California High-Speed Rail Project

Comparison of Providing the Equivalent Capacity to High-Speed Rail through Other Modes

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1) Estimating Alternative Capacity to HSR

California continues to grow, and is projected to reach 50 million residents by 2030 and 60 million by 2050 – the equivalent of adding the entire state of New York. This growth brings with it increased demand for mobility. To accommodate a growing population and a rising demand for inter-city travel in the coming decades, California will need to add significant capacity to its transportation network.

This analysis was designed to answer the following questions:

1. What is the people-carrying capacity of the 520-mile Phase 1 HSR system?
2. What would be the composition and cost of providing this same capacity increase through freeways and airports?

However, this is <u>not</u> an assessment of the whether the state would *need* to or *choose* to build this infrastructure if it did not build high-speed rail. Several other reports have recently been released that do provide needs assessments for the state's infrastructure. These include:

- In October 2011, the California Transportation Commission issued its 2011 *Statewide Needs Assessment Report* that identified $183 billion in capital expansion needs in the state by 2020 (without including high-speed rail). Out of that $183 billion, $79 billion is estimated for highways and another $5 billion is estimated for airports. This report can be accessed at www.catc.ca.gov/reports/2012%20Reports/Trans_Needs_Assessment_corrected_01172012.pdf
- The independent, non-partisan *Think Long Committee for California*—which includes such distinguished members as George P. Schultz, Condoleezza Rice, former chair of the Council of Economic Advisors Laura Tyson, and Google Chief Executive Officer (CEO) Eric Schmidt—has cited the state's transportation investment needs at $550 billion over the next *decade*. This report can be accessed at http://berggruen.org/files/thinklong/2011/blueprint_appendix_3_jobs_infrstructure.pdf
- The American Society of Civil Engineers estimated that California needs to invest $365 billion in infrastructure *above* existing funding levels over the next 10 years. This report can be found at http://www.ascecareportcard.org/

In contrast to those studies, this analysis is designed to compare the capital costs of the infrastructure that would add equivalent capacity through high-speed rail or through a mixture of airports and highways. These estimates are grounded in the work that was done for the Statewide California High-Speed Train Program EIR/EIS (2005), which was certified by the US Department of Transportation (USDOT), advised by Caltrans, and designed to be more directly comparable with the high-speed rail plans laid out in the 2012 Business Plan[1]. While this study

[1] *California High Speed Train Program Environmental Impact Report/Environmental Impact Statement Capital and Operation and Maintenance Costs*, prepared for the California High Speed Rail Authority and the US Department of Transportation Federal Railroad Administration. January 2004.

draws on the work that was done for the 2005 Program EIR/EIS, it is a separate analysis that uses the previous study as an input but neither replicates nor conflicts with the prior analysis. While the 2005 analysis evaluated the impacts of the modal alternatives being considered, this analysis measures the equivalent “people-carrying” capacity that would have to be added to the California transportation system through highways and airports to match the capacity of the high-speed rail system. Thus the analysis is based on the performance, as measured by capacity, of each set of infrastructure.

The basis for using a capacity-based comparison lies in the origins of the high-speed rail program. It is different than other infrastructure programs in that the Legislature specifically established the need for the investment and defined it in statute, which was then approved by the voters as Proposition 1A:

> *Cal.S. & H. code § 2704.04. Legislative intent regarding construction of a high-speed train system; use of proceeds of bonds*
>
> *(a) It is the intent of the Legislature by enacting this chapter and of the people of California by approving the bond measure pursuant to this chapter to initiate the construction of a high-speed train system that connects the San Francisco Transbay Terminal to Los Angeles Union Station and Anaheim, and links the state's major population centers, including Sacramento, the San Francisco Bay Area, the Central Valley, Los Angeles, the Inland Empire, Orange County, and San Diego consistent with the authority's certified environmental impact reports of November 2005 and July 9, 2008.*

There are two fundamental changes to assumptions that make this a different study than the one conducted for the 2005 Program EIR/EIS.

- The scope of the analysis is the 520-mile Phase 1 system, unlike the original analysis, which looked at the Full 800-mile System, including both Phase 1 and Phase 2. Although the Full System remains the complete plan for the HST program, the updated cost estimates in the Business Plan are for the Phase 1 system. This analysis was designed to provide a more direct comparison with the Phase 1 system and its costs.
- The second major change in assumptions was a switch from estimating the needed capacity based on ridership to estimating it based on equivalent “people-carrying” capacity of the HSR system whereas the 2005 analysis was prepared based on a ridership projection. Equivalent sets of assumptions are made for high-speed rail as for the other modes to measure the capacity that each mode adds to the state’s transportation system. Thus to provide an apples-to-apples comparison, this report examines the cost of adding the equivalent amount of people-carrying capacity to California’s transportation system through high-speed rail versus through highways and airports. This does not, however, suggest or imply a change in the previously identified operating conditions.

For this analysis, system capacity was used instead of a ridership forecast to make the comparison between a high-speed rail investment versus an equivalent investment in highways and airports. System capacity was used because:

- As with any major transportation infrastructure investment, high-speed rail is an investment with a useful life of 50 to 100+ years. Similarly, freeway and airport projects also represent long-term investments. Thus, they have useful lives that go well beyond any ridership forecast and to appropriate reflect that, total capacity provides a more equivalent comparison. The underlying infrastructure provides a given amount of capacity; the ridership levels can fluctuate, with service adjusted to meet that demand.
- Over time, demand for travel will grow with population, economic growth, and other factors. The high-speed rail system will have the capacity to accommodate this growth in demand; similarly additional highway lanes and airport gates and runways would need to be added over time to accommodate the growth (assuming they are being expanded instead of high-speed rail). If the analysis used demand-based factors, it would be comparing a steady-state of two high-speed rail tracks against other modes, which would be fluctuating and growing over time. Capacity provides an equivalent steady-state comparison between the modes because it is tied to the physical infrastructure being provided, not the number of people using it in any given year.
- The detailed ridership forecasts that have been prepared for the program are valuable planning tools that reflect estimates of ridership given a set of underlying assumptions. However, over the life of the system, the underlying factors that make up the assumptions (such as fare levels, economic growth, the rate of actual population growth, etc.) can still change. Conversely, the performance of the physical infrastructure (as in the capacity that each one provides) will not change over its lifespan, thus offering a stable and direct comparison.
- Ridership forecasts are also tied to a certain year or period of years close to the system's opening to evaluate the extent of potential demand for the system at that time. This is necessary for making decisions about how the system should be designed and how it should be built. This capacity analysis evaluates the system that is currently planned as a given and uses its throughput to compare it to other modes at any given time. However, it must be acknowledged that if the system design changes, its capacity might change as well.

Since the release of the Draft Business Plan (Draft Plan), the Authority has worked with Caltrans to evaluate its methodology and assumptions related to the highway construction. Based on that evaluation, the Authority has revised its estimates, incorporating Caltrans' estimates to be consistent with the current standard Caltrans highway planning assumptions. This resulted in higher estimates of highway lane-miles that would be needed to provide the equivalent capacity but lower per-lane-mile costs. The increase in lane miles is due to Caltrans' lower vehicle occupancy rates (26% lower than the previous Authority factor), lower per-lane vehicle capacity (21% lower than the previous Authority factor), and requirement for equal lanes to be built in each direction. The lower lane-mile costs are a result of the original estimates being from projects in 2003/2004, when the economy was strong and bids were generally higher than engineer's estimates, whereas Caltrans' methodology used recent project bids which have been at or below engineer's estimates. To be more conservative in the estimate of the cost of the alternatives, the lower recent estimates are used.

