3.0 Executive Summary

Introduction

This Milestone Report is the third in series of eleven. It describes the Route Alignment and Technology Alternatives that were developed for a high speed ground access system from Los Angeles International Airport (LAX) to Palmdale International Airport (PMD). The report goes on to describe the evaluation of the alignments and their screening, into a recommended short list. Similarly, a full range of technology alternatives, originally identified in Milestone 2, are described and a screening of these technology alternatives undertaken. The purpose of this Milestone is to ensure that the full potential range of Route and Technology Alternatives have been examined and then to narrow them down to a more manageable number of routes and technologies to be examined in more detail in subsequent milestones.

This study will culminate in a Project Deployment Plan (Milestone 10), which will bring together the various elements from the other milestones to recommend a combined alignment, technology and implementation alternative for the LAX/PMD Ground Access System.

Milestone 3 is made up of four tasks:

3.1 Identification of Conceptual Alternatives;
3.2 Initial Screening of Alignment Alternatives;
3.3 Technology Alternatives;
3.4 Assessment of Technology Alternatives.

The results of each task are described in subsequent sections of this report.

Identification of Conceptual Alternatives

Three groups of alignment concepts for a high-speed LAX/Palmdale system were identified in Milestone 2:

1. ***Base:*** *Palmdale-Santa Clarita-Van Nuys-West Los Angeles-Los Angeles International Airport (LAX).* This basic western alignment generally follows the SR-14 and I-405 Freeway corridors, and is approximately 70 miles long.

2. ***"S" Configuration****: Palmdale-Santa Clarita-Van Nuys (option)-Union Station-West LA (option) -LAX*. This "S"-shaped alignment follows the SR-14 and I-5 corridors between Palmdale and Union Station, and then connects to LAX via a combination of I-10/I-405 (through West LA) or some other routing. This alignment is approximately 85 miles long. A longer option is to include a connection from Santa Clarita to Van Nuys via the I-405 corridor and then proceed to Union Station.

3. ***San Gabriel Tunnel****: Palmdale-Glendale-Union Station-West LA (option) -LAX*. This direct eastern routing would follow (approximately) the N-3 Highway through the Los Angeles National Forest (San Gabriel Mountains) directly from Palmdale toward Union Station, and then proceed to LAX. This alignment is approximately 60 miles long.

The San Gabriel tunnel alignment concept has been eliminated from further consideration for two major reasons:

- The concept has the lowest ridership potential, missing many of the population centers in the region. The concept connects Palmdale most directly to Union Station but it bypasses Santa Clarita and the San Fernando Valley. This also limits its effectiveness as a congestion reliever and makes the system less likely to be able to pay for itself.

- The construction costs associated with tunneling through the San Gabriel Mountains would offset most or all of the potential savings from the shorter alignment. With similar costs and much lower ridership potential, this alignment concept would be least cost effective of the three.

The two remaining alignment concepts (Base and "S"), were examined in more detail and looked at using four physical segments:

- *North Segment*: 5 alignments between Palmdale Airport and Santa Clarita (SR-14 at I-5);

- *West Central Segment*: 1 alignment via I-405 from Santa Clarita to LAX;

- *East Central Segment*: 7 alignments between Santa Clarita and Union Station; and

- *South Segment*: 2 alignments between Union Station and LAX.

The full list of alignment segments and potential station locations is described in Section 3.1.

Initial Screening of Alignment Alternatives

These alternatives were then subjected to an evaluation using the following criteria:

1. Operations. The main measurement of the relative operational efficiency of each of these alternatives is travel time. The preliminary range of travel times from LAX to Palmdale is 49 to 62 minutes (on a Base alignment), and 64 to 90 minutes (following the "S" configuration through Union Station). Speeds were estimated using a range of technology alternatives.

2. Ridership Potential. The relative ridership potential of the alignment alternatives in each segment is assessed by considering the travel markets to be served by each alternative, taking into account travel time.

3. Preliminary Capital Costs. Preliminary capital costs for each segment were estimated based upon unit costs developed for the LAX to March Field Maglev study and for the California High Speed Rail Authority. These were converted to a cost index to compare alignments within each segment.

4. Environmental Impacts. First, an environmental fatal flaw analysis was made for each alignment within the defined segments. Such fatal flaws were not found.

Next, culture resources and environmental land use impacts were surveyed and an overall qualitative comparison made.

5. Physical Constraints. Each alignment was examined for the identification of physical constraints. These physical constraints for the corridors included: major freeway interchanges (which make it difficult for the high speed line to thread its way through the area), curves, and limited rights-of-way, which either increase potential costs due to land takes, or constrain potential speeds.

