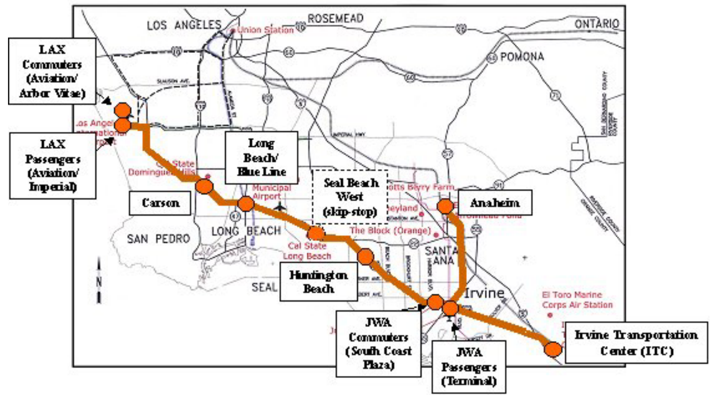
- "Guidelines for California Environmental Quality Act," California Code of Regulations, Title 14, Chapter 3, Sections 1500-15387, and Appendix G (environmental checklist);
- The Federal Railroad Administration's "Procedures for Considering Environmental Impacts," 45 CFR 40854; and
- "Environmental Impact and Related Procedures" of the Federal Highway Administration and the Federal Transit Administration, 23 CFR 771.

### Final Recommended Alignment Alternatives

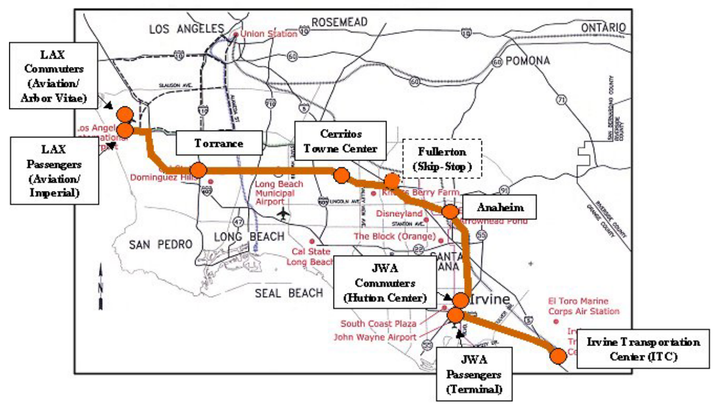
The project team developed three final recommended alignment alternatives, along with conceptual station locations, each of which is aimed at fulfilling one of the three major system roles developed for this project.

The **Southern Alignment** fulfills the primary system role of **Airport Connector and Feeder** by providing the quickest, most direct connections to all airports in the study area. From LAX, it stays almost entirely within the I-405 corridor from

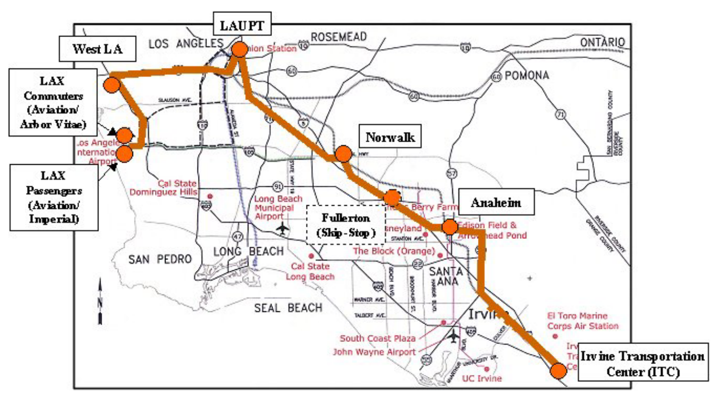
I-105 to the Irvine Transportation Center (ITC), with a stub track north from the John Wayne Airport (JWA) area to Anaheim. One alternative alignment uses SR-22 to serve Anaheim directly. The primary alignment using I-405 (and including the stub line to Anaheim) is approximately 58 miles long.




The **Central Alignment** focuses on the SR-91 corridor as the primary means to connect the two ends of the study area. It best fulfills the system role of **Activity Center Connector** by linking the major destinations in the Orange County area. The primary alignment is approximately 52 miles long.




The **Northern Alignment** is focused on the UP railroad branch that parallels I-5, with the use of various railroad and roadway alignments to link LAUPT (and LAX) with Orange County. It best fulfills the role of **Multi-Modal Connector**, and the primary alignment is approximately 63 miles long counting the LAX-March recommended alignment between LAX and LAUPT.



This alignment would not serve Long Beach Airport or JWA.

## Organization of This Report

- The section on **public resources** analyzes existing conditions related to parks and recreational facilities, schools, hospitals, public buildings, golf courses, and fire and police buildings.
- The section on **land use** focuses on land use within 500 feet of the three proposed alignments and conceptual station locations, with documentation on sensitive land uses within 1,000 feet of the alignment.
- The section on **cultural resources** focuses on archaeological sites, historic structures, and historic landmarks near the alignments.
- The section on **biological resources** documents existing conditions related to sensitive plant species, sensitive wildlife species, and wetlands or drainage areas.

## Public Resources

The goal of this section was to identify public resources adjacent to and near potential locations of the LAX / South (Orange County) High-Speed Ground Access alignments and stations. Public resources documented included parks and recreational facilities, schools, hospitals, public buildings or facilities, golf courses, and fire and police buildings.

### Parks and Recreational Facilities

This analysis documented parks within 250 feet of either side of each alignment and within one-quarter mile of any proposed station location.

- The Southern Alignment has 30-36 parks near its proposed routes, depending on the exact alignment chosen.
- The Central Alignment is near 34 parks.

- The Northern Alignment is adjacent to 19 parks.

## Schools

This analysis documented schools located within 250 feet of an alignment and within one-quarter mile of proposed station locations.

- The Southern Alignment passes near 34-42 schools, depending on the exact alignment chosen.
- The Central Alignment is near 47 schools.
- The Northern Alignment is near 25 schools.

## Hospitals

No hospitals would be located within 250 feet of the alignments or within one-quarter mile of the proposed station locations.

## Public Buildings

This analysis documented the government buildings within 250 feet of the proposed alignments and within one-quarter mile of stations.

- The Southern Alignment passes near 12-15 public buildings, depending on the exact alignment chosen.
- The Central Alignment is near 8 public buildings.
- The Northern Alignment is near 13 public buildings.

## Golf Courses

This analysis documented golf courses within 250 feet of the proposed alignments and within one-quarter mile of stations.

- The Southern Alignment passes near 5-8 golf courses, depending on the exact alignment chosen.
- The Central Alignment is near 2 golf courses.
- The Northern Alignment is near 2 golf courses.

### Fire and Police Protection

No fire or police stations are located adjacent to any of the alignments or within one-quarter mile of a proposed station.

## LAND USE

This section describes the land use setting for the three proposed alignments of the LAX / South (Orange County) high-speed ground access system. This section focuses on existing land uses immediately adjoining and within 500 feet of the proposed alignments and transit stations. Where applicable, sensitive land uses within 1,000 feet on either side of the proposed alignments are also mentioned. Planned land uses may vary from the existing land uses. A general review of regional and local land use regulations is also included.

### Southern Alignment

#### Rights-of-Way

The most predominant right-of-way category along the Southern Alignment is highway, followed by railroad corridor.

#### Land Uses

Based on total acreage within 500 feet of the southern alignment, the most predominant land use is Transportation and Utilities. Four segments are bordered most predominantly by industrial land uses. Seven segments of the southern alignment border significant portions of low-density to high-density residential development. The longest stretch of low-density residential use occurs between Long Beach Airport and John Wayne Airport. The most significant areas of industrial use occur between Edison Field and the John Wayne Airport. Commercial uses are more prevalent for segments near John Wayne Airport and adjacent to Edison Field and the section of I-405 between I-110 and I-710. The southernmost portion of the alignment, near the ITC, has significant areas of undeveloped (vacant) land, as does the portion of I-405 just south of I-605 before SR 22.

### Sensitive Land Uses

The placement of an elevated rail line could potentially be incompatible with sensitive land uses. Schools and religious institutions within 1000 feet (one-quarter mile) of the proposed route are considered.

There are 47 schools, 6 religious institutions, and 1,318 acres of residential uses are within one-quarter mile of the proposed Southern Alignment. One segment could potentially pass within 250 feet of an elementary school and near approximately 147 acres of residential uses. This segment, which extends along I-405 from Artesia Boulevard (in Torrance) to the I-110/I-405 interchange, is bordered to the north by Yukon Elementary School. There are four other schools near the alignment. One segment, which extends along the I-405 from approximately Marine Avenue to Artesia Blvd, also has relatively high number of sensitive land uses. There are 3 schools, 5 religious institutions, and 96 acres of residential land uses near to this relatively small segment of the proposed Southern Alignment.

### Stations

Fifteen locations were considered for transit stations along the proposed Southern Alignment. Milestone 4 made preliminary recommendations on station locations. However, those locations are subject to change depending on ridership and cost analysis. Therefore, all potential station locations are included in this analysis.

Station areas that are already zoned for transportation are more likely to be compatible with surrounding land uses and zoning codes; these would include the potential station sites at: LAX Passenger, LAX Commuter at Aviation, Huntington Beach, JWA Passenger, JWA at Hutton Center, and the ITC. Stations in commercial areas may be more difficult to integrate into existing land use patterns, unless the area is already dominated by transportation uses (e.g., Anaheim). The proposed Carson and JWA Commuter-South Coast Plaza stations would have to be incorporated into shopping areas on land that is currently zoned for commercial use. The LAX Commuter station north of Imperial would be located on land currently zoned for industrial use. Likewise, two of the proposed Seal Beach stations would be located on land that is currently zoned for government use (United States Weapons Station).

## Central Alignment

### Rights-of-Way

Rights-of-way along the Central Alignment are primarily highway, followed by railroad corridors and some utility corridors.

### Land Uses

The Central Alignment would follow existing transportation and utility corridors, which is the predominant land use along most of the route. However, the majority of the areas on either side of the existing transportation corridor are zoned as low density residential or industrial. There is also a significant amount of commercial land use on either side of the alignment. Just north of Edison Field, a small segment traversing a utility corridor is also bordered by a higher percentage of public facility type uses. Near the Irvine Transportation Center, a significant portion of adjacent land is vacant.

Along I-405 from LAX to the I-110 freeway, low-density residential land uses on either side of the alignment are interspersed with commercial and some industrial areas. The segment between the I-110 and I-710 freeways is predominantly industrial. East of the I-710 freeway, (between I-710 and Anaheim) land uses are more diverse. There is a mix of low-density and high-density residential with large pockets of commercial uses. Between Anaheim and the John Wayne Airport, the route travels through areas dominated by industrial and residential uses with scattered commercial development. The commercial development becomes denser near John Wayne Airport and then becomes low density residential south along I-405. The area near the ITC is dominated by undeveloped and agricultural land uses.

### Sensitive Land Uses

There are 50 schools, 1 college, and 6 religious institutions within one-quarter mile of the primary Central Alignment. There are also 1,336 acres of residential land uses within 500 feet of the alignment. The most sensitive segments are located between I-710 and Anaheim. One segment along SR-91, near the Blue line station is by far the most sensitive area because three of the six schools are located within 250 feet of the proposed alignment. Lincoln, St Bernard, and Las Flores Elementary Schools each abut SR 91. Compton Community College also is within 250 feet. The highest concentration of religious institutions near the alignments occurs near a small segment, which follows I-405 from Marine Avenue to Artesia Boulevard in the Hawthorne/Lawndale area, which comes within 1000 feet of 5 religious institutions, 3 schools, and many residential land uses. Public concerns in the Hawthorne/Lawndale area may, therefore, be vital to the implementation of the project via this segment. Furthermore, all local municipalities and jurisdictions in which the alignment passes may have specific concerns. As mentioned before, the project has a potential to result in direct and indirect impacts and secondary effects such as inducing growth within built-up areas.

### Stations

Ten locations were being considered for transit stations along the proposed Central Alignment.

Station locations that are adjacent to existing transit stations or that are already zoned for transportation are the most likely areas to be compatible with surrounding land uses and zoning. The Compton station is the only proposed location that would be in area zoned as commercial and is not dominated by transportation uses.

## Northern Alignment

### Rights-of-Way

This alignment's right-of-way is almost equally split between highway and railroad corridors.

### Land Uses

The primary Northern Alignment travels through predominantly industrial land uses north of the Anaheim station. South of the Anaheim station, land uses are dominated by residential land uses with a mix of many other types of uses. There are major pockets of industrial and commercial uses between Anaheim and the ITC. The predominant land use near the ITC varies between residential, public facilities, and agricultural uses.

The areas on either side of the Metrolink (Orange County Line) right-of-way and the Union Pacific "Patata" Line, in downtown, are dominated by industrial land uses. There are small pockets of low- to high-density residential uses near the northern portion of the right-of-way. South of I-710, there are more commercial uses intermixed with the industrial uses. North of SR 91 along I-5, there is a combination of industrial and commercial. South of SR 91 along 1-5 to Edison International Field, the dominant land use is low density residential with pockets of commercial and industrial. Southeast of Edison International Field, the primary Northern Alignment follows Metrolink Rail through primarily residential areas. Near Irvine, a portion of the route is zoned Agriculture but is a utility corridor currently used as a commercial plant nursery. As the route reconnects with the Metrolink Orange County Line in Tustin, there continues to be heavy concentrations of residential areas to the ITC.

### Sensitive Land Uses

The Northern Alignment would come within 500 feet of approximately 7260 acres of residential land uses. It would also come within 1000 feet of 1 religious institution and 27 schools (250 feet within 1 school).

The segment southeast of LAUPT contains 12 schools but is a long segment stretching from downtown Los Angeles to Anaheim. Only one of the 12 schools is within 250 feet of the proposed Northern Alignment.

The proposed alignment would traverse many jurisdictions and municipalities in both Los Angeles and Orange Counties. Because the project has a potential to result in indirect and secondary effects of inducing growth within built areas, public interest may by of vital concern. This would be expected to occur as a result of the availability of high-speed transit service within the Los Angeles basin, as well as from the change in land use associated with ongoing growth. A land use incompatibility could occur if an existing land use becomes more intensive.

### Stations

Six locations are being considered for transit stations along the proposed Northern Alignment. Most land use around stations on this alignment is transportation related, as many stations are located at existing multi-modal facilities.

## CULTURAL RESOURCES

A cultural resources records search was conducted for three primary alternative alignments of the LAX/South (Orange County) High Speed Ground Access Study. The records search was conducted to 1) identify known cultural resources within each alternative that might be impacted by construction of the MAGLEV system and 2) delineate areas of special sensitivity regarding known or potential cultural resources in each alternative.

### Summary of Results

A cultural resources records search conducted by Chambers Group for the proposed MAGLEV project indicated that most of the areas included in the three primary alignments, as described earlier in this report, have not previously been surveyed for cultural resources. Many of the relatively small portions of the three alignments that have been studied were surveyed ten or more years ago. The OHP considers field surveys conducted more than ten years ago inadequate to address issues of current conditions and recommends new surveys of those areas.

### Southern Alignment

Seven archaeological sites are potentially located within the Southern Alignment construction corridor.

Even though all seven sites contain non-fossilized marine shell typical of prehistoric cultural deposits in near-coastal areas, the investigators at two sites did not observe artifacts are part of the deposits. These two locations, therefore, may not actually be archaeological sites.

Of the remaining five sites, one (Long Beach area near Bellflower Boulevard) is especially sensitive because human burials have been recovered from the site and additional remains could still be present. Similarly, a site in Westminster is reported to have contained human bone and additional remains could still be present. A site at Costa Mesa includes intact subsurface features such as earthen pits containing cultural materials and other features could still be present. A site in Irvine may date from the Millingstone Period of several thousand years ago and represents uncommon research potential.

### Central Alignment

Two archaeological sites are potentially located within the Central Alignment construction corridor. Both sites are reported to contain prehistoric lithic artifacts and marine shell. One may be within the State Route 91 ROW in the Gardena area, and another is located adjacent to the Interstate 405 ROW in the Irvine area.

Utilizing portions of the UPRR route in the Cerritos, Santa Ana, and Tustin areas, the Central Alignment would overlay parts of the historic Southern Pacific

Railroad route. Although the Southern Pacific route dates as early as 1869, the actual materials of the present-day Union Pacific operation are largely recent in age, the historic rails and other fittings having been replaced in many areas during regular maintenance.

Most of the historic standing structures in the vicinity of the Central Alignment are not located directly adjacent to the route. A number of significant structures, however, are clustered in the City of Orange and comprise the Plaza Historic District, listed on the National Register of Historic Places (NRHP) as a district. The district contains dozens of early residential and commercial structures from the beginnings of the city, including the historic Santa Fe Depot (1938) and Railroad Park area directly adjacent to the BNSF ROW.

### Northern Alignment

Two archaeological sites are potentially located within the Northern Alignment construction corridor. Both sites are reported to contain prehistoric human burials and other significant archaeological components. One is associated with Union Station (LAUPT) in downtown Los Angeles, while another is located in the Tustin area within the BNSF ROW.

A variety of historic structural resources are located within or directly adjacent to the Northern Alignment. Utilizing portions of the UPRR route through the greater Los Angeles area, the Northern Alignment would overlay the historic Southern Pacific Railroad route. Although the Southern Pacific route dates as early as 1869, the actual materials of the present-day Union Pacific operation are largely recent in age, the historic rails and other fittings having been replaced in many areas during regular maintenance.

A number of historic standing structures are situated directly adjacent to the Northern Alignment, and most are either California Historical Landmarks or

National Register of Historic Places (NRHP) properties. These structures are present in at least three discrete areas along the alignment:

- Union Station (LAUPT) area, downtown Los Angeles
- Paddison Ranch mansion, ancillary buildings, and landscaped grounds, Norwalk
- East Irvine Old Town complex

## Concluding Summary

Among the three primary alignments, the Northern Alignment appears to face the most substantial constraints posed by potential cultural resources issues. These include archaeological issues represented by two sites that contain multiple human burials, with one of these sites (associated with Union Station/LAUPT) especially significant because it contains a prehistoric Native American cemetery as well as several distinct historic components dating to the earliest phases of the city of Los Angeles. These issues also include substantial problems represented by significant historic structures, or groups of structures, constituting NRHP, CHL, and other types of recognized historic properties, potentially constituting a "fatal flaw" to these portions of the Northern Alignment because impacts to the integrity of setting from the MAGLEV system may not be mitigable.

The Central Alignment appears to face a substantial constraint only from potential issues represented by the Plaza Historic District along the BNSF ROW in the City of Orange. The overall district is an NRHP property and includes the historic Santa Fe Depot and Railroad Park area. It is likely that the integrity of setting of the Santa Fe Depot and, possibly, other structures in the District, will be adversely affected by construction of the MAGLEV.

No issues stemming from historic structures appear to pose constraints on the Southern Alignment, but archaeological issues associated with at least five recorded sites, two of which contain human remains, may pose substantial constraints. Impacts to significant archaeological sites can often be more easily mitigated because the materials can be excavated using a data recovery program, and construction may resume once a sample of information about the site has been recovered.  The exposure of human remains, however, will necessitate a series of legal procedures including immediate stoppage of work in that location, followed by involvement of the Los Angeles or Orange County Coroner, Native American Heritage Commission (if the remains are determined to be prehistoric), and Most Likely Descendant (named by the Native American Heritage Commission) to determine the disposition of the remains.

Based on available data without field confirmations, potential constraints posed by cultural resources issues clearly show that the Northern Alignment is the least favorable alternative LAX-OC MAGLEV route. The Central and Southern Alignments are faced with different, but comparably weighted, constraints.  The Central Alignment will likely affect the integrity of setting of historic structures and the Southern Alignment will likely impact one or more archaeological sites, some of which may contain human remains.

## BIOLOGICAL AND WETLANDS ANALYSIS

### Southern Alignment

#### Sensitive Plant Species

A total of 44 sensitive plant species were found to occur within the quadrangles of the Southern Alignment.  Of these plants, 10 are federal -  or state-listed as threatened, endangered, or rare.  An additional 11 plants are federal species of concern.

#### Sensitive Wildlife

It was determined that a total of 45 sensitive wildlife species have the potential to occur within the proposed alignment. Seventeen of the 45 sensitive wildlife species have either federal- or state-listed, or proposed federal – or state-listed endangered or threatened status. The potential for the majority of these sensitive wildlife species are assumed to be high until a survey of the alignment can be conducted for suitable breeding, nesting, and foraging habitat.

#### Jurisdictional Waters

Based solely on reviewing the proposed Southern Alignment as mapped on USGS quadrangles, there are at least 21 named blue-line drainages that will be crossed by the proposed alignment. The majority of these crossings include major perennial (carries water year-round) or intermittent (carries water only during certain times of the year) drainages such as the Santa Ana River.