Additionally, Caltrans conducted an analysis of the operating and maintenance (O&M) costs of the equivalent highway capacity over a 50-year period. These costs would be borne by the state, whereas high-speed rail O&M costs are fully borne by users of the system.

2) Summary of Findings

Starting with the analysis for the 2005 Program EIR/EIS, the costs of building equivalent capacity in alternative modes was estimated for the Phase 1 system. After adjusting the analysis to be more comparable to the costs described in the Business Plan, the total costs of equivalent investment in airports and highways would be $123-138 billion (in 2011 dollars) to build 4,295-4652 lane-miles of highways, 115 gates, and four runways for Phase 1 Blended and Phase 1 Full Build, respectively. It is important to note that these investments would also require substantially more land and have much larger impacts on communities than high-speed rail. This paper does not address the likelihood that such investments could actually be made. In year-of-expenditure (YOE) dollars, the highway and airport costs would be $158-186 billion. The YOE costs were estimated by assigning the same percentage of highway and airport costs to each year as the 2012 Business Plan assumed for high-speed rail and then inflating using the inflation rates used throughout the Business Plan.

It is important to acknowledge several additional important points. First, since much of the cost information for was airports is based on studies conducted in 2003/2004, they are likely to underestimate the true cost of building the equivalent airport capacity. Since 2005, there has been significant urbanization, which would make airport construction more expensive but which is not reflected in the escalation of costs through simple inflation measures used in this analysis. Additionally, the cost estimates that were used in this analysis, based on the 2005 study, are for planning-level design and do not reflect the likely added costs that would be required for mitigation measures if the state actually tried to expand the airports in areas where significant urbanization has occurred since the original estimates were prepared. As the Authority found out over the last few years, cost increases from mitigation are often likely to be significant. Finally, the assumptions used in this analysis to measure the maximum capacity on the Phase 1 system do not preclude the potential addition of the Phase 2 system because of the use of average load factors. The load factor used in this analysis is designed to create actual operating patterns that would be sufficient to serve the demand requirements across both the Phase 1 and Phase 2 system without the system actually running out of capacity in the peak.

Table 1. The capacity needed and cost of providing equivalent capacity to two tracks of the Phase 1 HSR system

	Capacity Needed	Cost (2011 $)	Cost (YOE)
Highway Component	4,295 - 4,652 lane-miles	$93.3 - 107.6 billion	$119.0 - 145.5 billion
Airport Component	115 gates and 4 runways	$30.3 billion	$38.6 - 41.0 billion
Total		**$123 - 138 billion**	**$158 - 186 billion**

Based on Caltrans' assessment of just the highway component of the alternative capacity improvements, O&M for the added highway lanes would cost $132.8 billion over 50 years of operations. These costs would be borne by the state while high-speed rail passengers would cover the full cost of the system's O&M.

The following sections describe the methodology for estimating that capacity and the basis for other assumptions driving the estimate of the total cost of comparable capacity.

3) *Estimating HSR Capacity*

The capacity that would be required in alternative modes is based on the total capacity offered by the HSR system. The main assumptions driving the HSR estimate are based on national inter-city rail (e.g. Amtrak) and international HSR examples. In creating these assumptions, an emphasis was placed on realism, consistency with other analyses in the Business Plan, the infrastructure requirements set out in Prop 1A and the 2005 Program EIR/EIS, and consistency with assumptions for the other modes.

The main assumptions, which are strictly tied to estimating total capacity for a business plan comparison with alternative modes, and do not reflect a change in planned operating characteristics, are below. They are equal to or lower than the operating characteristics identified in the 2005 Program EIR/EIS.

- 12 trains per hour in each direction
- 1000 seats per train
- 70% average load factor for trains (based on international experience and Travel Demand Model output)[2]

Under these conditions, a realistic maximum number of passengers that each point on the system can accommodate is 8,400 per hour in each direction. However, the system as a whole could accommodate substantially more *trips* than this as multiple passengers could use the same seat on different parts of the line. Instead, the 8,400 per direction the average capacity of any given point on the line (i.e. how many passengers could go through that point over the span of an hour). It is also important to note this scenario still leaves potential room for additional trains. The Shinkansen system in Japan is currently operating headways as low as four minutes (15 trains per hour) and the California HST system is being designed to accommodate three-

[2] The load factor is the average number of passengers divided by the number of available seats so an 80-seat train car with 60 passengers on-board has a 75% load factor.

minute headways (up to 20 trains per hour). If a frequency of 15 or 20 trains per hour was used as the base assumption, the costs of the alternatives would be 25-66% higher because more capacity (lanes, runways, gates) would be needed in the other modes. Thus, there is a significant level of conservatism that is applied to estimate high-speed rail capacity.

For the Phase 1 Blended system, the analysis assumes no capacity additions between Los Angeles and Anaheim (although the corridor will be upgraded for safety and reliability) and four trains per hour of additional capacity on the Peninsula between San Jose and San Francisco. These estimates are based on the capital costs included in the Business Plan for capacity expansion on those corridors. Other improvements that will be made on the corridors will improve service but will not necessarily add capacity.

4) *Split Between Air and Rail*

To estimate alternative capacity needs, it was necessary first to calculate how much capacity was to be provided by airports and how much by highways. The split in needed capacity between air and rail was tied to the diversion rates created in the Travel Demand Model (TDM). While the number of riders diverted from each mode to the HSR system is tied to fares and other assumptions of the TDM, their *relative* share is assumed to be consistent across a wide set of other assumptions. For the 2012 Business Plan, the 2030 TDM output shows that 7 million riders will be diverted from air to HSR and 20 million from highways to HSR. That is equivalent to 26% and 74% for air and highways, respectively. Generalized, the capacity needed was assigned as 25% for airports and 75% for highways in the analysis. Although rail, inter-city bus, and other modes also contribute passengers to the HSR system, they are not included in this analysis because their relative share is very small.

5) Air Capacity

For the aviation component of the alternative modal capacity analysis, hypothetical capacity improvements (terminal gates, runways, and other associated improvements) were identified at representative airports. Specific constraints at each representative airport were considered and improvements were assigned on a case-by-case basis. For estimation of capital costs, the terminal gates and associated capacity improvements are represented in terms of additional passenger terminal area, rights-of-way (additional physical footprint), parking spaces (on/off site), and primary lanes of access road.

The estimated costs for the aviation component are based on recent cost information for other airport improvements in California and around the United States included in the 2005 study. The aviation component costs are for runways, gates, access roads, demolition/clearing, utility relocation, and right-of-way. Other improvements (e.g., aprons, taxiways, passenger facilities, parking) are included based on planning-level assumptions regarding their size, extent, and placement. Descriptions of each cost element, specific cost assumptions, associated unit costs, and sources for the aviation component are presented below. Cost breakdowns for each airport are presented in Appendix 2.

The required air capacity (approximately 2,100 passengers per hour) was split between the California airports according to the estimates presented in the TDM and overall flight patterns in California. Table 2 shows the regional distribution of air travelers diverted to HSR.

Table 2. Summary of Relative Air Diversion by Region

Region	Percent of Total Diverted Air Travel
Bay Area	41%
Los Angeles	36%
San Diego	11%
Monterey	4%
San Joaquin Valley	5%
Sacramento	2%

Since many of these regions have multiple airports, the diverted traffic was assigned to airports based on the relative 2009 levels of intra-state air traffic at each airport as summarized by Cambridge Systematics and Aviation System Consulting in the *Potential Airline Response to High-Speed Rail Service in California*. Appendix 1 includes the full summary of current air travel in California.