6. Transit Connections and Competition. The corridors were examined to determine potential for transit connection and the degree to which each alignment complemented or competed with existing services.

7. Public Input. A number of briefings were conducted with key stakeholders along the potential travel corridors. The meetings were used to introduce the project to stakeholders and to initiate discussion about alignment and station locations, where applicable.

8. System Continuity and Network Consideration. This criterion dealt with the relationship of the various alignment segments with each other and with other regional projects, such as the California Maglev Project and the proposed California High Speed Rail System through the study area.

Section 3.2 provides a more thorough description of the evaluation process and major findings, while Appendix A documents the details of the technical evaluation.

Overall Comparison

The results of the evaluation of alignment segments were summarized and compared by corridor. Appendix C of this report summarizes the relative comparisons. **Table 3.0-1** displays the most significant results from the comparison of segments and the recommendations coming out of this evaluation.

Table 3.0-1
Alignment Segment Evaluation Summaries

Alternative	Evaluation Highlights	Recommendation
Northern Segment Alignment Alternatives		
N1	• Lowest ridership potential, due to travel time. • High cost. (Inferior to N2)	• Drop
N2	• Second highest ridership in north • Shorter and lower cost than N1 (the other alignment providing service to Valencia area)	• Carry Forward
N3	• Lowest travel time, highest ridership potential	• Carry Forward, revise alignment to avoid cutting through Newhall

Alternative	Evaluation Highlights	Recommendation
	• One of three alignments with lower costs	to avoid cutting through Newhall
N4	• Higher travel time and lower ridership than N3 or N5 • Significant impacts in Agua Dulce area (no clear alignment through residential area)	• Drop
N5	• One of three with lower costs in the North • Least potential for environmental impacts	• Carry Forward
East Central Alignment Alternatives		
C1	• One of two most expensive alignments • Lowest ridership potential	• Drop
C2	• Lowest travel time to/from Union Station • Second highest ridership potential	• Carry Forward
C3	• Slower, larger system than C2, with less ridership potential (Inferior to C2)	• Drop
C4	• Cost is average, ridership below average • Significant right of way constraints along Hollywood Freeway, particularly near Union Station	• Drop
C5	• Highest ridership potential • Only alternative connecting Van Nuys to North Burbank area	• Carry Forward
C6	• Potential "fatal flaw" due to land use and planned busway in Chandler corridor	• Drop
C7	• No apparent travel time or ridership advantage to alignment on Ventura Freeway (causes least direct alignment between Palmdale, Union Station, and LAX)	• Drop
Southern Alignment Alternatives		
S1	• One of two candidate alignments for California Maglev (Union Station to LAX), higher ridership potential serving West LA	• Carry Forward
S2	• One of two candidate alignments for California Maglev, faster travel time than S1	• Carry Forward

Alternative	Evaluation Highlights	Recommendation
West Central Alternative versus Combinations via Union Station		
WC1	• Significant travel time advantage over combinations of east central and southern corridors (for trips between LAX and Palmdale)	• Carry Forward
C2 + S1 or C2 + S2	• Higher ridership potential than WC1 (more markets, service through to Union) • Faster travel time between Palmdale and Union Station, but slower to LAX • Higher cost, but there are potential savings from overlap with California Maglev on Union to LAX leg	• Carry Forward C2, S1 and S2 (with at least one of these two combinations)

Coming out of this screening process, eight alignment segments are recommended for inclusion in the final LAX/PMD alternatives. The alignment segments to be carried forward for further study are shown on **Exhibit 3.0-1**.

Recommended System Alternatives

The eight alignment segments can be combined into fifteen different system alternatives. By focusing on the major system objectives, three alternatives stand out:

1. Alternative N3+WC1 is the fastest combination between LAX and PMD and best serves the airport connector role The other two alternatives focus more on greater coverage of the study area and therefore have higher travel times;

2. Alternative N2+C5+S1 achieves maximum penetration into the areas being served and therefore supports the role of congestion relief;

3. Alternative N5+C2+S2 includes the other short-listed alternatives, and is a compromise between the congestion relief and airport connector roles.

These are shown on Exhibit 3.0-2. The alignment alternatives follow these specific themes:

1. *Airport Connector* (Alternative N3+WC1). The length of this alternative is 116 kilometers (72 miles), subject to revisions of certain parts of the alignment. The initial estimate of the end-to-end travel time ranges from 49 to 56 minutes. This is comparable to the desired 60-minute terminal-to-terminal connection time for air passengers, discussed in Milestone 2.
2. *Maximum Geographic Coverage* (Alternative N2+C5+S1). The length of this alternative is estimated at 158 kilometers (98 miles), including the portion from Union Station to LAX that may be part of the California Maglev Project. The initial travel time estimate is 77 to 83 minutes from end to end.
3. *Transit Hub Connector* (Alternative N5+C2+S2). This alternative is 130 kilometers (81 miles) in length, and has an estimated end-to-end travel time of 68 to 74 minutes.