### Central Alignment

#### Sensitive Plant Species

A total of 47 sensitive plant species were found to occur within the quads of the Central Alignment. Of these plants, 14 are federal – or state-listed as threatened, endangered, or rare, and one species having candidate status for listing as threatened. An additional 14 species are federal species of concern.

#### Sensitive Wildlife

It was determined that a total of 45 sensitive wildlife species have the potential to occur within the proposed alignment. Sixteen of the 45 sensitive wildlife species have either federal- or state-listed, or proposed federal- or state-listed endangered or threatened status.

#### Jurisdictional Waters

Based solely on reviewing the proposed Central Alignment as mapped on USGS quadrangles, there are at least 16 named blue-line drainages that will be crossed by the proposed alignment. The majority of these crossings include major perennial (carries water year-round) or intermittent (carries water only during certain times of the year) drainages such as the San Gabriel River.

## Northern Alignment

### Sensitive Plant Species

It was determined that a total of 40 sensitive plant species were found to occur within the USGS 7.5-minute quadrangles of the Northern Alignment. Of these plants, 10 are federal - or state-listed as threatened, endangered, or rare, and one species has the candidate status for listing as threatened. An additional 13 species are federal species of concern.

### Sensitive Wildlife

It was determined that a total of 38 sensitive wildlife species have the potential to occur within the proposed alignment. Fourteen of the 38 sensitive wildlife species have either federal- or state-listed, or proposed federal- or state-listed endangered or threatened status.

### Jurisdictional Waters

Based solely on reviewing the proposed Northern Alignment as mapped on USGS quadrangles, there are at least 15 named blue-line drainages that will be crossed by the proposed alignment. The majority of these crossings include major perennial (carries water year-round) or intermittent (carries water only during certain times of the year) drainages such as the Los Angeles River.

# SUMMARY AND CONCLUSIONS

Based on the information contained in this chapter, **Table 5-1** summarizes the environmental impacts of each of the three alignments under study. The table compares each alignment to the others in relative impacts. The alignment with the fewest impacts in a particular category has a “+” rating; the alignment with the most impacts in a category has a “-“ rating; and a “0” indicates a neutral rating with some impacts but nothing significant.

| Table 5-1: Initial Environmental Assessment for Final Initial Alternatives | | | |
|---|---|---|---|
| **Category** | **Southern Alignment** | **Central Alignment** | **Northern Alignment** |
| Public Resources | - | 0 | + |
| Land Use | + | 0 | - |
| Cultural Resources | + | 0 | 0 |
| Biological Resources | 0 | 0 | 0 |
| Summary | + | 0 | 0 |

Source: URS Corp., in conjunction with Myra Frank and Associates, April 2002

The table shows that there are not significant discriminators between any of the alignments related to environmental impacts, given the length of the corridors and the relatively small numbers of impacts noted. However, the Southern Alignment has the most "+" ratings, giving it a slight edge over the other two.

# 6.0 RIDERSHIP

## INTRODUCTION

The purpose of this chapter is to summarize both the methodology and the results of ridership forecasting for the final initial alternatives described in Chapter 3. This chapter consists of the following elements:

- A summary of the results of a survey of Metrolink riders to determine their current travel patterns and their reaction to potential Maglev services and fares;
- A summary of the methodology used to develop ridership forecasts for this project, including the integration of Regional Airport Demand Allocation Model (RADAM) data into the forecasting process; and
- The initial ridership results for the three final initial alternatives under consideration.

It is anticipated that, after this initial ridership forecasting exercise, supplemental forecasts will be developed as the alternatives are refined and improved based on continuing analysis by the project team and comments and guidance from SCAG staff and the regional Maglev Task Force.

## MARKET RESEARCH

### Introduction

To gauge information and interest of potential customers regarding the proposed Maglev line between LAX and Orange County, Strategic Consulting & Research (a subconsultant to URS) conducted surveys on board the Orange County Metrolink line. Interviewers boarded the train at Oceanside, the Irvine Transportation Center and LA Union Station. Passengers on a total of seven trips were interviewed, and respondents were offered a survey and pencil either as they boarded the train, or shortly after their trip began.

A total of 943 surveys were collected between August 7 and 9, 2001, greatly exceeding the goal of 400. A sample size of 943 respondents provides accuracy of ±3.2% at a 95% confidence level.

## Key Findings

- Most passengers use Metrolink to get from home to work, with 96 percent of passengers saying they were at home prior to boarding Metrolink train and 90 percent saying they are going to work after they de-board the train.

- The Irvine Transportation Center has the highest percentage of boardings (26%) on the Orange County line. Additionally, almost two-thirds (63 percent) of the passengers surveyed board between the Irvine Transportation Center and LA Union Station, although it should be noted that 37 percent of the passengers are boarding prior to the Irvine Transportation Center, with the highest portion boarding at Oceanside.

- Seventy percent of riders drove themselves to the station where they boarded the train, and 17 percent were dropped off at the station.

- Thirty-one percent of passengers transfer to the Red Line to get to their final destination. Another 19 percent say they use the bus to arrive at their final destination, for a total of 54 percent of passengers using some form of public transportation to reach their final destination. Alternatively, 18 percent say they walk to their final destination.

- Over three-fourths (79 percent) of Metrolink passengers said they make the same trip four or more times per week. This is followed by 13 percent who make the same trip two to three times per week. Only eight percent of passengers were noted as riding less than once a week.

- Approximately two-thirds of Metrolink passengers are long-term users, with 62 percent reporting that they have used Metrolink for the trip where they were interviewed for more than one year (the highest user category). Thirteen percent have made that specific trip on Metrolink between six months and one year and 26 percent have been using Metrolink for that specific trip for less than six months.

- More than half of the passengers (56 percent) say they made the same trip prior to riding Metrolink, and 74 percent of those passengers drove themselves to work prior to riding Metrolink. These figures indicate that Metrolink has eliminated vehicle trips for 41 percent of their passengers.

- Metrolink passengers who made the same trip prior to using Metrolink (N = 526) attribute their switch to Metrolink because Metrolink is "less stressful," mentioned by 82 percent of participants. Other top ranking motivators for change include: "more comfortable" (37%), "less expensive" (35%), and "safety" (34%).

- Eighty-nine percent of Metrolink passengers buy fare media in "bulk," with 58 percent purchasing monthly passes and 31 percent purchasing 10-trip tickets.

- Respondents were asked about the likelihood of their using a high-speed rail link in the to the LAX area from Orange County. The results of that survey question are shown in **Table 6-1**.

| Table 6-1: Uses of the High Speed Rail System | | | | |
|---|---|---|---|---|
| Type of Travel | I would use this service. . . | | | |
| | Never or Rarely | Once or Twice Per Year | Once or Twice Per Month | Once or Twice Per Week |
| Business Meetings | 75% | 17% | 5% | 3% |
| Airport for Business Air Travel | 53% | 34% | 11% | 2% |
| Airport for Personal Air Travel | 41% | 51% | 5% | 2% |
| Employment | 77% | 3% | 4% | 16% |
| Entertaining/Dining | 68% | 20% | 8% | 3% |
| Special Events | 62% | 29% | 6% | 3% |

Source: Strategic Consulting & Research, September 2001

The table shows that employment was the most frequently mentioned response when it came to using the system once or twice per week. For longer intervals between usage (once or twice per year), personal air travel and air travel for business comprise the largest category of respondents.

## REGIONAL MODEL PREPARATION

### Overview

Travel in the LAX/South study corridor is very diverse, so numerous forecasting tools have been used to forecast ridership and revenue for high-speed modes in this corridor. The new regional travel demand model was used to forecast traditional resident-based work and non-work trips. This model does not forecast all modes of travel. SCAG used the Regional Air Demand Allocation Model (RADAM 4.2) to forecast air passenger trips by determining which trips would be attracted to high-speed modes of travel connecting airports. RADAM is described later in this section. In addition, using corridor market research determinants, visitor trips to special events and special generators were estimated. Finally, because of the superior travel time advantage and reliability, Maglev technologies will create induced demand beyond the trips accounted for from the above categories.

Travel forecasts for the LAX/South study corridor for all trip purposes followed the same approach and methodology as was used for modeling purposes for Phase 1 of the California Maglev Deployment Program and other SCAG Maglev studies, and will not be repeated here.

## Background Assumptions

### Year 2025 Roadway and Transit Network Assumptions

In travel forecasting, a major concern is the degree of competition and interaction that is assumed between the mode being studied and other automotive and transit modes. The extent of ridership drawn to Maglev is greatly affected by a corridor's roadway capacity assumed for year 2025, as well as the levels of service on Metrolink Commuter Rail and Express Bus. For this Maglev project and others in the region, SCAG's most recent Regional Transportation Plan roadway and transit networks were used as a starting point.  Those networks include all the planned and programmed transportation improvements been adopted for the region.

### Regional Trip Generation

The new regional travel model implemented by SCAG forms the basis for the modeling of residential based work and non-work trips. The model was validated against 1997 conditions and was approved for travel forecasting for the region. The new highway and transit networks for 2025 that were prepared for the current Regional Transportation Planning  (RTP) effort were used as background for this study

SCAG's new travel demand model utilizes a more detailed traffic analysis zone (TAZ) system and transportation networks than previous models. The previous SCAG zone system included only 1,555 transportation analysis zones (TAZs); the revised model includes 3,217 zones.

The new SCAG travel model generates nine overall categories of trip purposes, including three variations for the first two categories, for a total of thirteen:

- Home-based work-direct trips (directly between home and work, without intermediate stops, generated for three household income groups);
- Home-based work-strategic trips (those that include an intermediate stop, such as to drop off or pick up a passenger, generated for three household income groups);
- Home-based elementary/high school trips;
- Home-based college/university trips;
- Home-based shopping trips;
- Home-based social-recreational trips;
- Home-based other trips;
- Work-based other trips; and
- Other miscellaneous trips.

In addition, the new SCAG model analyzes time-of-day factors for trip generating, resulting in forecasts for peak and off-peak periods, resulting in 26 separate trip categories.

The SCAG model, like other similar models, employs the "gravity" model form, where trips for an origin or destination (or interchange) are directly proportional to the trip productions and trip attractions at the ends of the interchange and inversely proportional to the travel impedance of the interchange. Finally, the SCAG model uses state-of-the-art techniques for mode choice, though the model required modification for the proper modeling of Maglev ridership. Traffic and transit assignment procedures were performed using standard modeling practices, with assignments made by time of day.

### Socioeconomic Assumptions

The most recently adopted (1997) socioeconomic growth forecasts for the SCAG Region were used in other Maglev studies for year 2025 and will be used in this project as well. SCAG's new transportation model uses the following socioeconomic variables for each of its traffic zones:

- Population (total population, resident population, and group quartered population);
- Households (single households and multiple households);
- Median Household Income;
- School Enrollment (K-12 school and college/university enrollment);
- Household Size; and
- Employment (retail, service, and basic employment).

## RADAM Model Input

### Introduction

Advanced Transportation Systems (Citigroup Technologies Corp.) initially developed the Regional Airport Demand Allocation Model (RADAM) to analyze airport demand in changing interactive multi-airport systems like those found in Southern California. The model is intended to assess and forecast the aviation planning needs of the region. RADAM is designed to realistically project the needs of future passengers throughout the region and spread the demand among all the existing airports and projected airports in the Southern California region. As described in the Milestone 5 report of the LAX-Palmdale High Speed Ground Access Study:

> "RADAM is a nested, modular, sequentially cascading model that incorporates multinomial logit, nested logit, and multinomial probit-based subsystems, to forecast passenger demand in any dynamically interacting multiple airport system. Although it builds on existing knowledge, the model represents an improvement compared to other efforts to simulate airport systems. RADAM's nested structure allows the synthesis of different modeling approaches to address a wide variety of elements by incorporating them as sub-systems within the larger modeling environment. Its modular design allows a flexibility and versatility to permit specialized and custom applications under a wide array of circumstances and planning objectives, and make it useful in multiple-scenario building analyses. Its state-of-the-art sequentially calibrating capability ensures that any inconsistencies with survey data, which is resident in the model, are incrementally modulated rather than magnified in subsequent modeling iterations. When only minor changes occur in

additional iterations, the model run is called mature and is then referred to as being in equilibrium.

"One of RADAM's features is its ability to test and simulate passenger demand for High Speed Rail (HSR) simultaneously and in a fully integrated fashion with airport passenger demand on both a regional and interregional basis. Either of the existing systems such as the TGV (France), ICE (Germany) or the Japanese HSR systems can be user selected for modeling as all three of these systems are fully calibrated into the model. Other conceptual HSR systems, such as magnetic levitation (Maglev) systems, can also be used, defined and modeled simultaneously with any future airport system. Due to the integration of HSR and airport demand, any change in schedule, capacity, speed or alignment in HSR has an immediate and direct impact on the number of passengers allocated to each of the airports as well as VMT for all the other modes of transportation. The HSR model has been used extensively to test various hypothetical HSR alignments for their ability to shift air passenger demand among airports, to strengthen potential demand at smaller airports and to minimize air pollution impacts. Airport passenger demand was also examined in various simulations to determine the degree to which airports can help spur overall passenger demand for High-Speed Rail."

### Methodology for Airport Employment Modeling

Distribution of direct airport employment poses a problem in that the employment occurs at the airport zone and does not need to be dispersed. Instead of using their work locations in the forecasting tool, the employees' residences were applied to a future potential airport. For the airports in Southern California, a six-stage methodology was developed and specifically calibrated to identify zones of residence for direct airport employment:

- Stage 1: Airport Distance and Percentage of Air Passengers;
- Stage 2: Allocation Based on Demographic Profiles;
- Stage 3: Re-Allocation Based on Demographic Constraints;
- Stage 4: Allocation Refinement Based on Income;
- Stage 5: Refinement Based on Airport Size; and
- Stage 6: Non-Resident Direct Airport Employment.

This methodology is based on survey data, current and projected demographic indicators, travel distances and a Multinomial Logarithmic Calibration Model. Due to the lack of data relating zonal housing with specific employment (by SIC code) for the present and 2025 condition, this represents the most sophisticated methodology for the distribution of airport employment. Its usefulness derives from identifying the distribution of airport employees by place of residence who all work at one concentrated work site.

### Methodology for Airport Passenger Modeling

The airport passenger generation model administers a variety of data to determine baseline, actuated and reactive air passenger markets via a variety of Sequentially Cascading Multinomial Logit and Probit Models. The strength of the air passenger markets in RADAM is a function of the regional demographic composition, the supply of air service, and the transportation infrastructure, particularly ground access. The following describes the inputs to the RADAM model.

**Airport System Definition:**

- Determination of which airports are to be included in the 2025 airport system. The 2025 Regional Transportation Plan (RTP) Medium scenario included the following airports: Pt. Mugu, Burbank, Los Angeles International (LAX), Ontario, John Wayne Orange County Airport, Long Beach Airport, Palm Springs Airport, Palmdale, San Bernardino Airport, Southern California International Airport (SCI or George AFB), and March Field.
- Development of flight service portfolios for each of the airports in the system, in terms of commuter, short, medium and long haul domestic service and international service by world region. The assumptions used for this model run replicated the RTP Medium Scenario in terms of individual airport portfolios.
- The model run is further characterized by airport constraint assumptions. The most significant assumption here is that LAX is unconstrained and feature

domestic as well as international service. On the other hand, Palmdale and SCI are assumed to be constrained airports limited only to commuter flights. Aside from LAX, only Ontario Airport offers international service. Long Beach Airport is limited to its terminal capacity, while Burbank and John Wayne Orange County Airports are constrained by gate utilization capacity.

**Demographic Variables:**

- Population;
- Population over 65;
- Employment;
- Retail Employment;
- Non-Retail Employment;
- High Tech Employment;
- Employment by major SIC categories (if available);
- Number of Households;
- Single Dwelling Units;
- Multiple Dwelling Units;
- Licensed Drivers;
- Population Density (population per acre);
- Employment Density (employment per acre);
- Median Income;
- Disposable Income;
- Special Generators (major tourist, and/or business attractors, convention centers);
- Current and projected number of hotel rooms (if available); and
- Number of direct and indirect airport employees.

**Travel Times to Airports**

Ground access travel times to airports reflect the following:

- Base year and 2025 congested and uncongested travel times from SCAG TAZs to each of the system airports;

- Perceived congested, uncongested and composite travel times from each passenger cluster to each of the system airports. Perceived travel times are generated by Citigroup Technology Corporation's databases reflecting the responses from approximately 60,000 air passenger surveys in southern California; and
- Existing and future mode choice (trend line 1993-1999) at all airports assumed in 2025.

**Current Flight Service Portfolios for All Airports**

Historical data on current flight service portfolios for all airports included the following:

- Passengers by haul type: commuter, short, medium, and long haul; international by world region (i.e. Atlantic, Asia, Latin America, Canada, Mexico);
- Aircraft fleet mix, based on historical data, demand placed by passengers for different haul types and procurement practices of airlines serving existing airports in the region;
- Number of aircraft operations by haul type;
- Percentage of connecting passengers (domestic to domestic, international to domestic, international to international);
- Passengers by resident/non-resident categories (business, non-business, inclusive tours, and military);
- For Air Cargo: Annual tonnage of air cargo by express, mail and freight; number of all cargo aircraft operations at all existing airports. Regional air cargo forecasts; and
- Hours of airport operations.

## Maglev System Operating Assumptions

To develop the ridership model for the LAX/South project alternatives, a number of assumptions regarding operating characteristics of the Maglev system have been made, corresponding with the operating assumptions developed for the other two Maglev studies.  Those operating assumptions are:

- All trains operate at 10-minute headways.
- For modeling purposes, all trains are assumed to stop at all stations. No skip-stop or express services have been assumed for the first model runs.
- Maglev service will operate 18 hours per day, from 5:30 a.m. to 11:30 p.m.
- A double-tracked configuration is assumed along all alignments.
- Train consists are comprised of six cars.
- System fares are the same as those developed for the LAX-March study ($9.60 + $0.62 per zone, averaging to approximately $11.50 per day each way in 1997 dollars). A parking charge of $5 per day applies.
- Airport demand is consistent with SCAG Regional Airport Scenario 8.
- All stations are assumed to have feeder bus or shuttles to connect stations with the surrounding communities. Smart shuttles are included at all stations, serving areas from 0.5 to 4.0 miles away.

## Ridership Results for Initial Final Alternatives

Using the modeling assumptions noted above, ridership results for the three initial final alternatives are summarized in the following sections.  Since the selection of the initial alternatives, the project team made minor refinements to some of the alignments and station assumptions; those changes are summarized in each section.

### Southern Alignment (Primary)

Since the project team made its initial recommendations on a primary Southern Alignment, the following changes have been made:

- Two stations are proposed for the LAX area, one to serve commuters with a park-and-ride in the vicinity of Aviation and Arbor Vitae, and one to serve airport passengers (with no park-and-ride) in the vicinity of Aviation and Imperial;

- The station proposed for the South Bay/Torrance area has been shifted to Carson, as recommended by the Maglev Task Force;

- The station at Long Beach Airport has been moved to the alignment's intersection with the Blue Line, based on discussions with elected officials and technical staff from Long Beach. A line to Long Beach has been preserved as an option for ridership analysis and cost estimating purposes;

- A "skip-stop" station has been added in the Seal Beach West area, meaning that for operational purposes, that station would be served during peak periods only;

- Two stations are proposed for the John Wayne Airport area, one to serve commuters with a park-and-ride in the vicinity of South Coast Plaza and one to serve airport passengers (with no park-and-ride) near the airport terminal.

**Figure 6-1a** shows the initial recommended Southern (Primary) Alignment. It is focused almost entirely in the I-405 corridor from I-105 to the Irvine Transportation Center, with a stub track north from the John Wayne Airport area to Anaheim along and an optional line to Long Beach. Including the Long Beach spur, it is 55.4 miles long.