The 2005 study, prepared for the programmatic EIR/EIS, and this analysis assumed that it was impossible to add capacity at either LAX or SFO so their shares were assigned to the other regional airports based on approximate relative shares of current travel[3]. For the San Diego region it was assumed that 50% of the air travel that normally would have been assigned to San Diego International Airport (SAN) was instead assigned to John Wayne Airport (SNA) since the Phase 1 HSR system only extends to Anaheim. Table 3 includes the final distribution of the regional air travel that is assigned to each airport.

[3] Both LAX and SFO have studied expansion possibilities and have found very limited options available to them. Expanding either airport would involve significant eminent domain takings in surrounding communities that are unrealistic in today's environment. The capacity requirements (and costs) are shifted to the other airports in the region.

Table 3. Summary of Projected Airport Capacity Needs

Region	Airport	% of Regional Travel	Bi-directional Total Passengers per Hour (including both take-offs and landings)	Planes per Hour	Gates Needed	Runway Needed?
Los Angeles Basin	BUR	48%	1,470	28	20	YES
	ONT	35%	1,050	20	14	YES
	LGB	17%	525	10	7	NO
Bay Area	SJC	42%	1,470	28	20	YES
	OAK	58%	1,995	38	27	YES
San Diego	SNA	71%	630	12	9	NO
	SAN	29%	263	5	4	NO
Monterey	MRY	100%	368	7	5	NO
San Joaquin Valley	FAT	51%	210	4	3	NO
	BFL	49%	210	4	3	NO
Sacramento	SMF	100%	210	4	3	NO
Total			**8,400**[4]	**160**	**115**	**4**

The following assumptions were made about short-haul air travel and airport capacity:

- 70 seats per plane (based on average current plane size for intra-California trips)
- 75% load factor for air travel (based on current high load factors for Southwest Airlines)
- 40 maximum operations per runway per hour
- 525,000 passengers per year per gate (based on 2005 Study)
- 1,400 parking spaces per 1,000,000 passengers (based on 2005 Study)
- Note: total passengers accommodated at all airports is 8,400 because each of the 4,200 (2,100 in each direction) air trips impacts two airports – the one that the flight leaves from and the one where it lands.

6) *Cost of Air Capacity*

The aviation component costs are primarily defined in terms of runways, gates, access roads, demolition/clearing, utility relocation, and right-of-way. There are other improvements (e.g., aprons, taxiways, passenger facilities, etc.) that are included based on assumptions regarding their size, extent, or placement. The following assumptions were taken from the US

[4] Note: the total capacity per hour is 8,400 because each passenger is served by two airports in the state—the one where he/she takes off from and the one where he/she lands.

Department of Transportation (USDOT)-certified 2005 study for the associated improvements considered for the cost estimate.

A. RUNWAY

Runway:
For regional jets and narrow-body aircraft (i.e., Boeing 737) operating purpose, a minimum runway length of 8000 ft x 150 ft (2438.4 m x 45.72 m) is assumed. The unit cost represents the cost for the airfield pavement, including sub-grade, pavement, shoulders, drainage, lighting, signing, striping, etc. This unit cost includes runways and taxiways.

Site Preparation:
This is the cost for clearing and grubbing to remove unsuitable surface debris and vegetation. This also includes the cost of grading, which is the movement of dirt onsite to prepare the surface for airfield pavement. Site preparation also includes work done to make the site usable after the demolition of existing structures.

The unit cost for site preparation is applied to the runway and taxiway.

Navaids (CAT-1):
This is the cost necessary for navigation aid instruments at each additional runway.

B. GATES

Total terminal size is based on the number of additional gates and on existing terminal area. Average gate capacity is assumed to be 525,000 passengers per year per additional gate.

Passenger Terminal Facilities:
This includes terminal building, circulation within the terminal building, lighting, security measures, and all auxiliary spaces including intermodal connection areas. Spaces are provided within the terminal building for ticket sales, passenger information, airport administration, baggage handling, and a reasonable amount of commercial space (e.g., newsstands, small restaurants, etc.). Passenger terminal costs are expected to vary widely at specific locations due to site constraints and existing terminal configurations. Therefore, the unit cost is representative, based on a rough average of typical terminal size and costs throughout the airports considered.

Costs of site development are also included, such as paving and landscaping around the passenger terminal building, along with the provision of street and roadway modifications necessary to connect access to the site.

Apron:
Includes the airfield pavement cost for airplane parking, airplane maneuvering, support vehicles (fuel, baggage, concession), and passenger holding area. It is estimated that a total of 45,000 sq. ft (0.42 hectares) of parking apron would be required at each gate.

This unit cost includes airfield pavement, sub-grade, drainage, lighting, signing, striping, etc.

Apron Site Preparation:
The site preparation for the parking apron is estimated in the same manner as runways. The area would be prepared for airfield pavement. It is estimated that a total of 45,000 sq. ft (0.42 hectares) of parking apron would be required at each gate.

Passenger Loading Bridge:
This includes the cost to furnish and install a passenger loading bridge (jetway).

C. PARKING FACILITIES

Parking:
The standard airport planning ratios for public parking at airports is 1,400 spaces for each 1,000,000 annually, including both originating and departing passengers. This number does not include rental car and employee parking spaces. Unit cost includes all facility costs associated with the construction of the parking structures, including right-of-way.

D. ACCESS ROADS

Primary Access Roads:
Using the annual representative intercity demand, a peak-hour enplaned and deplaned demand was calculated based on the Federal Aviation Administration (FAA) formula of 0.045 total peak-hour passengers (TPHP) as a percent of annual flow. An estimated 2.25 persons per vehicle is assumed for all of the airports to forecast the number of cars accessing the airport. Access road capacity requirements were estimated using the above numbers and the Highway Capacity Manual. Number of lanes is rounded to the nearest full lane for each airport. The length of the additional lane is assumed to be 1 mi (1.609 m) long.

The unit costs applied for these roads include all of the cost elements necessary to complete the construction of the primary road such as earthwork, traffic handling, landscape, right-of-way, mobilization, drainage, signs, signals, lighting, etc.

Demolition/Clearing

This estimate is based on any demolition/clearing needed for the additional physical footprint outside of existing right-of-way required at each airport. For this level of planning, no internal airport improvements, such as reconfiguration of existing circulation patterns or terminal gates, are included.

A. OPEN LAND CLEARING

The costs for clearing and grubbing includes the removal of unsuitable surface debris and vegetation, and the cost of grading, which is the movement of dirt onsite to prepare the surface for construction. Site preparation also includes work done to make the site usable after the demolition of existing structures.

Unit costs for open land clearing are applied to the required additional physical footprint (total area). The physical footprint is based on the land required for precision runway safety, and within the noise level of 65 Ldn for a typical regional jet or narrow-body aircraft.

B. DEMOLITION CLEARING/DEVELOPED PROPERTY

For this cost estimate purpose, it is assumed that the required physical footprint is occupied by large buildings that need to be demolished in order to construct new runways and gates.

C. UTILITY RELOCATION

Utility Relocation:
This includes the cost of major utility relocations that must be done before constructing the facilities, such as overhead power lines, pipelines, sewers, fiber optics, and underground ductbanks. Different unit costs were applied to each airport based on the intensity of land use development around the existing airport. Using U.S. Geological Survey (USGS) planimetric information, field reconnaissance, and other mapping sources, each airport was categorized in a land use density category for estimating purposes (dense urban, urban, dense suburban, suburban, and undeveloped).

Right-of-Way Items

A. LAND ACQUISITION

It is assumed that the area within 1 mi (1.609 m) from the end of the proposed runways, and 1,000 ft to the side and parallel to the runway, would be acquired for safety and environmental purposes. This area includes the land required for precision runway safety and the 70Ldn noise contour for a typical regional or narrow-body aircraft.