Exhibit 3.0-1

ALIGNMENT SEGMENTS FOR FURTHER STUDY

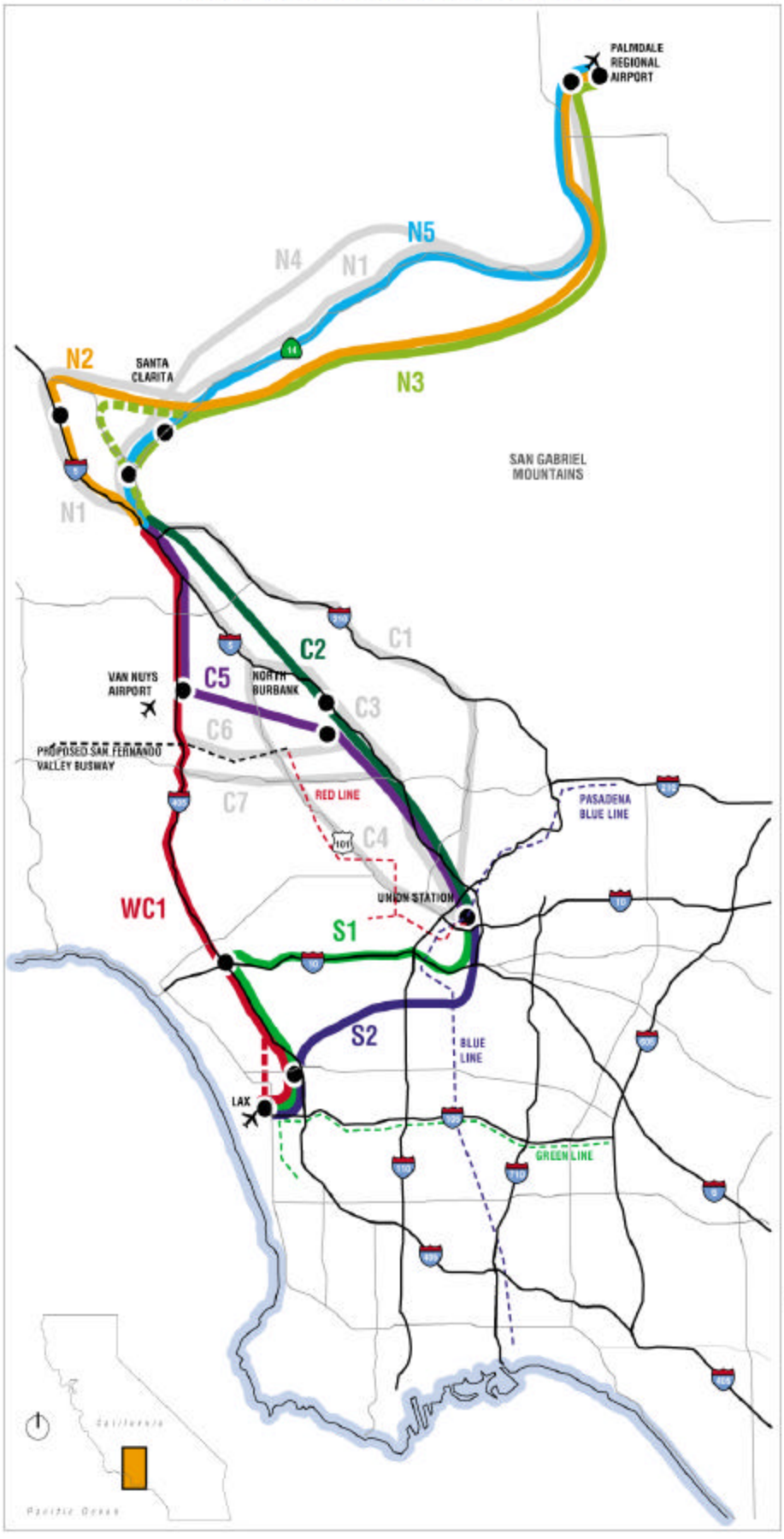
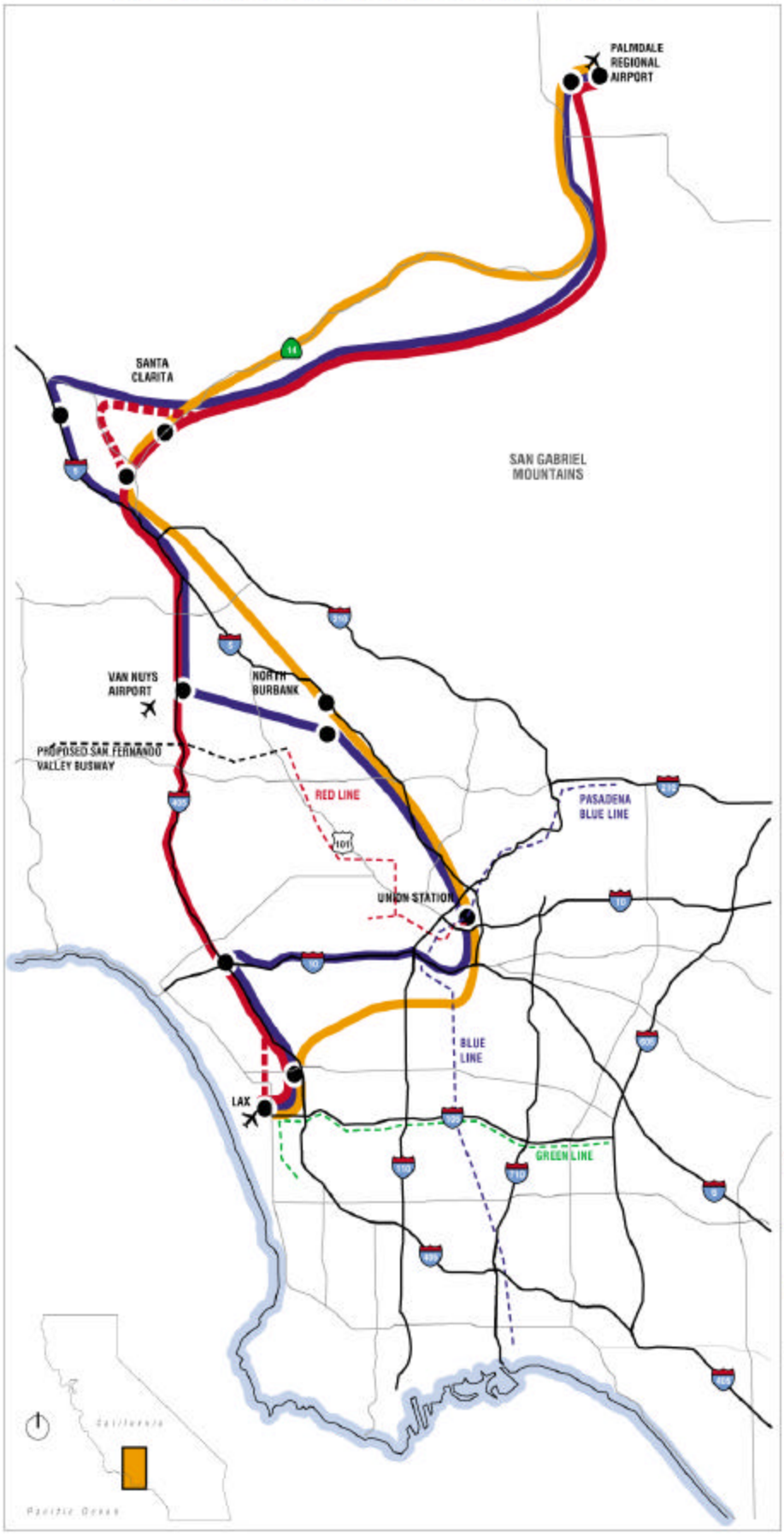