*Figure 6-1a: Recommended Initial Southern (Primary) Alignment*

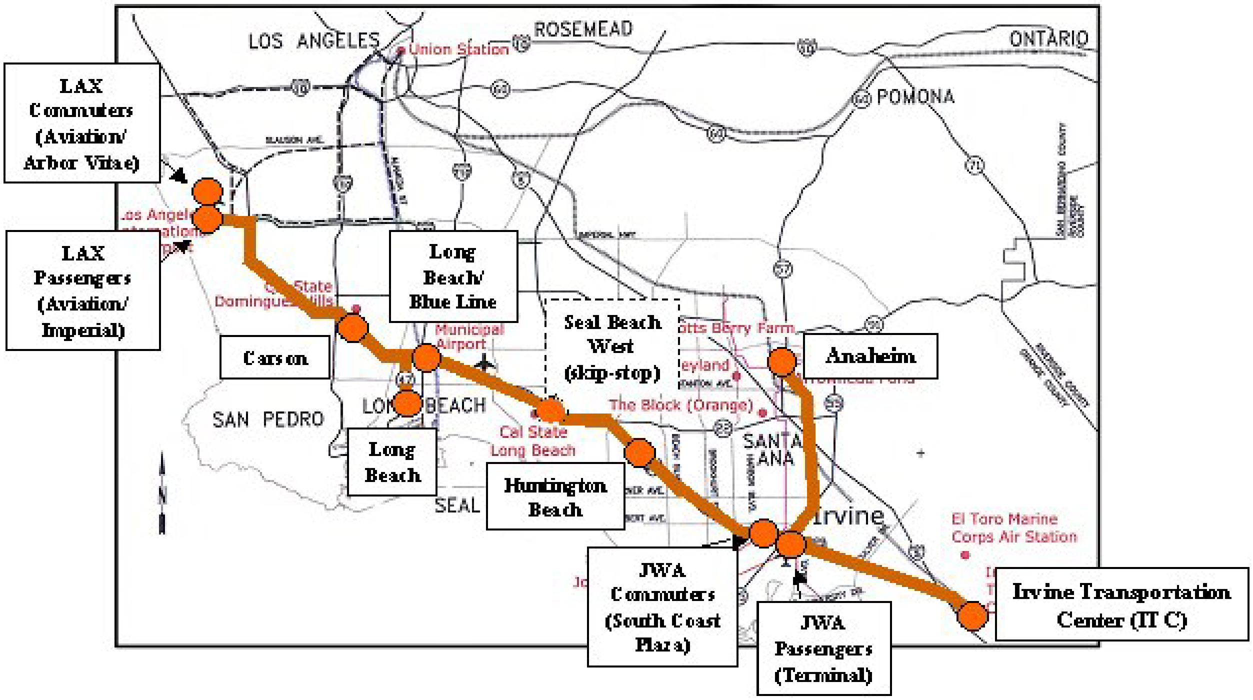



**Table 6-2a** summarizes the results of the ridership forecasts for this alternative without the Long Beach extension, and **Table 6-2b** summarizes 2025 ridership for this alternative including the Long Beach extension.

**Table 6-2a: Southern Alignment (Primary) w/o Long Beach CBD Spur Ridership Forecast Summary**
**Daily Passenger Volumes and Mode of Access**

| Station | Daily Passenger Volumes: Peak Commute | Off Peak | Air Passengers | Others | Total Daily Riders | Mode of Access: Auto | Walk | Parking |
|---|---|---|---|---|---|---|---|---|
| LAX | 4,470 | 3,046 | 10,103 | 1,804 | 19,423 | 16.13% | 83.87% | 1,840 |
| Carson | 4,976 | 3,460 | 2,424 | 2,025 | 12,884 | 48.31% | 51.69% | 4,506 |
| Long Beach | 4,731 | 2,990 | 4,934 | 1,853 | 14,507 | 33.00% | 10.80% | 4,255 |
| Seal Beach | 3,864 | 2,453 | 1,325 | 1,516 | 9,158 | 47.03% | 52.97% | 2,706 |
| Huntington | 4,522 | 3,675 | 1,657 | 1,967 | 11,822 | 42.47% | 57.53% | 3,345 |
| JWA | 7,750 | 4,144 | 6,231 | 2,855 | 20,980 | 32.47% | 67.53% | 3,469 |
| Irvine | 3,072 | 1,457 | 3,053 | 1,087 | 8,669 | 43.45% | 56.55% | 3,777 |
| Anaheim | 5,427 | 3,238 | 3,033 | 2,079 | 13,777 | 37.64% | 62.36% | 2,885 |
| **Totals** | **38,812** | **24,462** | **32,759** | **15,186** | **111,220** | | | **26,781** |

**Line Boarding Summary**

| Stations | AM Peak Hour SB On | AM Peak Hour SB Off | AM Peak Hour SB In | AM Peak Hour NB On | AM Peak Hour NB Off | AM Peak Hour NB In | Daily SB On | Daily SB Off | Daily SB In | Daily NB On | Daily NB Off | Daily NB In |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAX | 1,655 | | | | 1,744 | | 19,421 | | | | 19,423 | |
| | | | 1,655 | | | 1,744 | | | 19,421 | | | 19,423 |
| Carson | 522 | 852 | | 837 | 496 | | 4,982 | 7,903 | | 7,905 | 4,981 | |
| | | | 1,325 | | | 1,403 | | | 16,500 | | | 16,499 |
| Long Beach | 936 | 543 | | 639 | 625 | | 8,463 | 6,044 | | 6,044 | 8,463 | |
| | | | 1,718 | | | 1,389 | | | 18,918 | | | 18,918 |
| Seal Beach | 524 | 487 | | 422 | 450 | | 4,896 | 4,261 | | 4,261 | 4,897 | |
| | | | 1,754 | | | 1,418 | | | 19,553 | | | 19,554 |
| Huntington | 612 | 500 | | 593 | 383 | | 6,208 | 5,613 | | 5,613 | 6,208 | |
| | | | 1,866 | | | 1,208 | | | 20,148 | | | 20,149 |
| JWA | 513 | 1,407 | | 923 | 321 | | 5,094 | 16,573 | | 16,574 | 5,094 | |
| | | | 972 | | | 606 | | | 8,669 | | | 8,669 |
| Irvine | | 972 | | 606 | | | | 8,669 | | 8,669 | | |
| JWA | | 3,547 | | 2,676 | | | | 13,777 | | 13,777 | | |
| | | | 3,547 | | | 2,676 | | | 13,777 | | | 13,777 |
| Anaheim | 3,547 | | | | 2,676 | | 13,777 | | | | 13,777 | |

Source: Meyer, Mohaddes Associates, Inc., using SCAG Model, June 2002

**Table 6-2b: Southern Alignment (Primary) with Long Beach CBD Spur Ridership Forecast Summary**

**Daily Passenger Volumes and Mode of Access**

| Station | Daily Passenger Volumes | | | | | Mode of Access | | Parking |
|---|---|---|---|---|---|---|---|---|
| | Peak Commute | Off Peak | Air Passengers | Others | Total Daily Riders | Auto | Walk | |
| LAX | 4,598 | 3,139 | 10,774 | 1,857 | 20,369 | 16.13% | 83.87% | 1,929 |
| Carson | 5,127 | 3,581 | 2,428 | 2,090 | 13,226 | 48.31% | 51.69% | 4,625 |
| Long Beach | 5,883 | 3,653 | 4,280 | 2,289 | 16,105 | 34.18% | 65.82% | 4,052 |
| Seal Beach | 4,042 | 2,610 | 1,328 | 1,596 | 9,577 | 47.03% | 52.97% | 2,830 |
| Huntington | 4,631 | 3,798 | 1,662 | 2,023 | 12,114 | 42.47% | 57.53% | 3,427 |
| JWA | 7,907 | 4,232 | 6,550 | 2,913 | 21,603 | 32.47% | 67.53% | 3,571 |
| Irvine | 3,100 | 1,473 | 3,076 | 1,097 | 8,746 | 37.64% | 62.36% | 3,874 |
| Anaheim | 5,511 | 3,296 | 3,209 | 2,114 | 14,130 | 43.45% | 56.55% | 2,910 |
| LB CBD | 3,100 | 2,195 | 2,154 | 1,271 | 8,720 | 17.98% | 82.02% | 1,051 |
| **Totals** | **43,900** | **27,977** | **35,462** | **17,250** | **124,589** | | | **28,271** |

**Line Boarding Summary**

| Stations | AM Peak Hour | | | | | | Daily | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SB | | | NB | | | SB | | | NB | | |
| | On | Off | In | On | Off | In | On | Off | In | On | Off | In |
| LAX | 1,841 | | | | 1,931 | | 20,367 | | | | 20,369 | |
| | | | 1,841 | | | 1,931 | | | 20,367 | | | 20,369 |
| Carson | 621 | 852 | | 837 | 571 | | 5,323 | 7,903 | | 7,905 | 5,323 | |
| | | | 1,610 | | | 1,665 | | | 17,787 | | | 17,787 |
| Long Beach | 1,283 | 651 | | 763 | 799 | | 10,228 | 7,332 | | 7,332 | 10,228 | |
| | | | 2,242 | | | 1,700 | | | 20,683 | | | 20,683 |
| Seal Beach | 658 | 542 | | 456 | 533 | | 4,896 | 4,680 | | 4,680 | 4,897 | |
| | | | 2,359 | | | 1,777 | | | 20,899 | | | 20,899 |
| Huntington | 839 | 527 | | 621 | 540 | | 6,208 | 5,905 | | 5,905 | 6,208 | |
| | | | 2,671 | | | 1,697 | | | 21,202 | | | 21,203 |
| JWA | 748 | 2,200 | | 1,405 | 454 | | 5,094 | 17,550 | | 17,551 | 5,094 | |
| | | | 1,219 | | | 746 | | | 8,746 | | | 8,746 |
| Irvine | | 1,219 | | 746 | | | | 8,746 | | 8,746 | | |
| JWA | | 2,491 | | 1,879 | | | | 14,130 | | 14,130 | | |
| | | | 2,491 | | | 1,879 | | | 14,130 | | | 14,130 |
| Anaheim | 2,491 | | | | 1,879 | | 14,130 | | | | 14,130 | |
| Long Beach | 1,863 | | | | 662 | | 8,720 | | | | 8,720 | |
| | | | 1,863 | | | 662 | | | 8,720 | | | 8,720 |
| LB CBD | | 1,863 | | 662 | | | | 8,720 | | 8,720 | | |

Source: Meyer, Mohaddes Associates, Inc., using SCAG Model, June 2002

## Southern Alignment (Optional)

The optional Southern Alignment was very similar to the Primary Southern Alignment, except that it included a connection between the East Seal Beach Area and the north-south Anaheim spur along SR-22. This would result in the elimination of the Huntington Beach Station and the move of the commuter station serving John Wayne Airport to Hutton Center (see **Figure 6-1b**). This alignment is 52.2 miles long.

***Figure 6-1b: Recommended Initial Southern (Alternative) Alignment***

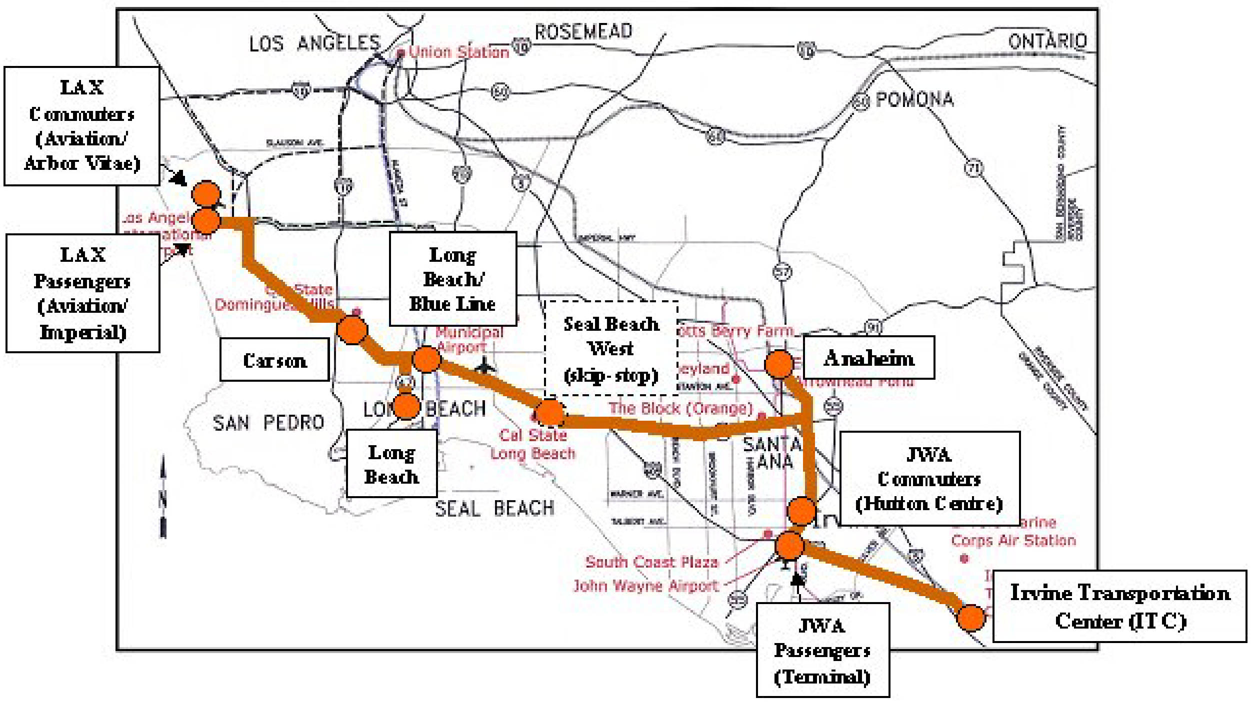



**Table 6-1c** summarizes the results of the ridership forecasts for this alternative without the Long Beach extension, and **Table 6-1d** summarizes ridership for this alternative including the Long Beach extension.

## Table 6-2c: Southern Alignment (Optional) with Long Beach CBD Spur Ridership Forecast Summary

### Daily Passenger Volumes and Mode of Access

| Station | Daily Passenger Volumes | | | | | Mode of Access | | Parking |
|---|---|---|---|---|---|---|---|---|
| | Peak Commute | Off Peak | Air Passengers | Others | Total Daily Riders | Auto | Walk | |
| LAX | 4,424 | 2,971 | 8,993 | 1,775 | 18,162 | 20.25% | 79.75% | 1,207 |
| Carson | 5,052 | 3,379 | 2,292 | 2,023 | 12,746 | 47.93% | 52.07% | 4,382 |
| Long Beach | 5,988 | 3,254 | 4,521 | 2,218 | 15,980 | 32.70% | 67.30% | 4,891 |
| Seal Beach | 4,448 | 2,897 | 1,693 | 1,763 | 10,801 | 42.92% | 57.08% | 3,582 |
| Anaheim | 7,311 | 4,040 | 3,019 | 2,724 | 17,096 | 38.11% | 61.89% | 4,662 |
| JWA | 6,091 | 3,198 | 5,938 | 2,229 | 17,457 | 27.09% | 72.91% | 1,883 |
| Irvine | 3,200 | 1,598 | 2,905 | 1,151 | 8,854 | 41.58% | 58.42% | 2,822 |
| **Totals** | **36,513** | **21,337** | **29,361** | **13,884** | **101,096** | | | **23,429** |

### Line Boarding Summary

| Stations | AM Peak Hour | | | | | | Daily | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SB | | | NB | | | SB | | | NB | | |
| | On | Off | In | On | Off | In | On | Off | In | On | Off | In |
| LAX | 1,719 | | | | 1,821 | | 18,162 | | | | 18,162 | |
| | | | 1,719 | | | 1,821 | | | 18,162 | | | 18,162 |
| Carson | 589 | 845 | | 828 | 561 | | 4,933 | 7,813 | | 7,813 | 4,933 | |
| | | | 1,462 | | | 1,554 | | | 15,281 | | | 15,282 |
| Long Beach | 1,673 | 625 | | 711 | 768 | | 9,785 | 6,195 | | 6,195 | 9,785 | |
| | | | 2,510 | | | 1,611 | | | 18,871 | | | 18,872 |
| Seal Beach | 936 | 524 | | 505 | 477 | | 5,869 | 4,932 | | 4,932 | 5,869 | |
| | | | 2,921 | | | 1,583 | | | 19,807 | | | 19,809 |
| Anaheim | 1,348 | 1,374 | | 883 | 466 | | 7,821 | 9,275 | | 9,276 | 7,821 | |
| | | | 2,896 | | | 1,166 | | | 18,353 | | | 18,354 |
| JWA | 506 | 2,135 | | 845 | 405 | | 3,979 | 13,478 | | 13,479 | 3,979 | |
| | | | 1,267 | | | 726 | | | 8,854 | | | 8,854 |
| Irvine | | 1,267 | | 726 | | | | 8,854 | | 8,854 | | |

Source: Meyer, Mohaddes Associates, Inc., using SCAG Model, June 2002

**Table 6-2d: Southern Alignment (Optional) with Long Beach CBD Spur Ridership Forecast Summary**

**Daily Passenger Volumes and Mode of Access**

| Station | Daily Passenger Volumes | | | | | Mode of Access | | Parking |
|---|---|---|---|---|---|---|---|---|
| | Peak Commute | Off Peak | Air Passengers | Others | Total Daily Riders | Auto | Walk | |
| LAX | 4,564 | 3,071 | 9,726 | 1,832 | 19,193 | 20.25% | 79.75% | 1,276 |
| Carson | 5,214 | 3,508 | 2,297 | 2,093 | 13,112 | 47.93% | 52.07% | 4,508 |
| Long Beach | 6,992 | 3,879 | 3,977 | 2,609 | 17,457 | 35.71% | 64.29% | 4,658 |
| Seal Beach | 4,650 | 3,086 | 1,697 | 1,857 | 11,289 | 42.92% | 57.08% | 3,744 |
| Anaheim | 7,640 | 4,221 | 3,210 | 2,846 | 17,917 | 38.11% | 61.89% | 4,886 |
| JWA | 6,262 | 3,283 | 6,285 | 2,291 | 18,122 | 27.09% | 72.91% | 1,954 |
| Irvine | 3,253 | 1,629 | 2,930 | 1,172 | 8,984 | 41.58% | 58.42% | 2,864 |
| LB CBD | 3,470 | 2,291 | 2,146 | 1,383 | 9,290 | 18.55% | 81.45% | 1,176 |
| **Totals** | **42,044** | **24,968** | **32,269** | **16,083** | **115,364** | | | **25,066** |

**Line Boarding Summary**

| Stations | AM Peak Hour | | | | | | Daily | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SB | | | NB | | | SB | | | NB | | |
| | On | Off | In | On | Off | In | On | Off | In | On | Off | In |
| LAX | 1,749 | | | | 1,861 | | 19,192 | | | | 19,193 | |
| | | | 1,749 | | | 1,861 | | | 19,192 | | | 19,193 |
| Carson | 626 | 845 | | 828 | 604 | | 5,298 | 7,813 | | 7,813 | 5,299 | |
| | | | 1,529 | | | 1,637 | | | 16,677 | | | 16,679 |
| Long Beach | 1,940 | 692 | | 794 | 875 | | 11,890 | 7,591 | | 7,591 | 11,891 | |
| | | | 2,776 | | | 1,718 | | | 20,976 | | | 20,978 |
| Seal Beach | 936 | 579 | | 549 | 477 | | 5,869 | 5,421 | | 5,420 | 5,869 | |
| | | | 3,133 | | | 1,646 | | | 21,424 | | | 21,426 |
| Anaheim | 1,348 | 1,494 | | 925 | 466 | | 7,821 | 10,096 | | 10,097 | 7,821 | |
| | | | 2,987 | | | 1,186 | | | 19,148 | | | 19,149 |
| JWA | 506 | 2,207 | | 858 | 405 | | 3,979 | 14,143 | | 14,144 | 3,979 | |
| | | | 1,286 | | | 733 | | | 8,984 | | | 8,985 |
| Irvine | | 1,286 | | 733 | | | | 8,984 | | 8,985 | | |
| Long Beach | 2,048 | | | | 727 | | 9,290 | | | | 9,290 | |
| | | | 2,048 | | | 727 | | | 9,290 | | | 9,290 |
| LB CBD | | 2,048 | | 727 | | | | 9,290 | | 9,290 | | |

Source: Meyer, Mohaddes Associates, Inc., using SCAG Model, June 2002

## Central Alignment

Since the project team made its initial recommendations on a Central Alignment, the following changes have been made:

- Two stations are proposed for the LAX area, one to serve commuters with a park-and-ride in the vicinity of Aviation and Arbor Vitae, and one to serve airport passengers (with no park-and-ride) in the vicinity of Aviation and Imperial;
- A station has been added at Torrance;
- An optional extension to Long Beach has been eliminated;
- A station has been added in the vicinity of Cerritos Towne Center;
- A "skip-stop" station has been added at Fullerton; and
- Two stations are proposed for the John Wayne Airport area, one to serve commuters with a park-and-ride in the vicinity of Hutton Centre and one to serve airport passengers (with no park-and-ride) near the airport terminal.

**Figure 6-2** shows the initial recommended Central Alignment. It is focused east-west in the SR-91 corridor from LAX to Anaheim, with an extension to John Wayne Airport and the Irvine Transportation Center. It is 51.9 miles long.