The total cost associated with the purchase of land and/or easement rights for the additional physical footprint includes relocation assistance, demolition, title searches, appraisals, legal fees, title insurance, surveys, and various other processes. Property values and acquisition costs can range from quite modest in undeveloped areas to quite significant in areas of high-value commercial properties.

The same methodology used in estimating utility relocation cost was used in estimating airport right-of-way cost.

Environmental Impact Mitigation

This represents the total cost associated with potential mitigation of environmental impacts such as impacts to wetlands, parklands, biological resources, and wildlife habitat.

The total cost of environmental mitigation is estimated to be 3% of the line construction costs (i.e., runway, gates, structures, roads, utilities, etc.) for each airport.

Program Implementation Costs

Costs for these elements are computed as a percentage of total construction and procurement costs. The percentages are intended to represent the average overall cost of these implementation items. These costs are included to more appropriately estimate order of magnitude of the total costs.

A. PRELIMINARY ENGINEERING AND ENVIRONMENTAL REVIEW

These costs represent preliminary engineering to approximately a 35% design level. This would include geotechnical investigations, land surveying and mapping, engineering, architecture, landscape architecture, traffic engineering, right-of-way engineering and preparation of preliminary plans and analyses in all necessary technical disciplines, various other technical studies, and the draft and final environmental document for project-level review. The environmental review would entail all studies and analyses necessary to complete further federal and state required environmental documents. (2.5%)

B. PROGRAM AND DESIGN MANAGEMENT

This includes costs for the overall management and administration of the project. Included are program manager's office, contract management and administration, project control (including both cost and schedule), general administration, computer support, quality assurance, configuration management, system safety, publications, public relations, support of the bidding process, agency liaison, community information and involvement, and legal support. (5%)

C. FINAL DESIGN

This includes costs for final design and preparation of construction and procurement documents for all facilities and systems, such as geotechnical investigations, land surveying and mapping, engineering, architecture, landscape architecture, traffic engineering, right-of-way engineering, preparation of plans and specifications in all necessary technical disciplines, and various other technical studies and support of the final design process. Design support during construction, including shop drawing review, is also included in this item. (5%)

D. CONSTRUCTION AND PROCUREMENT MANAGEMENT

This includes costs for all management of construction and procurement work after contracts are awarded to contractors or suppliers, such as onsite inspection in factory and field, quality control, contract administration, and acceptance inspection. (5%)

E. AGENCY COSTS

This includes costs of maintaining the owner's (probably airport authorities) organization during the entire program, whether that owner is a franchisee or a government agency. (1%)

F. FORCE ACCOUNT COSTS

Cost includes the services of other organizations or agencies of local, state, or federal government that may be required to support the project. (1%)

G. RISK MANAGEMENT

This includes costs of owner (probably airport authorities)-supplied insurance or any other allowances decided to be applied for the management of risk to the owner. (6%)

Contingencies

A contingency is added as a percentage of overall project costs, based on past experience for projects in early stages of definition. Contingencies should not be considered as potential savings. They are an allowance added to a basic estimate to account for items and conditions that cannot be assessed at the time of the estimate. The contingency amount is expected to be reduced as the project matures.

The cost estimates for the needed alternative airport capacity are based on the costs and assumptions from the 2005 study as described above. The costs were broken down into fixed and variable costs and the variable costs were scaled based on the required capacity from the 2005 study and from the estimates presented earlier in this report.

To provide equivalent capacity through airports as high-speed rail, California would have to build four new runways and 115 new gates at a total cost of $30.3 billion (in 2011 $) and requiring over 1,620 hectares of land. The costs are broken down by airport in Table 5. The costs were escalated from 2003 dollars to 2011 dollars using the Construction Cost Index from the Engineering News Record[5].

[5] Engineering News Record. *Construction Cost Index - February 2012*. McGraw-Hill, 2012. Index from 2003 to 2011 costs was used in this analysis.

Table 4. Equivalent Capacity and Costs by Airport

Airport	Gates	Runways	Cost (millions of 2011 $)
BUR	20	1	$ 5,248
ONT	14	1	$ 8,261
LGB	7	0	$ 351
OAK	20	1	$ 1,804
SJC	27	1	$ 9,341
SNA	9	0	$ 3,376
SAN	4	0	$ 1,273
MRY	5	0	$ 267
FAT	3	0	$ 103
BFL	3	0	$ 127
SMF	3	0	$ 116
Total	**115**	**4**	**$ 30,266**

Highway Capacity

The required highway capacity to accommodate 6,300 passengers per hour was divided into required lanes and assigned to specific highway stretches according to the estimates from the 2005 study and standard Caltrans planning assumptions. The total length of highway required to accommodate the capacity was estimated from the 2005 study by removing stretches of highway that would be equivalent to the Phase 2 system instead of Phase 1. This removed the connections from Los Angeles to San Diego via the Inland Empire, from Anaheim to San Diego, and from San Francisco to Sacramento. The following assumptions were used for estimating highway capacity at any location based on Caltrans planning assumptions:

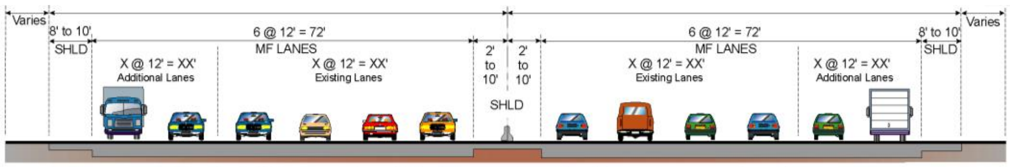
- 1,817 cars per lane per hour
- 1.4 passengers per car

7) Cost of Highway Capacity

Capital costs were estimated by Caltrans for the highway component are based on recent freeway widening and interchange improvement projects in California. Recent Caltrans projects have been bid on and constructed during a low an economic and construction industry recession so they likely represent the very low end of possible costs. Many bids have actually come in under engineer's estimates for projects. The average costs found in the 2005 study were higher because they were taken from projects built during an economic and construction industry boom time.

The improvements were all assumed to be highway widening rather than new facilities.

Figure 1
Typical Highway Improvement Cross-Sections



Modal Alternative Highway Widening Cross-Section

8) Full Cost Estimate

Table 5. Summary of Highway Segments

Highway Corridor	Segment (From–To)	Urban/Rural	Miles
Bay Area to Merced			
US-101	San Francisco to SFO	Urban	11.3
US-101	SFO to Redwood City	Urban	13.8
US-101	Redwood City to I-880	Urban	19.7
I-880	US-101 to San Jose	Urban	0.9
US-101	San Jose to Gilroy	Urban	31.2
US-101	Gilroy to SR-152	Urban	1.4
SR-152	US-101 to I-5	Rural	40.8
SR-152	I-5 to SR-99	Rural	42.8
I-80	San Francisco to I-880	Urban	9.2
I-880	I-80 to I-238	Urban	13.8
I-580	I-880 to I-5 (via I-238)	Rural	52.7
I-880	I-238 to Fremont/Newark	Urban	14.5
I-880	Fremont/Newark to US-101	Urban	12.4
Merced to Bakersfield			
I-5	SR-152 to SR-99	Rural	186
SR-99	Merced to SR-152	Rural	21.5
SR-99	SR-152 to Fresno	Urban	33.4
SR-99	Fresno to Tulare/Visalia	Urban	46.4
SR-99	Tulare/Visalia to SR-58	Urban	68.9
Bakersfield to Los Angeles			
I-5	SR-99 to SR-14	Rural	65
I-5	SR-14 to I-405	Urban	2.5
I-5	I-405 to Burbank	Urban	15.3
I-5	Burbank to Los Angeles Union Station (LAUS)	Urban	7.4
SR-14	Palmdale to I-5	Urban	34.8
Los Angeles to Anaheim			
I-5	LAUS to I-10	Urban	0.8
I-5	I-10 to Norwalk	Urban	20.7
I-5	Norwalk to Anaheim	Urban	8.1

From the capacity estimate, each stretch of highway listed in Table 6, would require a total of six lanes. For Phase 1 Blended, the capacity on the Peninsula was reduced by two-thirds to account for the HSR improvements adding capacity for four additional trains per hour, not 12, and the sections between Los Angeles and Anaheim were removed as the improvements on that corridor would not add capacity. The total lane-miles required to match the capacity for HSR assigned to highways is 4,295 for Phase 1 Blended and 4,652 lane-miles for Phase 1 Full Build.