Exhibit 3.0-2

RECOMMENDED SHORTLIST OF SYSTEM ALTERNATIVES



Technology Alternatives

Milestone 2 selected four technologies for more detailed analysis:

- High Speed, High Quality Bus. Systems traveling at highway speeds in priority and/or exclusive lanes where available. Buses have the advantage of being flexible but would be subject to delays due to traffic congestion. This service is primarily seen as a relatively inexpensive interim option.

- Conventional Rail. Conventional rail systems travel anywhere from 50-90 mph, and are powered either electrically by overhead catenary cables or by diesel engines. Conventional rail systems such as Metrolink and Amtrak serve parts of the LA region.

- High Speed/Very High Speed Rail. These rail systems use special technologies to reach speeds well in excess of 100 mph, with some systems in the 200 mph range. Propulsion is usually by electric motors with overhead catenary cables, but there are some diesel or turbine high speed trains. These systems typically require dedicated track with very gentle horizontal and vertical curves in order to reach and maintain their high speeds.

- Very High Speed Maglev. Trains are magnetically levitated (using attractive and repulsive forces) and propelled by linear motors. Most high speed maglev systems are still in the development stage. Yamanashi in Japan and Transrapid in Germany have test tracks that have operated maglev vehicles at over 250 mph. At this point, Transrapid appears to have the maglev technology most prepared for implementation.

These alternative technologies were evaluated with respect to the following factors or criteria:

- Operational Factors:
  - Speed;
  - Geometry;
  - Mixed use Right of Way;
  - Competition with Exiting Services;
  - Complementing Services;
  - Crash Energy Management;
  - Trip times;
  - Passenger use;

- Community/Environmental:
  - Right of Way Impacts ;
  - Noise;
  - Visual;
  - Electromagnetic interference;
  - Energy;
  - Air Quality;

- Cost:
  - Capital;
  - Operations and Maintenance;

- Procurement:
  - Availability and Competition.

The assessment of the technologies is summarized in **Table 3.0-2**.

Table 3.0-2
Summary of Technology Rankings

Criteria	Conventional Rail	High Speed Rail	Very High Speed Rail	Very High Speed Maglev
OPERATIONS				
Speed	4	3	2	1
Horizontal Geometry	1	2	3	4
Vertical Geometry	4	3	3	1
Mixed Operations	3	3	3	4
Competing Services	4	3	1	1
Complementing Services	3	4	2	1
Crash Energy Mgmt.	1	1	4	1
Trip Time	4	2	2	1
Rider Potential	4	3	2	1
COMMUNITY / ENVIRONMENTAL				
Right of Way Needs	1	2	3	4
Noise	4	3	3	1
Visual	1	2	4	3
EMI/EMF	1	1	1	1
Energy	1	2	3	4
Air Quality	4	3	3	1
COST				
Capital	1	2	3	4
Operations & Maintenance	2	2	4	1
PROCUREMENT				
Availability & Competition	1	3	3	4
TOTAL	44	44	49	38
SUMMARY RANKING	2	2	4	1

The above table summarizes generic issues related to the four technologies under consideration, where lowest number is best. As can be seen in the table, the outcome of the ranking selects Very High Speed Maglev as the top ranked technology. It should be noted that the rankings are not only generic but also somewhat subjective, and ultimately inconclusive. These issues must be addressed for specific alignments, which is planned for subsequent milestone efforts.

The operational analysis done for the initial set of segments is the better approach to reducing the number of technology alternatives. Result of this analysis is summarized in **Table 3.0-3**.

Table 3.0-3
Average and Top Speeds on All Segments (mph)

	Conventional Rail	High Speed Rail	Very High Speed Rail	Very High Speed Maglev
Top Speed	70	125	163	215
Average Speed	55	70	67	73

Top speed and average speed reflect speeds that are reached along alignment alternatives that follow existing freeway and rail rights of way. It should be noted that alignment routes have not been optimized for this analysis. Higher speeds for the high and very high speed technologies are achievable with optimization.

The average speeds shown in Table 3.0-3 clearly show the significant advantage high speed rail, very high speed rail and very high speed maglev enjoy over conventional rail. Simulation results in the current alignments show no advantage to 175 mph rail over 125 mph rail, and only a small advantage to the very high speed maglev. This is due to the number and degree of curves in the current alignments. In the next part of the study, the alignments will be refined to improve the operating speeds of the systems, and a performance comparison of the technologies will be made at that time.

Along with the selected alignments, it is recommended that a subset of the applicable technologies be carried forward for further review in subsequent milestones. The recommended alternatives are:

- Very High Speed Maglev
- High Speed/Very High Speed Rail

The primary advantages of these systems are their speed and level of service. Maglev and high/very high speed rail boast low travel times, high travel time reliability and would likely be well perceived and attract a significant level of ridership. These could also fit in well with other planned high speed networks such as CHSRA's state wide high speed rail system and SCAG's regional maglev system.

Next Steps

The next step will be to take the recommended shortlist of system alternatives and technology options into the more detailed analysis of Milestones 5 through 7. Milestone 5 will developed a ridership assessment of the alignment alternatives. Milestone 6 will conduct an environmental assessment. Milestone 7 will develop a detailed capital and operations & maintenance cost for the alignment alternatives. These milestones will culminate in a Project Deployment Plan, Milestone 10, which will recommend the most appropriate combined alignment, technology and implementation alternative for the LAX/PMD High Speed Ground Access System.