*Figure 6-2: Recommended Initial Central Alignment*

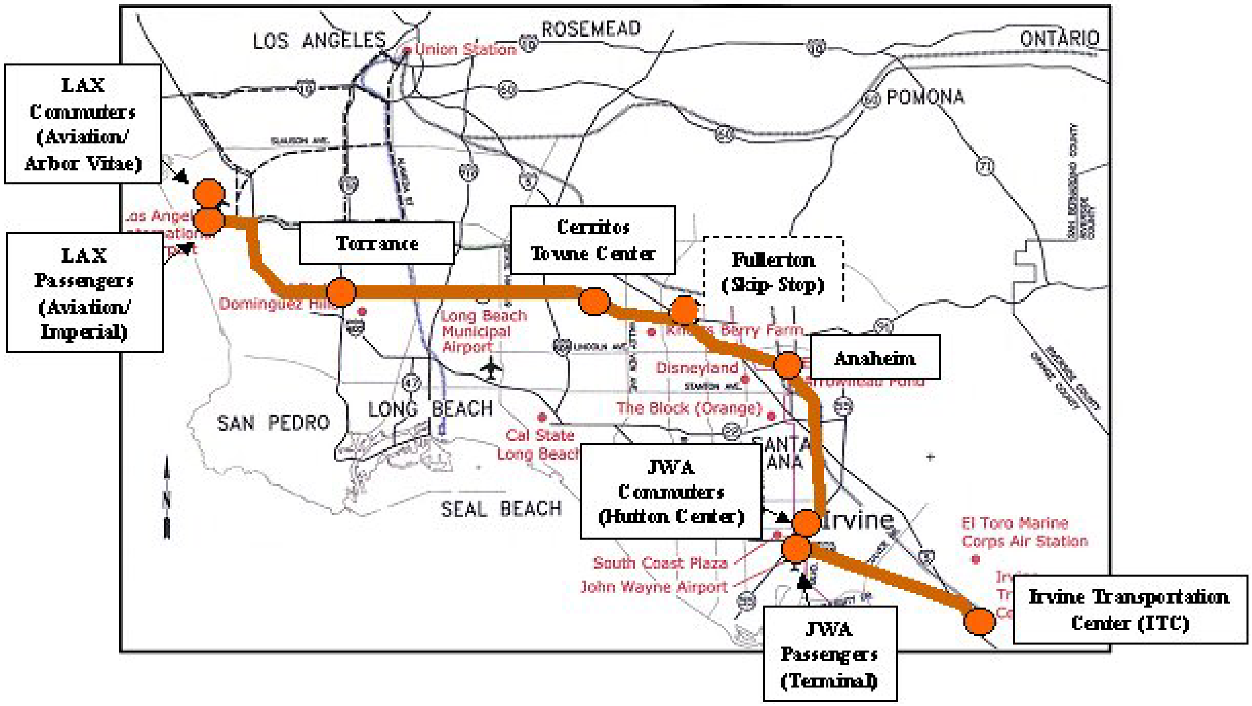



**Table 6-3** summarizes the results of the ridership forecasts for this alternative.

| Table 6-3: Central Alignment Ridership Forecast Summary<br>Daily Passenger Volumes and Mode of Access (2025) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Daily Passenger Volumes | | | | | Mode of Access | | |
| Station | Peak Commute | Off Peak | Air Passengers | Others | Total Daily Riders | Auto | Walk | Parking |
| LAX* | 2,510 | 2,341 | 6,518 | 1,164 | 12,533 | 12.90% | 87.10% | 1,142 |
| Torrence | 3,765 | 2,505 | 1,499 | 1,505 | 9,273 | 52.11% | 47.89% | 3,441 |
| Cerritos | 4,671 | 3,624 | 772 | 1,991 | 11,057 | 45.97% | 54.03% | 3,487 |
| Fullerton | 4,059 | 3,516 | 899 | 1,818 | 10,292 | 45.92% | 54.08% | 3,250 |
| Anaheim | 5,907 | 3,948 | 2,764 | 2,365 | 14,985 | 37.92% | 62.08% | 4,068 |
| JWA* | 5,387 | 2,973 | 5,281 | 2,006 | 15,647 | 28.72% | 71.28% | 2,060 |
| Irvine | 3,031 | 1,550 | 2,405 | 1,099 | 8,086 | 40.01% | 59.99% | 2,453 |
| **Totals** | **29,330** | **20,457** | **20,138** | **11,949** | **81,874** | | | **19,901** |

| Line Boarding Summary | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AM Peak Hour | | | | | | Daily | | | | | |
| | SB | | | NB | | | SB | | | NB | | |
| Stations | On | Off | In | On | Off | In | On | Off | In | On | Off | In |
| LAX* | 901 | | 901 | | 1,139 | 1,139 | 12,547 | | 12,547 | | 12,533 | 12,533 |
| Torrence | 730 | 311 | 1,320 | 424 | 506 | 1,222 | 5,060 | 4,211 | 13,396 | 4,215 | 5,062 | 13,381 |
| Cerritos | 933 | 396 | 1,857 | 411 | 563 | 1,374 | 7,134 | 3,924 | 16,606 | 3,924 | 7,133 | 16,590 |
| Fullerton | 669 | 444 | 2,082 | 560 | 356 | 1,170 | 5,074 | 5,215 | 16,466 | 5,198 | 5,077 | 16,469 |
| Anaheim | 1,120 | 967 | 2,235 | 627 | 433 | 976 | 7,090 | 7,895 | 15,660 | 7,895 | 7,090 | 15,665 |
| JWA* | 499 | 1,635 | 1,098 | 714 | 385 | 647 | 4,036 | 11,611 | 8,086 | 11,615 | 4,036 | 8,086 |
| Irvine | | 1,098 | | 647 | | | | 8,086 | | 8,086 | 0 | |

* - combination of two stations at this location
Source: Meyer, Mohaddes Associates, Inc., using SCAG Model, June 2002

## Northern Alignment

Since the project team made its initial recommendations on a Northern Alignment, the following changes have been made:

- Two stations are proposed for the LAX area, one to serve commuters with a park-and-ride in the vicinity of Aviation and Arbor Vitae, and one to serve airport passengers (with no park-and-ride) in the vicinity of Aviation and Imperial;
- A station has been added in West LA to coincide with the LAX-March and LAX-Palmdale studies; and
- A "skip-stop" station has been added at Fullerton.

**Figure 6-3** shows the initial recommended Northern Alignment. It includes a line from LAX to Union Station, then runs in the UP corridor paralleling I-5 through Anaheim to the Irvine Transportation Center, bypassing John Wayne Airport. It is 64 miles long.

***Figure 6-3: Recommended Initial Northern Alignment***

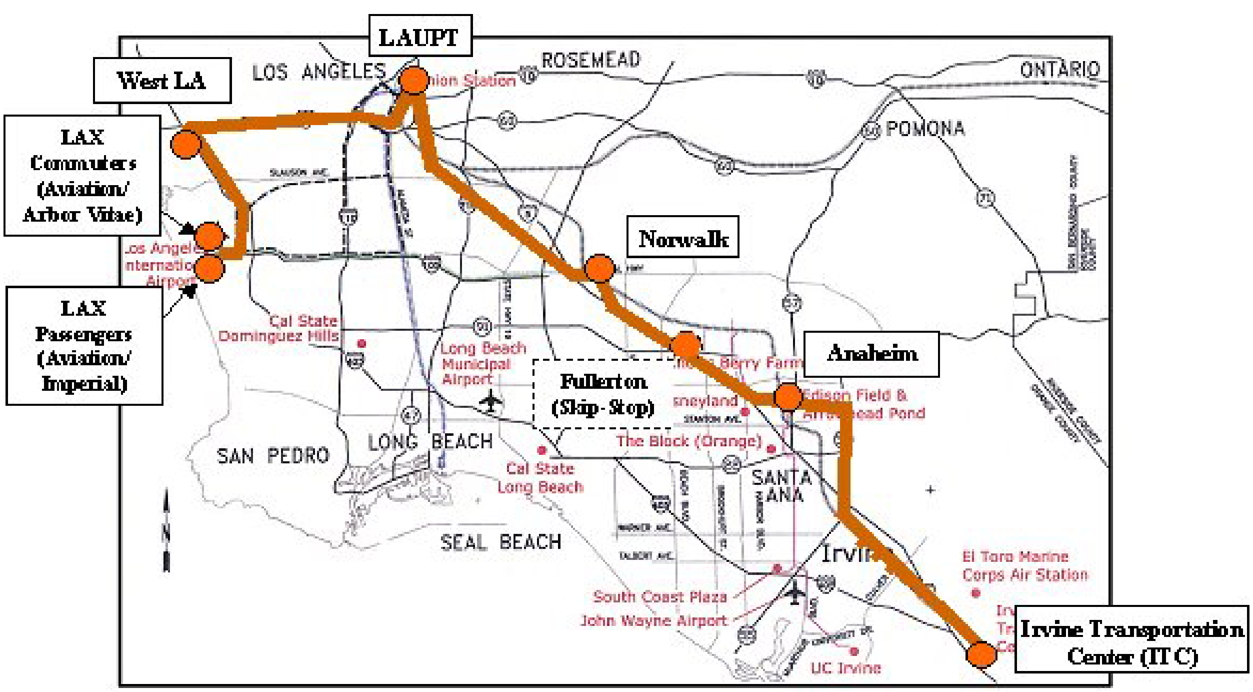


**Table 6-4** summarizes the results of the ridership forecasts for this alternative.

**Table 6-4: Northern Alignment Ridership Forecast Summary**

**Daily Passenger Volumes and Mode of Access (2025)**

| Station | Daily Passenger Volumes: Peak Commute | Off Peak | Air Passengers | Others | Total Daily Riders | Mode of Access: Auto | Walk | Parking |
|---|---|---|---|---|---|---|---|---|
| LAX* | 7,816 | 4,115 | 8,847 | 2,864 | 23,643 | 17.14% | 82.86% | 2,769 |
| West LA | 15,634 | 6,423 | 2,615 | 5,294 | 29,966 | 15.74% | 84.26% | 3,445 |
| Union | 22,177 | 9,444 | 2,525 | 7,589 | 41,734 | 18.40% | 81.60% | 5,402 |
| Norwalk | 11,033 | 5,148 | 1,305 | 3,883 | 21,369 | 46.04% | 53.96% | 6,851 |
| Fullerton | 6,840 | 4,472 | 718 | 2,715 | 14,745 | 47.00% | 53.00% | 4,766 |
| Anaheim | 7,786 | 4,228 | 1,398 | 2,883 | 16,296 | 30.26% | 69.74% | 3,511 |
| Irvine | 3,646 | 1,530 | 1,191 | 1,242 | 7,608 | 31.64% | 68.36% | 1,840 |
| **Totals** | **74,931** | **35,359** | **18,600** | **26,470** | **155,360** | | | **28,584** |

**Line Boarding Summary**

| Stations | AM Peak Hour SB On | AM Peak Hour SB Off | AM Peak Hour SB In | AM Peak Hour NB On | AM Peak Hour NB Off | AM Peak Hour NB In | Daily SB On | Daily SB Off | Daily SB In | Daily NB On | Daily NB Off | Daily NB In |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LAX* | 2,515 | | 2,515 | | 2,332 | 2,332 | 23,655 | | 23,655 | | 23,643 | 23,643 |
| West LA | 1,403 | 1,294 | **2,624** | 790 | 4,225 | **5,767** | 20,388 | 9,577 | 34,466 | 9,579 | 20,388 | 34,452 |
| Union | 1,964 | 2,079 | 2,510 | 3,906 | 2,832 | 4,693 | 17,944 | 23,788 | 28,622 | 23,787 | 17,946 | 28,611 |
| Norwalk | 1,154 | 1,052 | 2,612 | 2,564 | 600 | 2,729 | 7,770 | 13,599 | 22,793 | 13,604 | 7,770 | 22,777 |
| Fullerton | 594 | 787 | 2,420 | 1,589 | 346 | 1,486 | 4,578 | 10,166 | 17,205 | 10,150 | 4,579 | 17,206 |
| Anaheim | 649 | 1,849 | 1,219 | 1,093 | 262 | 655 | 3,349 | 12,946 | 7,608 | 12,948 | 3,349 | 7,608 |
| Irvine | | 1,219 | | 655 | | | | 7,608 | | 7,608 | | |

* - combination of two stations at this location

Source: Meyer, Mohaddes Associates, Inc., using SCAG Model, June 2002

## INITIAL RIDERSHIP CONCLUSIONS

**Table 6-5** summarizes the total daily riders for each of the initial alternatives.

| Table 6-5: Summary of 2025 Total Daily Riders- Initial Alternatives | |
|---|---|
| Initial Alternative | Total Daily Riders |
| Southern Alignment (Primary)- No Long Beach CBD Station | 111,220 |
| Southern Alignment (Primary)- Long Beach CBD Station | 124,589 |
| Southern Alignment (Optional)- No Long Beach CBD Station | 101,096 |
| Southern Alignment (Optional)- Long Beach CBD Station | 115,364 |
| Central Alignment | 81,874 |
| Northern Alignment | 155,360 |

Source: Meyer, Mohaddes Associates, Inc., using SCAG Model, June 2002

Based on these initial results, the following conclusions were drawn:

- The northern alignment provides the highest ridership (155,360 average daily riders). However, since this is the only alignment that stops in Downtown Los Angeles, this ridership is not comparable to the other alignments.

- The southern alignments perform better overall with a stop at Downtown Long Beach.

- Due to more transit competition and lower level activity centers, the central alignment has the poorest performance.

- The primary southern alignment has the best overall performance when considering it is in the least overall competition with other transit corridors. The optional southern alignment also performs well, and could be considered if the primary alignment proves to be less cost-effective.

- Based on SCAG trip table information, it was estimated the both southern alignments and the central alignment would have similar or higher ridership compared to the northern alignment if all alternatives had a station at Los Angeles Union Station.

- The calculated average trip length is 22.15 miles, though the SCAG model may tend to underestimate average trip lengths. Therefore, the actual average trip length may be in the 30 to 40 mile range.

## IMPACT ON REGIONAL RAIL RIDERSHIP

Two additional ridership analyses were conducted as a part of this study. The project team wanted to know the impact of the four final alignment options on regional commuter rail and urban rail ridership. **Table 6-6** summarizes the impact of the alignments on the region's 2025 commuter rail and Amtrak ridership.

**Table 6-6: Impact of Maglev Ridership on Regional Commuter Rail Ridership**

| Commuter Rail Line: | Baseline 2025 Ridership | Impact of: Primary Southern | Optional Southern | Central | Northern |
|---|---|---|---|---|---|
| Antelope Valley | 13,647 | 15,634 (+1,987) | 15,615 (+1,968) | 15,305 (+1,658) | 15,333 (+1,686) |
| Orange County | 9,931 | 12,156 (+2,225) | 12,564 (+2,634) | 12,009 (+2,078) | 12,365 (+2,434) |
| Riverside | 6,424 | 5,806 (-619) | 5,748 (-676) | 5,725 (-700) | 5,675 (-750) |
| San Bernardino | 10,569 | 10,639 (+70) | 10,649 (+80) | 10,603 (+34) | 10,773 (+204) |
| Ventura County | 4,606 | 4,949 (+343) | 4,951 (+345) | 4,908 (+302) | 4,911 (+305) |
| 91 | 5,960 | 6,697 (+737) | 6,710 (+750) | 6,685 (+725) | 8,700 (+2,740) |
| IE-OC | 5,365 | 6,220 (+855) | 6,499 (+1,134) | 6,339 (+974) | 5,670 (+305) |
| **Subtotal: All Metrolink** | **56,502** | **62,101 (+5,599)** | **62,735 (+6,233)** | **61,573 (+5,071)** | **63,426 (+6,924)** |
| All Amtrak Lines | 6,529 | 8,747 (+2,218) | 8,710 (+2,181) | 8,242 (+1,713) | 8,106 (+1,577) |
| **Total Commuter Rail** | **63,031** | **70,848 (+7,817)** | **71,445 (+8,414)** | **69,814 (+6,783)** | **71,532 (+8,501)** |

Source: Meyer, Mohaddes Associates, Inc., using SCAG Model, January 2004

The table shows that all alternatives result in increased commuter rail ridership throughout the region. The only line that shows a net ridership drop as a result of the LAX/South Maglev line being in place is the Riverside line; all other commuter lines show ridership increases, with the Orange County line having the largest net increase as a result of the project. This is probably a result of the new markets and activity centers served by the LAX/South line, which feeds additional riders into the regional commuter rail network.

**Table 6-7** shows the impact of the alignments on the region's "urban rail" system ridership, including existing and planned light rail and heavy rail lines.

**Table 6-7: Impact of Maglev Ridership on Regional Urban Rail Ridership**

| Urban Rail Line: | Baseline 2025 Ridership | Impact of: Primary Southern | Optional Southern | Central | Northern |
|---|---|---|---|---|---|
| CenterLine | 19,370 | 20,150 (+780) | 20,218 (+848) | 18,308 (-1,062) | 21,094 (+1,725) |
| Blue Line | 54,685 | 58,522 (+3,837) | 58,251 (+3,566) | 60,802 (+6,117) | 63,291 (+8,605) |
| Red Line | 128,182 | 180,805 (+52,623) | 180,742 (+52,560) | 181,109 (+52,927) | 180,617 (+52,435) |
| Green Line | 21,128 | 26,177 (+5,049) | 26,096 (+4,968) | 25,801 (+4,672) | 29,815 (+8,687) |
| Gold Line | 14,528 | 17,850 (+3,322) | 17,836 (+3,308) | 17,734 (+3,206) | 17,780 (+3,252) |
| Eastside | 15,291 | 22,851 (+7,560) | 22,831 (+7,541) | 23,193 (+7,902) | 22,929 (+7,638) |
| **Total** | **305,099** | **372,640 (+67,542)** | **372,409 (+67,310)** | **373,458 (+68,359)** | **382,788 (+77,960)** |

Source: Meyer, Mohaddes Associates, Inc., using SCAG Model, January 2004

Again, the table shows an almost entirely positive impact of the LAX/South Maglev line on urban light rail and heavy rail systems by providing additional feeder and activity center access opportunities.

# 7.0 COSTS

## INTRODUCTION

The purpose of this chapter is to summarize the anticipated capital and operating costs for the initial recommended alternatives. This chapter includes sections on cost estimating methodology, primarily using the same methodologies used by the LAX-March and LAX-Palmdale studies. Those methodologies will not be repeated in detail here but are summarized.

## CAPITAL COST ESTIMATING METHODOLOGY

### Approach and Basic Assumptions

Several sources of input were used to develop capital cost estimates for the LAX/South Maglev alignments:

- Sketch-plan level plans and profiles were developed for each alignment. Areas with grades over 3.5% were revisited to determine a feasible (lower grade) profile, to determine the possibility of a shift from aerial or fill sections to cut sections or tunnels. Areas where high grades were noted primarily were at major freeway-to-freeway interchanges, including the I-405 interchanges at I-110, I-710, I-605, SR-22, SR-73, and SR-55.
- Quantity sheets for capital cost items were used for capital cost estimating.
- Travel times were estimated from the ridership forecasting process. Ridership forecasts were used to determine the vehicle fleet and stations, and also helped determine operating characteristics for the operating and maintenance cost estimates.

## Maglev Cost Components

Much like the other SCAG Maglev projects, the capital cost estimates developed for the LAX/South project consisted of seven major elements. Those seven elements were:

1. Structures, foundations, and tunnels;
2. Earthwork;
3. Stations and maintenance facilities;
4. Guideway, power, and communications;
5. Vehicles;
6. Right-of-way and utilities; and
7. Contingencies, project implementation, and environmental mitigation.

Using the two other Maglev studies as starting points, the project team developed unit costs (per mile, linear foot, cubic meter, or other standard) for each cost category. The major elements in each category, along with the unit cost used for this study, are described below.

### Structures, Foundations and Tunnels

- This category includes guideway structure, foundations/caissons, support columns, special civil structures (bridges, viaducts), and tunnels. Guideway structure costs were estimated for a double-track guideway. The structure cost per route mile for double track depends on column height and construction complexity. Three generic categories were used to account for this: nominal viaducts, priced at $11.6 million/mile ($7 million/KM); medium-high viaducts, priced at $20 million/mile ($12 million/KM); and long span viaducts, priced at $25 million/mile ($15 million/KM).
- Tunnel structure work includes boring/drilling/digging costs, ventilation systems, and tunnel electrical systems (such as lighting, fans, and other items), and is priced at $52 million/mile ($31.5 million/KM).

### Earthwork

This category includes the excavation and grading of earth in cuts (removal of earth) and fills (addition of earth). The unit cost for cut is $7,000 per cubic meter, and fill is $11,000 per cubic meter. Drainage structures, including culverts and under drains, are estimated at 5% of the gross earthwork (cut or fill) costs.

### Stations and Maintenance Facilities

- **Stations:** Basic station requirements and features were described in Chapter 3 and includes platforms, circulation, lighting, security measures, and auxiliary spaces, ticket sales, passenger information, station administration, baggage handling, and commercial space, the station building, station interior/equipment, platform doors, access roads, landscaping and preparation of site, and control and safety equipment. Each station is assumed to have two 1,200-foot long platforms.

  Unit costs for stations change per alignment, due to the different locations and requirements of the stations. The typical station unit cost ranges from $30 million to $60 million, depending on complexity, with a major commuter and passenger facility at LAX estimated at $110 million.

  Station costs include parking facilities, with the number per alignment determined by ridership modeling. A parking space in structure is estimated to cost $10,000. Parking costs are in addition to basic station costs.