The analysis used the per-mile costs from recent Caltrans projects to create costs for urban and rural highway lanes. Segments of highway that were primarily urban or suburban in the 2005 study were grouped together as urban highways while rural highways were evaluated separately. Caltrans recommended an urban lane-mile cost range of $30 million to $50 million per lane-mile so an average of $40 million per lane-mile was used. For rural lanes, Caltrans recommended $6 million to $10 million pre lane-mile so an average of $8 million was used. The total cost (in 2011 $) for the highway component was $93.3 and $107.6 billion for Phase 1 Blended and Phase 1 Full Build, respectively.

Appendix 1 – Current Levels of Air Travel in California

		Estimated O&D Passengers (both ways)					
		2000	2005	2006	2007	2008	2009
OAK	BUR	839,381	883,892	908,204	949,173	841,825	766,718
	LAX	1,530,030	1,146,316	1,102,921	1,051,679	786,624	644,502
	LGB	0	464,270	421,730	399,030	357,050	231,190
	ONT	597,163	635,396	607,986	628,693	557,329	465,069
	SNA	762,539	796,070	834,669	878,171	680,503	508,620
	SAN	708,623	1,009,027	1,069,535	1,019,128	780,109	647,300
		4,437,737	4,934,971	4,945,046	4,925,874	4,003,439	3,263,399
Pct 2000			111.2%	111.4%	111.0%	90.2%	73.5%
SFO	BUR	450,020	99,310	156,150	145,300	97,240	71,420
	LAX	1,419,830	721,490	950,160	1,246,503	1,738,201	1,877,739
	LGB	0	70	0	0	32,980	168,780
	ONT	200,800	38,330	89,360	46,740	38,990	38,800
	PSP	95,310	137,210	158,850	158,880	149,380	143,810
	SNA	589,490	242,500	246,380	220,600	201,473	650,727
	SAN	1,008,678	347,100	319,910	626,552	1,012,399	1,119,464
		3,314,108	1,486,700	1,764,660	2,185,867	3,173,422	3,999,321
Pct 2000			44.9%	53.2%	66.0%	95.8%	120.7%
SJC	BUR	460,199	437,295	439,554	480,809	450,996	410,556
	LAX	1,147,415	682,634	750,511	748,327	615,371	529,173
	LGB	0	0	0	0	108,450	147,740
	ONT	354,157	344,121	352,678	377,853	328,405	273,450
	PSP	26,370	3,210	5,130	9,590	10,450	10,800
	SNA	871,380	639,536	635,255	672,910	622,661	524,100
	SAN	844,152	753,072	791,918	773,408	674,107	603,983
		3,703,674	2,859,868	2,975,044	3,062,897	2,810,439	2,499,802
Pct 2000			77.2%	80.3%	82.7%	75.9%	67.5%
STS	LAX	2,880	0	0	54,360	69,770	61,280
Bay Area		11,908,419	9,380,849	9,840,900	10,487,704	10,154,310	9,895,222
Pct 2000			78.8%	82.6%	88.1%	85.3%	83.1%

		Estimated O&D Passengers (both ways)					
		2000	2005	2006	2007	2008	2009
SMF	BUR	567,214	540,621	539,260	575,691	522,194	467,032
	LAX	810,428	612,360	627,871	598,030	526,060	459,380
	LGB		0	116,140	153,240	134,770	124,530
	ONT	657,539	633,628	647,810	674,237	602,531	514,927
	PSP	8,730	27,390	29,030	31,310	30,030	27,020
	SNA	215,250	492,551	508,460	551,398	486,521	448,992
	SAN	697,861	778,632	777,320	828,208	738,532	678,050
		2,957,023	3,085,182	3,245,893	3,412,114	3,040,638	2,719,931
Pct 2000			104.3%	109.8%	115.4%	102.8%	92.0%

Market		Estimated O&D Pax (both ways)	Average Fare Current $ (one way)	Average Fare 2005$ (one way)	Avg Daily Frequency (both ways)	CPI Factor (2005 = 100)	CPI Source
LAX	PSP	3,980	252.76	228.52	13.7	110.6	*(note 2)*
	SAN	26,720	211.09	191.55	60.0	110.2	*(note 3)*
SMF	SFO	2,280	268.29	242.35	13.7	110.7	*(note 4)*
BFL	SFO	4,630	226.59	204.69	4.9	110.7	*(note 5)*
	SMF	880	217.47	196.45	*(note 1)*	110.7	*(note 5)*
FAT	SFO	4,750	279.65	252.61	12.8	110.7	*(note 4)*
	LAX	26,940	192.08	173.51	22.3	110.7	*(note 5)*
	SNA	910	270.26	244.14	*(note 1)*	110.7	*(note 5)*
	SAN	26,930	143.54	130.13	*(note 1)*	110.3	*(note 6)*
MOD	SFO	2,290	51.82	46.81	8.9	110.7	*(note 4)*
	LAX	6,300	119.70	108.13	*(note 1)*	110.7	*(note 5)*
	SNA	3,330	97.20	87.81	*(note 1)*	110.7	*(note 5)*
	SAN	5,210	107.25	97.24	*(note 1)*	110.3	*(note 6)*

Notes:
1. No direct service
2. Southern California CPI
3. Average CPI for Southern California and San Diego
4. Bay Area CPI
5. Average CPI for Bay Area and Southern California
6. Average CPI for Bay Area and San Diego

Airport codes:
BFL Bakersfield Meadows Field Airport
FAT Fresno Yosemite International Airport
MOD Modesto City-County Airport

Appendix 2 – Estimated Airport Costs (2003 $)