- **Operations and Maintenance Facilities:**
  - The Central Maintenance Facility includes the vehicle maintenance equipment and personnel required for major scheduled vehicle maintenance and for cleaning and repair of exterior or interior damage. It will also include route maintenance personnel and equipment, and bays for vehicle repair and maintenance work, storage space for spare parts, and areas for offices, and related personnel. An Operations

Control Center (OCC) is assumed to be part of the central maintenance facility.

- A Secondary Maintenance Facility would include equipment and personnel required for unscheduled or light maintenance, vehicle washing, and storage tracks.

A lump sum cost of $260 million has been assumed for the central maintenance facilities and operations control center, plus an additional $20 million for the secondary facility.

### Guideway, Power and Communications

- **Guideway:** The guideway includes guideway beams, switches, equipment, power substations, electric propulsion system, wayside equipment, energy supply, substations, and operation control system. Guideway costs assume a double-track guideway, and use the Transrapid design for guideway beams, and for concrete elements. The unit cost assumed for the system guideway is $13.4 million/mile ($8 million/KM).

- The **power (propulsion) system** cost estimates include substations (building and equipment), wayside equipment, and the energy supply and distribution equipment for the substations; their number and size requirements are determined by the operating schedule, fleet size, and route characteristics (such as trip time, grades and curves, and other factors). Wayside equipment includes propulsion equipment along the route, including switches, switch stations, power rails, and communication equipment. The trackside equipment (transformer stations, etc.) and supply cabling provide power to the wayside components along the route. The energy supply equipment provides power to the substations at the 23 kV level and distributes power to all wayside elements of the system. The substation operating facilities provide non-interruptible electrical power to the operation control center. For this project, the unit cost for the power substations and distribution system are estimated at $8.35 million/mile ($5 million/KM).

- **Communications equipment** includes maintenance facilities, emergency systems, closed circuit television, public information and address systems, and other monitoring and detection devices needed for safety and security. For this project, the unit cost for electric, signals, and communications equipment is estimated at $4.175 million/mile ($2.5 million/KM).

- An allowance for **sound walls** has been made along the entire alignment. For this project, the unit cost for sound walls is $668,000 per mile ($400,000/KM).

- **Safety Fencing and Landscaping** have been assumed along the entire alignment. The unit cost for safety fencing and landscaping is $668,000 per mile ($400,000/KM).

### Maglev Vehicles

Similar to other SCAG Maglev studies, each Maglev train consists of six (6) semi-permanently coupled cars. The two types of cars are end sections and intermediate sections. The end sections are aerodynamic for maximum efficiency and contain on-board control systems. Some end sections could be configured to accommodate airline luggage and other cargo in uniform containers. The intermediate sections contain seating and related passenger amenities. Each section includes a car body, interior furnishings, vehicle on-board operation control system (end sections only), diagnostics, vehicle location system (end sections only), HVAC, and magnetic suspension (undercarriage).

The number of vehicles was estimated based on the round-trip time for each alternative, a 10-minute service headway, the capacity of the standard six-car train set, and the peak passenger load for each alternative. Spares are included in the estimated number of vehicles.

For this project, the unit cost for vehicles is $46,200,000 per six-car consist.

### Right-of-Way and Utilities

- **Right-of-way/Utility Relocation:** This category includes costs associated with the purchase of land or easement rights, including relocation, demolition, and acquisition outside of freeway rights-of-way (which are assumed to be at no cost); this could include transitions into and out of stations, areas where curves are "flattened" to maximize speeds, and other similar areas, typically comprising about 15-20% of a system's total length. For this project, the unit cost for Dense Urban ROW is $9.9 million/mile ($5.9 million/KM); for Urban ROW is $1.94 million/mile ($1.164 million/KM); and for Industrial ROW is $1.92 million/mile ($1.15 million/KM). Major utility relocations include overhead power lines, and underground facilities such as pipelines, water and sewer mains, and underground duct banks and vaults. For this project, the unit cost for utility relocations in Dense Urban Area is $1.17 million/mile ($700,000/KM); for Urban Areas is $626,000 per mile ($375,000/KM); and for Industrial Areas is $359,050 per mile ($215,000/KM).

### Contingencies, Project Implementation and Environmental Mitigation

Additional allowances are added to the capital costs of each alignment to cover a variety of standards costs, each at different percentages based on standard engineering practice. Altogether, these extra costs and contingencies add up to approximately 31% of the total capital cost of each alignment. **Design and Construction Contingencies** are allowances added to construction cost estimates at the conceptual planning/engineering stage, to account for design details not available at this level of engineering. A contingency of 25% of total capital costs has been assumed for construction and right-of-way. For vehicles, 10% has been added to the capital costs. **Project Implementation Costs:** Project Management and Implementation includes costs associated with planning, engineering, and implementation of the project. A contingency of 30% of the total capital costs has been assumed. For vehicles, 5% has been added to account for procurement, including specification, purchase and testing. **Environmental Impact Mitigation** is an allowance added to the construction cost estimates to account for potential mitigation treatments that will be identified during a formal environmental process. A contingency of 3% of the total capital cost was added to account for environmental impact mitigation.

## OPERATING AND MAINTENANCE COST ESTIMATING METHODOLOGY

### Operating Cost Components

Similarly to other SCAG Maglev studies, annual Operating and Maintenance (O&M) costs for this project were based on unit costs from SCAG's *California Maglev Deployment Project.* The O&M cost structure uses five principal categories commonly used in North American railroad cost estimating. Those five categories of O&M costs are:

#### Maintenance-of-Way (MOW)

Maintenance-of-Way (MOW) operations include the activities necessary to keep the guideway and related infrastructure in good working condition and include:

- Permanent Way Maintenance – regular inspections of guideway switches (geometric inspection, switch inspection, and switch repairs) according to FRA requirements;
- Major Structures Maintenance – regular inspections and repairs of the structure;
- Electric Power Maintenance – maintenance of energy supply elements, primarily traction power substations and power cables;
- Signals, Communications, and Propulsion Maintenance – maintenance of the propulsion system and elements of the operations control technology outside the Operation Control Center;
- Maintenance-of-Way Overhead – operating and maintaining space needed for MOW operations, staff costs, associated civil and electrical engineering functions, and leased highway vehicle costs.

### Maintenance of Equipment (MOE)

MOE Operations include both maintaining vehicles in good working condition and exterior and interior cleaning, most of which would occur at a central maintenance facility. They include:

- Cleaning and Washing Vehicles – short turnaround cleaning, service and inspection, long-cycle car interior cleaning, and exterior washing;
- Maintenance and Repair;
- MOE Overhead Expense – operating and maintaining the Central Maintenance Facility and other facilities required for both the MOE and the MOW functions.

### Transportation Operations

Transportation operations refer to the costs of moving trains carrying passengers. They include:

- Superintendence and Dispatching – including the system train operation and dispatching activities;
- Train Movement – the electric power required for train movement. Costs for this activity are the product of the local electric utility cost per kilowatt-hour and the total kilowatt-hours consumed by operating trains. The costs developed for the other SCAG Maglev studies assumed an average cost of $.10 per kilowatt-hour
- Yard Operations – includes yard movements in the Central Maintenance Facility, and equipment moves between the CMF and the terminal where trains are taken in and out of service.
- Transportation Facilities Overhead – includes mechanical and electrical systems of the Control Center, and the O&M costs for crew assembly and lounge areas.

### Passenger and Station Services

Passenger and station services are a major portion of total O&M costs for passenger transportation systems but are difficult to estimate in the aggregate from other costs because they are derived from the level of service and associated amenities. These costs include:

- Marketing, Service Design, and Pricing - includes the determination of how to increase ridership and revenues, along with an advertising program. Service design determines what services should be offered. Schedule development includes generating pubic and employee timetables.
- Information, Reservations, and Ticketing – all the Maglev projects assume that no reservations, reserved seats, or service class differentiation services will be provided. Tickets will be sold by vending machines, the Internet, and by mail, with some ticket window services provided during normal operation at each station.
- Station Operation and Maintenance – including maintaining passenger information services and other amenities.
- On-Board Services – including on-board passenger information and other amenities as needed.

### General and Administration (G&A)

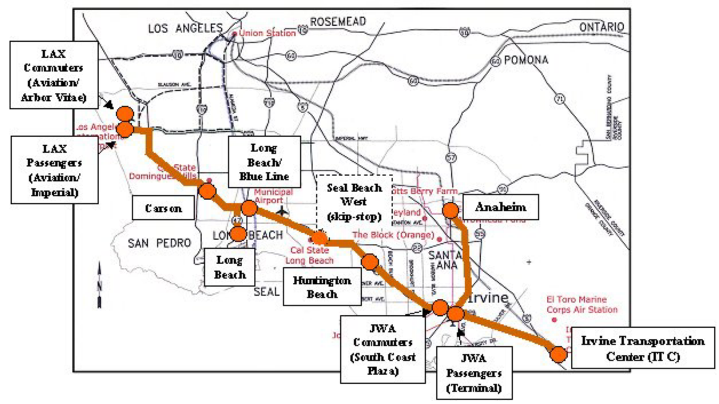
The General and Administration account includes annual expenses O&M expenses that cannot readily be assigned to other categories, such as management oversight, personnel and contract administration, security, and headquarters expenses.

## ESTIMATED CAPITAL AND OPERATING COSTS FOR INITIAL ALIGNMENTS

The four initial alignments (three primary and one alternate) range between 52 and 64 miles long. With capital costs ranging between $6.9 billion and $7.8 billion, resulting in a capital-cost-per-mile range of $122 million to $136 million (detailed spreadsheets on capital and operating costs for all alternatives are included in Appendix C of this report). The following assumptions were used when estimating the costs: double-track guideway; costs added for higher grades and structures and for tunnels; service 18 hours per day; ten-minute headways; and fleet size and parking based on preliminary ridership

## Southern Alignment: Airport Connector

The primary southern alignment follows the 405 from LAX airport to the Irvine Transportation Center (ITC). The capital costs are listed in **Table 7-1a** and the annual operating and maintenance (O&M) costs are listed in **Table 7-1b.**




| Table 7-1a: Capital Costs for the Primary Southern Alignment | |
|---|---|
| Length | 55.4 Miles (92.3 KM) |
| Structure | $1.6 billion |
| Earthwork | $3.0 million |
| Stations | $805.8 million (11 stations) |
| Maintenance Facility/Parking | $845.6 million |
| Guideways/Signals/Power | $2.4 billion |
| Vehicles | $1.7 billion |
| ROW/Utility Relocation | $127.5 million |
| **TOTAL** | **$7.434 billion** |
| Cost/Mile | $134.2 million |
| Cost/KM | $80.6 million |

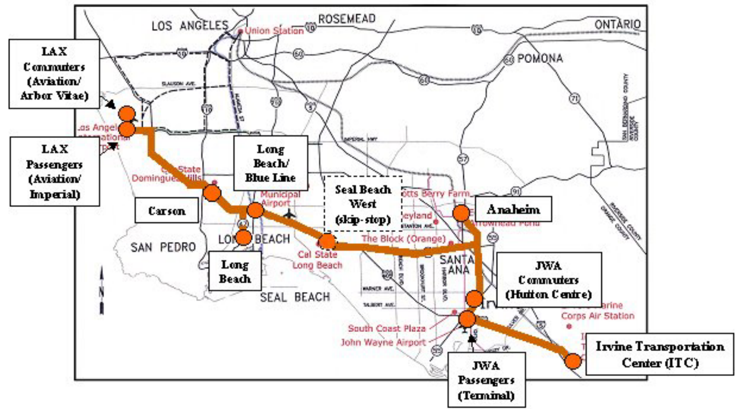
Source: Aztec Engineering, July 2003. All costs in year 2000 dollars

**Table 7-1b: Annual O&M Costs for the Primary Southern Alignment**

| Cost Item | Cost/Mile | Annual Train Miles | Annual O&M Costs | % of Total O&M Costs |
|---|---|---|---|---|
| **Maintenance of Way** | $3.28 | 4.485M | $14.7M | 15.3% |
| **Maintenance Equipment** | $4.62 | 4.485M | $20.7M | 21.5% |
| **Transportation/ Energy** | $7.50 | 4.485M | $33.6M | 34.9% |
| **Passenger Services** | $2.70 | 4.485M | $12.0M | 12.6% |
| **General & Admin** | $3.40 | 4.485M | $15.2M | 15.8% |
| **Total O&M Costs** | **$21.50** | **4.485M** | **$96.4M** | |

Source: Aztec Engineering, July 2003. All costs in year 2000 dollars

The alternative southern alignment follows the 405 then uses SR-22 to directly connect to Anaheim. The capital costs are listed in **Table 7-1c** and the annual operating and maintenance (O&M) costs are listed in **Table 7-1d.**




| Table 7-1c: Capital Costs for the Alternative Southern Alignment | |
|---|---|
| Length | 52.2 Miles (87.0 KM) |
| Structure | $1.4 billion |
| Earthwork | $3.0 million |
| Stations | $679.4 million (10 stations) |
| Maintenance Facility/Parking | $784.8 million |
| Guideways/Signals/Power | $2.3 billion |
| Vehicles | $1.7 billion |
| ROW/Utility Relocation | $102.1 million |
| **TOTAL** | **$6.924 billion** |
| Cost/Mile | $132.7 million |
| Cost/KM | $79.7 million |

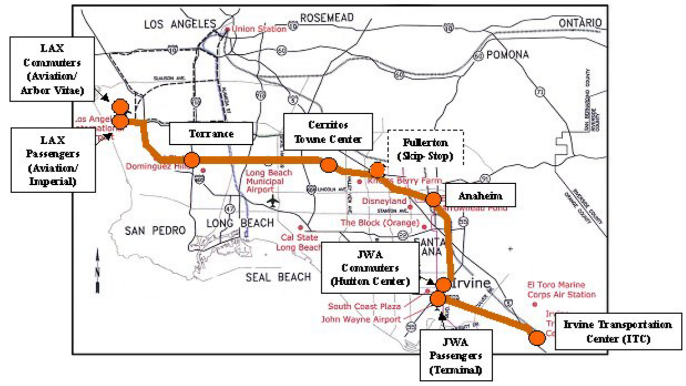
Source: Aztec Engineering, July 2003. All costs in year 2000 dollars

| Cost Item | Cost/Mile | Annual Train Miles | Annual O&M Costs | % of Total O&M Costs |
|---|---|---|---|---|
| **Maintenance of Way** | $3.28 | 4.226M | $13.9M | 15.3% |
| **Maintenance Equipment** | $4.62 | 4.226M | $19.6M | 21.5% |
| **Transportation/ Energy** | $7.50 | 4.226M | $31.7M | 34.9% |
| **Passenger Services** | $2.70 | 4.226M | $11.4M | 12.6% |
| **General & Admin** | $3.40 | 4.226M | $14.4M | 15.8% |
| **Total O&M Costs** | **$21.50** | **4.226M** | **$90.9M** | |

Source: Aztec Engineering, July 2003. All costs in year 2000 dollars

## Central Alignment: Activity Center Connector

The central alignment primarily follows the SR-91 from LAX airport to the Irvine Transportation Center (ITC). The capital costs are listed in **Table 7-2a** and the annual operating and maintenance (O&M) costs are listed in **Table 7-2b**.



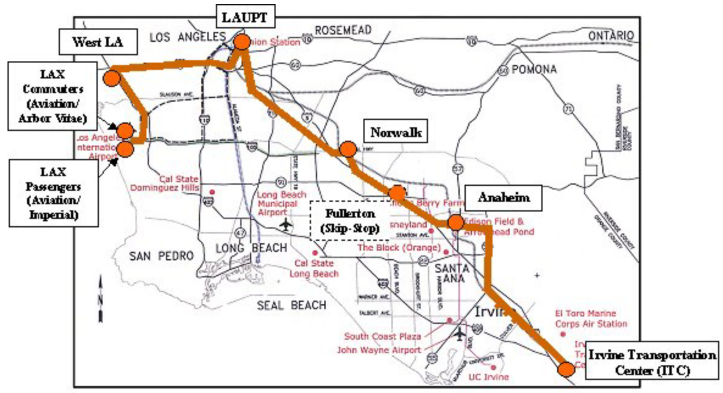

| Table 7-2a: Capital Costs for the Central Alignment | |
|---|---|
| Length | 51.9 Miles (86.6 KM) |
| Structure | $1.4 billion |
| Earthwork | $3.0 million |
| Stations | $790.0 million (9 stations) |
| Maintenance Facility/Parking | $827.9 million |
| Guideways/Signals/Power | $2.2 billion |
| Vehicles | $1.7 billion |
| ROW/Utility Relocation | $102.0 million |
| **TOTAL** | **$7.040 billion** |
| Cost/Mile | $135.6 million |
| Cost/KM | $81.3 million |

Source: Aztec Engineering, July 2003. All costs in year 2000 dollars

| Table 7-2b: Annu | | Costs for the Central Alignment | | |
|---|---|---|---|---|
| **Cost Item** | **Cost/Mile** | **Annual Train Miles** | **Annual O&M Costs** | **% of Total O&M Costs** |
| **Maintenance of Way** | $3.28 | 4.206M | $13.7M | 15.3% |
| **Maintenance Equipment** | $4.62 | 4.206M | $19.4M | 21.5% |
| **Transportation/ Energy** | $7.50 | 4.206M | $31.7M | 34.9% |
| **Passenger Services** | $2.70 | 4.206M | $11.4M | 12.6% |
| **General & Admin** | $3.40 | 4.206M | $14.4M | 15.8% |
| **Total O&M Costs** | **$21.50** | **4.206M** | **$90.4M** | |

Source: Aztec Engineering, July 2003. All costs in year 2000 dollars

## Northern Alignment: Multi-Modal Connector




The northern alignment primarily follows the UP railroad branch that parallels I-5 from LAX airport to the Irvine Transportation Center (ITC). The capital costs are listed in **Table 7-3a** and the annual operating and maintenance (O&M) costs are listed in **Table 7-3b.**

| Table 7-3a: Capital Costs for the Northern Alignment | |
|---|---|
| Length | 64.0 Miles (106.7 KM) |
| Structure | $1.7 billion |
| Earthwork | $3.0 million |
| Stations | $790.0 million (8 stations) |
| Maintenance Facility/Parking | $791.6 million |
| Guidelines/Signals/Power | $2.2 billion |
| Vehicles | $1.7 billion |
| ROW/Utility Relocation | $68.8 million |
| **TOTAL** | **$7.254 billion** |
| Cost/Mile | $113.3 million |
| Cost/KM | $67.9 million |

Source: Aztec Engineering, July 2003. All costs in year 2000 dollars

| Table 7-3b: Annual O&M Costs for the Northern Alignment | | | | |
|---|---|---|---|---|
| **Cost Item** | **Cost/Mile** | **Annual Train Miles** | **Annual O&M Costs** | **% of Total O&M Costs** |
| **Maintenance of Way** | $3.28 | 5.187M | $17.0M | 15.3% |
| **Maintenance Equipment** | $4.62 | 5.187M | $23.9M | 21.5% |
| **Transportation/ Energy** | $7.50 | 5.187M | $38.9M | 34.9% |
| **Passenger Services** | $2.70 | 5.187M | $14.0M | 12.6% |
| **General & Admin** | $3.40 | 5.187M | $17.6M | 15.8% |
| **Total O&M Costs** | **$21.50** | **5.187M** | **$111.5M** | |

Source: Aztec Engineering, July 2003. All costs in year 2000 dollars

## Summary of All Alignments

**Table 7-4** summarizes the four alignments and their capital and O&M cost estimates.

| Table 7-4: Summary of All Alignments | | | | |
|---|---|---|---|---|
| **Cost Item** | **Primary Southern** | **Alternative Southern** | **Central** | **Northern** |
| **CAPITAL** | | | | |
| **Length**<br>**Mile**<br>**KM** | <br>55.4<br>92.3 | <br>52.2<br>87.0 | <br>51.9<br>86.6 | <br>64.0<br>106.7 |
| **Total Capital Cost** | $7.434B | $6.924B | $7.04B | $7.254B |
| **Cost per**<br>**Mile**<br>**KM** | <br>$134.2M<br>$80.6M | <br>$132.7M<br>$79.7M | <br>$135.6M<br>$81.3M | <br>$113.3M<br>$67.9M |
| **O&M** | | | | |
| **Annual Train Miles** | 4.485M | 4.226M | 4.206M | 5.187M |
| **Annual O&M Cost** | $96.4M | $90.9M | $90.4M | $111.5M |

Source: Aztec Engineering, July 2003. All costs in year 2000 dollars

## Comparison with LAX-Palmdale

Now that the initial cost estimates have been developed for the LAX/South Maglev project, it is useful to compare its findings with those of the LAX-Palmdale study to determine their viability. **Table 7-5** provides a summary comparison of the two studies.

| Table 7-5: Comparison with LAX-Palmdale | | |
|---|---|---|
| | **LAX/South** | **LAX-Palmdale** |
| Length Range<br>Miles<br>KM | <br>52-64<br>87-107 | <br>72-106<br>115-171 |
| Total Capital Cost Range | $6.9B - $7.4B | $8.2B - $11.9B |
| Capital Cost/Mile Range | $113M - $136M | $112M - $115M |
| Capital Cost/KM Range | $68M - $81M | $69M - $71M |

Sources: LAX/South: Aztec Engineering, July 2003. LAX-Palmdale: IBI Group, November 2001. All costs in year 2000 dollars.

As shown by the table, the capital cost per mile for the LAX/South study was slightly higher than that of the LAX-Palmdale project. The LAX/South study used many of the same unit cost assumptions as the Palmdale study, so the starting point for the cost elements were the same. But there are several reasons why the LAX/South project has a slightly higher cost-per-mile than that of the Palmdale study:

- The LAX/South project has roughly the same amount of fixed costs (operations and maintenance facilities, vehicle fleet) as the Palmdale project, but spread out over a shorter distance, making the per-mile cost higher. The vehicle fleet for the shorter LAX/South alignment is roughly the same as Palmdale's because ridership is similar, even over the shorter distance of the LAX/South project.

- The LAX/South project has more stations than the Palmdale project (LAX/South: eight to ten, depending on alignment; LAX-Palmdale: five to seven, depending on alignment), so the capital cost element for stations is higher.

- Because virtually all of the LAX/South alignments are in freeway rights-of-way, the structural costs are higher than those for LAX-Palmdale, which uses more railroad rights-of-way depending on alignment alternative. Initial calculations show that roughly 60% of all structures in the LAX/South alignments are categorized as "high" or "very high" to allow crossings of freeway interchanges and other major high structures.

# 8.0 RECOMMENDATIONS

## INTRODUCTION

The purpose of this chapter is to make an initial recommendation on a preferred alignment, based on the data contained in the previous chapters, with subsequent refinement of the preferred alignment based on a re-examination of capital and operating costs, ridership, and comments from affected jurisdictions and the Maglev Task Force. The chapter also includes a financial pro forma for the final recommended alternative.

## INITIAL RECOMMENDATION

Based on the data and analyses contained in previous chapters, it is recommended that the LAX/South Maglev project utilize an alignment focused on the Southern Alignment, along the I-405 corridor. This recommendation is made for the following reasons:

- The primary Southern alignment has the best overall performance when considering that it has the least overall competition with other transit corridors, such as Metrolink or the proposed Orange Line. The optional southern alignment also performs well, and could be considered if the primary alignment proves to be less cost effective.

- The Southern alignment had the second-highest number of station areas with overall development potential and the second-highest number of station areas specifically with Transit-Oriented Development potential.

- The Southern alignment had slightly fewer environmental impacts than the other two alignments.

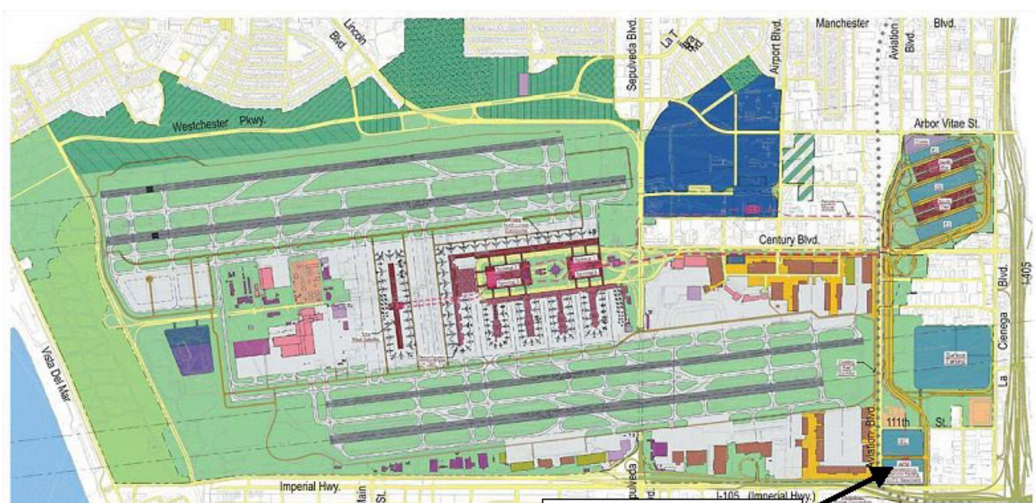
- The Southern alignment best fulfills the role of airport connector and feeder, one of the major initial goals of the project.

## DETAILED EXAMINATION OF SOUTHERN ALIGNMENT OPTIONS

Since the development of the initial Southern alignment, the project team was guided by a number of factors in developing a final recommendation. Those factors, derived from continued discussions with the members of the SCAG Maglev Task Force and representatives of jurisdictions in the corridor, included the following:

- The nature of the station location process at LAX has changed significantly since the initiation of this project. The study's initial station location recommendations were made before the events of September 11, 2001, at which time the entire master planning process at LAX was modified to include a major focus on security issues. Accordingly, all ongoing Maglev studies revised their thinking about LAX to focus on an Intermodal Transportation Center, to be located on the southeast side of the airport (at the northeast corner of the Imperial Highway/Aviation Blvd. intersection – see **Figure 8-1**). This center is envisioned as a connecting point for the Green Line LRT system, all regional transit buses, and other future transportation improvements such as Maglev, with a direct connection into the airport by a people-mover system

***Figure 8-1: Proposed LAX Master Plan and Intermodal Transportation Center***




Source: Los Angeles World Airports

- The CenterLine project in Orange County has re-emerged as a viable project. Elected officials and technical staff in Orange County expressed a strong desire for the Maglev project to minimize its competition with a potential CenterLine project. The proposed CenterLine is the starter segment of a light rail system being developed by the Orange County Transportation Authority (OCTA) that is 8.5 miles long and runs from Santa Ana through Costa Mesa to Irvine, with a proposed 0.8 mile extension to Santa Ana College (see **Figure 8-2**). The initial Southern alignment connection between Irvine and Anaheim was almost identical to the CenterLine alignment, so the project team worked with SCAG and OCTA to find an alternate route between the Irvine area and Anaheim that was complementary to the travel demands and transportation systems in the area.

***Figure 8-2: Proposed CenterLine Alignment***


Source: Orange County Transportation Authority

- The Maglev Task Force expressed a preference for a station in downtown Santa Ana. Accordingly, the project team analyzed two potential sites, depending on the final alignment chosen. The first, shown in **Figure 8-3a**, would be located near SR-22 and Bristol or the City Drive. The second, shown in **Figure 8-3b**, would be located at or near the Santa Ana Regional Transportation Center (SARTC). The precise locations of both stations will be determined in the next phase of study and design.

***Figure 8-3a: Proposed Downtown Santa Ana Station Option 1***

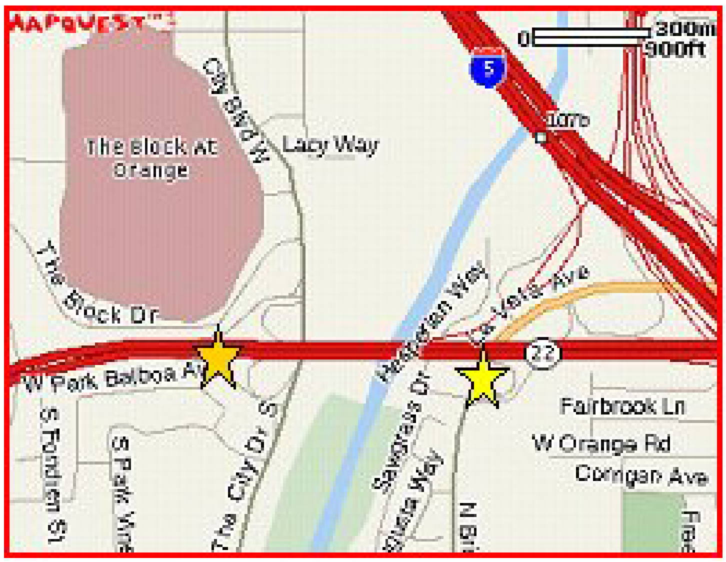
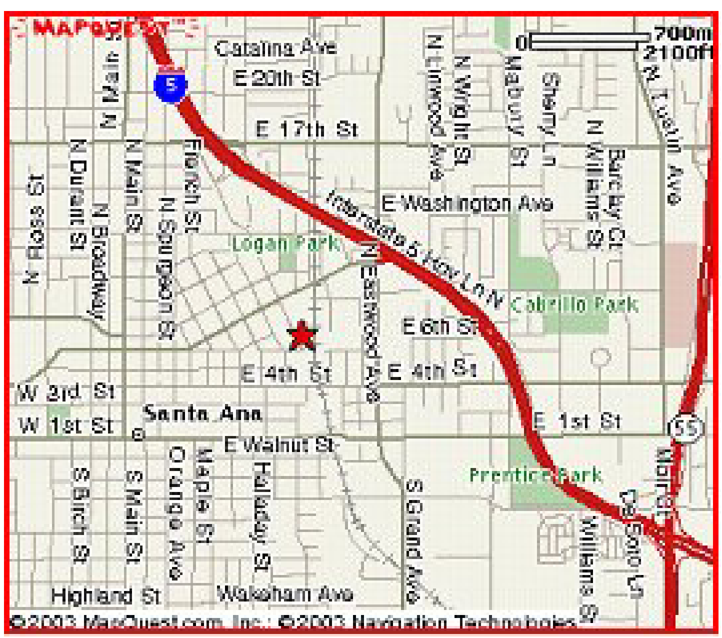



***Figure 8-3b: Proposed Downtown Santa Ana Station Option 2***



- Finally, the project team examined various options to maximize the cost-effectiveness of the system by developing a hybrid alignment that would provide the most ridership possible for the smallest possible capital investment. The project team experimented with several different scenarios for combinations of alignments and determined that the most successful combination was an extension of the Southern alignment through West LA to Los Angeles Union Station.

## FINAL ALIGNMENT OPTIONS

To respond to the new issues mentioned above, the project team developed four final alternatives focused in the I-405 corridor and including an extension through West LA to Union Station.

### Final Alignment Option 1

**Figure 8-4** shows this option, which extends from Union Station through West LA to LAX, and stays within the I-405 corridor to the Irvine Transportation Center, and an optional extension to Long Beach. Its major characteristics are:

- Length: 69 miles;
- Capital cost: $7.5 billion;
- Capital cost per mile: $104 million;
- Annual operating and maintenance costs: $120.2 million; and
- Average daily ridership: 202,400.

***Figure 8-4: Final Alignment Option 1***

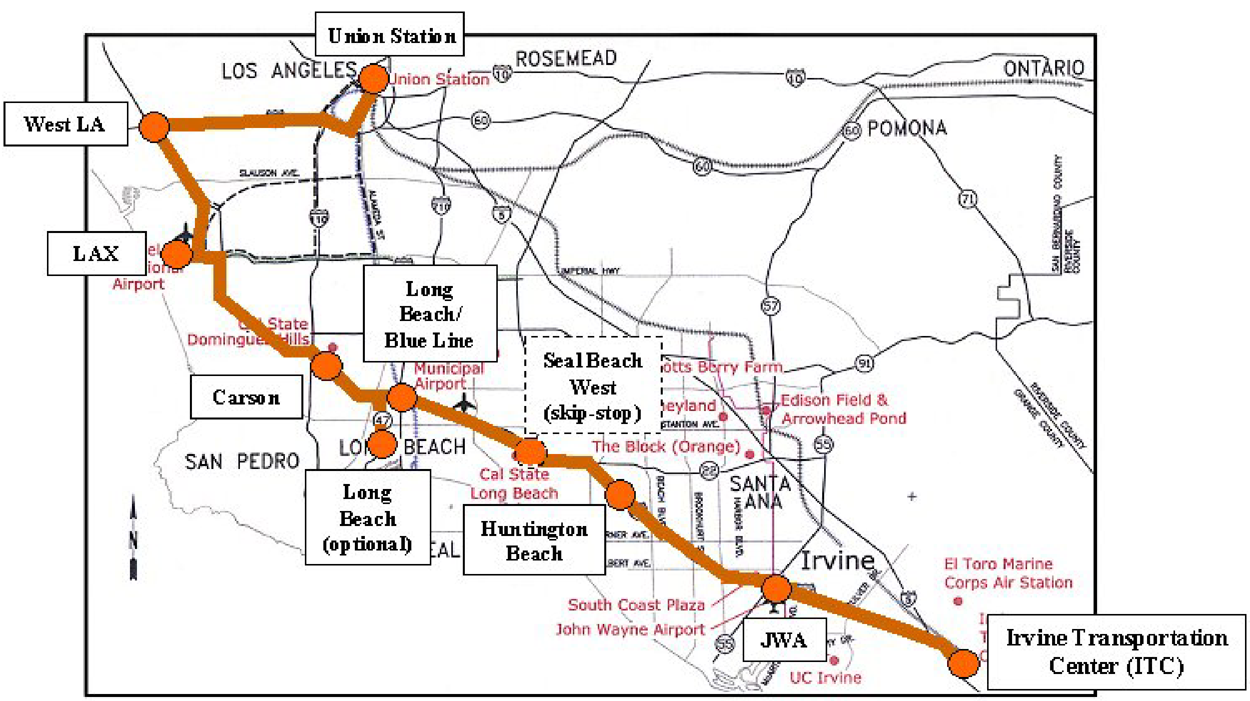


**Table 8-1a** summarizes the estimated capital costs for Final Alignment Option 1; **Table 8-1b** summarizes operations and maintenance costs; and **Table 8-1c** summarizes the results of the ridership analysis for this option

| Table 8-1a: Capital Costs for Final Option 1 | |
|---|---|
| Length | 69.0 Miles (115.0 KM) |
| Structure | $1.8 billion |
| Earthwork | $3.6 million |
| Stations | $742.6 million (10 stations) |
| Maintenance Facility/Parking | $845.6 million |
| Guideways/Signals/Power | $2.9 billion |
| Vehicles | $1.3 billion |
| ROW/Utility Relocation | $127.5 million |
| **TOTAL** | **$7.75 billion** |
| Cost/Mile | $104 million |
| Cost/KM | $67.4 million |

Source: Aztec Engineering, December 2003. All costs in year 2000 dollars

| Table 8-1b: Annual O&M Costs for Final Option 1 | | | | |
|---|---|---|---|---|
| **Cost Item** | **Cost/Mile** | **Annual Train Miles** | **Annual O&M Costs** | **% of Total O&M Costs** |
| **Maintenance of Way** | $3.28 | 5.59M | $18.3M | 15.3% |
| **Maintenance/ Equipment** | $4.62 | 5.59M | $25.8M | 21.5% |
| **Transportation/ Energy** | $7.50 | 5.59M | $41.9M | 34.9% |
| **Passenger Services** | $2.70 | 5.59M | $15.1M | 12.5% |
| **General & Admin** | $3.40 | 5.59M | $19.0M | 15.8% |
| **Total O&M Costs** | **$21.50** | **5.59M** | **$120.2M** | |

Source: Aztec Engineering, December 2003. All costs in year 2000 dollars

**Table 8-1c: Final Alignment Option 1 Ridership Forecast Summary**
**Daily Passenger Volumes and Mode of Access**

| Station | Daily Passenger Volumes | | | | | Mode of Access | | Parking |
|---|---|---|---|---|---|---|---|---|
| | Peak Commute | Off Peak | Air Passengers | Others | Total Daily Riders | Auto | Walk | |
| Union | 20,038 | 8,857 | 3,305 | 6,935 | 39,135 | 21.74% | 78.26% | 5,025 |
| West LA | 14,436 | 6,333 | 3,440 | 4,985 | 29,194 | 18.54% | 81.46% | 3,855 |
| LAX | 8,291 | 4,940 | 14,962 | 3,175 | 31,368 | 15.03% | 84.97% | 3,240 |
| Carson | 6,495 | 4,279 | 2,420 | 2,586 | 15,780 | 50.07% | 49.93% | 5,639 |
| Long Beach | 9,601 | 5,355 | 4,566 | 3,589 | 23,111 | 32.88% | 67.12% | 5,460 |
| Seal Beach | 5,410 | 3,178 | 1,282 | 2,061 | 11,932 | 16.66% | 83.34% | 3,475 |
| Huntington | 5,081 | 3,882 | 1,494 | 2,151 | 12,608 | 41.89% | 58.11% | 3,465 |
| JWA | 7,700 | 3,856 | 5,859 | 2,774 | 20,189 | 32.59% | 67.41% | 3,396 |
| Irvine | 3,007 | 1,396 | 2,650 | 1,057 | 8,110 | 42.66% | 57.34% | 2,630 |
| LB CBD | 4,254 | 2,872 | 2,104 | 1,710 | 10,940 | 17.38% | 82.62% | 1,269 |
| Totals | 84,313 | 44,949 | 42,082 | 31,023 | 202,366 | | | 37,455 |

**Line Board Summary**

| Stations | AM Peak Hour | | | | | | Daily | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SB | | | NB | | | SB | | | NB | | |
| | On | Off | In | On | Off | In | On | Off | In | On | Off | In |
| Union | 6,219 | | | | 4,228 | | 39,134 | | | | 39,135 | |
| | | | 6,219 | | | 4,228 | | | 39,134 | | | 39,135 |
| West LA | 1,051 | 3,077 | | 1,294 | 2,226 | | 13,885 | 15,309 | | 15,309 | 13,885 | |
| | | | 4,194 | | | 5,160 | | | 37,710 | | | 37,711 |
| LAX | 1,716 | 1,264 | | 1,420 | 1,800 | | 18,981 | 12,384 | | 12,383 | 18,984 | |
| | | | 4,645 | | | 5,540 | | | 44,307 | | | 44,311 |
| Carson | 572 | 1,062 | | 1,398 | 526 | | 4,906 | 10,874 | | 10,876 | 4,906 | |
| | | | 4,155 | | | 4,668 | | | 38,339 | | | 38,341 |
| Long Beach | 1,079 | 1,904 | | 2,331 | 672 | | 8,602 | 18,184 | | 18,186 | 8,602 | |
| | | | 3,331 | | | 3,009 | | | 28,757 | | | 28,757 |
| Seal Beach | 547 | 912 | | 956 | 443 | | 4,069 | 7,862 | | 7,862 | 4,069 | |
| | | | 2,966 | | | 2,496 | | | 24,963 | | | 24,964 |
| Huntington | 587 | 802 | | 950 | 378 | | 4,343 | 8,265 | | 8,266 | 4,343 | |
| | | | 2,751 | | | 1,924 | | | 21,041 | | | 21,041 |
| JWA | 533 | 2,132 | | 1,530 | 323 | | 3,629 | 16,560 | | 16,561 | 3,629 | |
| | | | 1,152 | | | 717 | | | 8,110 | | | 8,110 |
| Irvine | | 1,152 | | 717 | | | | 8,110 | | 8,110 | | |
| LB CBD | | 1,980 | | 1,494 | | | | 10,943 | | 10,940 | | |
| | | | 1,980 | | | 1,494 | | | 10,943 | | | 10,940 |
| LB | 1,980 | | | | 1,494 | | 10,943 | | | | 10,940 | |

Source: Meyer, Mohaddes Associates, Inc., using SCAG Model, December 2003

## Final Alignment Option 2

**Figure 8-5** shows this option, which extends from Union Station through West LA to LAX, and stays within the I-405 corridor to the Irvine Transportation Center, and a spur from the East Seal Beach area to Santa Ana and Anaheim along or in the vicinity of SR-22 (as a conceptual corridor for further study), and an optional extension to Long Beach. Its major characteristics are:

- Length: 84.5 miles;
- Capital cost: $9.24 billion;
- Capital cost per mile: $109.4 million;
- Annual operating and maintenance costs: $147.2 million; and
- Average daily ridership: 238,800.