Cost Element	Unit	Unit Price	Oakland	
Runway			**Quantities**	**Cost**
Runway	ea	$20,000,000	1.00	$ 20,000,000
Site Preparation	Hectares	$12,355	11.15	$ 137,758
Navaids	ea	$2,000,000	1.00	$ 2,000,000
Gates				
Passenger Terminal Facilities	m^2	$4,306	35,898.08	$ 154,561,335
Apron	ea	$750,000	27.00	$ 20,250,000
Apron Site Preparation	Hectares	$12,355	11.30	$ 139,550
Passenger Landing Bridge	ea	$400,000	27.00	$ 10,800,000
Parking				
Parking Spaces	ea	$15,000	19,369.46	$ 290,541,825
Access Roads				
Additional Lanes on Primary Access Roads	km	$218,723	1.61	$ 351,925
Demolition/Clearing				
Open Land Clearing	Hectares	$12,355	140.33	$ 1,733,746
Clearing of Developed Land	Hectares	$8,611,128	36.06	$ 310,492,734
Utility Relocation				
Major Utility Relocations - Dense Urban	Hectares	$497,711	-	$ -
Major Utility Relocations - Urban	Hectares	$380,393	-	$ -
Major Utility Relocations - Dense Suburban	Hectares	$266,631	-	$ -
Major Utility Relocations - Suburban	Hectares	$76,434	36.06	$ 2,755,992
Major Utility Relocations - Undeveloped	Hectares	$3,911	140.33	$ 548,821
Right-of-Way				
Right-of-way - Dense Urban	Hectares	$3,499,093	-	$ -
Right-of-way - Urban	Hectares	$2,332,729	-	$ -
Right-of-way - Dense Suburban	Hectares	$1,166,364	-	$ -
Right-of-way - Suburban	Hectares	$408,227	36.06	$ 14,719,502
Right-of-way - Undeveloped	Hectares	$291,591	140.33	$ 40,918,221
Environmental Mitigation				
Environmental Mitigation	3% of Construction Cost			
Program Implementation Costs				
Program Implementation Costs	25.5% of Total Cost			
Contingencies				
Contingencies	25% of Total Cost			
Total Construction				**$ 814,313,686**
Total Construction and Right of Way				**$ 894,380,820**
Grand Total				**$ 1,346,043,134**

Cost Element	Unit	Unit Price	San Jose	
Runway			Quantities	Cost
Runway	ea	$20,000,000	1.00	$ 20,000,000
Site Preparation	Hectares	$12,355	11.15	$ 137,758
Navaids	ea	$2,000,000	1.00	$ 2,000,000
Gates				
Passenger Terminal Facilities	m^2	$4,306	54,354	$ 234,026,418
Apron	ea	$750,000	20.00	$ 15,000,000
Apron Site Preparation	Hectares	$12,355	8.37	$ 103,370
Passenger Landing Bridge	ea	$400,000	20.00	$ 8,000,000
Parking				
Parking Spaces	ea	$15,000	14,272	$ 214,083,450
Access Roads				
Additional Lanes on Primary Access Roads	km	$218,723	1.61	$ 351,925
Demolition/Clearing				
Open Land Clearing	Hectares	$12,355	-	$ -
Clearing of Developed Land	Hectares	$8,611,128	320.03	$ 2,755,842,257
Utility Relocation				
Major Utility Relocations - Dense Urban	Hectares	$497,711	320.03	$ 159,283,779
Major Utility Relocations - Urban	Hectares	$380,393	-	$ -
Major Utility Relocations - Dense Suburban	Hectares	$266,631	-	$ -
Major Utility Relocations - Suburban	Hectares	$76,434	-	$ -
Major Utility Relocations - Undeveloped	Hectares	$3,911	-	$ -
Right-of-Way				
Right-of-way - Dense Urban	Hectares	$3,499,093	320.03	$ 1,119,824,064
Right-of-way - Urban	Hectares	$2,332,729	-	$ -
Right-of-way - Dense Suburban	Hectares	$1,166,364	-	$ -
Right-of-way - Suburban	Hectares	$408,227	-	$ -
Right-of-way - Undeveloped	Hectares	$291,591	-	$ -
Environmental Mitigation				
Environmental Mitigation	3% of Construction Cost			
Program Implementation Costs				
Program Implementation Costs	25.5% of Total Cost			
Contingencies				
Contingencies	25% of Total Cost			
Total Construction				**$ 3,408,828,957**
Total Construction and Right of Way				**$ 4,630,917,889**
Grand Total				**$ 6,969,531,423**

Cost Element	Unit	Unit Price	Sacramento	
Runway			**Quantities**	**Cost**
Runway	ea	$20,000,000	-	$ -
Site Preparation	Hectares	$12,355	-	$ -
Navaids	ea	$2,000,000	-	$ -
Gates				
Passenger Terminal Facilities	m^2	$4,306	4,947	$ 21,299,971
Apron	ea	$750,000	3.00	$ 2,250,000
Apron Site Preparation	Hectares	$12,355	1.26	$ 15,506
Passenger Landing Bridge	ea	$400,000	3.00	$ 1,200,000
Parking				
Parking Spaces	ea	$15,000	2,039	$ 30,583,350
Access Roads				
Additional Lanes on Primary Access Roads	km	$218,723	1.61	$ 351,925
Demolition/Clearing				
Open Land Clearing	Hectares	$12,355	-	$ -
Clearing of Developed Land	Hectares	$8,611,128	-	$ -
Utility Relocation				
Major Utility Relocations - Dense Urban	Hectares	$497,711	-	$ -
Major Utility Relocations - Urban	Hectares	$380,393	-	$ -
Major Utility Relocations - Dense Suburban	Hectares	$266,631	-	$ -
Major Utility Relocations - Suburban	Hectares	$76,434	-	$ -
Major Utility Relocations - Undeveloped	Hectares	$3,911	-	$ -
Right-of-Way				
Right-of-way - Dense Urban	Hectares	$3,499,093	-	$ -
Right-of-way - Urban	Hectares	$2,332,729	-	$ -
Right-of-way - Dense Suburban	Hectares	$1,166,364	-	$ -
Right-of-way - Suburban	Hectares	$408,227	-	$ -
Right-of-way - Undeveloped	Hectares	$291,591	-	$ -
Environmental Mitigation				
Environmental Mitigation	3% of Construction Cost			
Program Implementation Costs				
Program Implementation Costs	25.5% of Total Cost			
Contingencies				
Contingencies	25% of Total Cost			
Total Construction				**$ 55,700,752**
Total Construction and Right of Way				**$ 57,371,775**
Grand Total				**$ 86,344,521**

Cost Element	Unit	Unit Price	Fresno	
Runway			Quantities	Cost
Runway	ea	$20,000,000	-	$ -
Site Preparation	Hectares	$12,355	-	$ -
Navaids	ea	$2,000,000	-	$ -
Gates				
Passenger Terminal Facilities	m^2	$4,306	3,623	$ 15,599,991
Apron	ea	$750,000	3.00	$ 2,250,000
Apron Site Preparation	Hectares	$12,355	1.26	$ 15,506
Passenger Landing Bridge	ea	$400,000	3.00	$ 1,200,000
Parking				
Parking Spaces	ea	$15,000	2,038	$ 30,583,350
Access Roads				
Additional Lanes on Primary Access Roads	km	$218,723	-	$ -
Demolition/Clearing				
Open Land Clearing	Hectares	$12,355	-	$ -
Clearing of Developed Land	Hectares	$8,611,128	-	$ -
Utility Relocation				
Major Utility Relocations - Dense Urban	Hectares	$497,711	-	$ -
Major Utility Relocations - Urban	Hectares	$380,393	-	$ -
Major Utility Relocations - Dense Suburban	Hectares	$266,631	-	$ -
Major Utility Relocations - Suburban	Hectares	$76,434	-	$ -
Major Utility Relocations - Undeveloped	Hectares	$3,911	-	$ -
Right-of-Way				
Right-of-way - Dense Urban	Hectares	$3,499,093	-	$ -
Right-of-way - Urban	Hectares	$2,332,729	-	$ -
Right-of-way - Dense Suburban	Hectares	$1,166,364	-	$ -
Right-of-way - Suburban	Hectares	$408,227	-	$ -
Right-of-way - Undeveloped	Hectares	$291,591	-	$ -
Environmental Mitigation				
Environmental Mitigation	3% of Construction Cost			
Program Implementation Costs				
Program Implementation Costs	25.5% of Total Cost			
Contingencies				
Contingencies	25% of Total Cost			
Total Construction				**$ 49,648,847**
Total Construction and Right of Way				**$ 51,138,312**
Grand Total				**$ 76,963,160**