*Figure 8-5: Final Alignment Option 2*

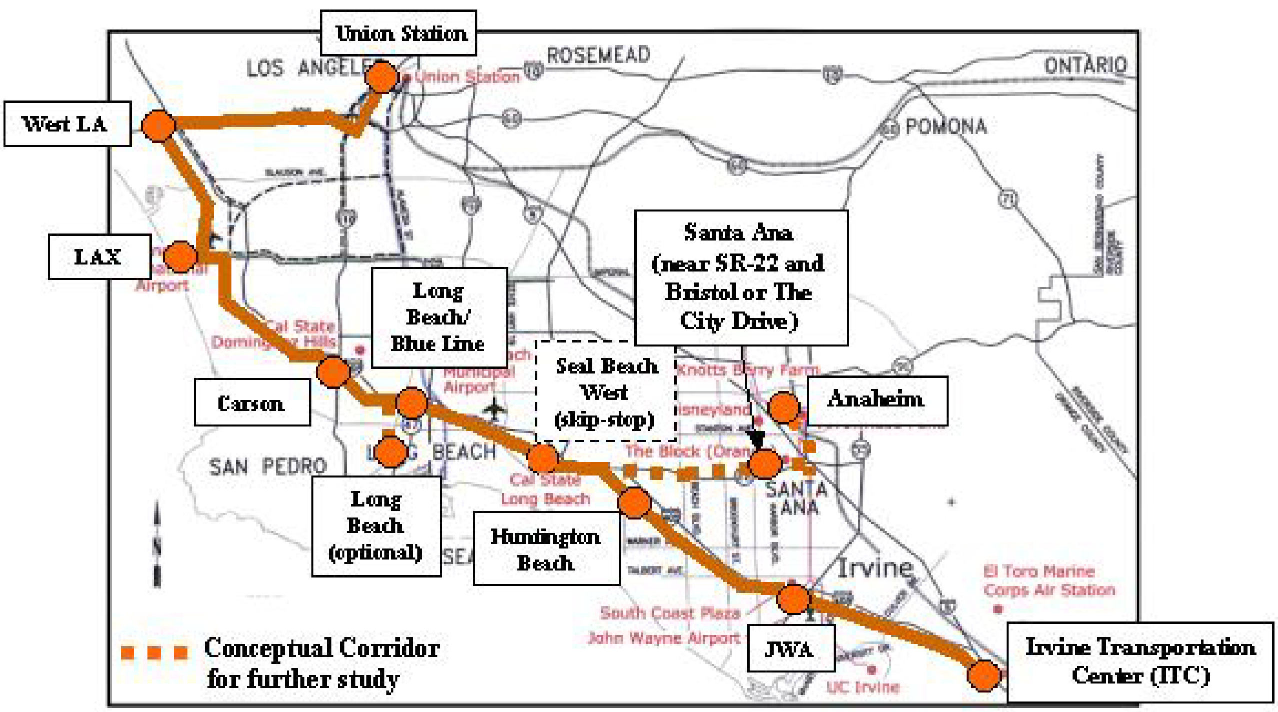


**Table 8-2a** summarizes the estimated capital costs for Final Alignment Option 2; **Table 8-2b** summarizes operations and maintenance costs; and **Table 8-2c** summarizes the results of the ridership analysis for this option

| Table 8-2a: Capital Costs for Final Option 2 | |
|---|---|
| Length | 84.5 Miles (140.8 KM) |
| Structure | $2.2 billion |
| Earthwork | $3.6 million |
| Stations | $916.4 million (12 stations) |
| Maintenance Facility/Parking | $845.6 million |
| Guideways/Signals/Power | $3.6 billion |
| Vehicles | $1.6 billion |
| ROW/Utility Relocation | $127.5 million |
| **TOTAL** | **$9.244 billion** |
| Cost/Mile | $109.4 million |
| Cost/KM | $65.6 million |

Source: Aztec Engineering, December 2003. All costs in year 2000 dollars

| Table 8-2b: Annual O&M Costs for Final Option 2 | | | | |
|---|---|---|---|---|
| **Cost Item** | **Cost/Mile** | **Annual Train Miles** | **Annual O&M Costs** | **% of Total O&M Costs** |
| **Maintenance of Way** | $3.28 | 6.845M | $22.4M | 15.3% |
| **Maintenance Equipment** | $4.62 | 6.845M | $31.6M | 21.5% |
| **Transportation/ Energy** | $7.50 | 6.845M | $51.3M | 34.9% |
| **Passenger Services** | $2.70 | 6.845M | $18.5M | 12.5% |
| **General & Admin** | $3.40 | 6.845M | $23.3M | 15.8% |
| **Total O&M Costs** | **$21.50** | **6.845M** | **$147.2M** | |

Source: Aztec Engineering, December 2003. All costs in year 2000 dollars

| Table 8-2c: Final Alignment Option 2 Ridership Forecast Summary<br>Daily Passenger Volumes and Mode of Access | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Daily Passenger Volumes | | | | | Mode of Access | | |
| Station | Peak Commute | Off Peak | Air Passengers | Others | Total Daily Riders | Auto | Walk | Parking |
| Union | 21,973 | 9,713 | 3,624 | 7,605 | 42,915 | 21.74% | 78.26% | 5,511 |
| West LA | 14,954 | 6,561 | 3,564 | 5,164 | 30,243 | 18.54% | 81.46% | 3,994 |
| LAX | 9,052 | 5,393 | 16,336 | 3,467 | 34,248 | 15.03% | 84.97% | 3,538 |
| Carson | 6,852 | 4,514 | 2,553 | 2,728 | 16,647 | 50.07% | 49.93% | 5,949 |
| Long Beach | 10,497 | 5,854 | 4,991 | 3,924 | 25,266 | 32.88% | 67.12% | 5,969 |
| Seal Beach | 6,190 | 3,637 | 1,467 | 2,358 | 13,651 | 16.66% | 83.34% | 3,976 |
| Huntington | 5,792 | 4,424 | 1,703 | 2,452 | 14,371 | 41.89% | 58.11% | 3,949 |
| JWA | 8,290 | 4,151 | 6,308 | 2,986 | 21,736 | 32.59% | 67.41% | 3,656 |
| Irvine | 3,109 | 1,444 | 2,740 | 1,093 | 8,386 | 42.66% | 57.34% | 2,720 |
| Anaheim | 4,047 | 2,285 | 2,216 | 1,568 | 10,116 | 36.55% | 63.45% | 2,663 |
| Santa Ana | 3,836 | 2,249 | 1,617 | 1,413 | 9,115 | 35.40% | 64.60% | 2,400 |
| LB CBD | 4,709 | 3,179 | 2,328 | 1,893 | 12,110 | 17.38% | 82.62% | 1,405 |
| **Totals** | **99,301** | **53,406** | **49,447** | **36,650** | **238,804** | | | **45,729** |

**Line Boarding Summary**

| | AM Peak Hour | | | | | | Daily | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SB | | | NB | | | SB | | | NB | | |
| Stations | On | Off | In | On | Off | In | On | Off | In | On | Off | In |
| Union | 6,820 | | | | 4,861 | | 42,914 | | | | 42,915 | |
| | | | 6,820 | | | 4,861 | | | 42,914 | | | 42,915 |
| West LA | 1,131 | 3,077 | | 1,294 | 2,395 | | 14,933 | 15,309 | | 15,309 | 14,934 | |
| | | | 4,874 | | | 5,961 | | | 42,539 | | | 42,540 |
| LAX | 1,976 | 1,264 | | 1,420 | 2,073 | | 21,861 | 12,384 | | 12,383 | 21,864 | |
| | | | 5,586 | | | 6,614 | | | 52,016 | | | 52,021 |
| Carson | 673 | 1,062 | | 1,398 | 619 | | 5,773 | 10,874 | | 10,876 | 5,773 | |
| | | | 5,197 | | | 5,835 | | | 46,915 | | | 46,917 |
| Long Beach | 1,496 | 1,904 | | 2,331 | 931 | | 11,927 | 18,184 | | 18,186 | 11,927 | |
| | | | 4,789 | | | 4,436 | | | 40,658 | | | 40,658 |
| Seal Beach | 1,029 | 2,293 | | 2,403 | 833 | | 7,655 | 19,764 | | 19,764 | 7,655 | |
| | | | 3,526 | | | 2,866 | | | 28,549 | | | 28,549 |
| Huntington | 587 | 973 | | 1,152 | 378 | | 4,343 | 10,028 | | 10,028 | 4,343 | |
| | | | 3,140 | | | 2,092 | | | 22,864 | | | 22,864 |
| JWA | 533 | 2,331 | | 1,673 | 323 | | 3,629 | 18,107 | | 18,107 | 3,629 | |
| | | | 1,342 | | | 741 | | | 8,386 | | | 8,387 |
| Irvine | | 1,342 | | 741 | | | | 8,386 | | 8,387 | | |
| Seal Beach | | 3,114 | | 2,349 | | | | 17,207 | | 17,207 | | |
| | | | 3,114 | | | 2,349 | | | 17,207 | | | 17,207 |
| Santa Ana | 1,466 | 183 | | 138 | 1,106 | | 8,103 | 1,012 | | 1,012 | 8,103 | |
| | | | 1,831 | | | 1,381 | | | 10,116 | | | 10,116 |
| Anaheim | 1,831 | | | | 1,381 | | 10,116 | | | | 10,116 | |
| Long Beach | 2,697 | | | | 958 | | 12,113 | | | | 12,110 | |
| | | | 2,697 | | | 958 | | | 12,113 | | | 12,110 |
| LB CBD | | 2,697 | | 958 | | | | 12,113 | | 12,110 | | |

Source: Meyer, Mohaddes Associates, Inc., using SCAG Model, December 2003

## Final Alignment Option 3

**Figure 8-6** shows this option, which extends from Union Station through West LA to LAX, and stays within the I-405 corridor to the Irvine Transportation Center, with a spur from the Irvine Transportation Center to Anaheim along or in the vicinity of the railroad corridor that parallels I-5 (as a conceptual corridor for further study), and an optional extension to Long Beach. Its major characteristics are:

- Length: 87 miles;
- Capital cost: $9.41 billion;
- Capital cost per mile: $108.2 million;
- Annual operating and maintenance costs: $151.5 million; and
- Average daily ridership: 228,800.

***Figure 8-6: Final Alignment Option 3***

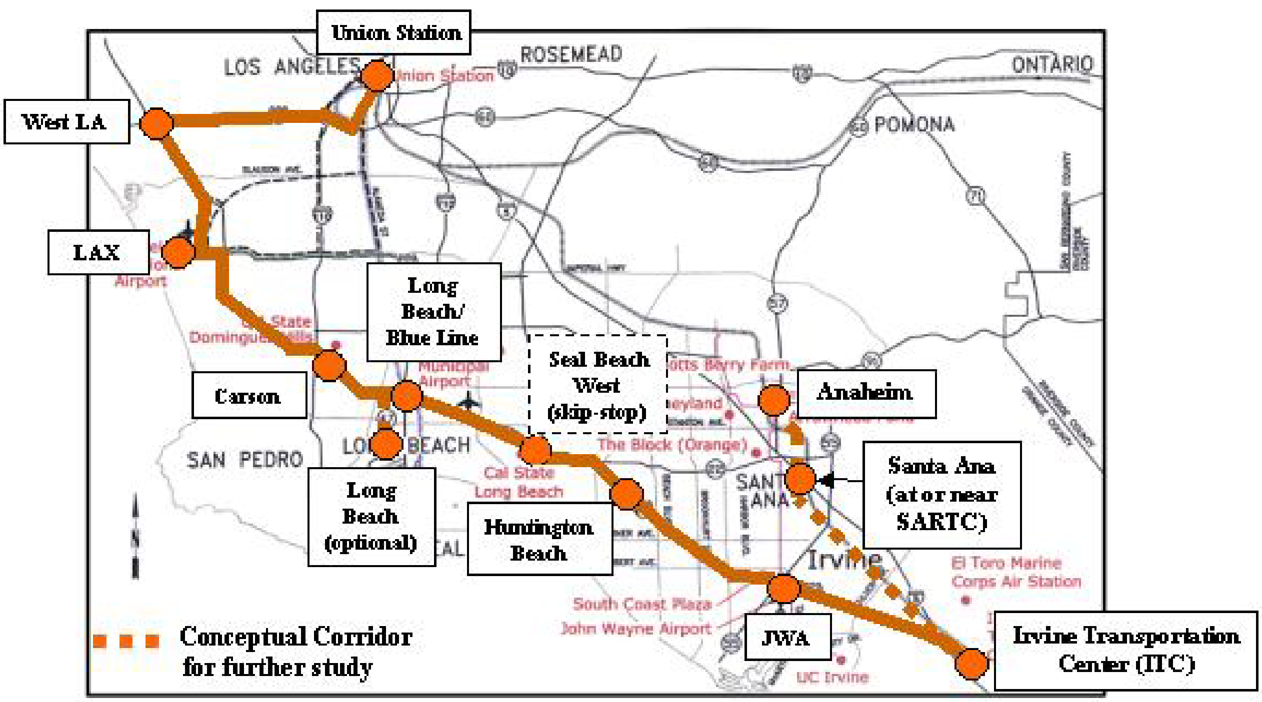


**Table 8-3a** summarizes the estimated capital costs for Final Alignment Option 3; **Table 8-3b** summarizes operations and maintenance costs; and **Table 8-3c** summarizes the results of the ridership analysis for this option

| Table 8-3a: Capital Costs for Final Option 3 | |
|---:|---|
| Length | 87.0 Miles (145.0 KM) |
| Structure | $2.2 billion |
| Earthwork | $3.6 million |
| Stations | $916.4 million (12 stations) |
| Maintenance Facility/Parking | $845.6 million |
| Guideways/Signals/Power | $3.7 billion |
| Vehicles | $1.6 billion |
| ROW/Utility Relocation | $127.5 million |
| **TOTAL** | **$9.414 billion** |
| Cost/Mile | $108.2 million |
| Cost/KM | $64.9 million |

Source: Aztec Engineering, December 2003. All costs in year 2000 dollars

Table 8-3b: Annual O&M Costs for Final Option 3

| Cost Item | Cost/Mile | Annual Train Miles | Annual O&M Costs | % of Total O&M Costs |
|---|---|---|---|---|
| **Maintenance of Way** | $3.28 | 7.047M | $23.1M | 15.3% |
| **Maintenance/ Equipment** | $4.62 | 7.047M | $32.6M | 21.5% |
| **Transportation/ Energy** | $7.50 | 7.047M | $52.8M | 34.9% |
| **Passenger Services** | $2.70 | 7.047M | $19.1M | 12.5% |
| **General & Admin** | $3.40 | 7.047M | $24.0M | 15.8% |
| **Total O&M Costs** | **$21.50** | **7.047M** | **$151.5M** | |

Source: Aztec Engineering, December 2003. All costs in year 2000 dollars

**Table 8-3c: Final Alignment Option 3 Ridership Forecast Summary**
**Daily Passenger Volumes and Mode of Access**

| Station | Daily Passenger Volumes | | | | | Mode of Access | | Parking |
|---|---|---|---|---|---|---|---|---|
| | Peak Commute | Off Peak | Air Passengers | Others | Total Daily Riders | Auto | Walk | |
| Union | 20,601 | 9,106 | 3,398 | 7,130 | 40,234 | 21.74% | 78.26% | 5,167 |
| West LA | 14,587 | 6,399 | 3,476 | 5,037 | 29,499 | 18.54% | 81.46% | 3,895 |
| LAX | 8,512 | 5,072 | 15,362 | 3,260 | 32,206 | 15.03% | 84.97% | 3,327 |
| Carson | 6,599 | 4,347 | 2,459 | 2,627 | 16,032 | 50.07% | 49.93% | 5,729 |
| Long Beach | 9,862 | 5,500 | 4,689 | 3,687 | 23,738 | 32.88% | 67.12% | 5,608 |
| Seal Beach | 5,587 | 3,283 | 1,324 | 2,129 | 12,323 | 16.66% | 83.34% | 3,589 |
| Huntington | 5,365 | 4,099 | 1,578 | 2,271 | 13,313 | 41.89% | 58.11% | 3,658 |
| JWA | 8,219 | 4,116 | 6,254 | 2,961 | 21,550 | 32.59% | 67.41% | 3,625 |
| Irvine | 4,957 | 2,302 | 4,369 | 1,742 | 13,371 | 42.66% | 57.34% | 4,336 |
| Anaheim | 3,190 | 1,792 | 1,799 | 1,244 | 8,025 | 36.55% | 63.45% | 2,113 |
| Santa Ana | 3,069 | 1,808 | 1,243 | 1,122 | 7,243 | 35.40% | 64.60% | 1,907 |
| LB CBD | 4,384 | 2,960 | 2,168 | 1,763 | 11,274 | 17.38% | 82.62% | 1,308 |
| **Totals** | **94,932** | **50,784** | **48,119** | **34,972** | **228,808** | | | **44,262** |

**Line Boarding Summary**

| Stations | AM Peak Hour | | | | | | Daily | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SB | | | NB | | | SB | | | NB | | |
| | On | Off | In | On | Off | In | On | Off | In | On | Off | In |
| Union | 6,394 | | | | 4,295 | | 40,233 | | | | 40,234 | |
| | | | 6,394 | | | 4,295 | | | 40,233 | | | 40,234 |
| West LA | 1,075 | 3,077 | | 1,294 | 2,275 | | 14,190 | 15,309 | | 15,309 | 14,190 | |
| | | | 4,392 | | | 5,276 | | | 39,115 | | | 39,116 |
| LAX | 1,791 | 1,264 | | 1,420 | 1,879 | | 19,819 | 12,384 | | 12,383 | 19,822 | |
| | | | 4,919 | | | 5,735 | | | 46,549 | | | 46,554 |
| Carson | 602 | 1,062 | | 1,398 | 553 | | 5,158 | 10,874 | | 10,876 | 5,158 | |
| | | | 4,458 | | | 4,890 | | | 40,834 | | | 40,836 |
| Long Beach | 1,200 | 1,904 | | 2,331 | 747 | | 9,563 | 18,184 | | 18,186 | 9,563 | |
| | | | 3,754 | | | 3,306 | | | 32,213 | | | 32,213 |
| Seal Beach | 600 | 912 | | 956 | 485 | | 4,460 | 7,862 | | 7,862 | 4,460 | |
| | | | 3,442 | | | 2,836 | | | 28,810 | | | 28,810 |
| Huntington | 734 | 802 | | 950 | 439 | | 5,048 | 8,265 | | 8,266 | 5,048 | |
| | | | 3,374 | | | 2,326 | | | 25,593 | | | 25,593 |
| JWA | 733 | 2,132 | | 1,530 | 444 | | 4,990 | 16,560 | | 16,561 | 4,990 | |
| | | | 1,975 | | | 1,240 | | | 14,022 | | | 14,022 |
| Irvine | | 1,975 | | 1,240 | | | | 14,022 | | 14,022 | | |
| Irvine | | 1,962 | | 1,480 | | | | 10,840 | | 10,840 | | |
| | | | 1,962 | | | 1,480 | | | 10,840 | | | 10,840 |
| Santa Ana | 912 | 370 | | 279 | 688 | | 5,039 | 2,047 | | 2,047 | 5,039 | |
| | | | 1,420 | | | 1,071 | | | 7,848 | | | 7,848 |
| Anaheim | 1,420 | | | | 1,071 | | 7,848 | | | | 7,848 | |
| Long Beach | 2,511 | | | | 892 | | 11,277 | | | | 11,274 | |
| | | | 2,511 | | | 892 | | | 11,277 | | | 11,274 |
| LB CBD | | 2,511 | | 892 | | | | 11,277 | | 11,274 | | |

Source: Meyer, Mohaddes Associates, Inc., using SCAG Model, December 2003

## Final Alignment Option 4

**Figure 8-7** shows this option, which combines all elements of the previous three options. It extends from Union Station through West LA to LAX, and stays within the I-405 corridor to the Irvine Transportation Center, with a spur from the East Seal Beach area to Santa Ana and Anaheim along or in the vicinity of SR-22, another spur from the Irvine Transportation Center to Anaheim along or in the vicinity of the UP railroad corridor that parallels I-5, and an optional extension to Long Beach. It is envisioned to operate in a loop system, potentially with every other train taking the alternate route to or from Irvine and Anaheim. Its major characteristics are:

- Length: 100.3 miles;
- Capital cost: $10.47 billion;
- Capital cost per mile: $104 million;
- Annual operating and maintenance costs: $174.6 million; and
- Average daily ridership: 254,300.

***Figure 8-7: Final Alignment Option 4***

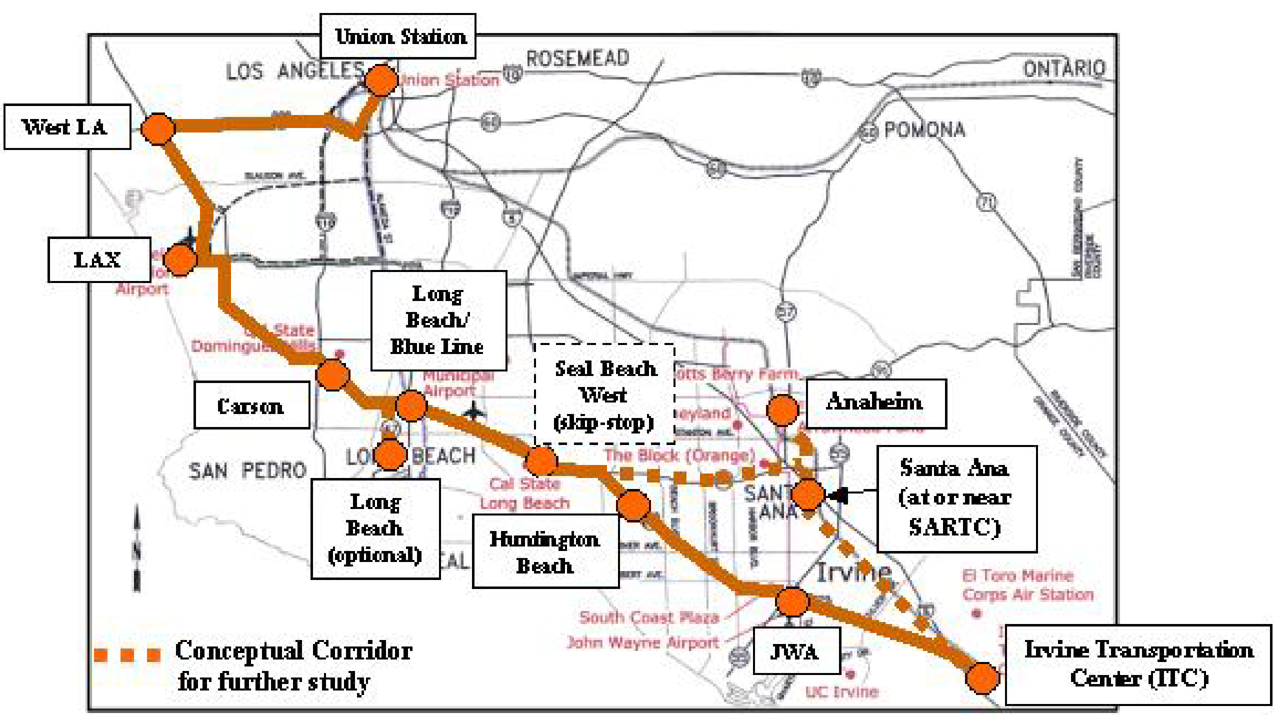


**Table 8-4a** summarizes the estimated capital costs for Final Alignment Option 4; **Table 8-4b** summarizes operations and maintenance costs; and **Table 8-4c** summarizes the results of the ridership analysis for this option

| Table 8-4a: Capital Costs for Final Option 4 | |
|---|---|
| Length | 100.3 Miles (167.2 KM) |
| Structure | $2.6 billion |
| Earthwork | $3.6 million |
| Stations | $916.4 million (12 stations) |
| Maintenance Facility/Parking | $893.0 million |
| Guideways/Signals/Power | $4.2 billion |
| Vehicles | $1.7 billion |
| ROW/Utility Relocation | $127.5 million |
| **TOTAL** | **$10.474 billion** |
| Cost/Mile | $104.4 million |
| Cost/KM | $62.7 million |

Source: Aztec Engineering, December 2003. All costs in year 2000 dollars

**Table 8-4b: Annual O&M Costs for Final Option 4**

| Cost Item | Cost/Mile | Annual Train Miles | Annual O&M Costs | % of Total O&M Costs |
|---|---|---|---|---|
| **Maintenance of Way** | $3.28 | 8.123M | $26.6M | 15.3% |
| **Maintenance/ Equipment** | $4.62 | 8.123M | $37.5M | 21.5% |
| **Transportation/ Energy** | $7.50 | 8.123M | $60.9M | 34.9% |
| **Passenger Services** | $2.70 | 8.123M | $21.9M | 12.5% |
| **General & Admin** | $3.40 | 8.123M | $27.6M | 15.8% |
| **Total O&M Costs** | **$21.50** | **8.123M** | **$174.6M** | |

Source: Aztec Engineering, December 2003. All costs in year 2000 dollars

| Table 8-4c: Final Alignment Option 4 Ridership Forecast Summary<br>Daily Passenger Volumes and Mode of Access | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Daily Passenger Volumes | | | | | Mode of Access | | |
| Station | Peak Commute | Off Peak | Air Passengers | Others | Total Daily Riders | Auto | Walk | Parking |
| Union | 22,138 | 9,786 | 3,651 | 7,662 | 43,237 | 21.74% | 78.26% | 5,552 |
| West LA | 15,000 | 6,581 | 3,575 | 5,179 | 30,335 | 18.54% | 81.46% | 4,006 |
| LAX | 9,197 | 5,479 | 16,597 | 3,522 | 34,795 | 15.03% | 84.97% | 3,594 |
| Carson | 6,891 | 4,540 | 2,567 | 2,743 | 16,741 | 50.07% | 49.93% | 5,983 |
| Long Beach | 10,659 | 5,945 | 5,068 | 3,985 | 25,656 | 32.88% | 67.12% | 6,061 |
| Seal Beach | 6,295 | 3,698 | 1,492 | 2,398 | 13,883 | 16.66% | 83.34% | 4,043 |
| Huntington | 5,792 | 4,424 | 1,703 | 2,452 | 14,371 | 41.89% | 58.11% | 3,949 |
| JWA | 8,290 | 4,151 | 6,308 | 2,986 | 21,736 | 32.59% | 67.41% | 3,656 |
| Irvine | 5,603 | 2,602 | 4,938 | 1,969 | 15,113 | 42.66% | 57.34% | 4,901 |
| Anaheim | 5,579 | 3,167 | 2,961 | 2,147 | 13,854 | 36.55% | 63.45% | 3,647 |
| Santa Ana | 5,196 | 3,031 | 2,278 | 1,927 | 12,431 | 35.40% | 64.60% | 3,273 |
| LB CBD | 4,734 | 3,196 | 2,341 | 1,903 | 12,174 | 17.38% | 82.62% | 1,413 |
| **Totals** | **105,373** | **56,601** | **53,479** | **38,874** | **254,327** | | | **50,872** |

| Line Boarding Summary | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AM Peak Hour | | | | | | Daily | | | | | |
| | SB | | | NB | | | SB | | | NB | | |
| Stations | On | Off | In | On | Off | In | On | Off | In | On | Off | In |
| Union | 6,871 | | | | 4,894 | | 43,236 | | | | 43,237 | |
| | | | 6,871 | | | 4,894 | | | 43,236 | | | 43,237 |
| West LA | 1,138 | 3,077 | | 1,294 | 2,409 | | 15,026 | 15,309 | | 15,309 | 15,026 | |
| | | | 4,932 | | | 6,009 | | | 42,953 | | | 42,955 |
| LAX | 2,025 | 1,264 | | 1,420 | 2,124 | | 22,409 | 12,384 | | 12,383 | 22,411 | |
| | | | 5,693 | | | 6,714 | | | 52,978 | | | 52,982 |
| Carson | 684 | 1,062 | | 1,398 | 629 | | 5,867 | 10,874 | | 10,876 | 5,867 | |
| | | | 5,316 | | | 5,945 | | | 47,971 | | | 47,973 |
| Long Beach | 1,553 | 1,904 | | 2,331 | 967 | | 12,382 | 18,184 | | 18,186 | 12,382 | |
| | | | 4,965 | | | 4,581 | | | 42,169 | | | 42,168 |
| Seal Beach | 925 | 2,293 | | 2,403 | 749 | | 6,882 | 19,764 | | 19,764 | 6,882 | |
| | | | 3,597 | | | 2,927 | | | 29,286 | | | 29,287 |
| Huntington | 587 | 973 | | 1,152 | 378 | | 4,343 | 10,028 | | 10,028 | 4,343 | |
| | | | 3,211 | | | 2,153 | | | 23,601 | | | 23,602 |
| JWA | 640 | 2,237 | | 1,606 | 388 | | 4,357 | 17,378 | | 17,379 | 4,357 | |
| | | | 1,615 | | | 935 | | | 10,580 | | | 10,580 |
| Irvine | | 1,615 | | 935 | | | | 10,580 | | 10,580 | | |
| Seal Beach | 2,720 | | | | 2,052 | | 15,032 | | | | 15,032 | |
| | | | 2,720 | | | 2,052 | | | 15,032 | | | 15,032 |
| Anaheim | 886 | 1,509 | | 1,139 | 668 | | 4,896 | 8,339 | | 8,339 | 4,896 | |
| | | | 2,097 | | | 1,582 | | | 11,589 | | | 11,589 |
| Santa Ana | 568 | 1,582 | | 1,193 | 429 | | 3,140 | 8,740 | | 8,740 | 3,140 | |
| | | | 1,084 | | | 818 | | | 5,989 | | | 5,989 |
| Irvine | | 1,084 | | 818 | | | | 5,989 | | 5,989 | | |
| Long Beach | 2,711 | | | | 963 | | 12,177 | | | | 12,174 | |
| | | | 2,711 | | | 963 | | | 12,177 | | | 12,174 |
| LB CBD | | 2,711 | | 963 | | | | 12,177 | | 12,174 | | |

Source: Meyer, Mohaddes Associates, Inc., using SCAG Model, December 2003

Note: The Orange County Transportation Authority (OCTA) has expressed concerns over the two possible extensions to the Santa Ana/Anaheim areas shown in Options 2, 3, and 4 for the following reasons:

- For the extension along or near SR-22 from Seal Beach to Santa Ana/Anaheim, OCTA is concerned about the potential impact of including a Maglev line within the SR-22 right-of-way given the pending initiation of the design/build project in the corridor. OCTA has stated it will work with SCAG to examine the possibility of retaining some right-of-way for Maglev column construction in a way that does not delay or complicate the SR-22 project.
- For the extension along or near the Union Pacific railroad corridor that parallels I-5 from Irving to Anaheim, OCTA has noted that this alignment overlaps the Metrolink line in that corridor and does not want to limit the future expansion capability of Metrolink.

Both alignments are shown as dashed lines in Options 2, 3, and 4, and are characterized as "conceptual corridors for further study" in this report. SCAG will continue to work with OCTA to resolve any Maglev implementation issues in these corridors in the future.

## Summary of All Options

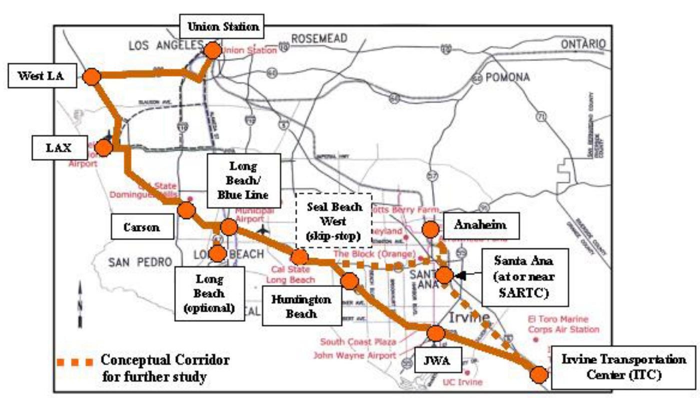
**Table 8-5** summarizes the four alignments and their capital and O&M cost estimates.

| Table 8-5: Summary of All Final Alignment Options | | | | |
|---|---|---|---|---|
| **Cost Item** | **Option 1** | **Option 2** | **Option 3** | **Option 4** |
| **CAPITAL** | | | | |
| **Length**<br>**Mile**<br>**KM** | <br>69.0<br>115.0 | <br>84.5<br>140.8 | <br>87.0<br>145.0 | <br>100.3<br>167.1 |
| **Total Capital Cost** | $7.749B | $9.243B | $9.414B | $10.472B |
| **Cost per**<br>**Mile**<br>**KM** | <br>$112.3M<br>$67.4M | <br>$109.4M<br>$65.6M | <br>$108.2M<br>$64.9M | <br>$104.4M<br>$62.7M |
| **O&M** | | | | |
| **Annual Train Miles** | 5.589M | 6.845M | 7.047M | 8.123M |
| **Annual O&M Cost** | $120.2M | $147.2M | $151.5M | $174.6M |
| **Average Daily Ridership** | 202,000 | 239,000 | 229,000 | 254,000 |

Sources: Costs: Aztec Engineering, December 2003. All costs in year 2000 dollars.
Ridership: Meyer, Modaddes Associates, Inc., using SCAG Model, December 2003

## Final Recommendation

Based on these findings, the project team recommends that Final Alignment Option 4 be carried forward for further study as the primary candidate for Maglev service in the LAX/South corridor. This recommendation is based on the following factors:



- The alignment provides the highest ridership (254,000 average daily riders) and the lowest capital cost per mile ($104 million) compared to other final options.

- The alignment provides the greatest flexibility of service and covers the widest possible range of activity centers, origins, and destinations, including LAX, Union Station, Anaheim, Santa Ana, and Irvine, while providing the most efficient connections to airports in the study corridor.

- The alignment, by initiating service in the north-south corridor between Irvine and Santa Ana/Anaheim, provides the opportunity for future connections northward to the LAX-March Maglev project, with additional potential future connections to the proposed Maglev line to Las Vegas and the proposed Orange Line corridor.

**While Option 4 is recommended as the primary candidate alignment, it is likely that the project will be implemented in phases. Therefore, an alignment similar or identical to any of the final four options may be implemented as a first step before the complete system as envisioned in Option 4 is constructed. Other factors that could influence the initial system configuration could include availability of right-of-way, financing, and other transportation projects in the region (including other Maglev projects, the I-405 corridor study east of John Wayne Airport, the extension of SR-57 south of SR-22, and the SR-22 Design/Build project nearing implementation). These projects present the opportunity to improve regional cost-effectiveness through the potential for sharing rights-of-way, stations, and other infrastructure. All of those projects will need to be analyzed in more detail and coordinated at the regional level in the years ahead.**

# FINANCIAL ANALYSIS

## Introduction

This section summarizes a proposed financial plan for implementation of the recommendations for the LAX/South (Orange County) High-Speed Ground Access Study. It provides a ***hypothetical*** sources and uses of funds analysis based on the capital and operating costs developed for Final Alignment 4 as described above. It assumes construction commencing in 2005, a 7-year construction period through 2011, and operations commencing in 2012. It also uses many of the same financial assumptions used by other similar studies, including:

- Short-term borrowing is used to fund planning and engineering costs in the first two years of construction (2005 and 2006);
- Federal Transportation Infrastructure Finance and Innovation Act (TIFIA) loans are used to finance one-third of the construction cost of the system between 2007 and 2011. TIFIA loans are required to be paid off 35 years after construction is completed, do not require level debt repayment schedules, and have interest rates corresponding to 30-year treasury bonds;
- Tax-exempt and/or vendor financing is assumed to be used for the remaining two-thirds of the construction cost of the system;
- Ridership is assumed to be 75% of its projected 2025 volume in the opening year (2012);
- A 3% per year inflation factor is used for revenues, along with a 1.4% escalation factor representing real growth in the Los Angeles area; and
- Operating and maintenance costs are inflated by 3% per year.

These assumptions result in the following conclusions regarding the development of the hypothetical financial plan for the system using Final Alignment 4:

- Overall capital costs of $10.472 billion in year 2000 dollars (or $14.496 billion in 2011, the last year of construction);

- Annual operating and maintenance costs of $174.6 million in year 2000 dollars (or $248.9 million in 2012, the first year of operations);
- Average daily ridership in year 2025 of 254,000 (resulting in an opening year ridership in 2012 of 190,500, or 75% of the 2025 total). After 2025, ridership is assumed to increase by 3% per year.

## Revenues

An estimate was made of potential annual revenues for Final Alignment 4, using the following assumptions:

- Average daily ridership was multiplied by a factor of 305 to determine estimated annual riders in 2025, then multiplied by 75% to determine annual riders in the first year of operation (2012);
- The average fare per ride was $9.60 for the base trip length with $0.62 added per zone (based on an average trip length of 22 miles), for an average fare of approximately $11.50 per one-way trip in year 1997 dollars (resulting in an opening year fare of just over $16 in 2011);
- Freight and cargo revenues are equal to 7% of passenger fares;
- Station parking revenues are equal to 11.5% of passenger fares;
- Station concessions and advertising are equal to 2% of passenger fares.

Using these assumptions, **Table 8-6** summarizes the estimated annual revenues for the system in year 2012, 2025, and 2050.

| Table 8-6: Estimated Annual Revenues for Final Option 4 | |
|---|---|
| Daily Passengers (2025) | 254,000 |
| Daily Passengers (2012) | 190,500 (75% of 2025 level) |
| Annual Passengers (2025) | 77.5 million |
| Annual Passengers (2012) | 58.1 million |
| Annual Passenger Fares (2012) | $929.6 million |
| Annual Freight & Cargo Revenues (2012) | $65.1 million |
| Annual Station Parking Revenues (2012) | $106.9 million |
| Annual Station Concessions & Advertising Revenues (2012) | $18.6 million |
| **Total Annual System Revenues (2012)** | **$1.12 billion** |
| **Total Annual System Revenues (2025)** | **$1.9 billion** |
| **Total Annual System Revenues (2050)** | **$5.5 billion** |

Source: URS Corporation, January 2004

With those assumptions in mind, **Table 8-7** shows a ***hypothetical*** financing scenario during a seven-year construction period commencing in 2005.

| Table 8-7: Hypothetical Construction Financing Scenario (all figures in millions of current dollars; capital cost = $10.472 B in 2000 dollars) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Initial capital cost inflated for year: | $12,140<br>2005 | $12,504<br>2006 | $12,879<br>2007 | $13,664<br>2008 | $13,664<br>2009 | $14,073<br>2010 | $14,496<br>2011 |
| % of capital:<br>Capital $ required: | 0.25%<br>$30.3 | 0.25%<br>$31.3 | 5.0%<br>$644 | 10.0%<br>$1,326 | 30.0%<br>$4,099 | 35.0%<br>$4,925 | 19.0%<br>$2,754 |
| Short-term principal<br>Short-term interest<br>Total short-term debt<br>Short-term cumu. | $30.3<br>$1.3<br>$31.6<br>$31.6 | $31.3<br>$3.2<br>$34.5<br>$66.1 | | | | | |
| TIFIA principal<br>TIFIA interest<br>TIFIA repayment<br>Cumu. TIFIA debt | | $22.1 | $214.6<br>$8.6<br>$223.2<br>$245.3 | $442.2<br>$44.6<br>$486.8<br>$732.1 | $1,366<br>$222.8<br>$1,589<br>$2,321 | $1,641<br>$373.0<br>$2,014<br>$4,336 | $918<br>$282.1<br>$1,200<br>$5,536 |
| Tax-exempt principal<br>Tax-exempt interest<br>Total repayment<br>Cumu. debt | | $44.1 | $429.3<br>$17.2<br>$446.5<br>$490.6 | $884.4<br>$89.1<br>$973.5<br>$1,464 | $2,732<br>$445.7<br>$3,178<br>$4,642 | $3,283<br>$746.0<br>$4,029<br>$8,672 | $1,836<br>$564<br>$2,400<br>$11,073 |
| TOTAL CUMULATIVE DEBT | $31.6 | $66.2 | $735.9 | $2,199 | $6,842 | $15,515 | $26,587 |

Source: URS Corporation, January 2004

Under this hypothetical scenario, operations would start in 2012 with the system opening with a debt of $26.6 billion. Using the assumptions listed above (ridership at 75% of its 2025 number at opening and increasing at 3% a year after 2025; annual revenues increasing by 4.4% per year; operations and maintenance costs increasing by 3% per year), this hypothetical scenario shows debt payoff in approximately the year 2052, or forty years after start-up (and 47 years after initiation of construction). This scenario shows the system's debt balance increasing from its initial amount of $26.6 billion in 2012 to a maximum of $38.1 billion in approximately 2034, with debt levels decreasing after that year. **Table 8-8** summarizes this hypothetical financial scenario at various intervals between initiation of operations in 2012 and debt payoff in 2052 (a detailed spreadsheet with complete data is included in **Appendix C**).

| Table 8-8: Hypothetical Financial Scenario between 2012 and 2015 (all figures in billions of current dollars) | | | | | | |
|---|---|---|---|---|---|---|
| Year | Beginning debt balance (from table 8-7) | Plus interest (6%) | Plus annual O&M cost (3% annual growth) | Subtotal Expenses | Minus revenues (4.4% annual growth) | Ending debt balance |
| 2012 | $26.6 | $1.6 | $0.248 | $28.4 | $1.12 | $27.3 |
| 2015 | $28.8 | $1.7 | $0.272 | $30.8 | $1.3 | $29.5 |
| 2020 | $31.6 | $1.9 | $0.306 | $33.8 | $1.5 | $32.3 |
| 2025 | $34.8 | $2.1 | $0.354 | $37.3 | $1.9 | $35.4 |
| 2030 | $37.3 | $2.2 | $0.411 | $39.9 | $2.3 | $37.6 |
| 2035 | $38.1 | $2.3 | $0.476 | $40.8 | $2.9 | $37.9 |
| 2040 | $36.1 | $2.1 | $0.552 | $38.8 | $3.6 | $35.2 |
| 2045 | $29.7 | $1.8 | $0.641 | $32.1 | $4.4 | $27.6 |
| 2050 | $16.3 | $0.98 | $0.743 | $18.1 | $5.5 | $12.5 |
| 2052 | $8.3 | $0.50 | $0.788 | $9.6 | $6.0 | $3.6 |
| 2053 | $3.6 | $0.22 | $0.812 | $4.6 | $6.2 | -$1.6 |

Source: URS Corporation, January 2004

**It is important to point out that this scenario is purely hypothetical and is subject to change based on outside factors such as changes in economic conditions, and on the ongoing decisions of SCAG and other entities as to when and how to move forward with this project; significant additional financial analysis is required before actual implementation can occur.**