Cost Element	Unit	Unit Price	Burbank	
Runway			Quantities	Cost
Runway	ea	$20,000,000	1.00	$ 20,000,000
Site Preparation	Hectares	$12,355	11.15	$ 137,758
Navaids	ea	$2,000,000	1.00	$ 2,000,000
Gates				
Passenger Terminal Facilities	m^2	$4,306	33,200	$ 142,947,221
Apron	ea	$750,000	20.00	$ 15,000,000
Apron Site Preparation	Hectares	$12,355	8.36	$ 103,262
Passenger Landing Bridge	ea	$400,000	20.00	$ 8,000,000
Parking				
Parking Spaces	ea	$15,000	14,272	$ 214,083,450
Access Roads				
Additional Lanes on Primary Access Roads	km	$218,723	1.61	$ 351,925
Demolition/Clearing				
Open Land Clearing	Hectares	$12,355	-	$ -
Clearing of Developed Land	Hectares	$8,611,128	169.81	$ 1,462,237,517
Utility Relocation				
Major Utility Relocations - Dense Urban	Hectares	$497,711	169.81	$ 84,515,257
Major Utility Relocations - Urban	Hectares	$380,393	-	$ -
Major Utility Relocations - Dense Suburban	Hectares	$266,631	-	$ -
Major Utility Relocations - Suburban	Hectares	$76,434	-	$ -
Major Utility Relocations - Undeveloped	Hectares	$3,911	-	$ -
Right-of-Way				
Right-of-way - Dense Urban	Hectares	$3,499,093	169.81	$ 594,173,616
Right-of-way - Urban	Hectares	$2,332,729	-	$ -
Right-of-way - Dense Suburban	Hectares	$1,166,364	-	$ -
Right-of-way - Suburban	Hectares	$408,227	-	$ -
Right-of-way - Undeveloped	Hectares	$291,591	-	$ -
Environmental Mitigation				
Environmental Mitigation	3% of Construction Cost			
Program Implementation Costs				
Program Implementation Costs	25.5% of Total Cost			
Contingencies				
Contingencies	25% of Total Cost			
Total Construction				**$ 1,949,376,390**
Total Construction and Right of Way				**$ 2,602,031,298**
Grand Total				**$ 3,916,057,271**

Cost Element	Unit	Unit Price	Ontario	
Runway			Quantities	Cost
Runway	ea	$20,000,000	1.00	$ 20,000,000
Site Preparation	Hectares	$12,355	11.15	$ 137,758
Navaids	ea	$2,000,000	1.00	$ 2,000,000
Gates				
Passenger Terminal Facilities	m^2	$4,306	42,921	$ 184,799,802
Apron	ea	$750,000	14.00	$ 10,500,000
Apron Site Preparation	Hectares	$12,355	5.85	$ 72,359
Passenger Landing Bridge	ea	$400,000	14.00	$ 5,600,000
Parking				
Parking Spaces	ea	$15,000	10,194	$ 152,916,750
Access Roads				
Additional Lanes on Primary Access Roads	km	$218,723	3.22	$ 704,069
Demolition/Clearing				
Open Land Clearing	Hectares	$12,355	201.27	$ 2,486,691
Clearing of Developed Land	Hectares	$8,611,128	314.44	$ 2,707,698,158
Utility Relocation				
Major Utility Relocations - Dense Urban	Hectares	$497,711	-	$ -
Major Utility Relocations - Urban	Hectares	$380,393	314.44	$ 119,611,441
Major Utility Relocations - Dense Suburban	Hectares	$266,631	-	$ -
Major Utility Relocations - Suburban	Hectares	$76,434	-	$ -
Major Utility Relocations - Undeveloped	Hectares	$3,911	201.27	$ 787,167
Right-of-Way				
Right-of-way - Dense Urban	Hectares	$3,499,093	-	$ -
Right-of-way - Urban	Hectares	$2,332,729	314.44	$ 733,507,389
Right-of-way - Dense Suburban	Hectares	$1,166,364	-	$ -
Right-of-way - Suburban	Hectares	$408,227	-	$ -
Right-of-way - Undeveloped	Hectares	$291,591	201.27	$ 58,688,521
Environmental Mitigation				
Environmental Mitigation	3% of Construction Cost			
Program Implementation Costs				
Program Implementation Costs	25.5% of Total Cost			
Contingencies				
Contingencies	25% of Total Cost			
Total Construction				**$ 3,207,314,195**
Total Construction and Right of Way				**$ 4,095,729,530**
Grand Total				**$ 6,164,072,943**

Cost Element	Unit	Unit Price	Long Beach	
Runway			Quantities	Cost
Runway	ea	$20,000,000	-	$ -
Site Preparation	Hectares	$12,355	-	$ -
Navaids	ea	$2,000,000	-	$ -
Gates				
Passenger Terminal Facilities	m^2	$4,306	19,510	$ 83,999,916
Apron	ea	$750,000	7.00	$ 5,250,000
Apron Site Preparation	Hectares	$12,355	2.93	$ 36,180
Passenger Landing Bridge	ea	$400,000	7.00	$ 2,800,000
Parking				
Parking Spaces	ea	$15,000	5,097	$ 76,458,375
Access Roads				
Additional Lanes on Primary Access Roads	km	$218,723	1.61	$ 351,925
Demolition/Clearing				
Open Land Clearing	Hectares	$12,355	-	$ -
Clearing of Developed Land	Hectares	$8,611,128	-	$ -
Utility Relocation				
Major Utility Relocations - Dense Urban	Hectares	$497,711	-	$ -
Major Utility Relocations - Urban	Hectares	$380,393	-	$ -
Major Utility Relocations - Dense Suburban	Hectares	$266,631	-	$ -
Major Utility Relocations - Suburban	Hectares	$76,434	-	$ -
Major Utility Relocations - Undeveloped	Hectares	$3,911	-	$ -
Right-of-Way				
Right-of-way - Dense Urban	Hectares	$3,499,093	-	$ -
Right-of-way - Urban	Hectares	$2,332,729	-	$ -
Right-of-way - Dense Suburban	Hectares	$1,166,364	-	$ -
Right-of-way - Suburban	Hectares	$408,227	-	$ -
Right-of-way - Undeveloped	Hectares	$291,591	-	$ -
Environmental Mitigation				
Environmental Mitigation	3% of Construction Cost			
Program Implementation Costs				
Program Implementation Costs	25.5% of Total Cost			
Contingencies				
Contingencies	25% of Total Cost			
Total Construction				**$ 168,896,396**
Total Construction and Right of Way				**$ 173,963,288**
Grand Total				**$ 261,814,748**

Cost Element	Unit	Unit Price	San Diego	
Runway			Quantities	Cost
Runway	ea	$20,000,000	-	$ -
Site Preparation	Hectares	$12,355	-	$ -
Navaids	ea	$2,000,000	-	$ -
Gates				
Passenger Terminal Facilities	m^2	$4,306	9,290.30	$ 39,999,961
Apron	ea	$750,000	4.00	$ 3,000,000
Apron Site Preparation	Hectares	$12,355	1.67	$ 20,674
Passenger Landing Bridge	ea	$400,000	4.00	$ 1,600,000
Parking				
Parking Spaces	ea	$15,000	2,548.61	$ 38,229,188
Access Roads				
Additional Lanes on Primary Access Roads	km	$218,723	1.61	$ 351,925
Demolition/Clearing				
Open Land Clearing	Hectares	$12,355	-	$ -
Clearing of Developed Land	Hectares	$8,611,128	50.24	$ 432,623,071
Utility Relocation				
Major Utility Relocations - Dense Urban	Hectares	$497,711	-	$ -
Major Utility Relocations - Urban	Hectares	$380,393	33.68	$ 12,812,525
Major Utility Relocations - Dense Suburban	Hectares	$266,631	-	$ -
Major Utility Relocations - Suburban	Hectares	$76,434	16.56	$ 1,265,568
Major Utility Relocations - Undeveloped	Hectares	$3,911	-	$ -
Right-of-Way				
Right-of-way - Dense Urban	Hectares	$3,499,093	-	$ -
Right-of-way - Urban	Hectares	$2,332,729	33.68	$ 78,571,762
Right-of-way - Dense Suburban	Hectares	$1,166,364	-	$ -
Right-of-way - Suburban	Hectares	$408,227	16.56	$ 6,759,286
Right-of-way - Undeveloped	Hectares	$291,591	-	$ -
Environmental Mitigation				
Environmental Mitigation	3% of Construction Cost			
Program Implementation Costs				
Program Implementation Costs	25.5% of Total Cost			
Contingencies				
Contingencies	25% of Total Cost			
Total Construction				**$ 529,902,912**
Total Construction and Right of Way				**$ 631,131,047**
Grand Total				**$ 949,852,225**

Cost Element	Unit	Unit Price	Monterey	
Runway			Quantities	Cost
Runway	ea	$20,000,000	-	$ -
Site Preparation	Hectares	$12,355	-	$ -
Navaids	ea	$2,000,000	-	$ -
Gates				
Passenger Terminal Facilities	m^2	$4,306	10,462	$ 45,045,705
Apron	ea	$750,000	5.00	$ 3,750,000
Apron Site Preparation	Hectares	$12,355	2.09	$ 25,843
Passenger Landing Bridge	ea	$400,000	5.00	$ 2,000,000
Parking				
Parking Spaces	ea	$15,000	3,568	$ 53,520,863
Access Roads				
Additional Lanes on Primary Access Roads	km	$218,723	-	$ -
Demolition/Clearing				
Open Land Clearing	Hectares	$12,355	80.01	$ 988,465
Clearing of Developed Land	Hectares	$8,611,128	-	$ -
Utility Relocation				
Major Utility Relocations - Dense Urban	Hectares	$497,711	-	$ -
Major Utility Relocations - Urban	Hectares	$380,393	-	$ -
Major Utility Relocations - Dense Suburban	Hectares	$266,631	-	$ -
Major Utility Relocations - Suburban	Hectares	$76,434	-	$ -
Major Utility Relocations - Undeveloped	Hectares	$3,911	80.01	$ 312,901
Right-of-Way				
Right-of-way - Dense Urban	Hectares	$3,499,093	-	$ -
Right-of-way - Urban	Hectares	$2,332,729	-	$ -
Right-of-way - Dense Suburban	Hectares	$1,166,364	-	$ -
Right-of-way - Suburban	Hectares	$408,227	-	$ -
Right-of-way - Undeveloped	Hectares	$291,591	80.01	$ 23,328,821
Environmental Mitigation				
Environmental Mitigation	3% of Construction Cost			
Program Implementation Costs				
Program Implementation Costs	25.5% of Total Cost			
Contingencies				
Contingencies	25% of Total Cost			
Total Construction				**$ 105,643,776**
Total Construction and Right of Way				**$ 132,141,909**
Grand Total				**$ 198,873,574**

Cost Element	Unit	Unit Price	Bakersfield	
Runway			**Quantities**	**Cost**
Runway	ea	$20,000,000	-	$ -
Site Preparation	Hectares	$12,355	-	$ -
Navaids	ea	$2,000,000	-	$ -
Gates				
Passenger Terminal Facilities	m^2	$4,306	6,277	$ 27,027,423
Apron	ea	$750,000	3.00	$ 2,250,000
Apron Site Preparation	Hectares	$12,355	1.26	$ 15,506
Passenger Landing Bridge	ea	$400,000	3.00	$ 1,200,000
Parking				
Parking Spaces	ea	$15,000	2,039	$ 30,583,350
Access Roads				
Additional Lanes on Primary Access Roads	km	$218,723	-	$ -
Demolition/Clearing				
Open Land Clearing	Hectares	$12,355	-	$ -
Clearing of Developed Land	Hectares	$8,611,128	-	$ -
Utility Relocation				
Major Utility Relocations - Dense Urban	Hectares	$497,711	-	$ -
Major Utility Relocations - Urban	Hectares	$380,393	-	$ -
Major Utility Relocations - Dense Suburban	Hectares	$266,631	-	$ -
Major Utility Relocations - Suburban	Hectares	$76,434	-	$ -
Major Utility Relocations - Undeveloped	Hectares	$3,911	-	$ -
Right-of-Way				
Right-of-way - Dense Urban	Hectares	$3,499,093	-	$ -
Right-of-way - Urban	Hectares	$2,332,729	-	$ -
Right-of-way - Dense Suburban	Hectares	$1,166,364	-	$ -
Right-of-way - Suburban	Hectares	$408,227	-	$ -
Right-of-way - Undeveloped	Hectares	$291,591	-	$ -
Environmental Mitigation				
Environmental Mitigation	3% of Construction Cost			
Program Implementation Costs				
Program Implementation Costs	25.5% of Total Cost			
Contingencies				
Contingencies	25% of Total Cost			
Total Construction				**$ 61,076,278**
Total Construction and Right of Way				**$ 62,908,567**
Grand Total				**$ 94,677,393**

Cost Element	Unit	Unit Price	Orange County (John Wayne)	
Runway			**Quantities**	**Cost**
Runway	ea	$20,000,000	-	$ -
Site Preparation	Hectares	$12,355	-	$ -
Navaids	ea	$2,000,000	-	$ -
Gates				
Passenger Terminal Facilities	m^2	$4,306	18,832	$ 81,082,268
Apron	ea	$750,000	9.00	$ 6,750,000
Apron Site Preparation	Hectares	$12,355	3.77	$ 46,517
Passenger Landing Bridge	ea	$400,000	9.00	$ 3,600,000
Parking				
Parking Spaces	ea	$15,000	6,117	$ 91,750,050
Access Roads				
Additional Lanes on Primary Access Roads	km	$218,723	-	$ -
Demolition/Clearing				
Open Land Clearing	Hectares	$12,355	-	$ -
Clearing of Developed Land	Hectares	$8,611,128	144.01	$ 1,240,084,321
Utility Relocation				
Major Utility Relocations - Dense Urban	Hectares	$497,711	-	$ -
Major Utility Relocations - Urban	Hectares	$380,393	-	$ -
Major Utility Relocations - Dense Suburban	Hectares	$266,631	144.01	$ 38,397,400
Major Utility Relocations - Suburban	Hectares	$76,434	-	$ -
Major Utility Relocations - Undeveloped	Hectares	$3,911	-	$ -
Right-of-Way				
Right-of-way - Dense Urban	Hectares	$3,499,093	-	$ -
Right-of-way - Urban	Hectares	$2,332,729	-	$ -
Right-of-way - Dense Suburban	Hectares	$1,166,364	144.01	$ 167,967,508
Right-of-way - Suburban	Hectares	$408,227	-	$ -
Right-of-way - Undeveloped	Hectares	$291,591	-	$ -
Environmental Mitigation				
Environmental Mitigation	3% of Construction Cost			
Program Implementation Costs				
Program Implementation Costs	25.5% of Total Cost			
Contingencies				
Contingencies	25% of Total Cost			
Total Construction				**$ 1,461,710,556**
Total Construction and Right of Way				**$ 1,673,529,380**
Grand Total				**$ 2,518,661,717**