California High-Speed Rail Project

CALIFORNIA
High-Speed Rail Authority

Cost 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. If California were to invest in alternative people-carrying capacity—freeways and airports—instead, what would that look like and how much would it cost?

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), and designed to be more directly comparable with the 2012 Business Plan[1]. While this study 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. This analysis does not examine the operating and maintenance costs of the different modes.

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

[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.

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.

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 $114 billion (in 2010 dollars) to build 2,326 lane-miles of highways, 115 gates, and four runways. 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 $171 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 3 percent inflation rate used throughout the Business plan.

It is important to acknowledge several additional important points. First, since much of the cost information for the alternative modes was based on studies conducted in 2003/2004, they are likely to underestimate the true cost of building the equivalent capacity in airports and highways. Since 2005, there has been significant urbanization along the corridors, which would make highway and 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 build the highways needed and 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 (2010 $)	Cost (YOE)
Highway Component	2,326 lane-miles	$84.6 billion	$126.9 billion
Airport Component	115 gates and 4 runways	$29.7 billion	$44.6 billion
Total		**$114 billion**	**$171 billion**

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. For comparison, the highest known level of usage of highways, translating into capacity, were assumed for the highway calculations.

- 12 trains per hour in each direction
- 1000 seats per train
- 19 hours of operation per day
- 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 319,200 per day or 116,508,000 per year. 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 116+ million is the average capacity of any given point on the line (i.e. how many passengers could go through that point over the span of a year). 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-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 25-100% 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.

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 airport 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

[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.

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, or 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 29 million passengers per year) 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. Regional Distribution of Air Travel Diverted to HSR[3]

Airport Destination Pairs	Air trips without HST	Diverted to HST	% to HST
LA Basin -SF Bay Area	11,785,000	4,087,600	35%
San Diego - SF	7,664,000	1,498,580	20%
LA-Monterey/SLO	2,075,000	560,920	27%
LA - San Joaquin Valley	1,367,000	344,620	25%
SF - San Joaquin Valley	973,000	342,660	35%
LA-Sacramento	2,577,000	288,180	11%
Smaller Markets Subtotal	4,692,000	180,000	4%
Sacramento - San Joaquin Valley		*36,960*	
SF - Monterey/SLO		*36,260*	
LA - Other		*35,420*	
San Diego - Sacramento		*26,240*	
San Joaquin - Monterey/SLO		*16,680*	
Intra San Joaquin Valley		*13,380*	
Sacramento - Monterey/SLO		*4,360*	
San Diego - Monterey/SLO		*4,200*	
San Diego - San Joaquin Valley		*3,920*	
SF - Other		*820*	
San Diego - Other		*780*	
San Joaquin Vall ey - Other		*720*	
Other		*260*	
TOTAL	31,133,000	7,302,560	23%

Source: CA HSR Travel Demand Model

Table 3 summarizes the results, grouping them by region.

Table 3. 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%

[3] Note: Although the Phase 1 system does not reach San Diego or Sacramento, its termini in Anaheim, Merced, and San Francisco still attract some of the passengers that would have flown out of the airports in the Sacramento and San Diego region. Additionally, John Wayne Airport (SNA) is included in the San Diego region even though its located in Santa Ana, just 13 miles from the site of the station in Anaheim. Much of the draw from the San Diego region is actually from SNA, not from San Diego International Airport (SAN).

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 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[4]. 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 4 includes the final distribution of the regional air travel that is assigned to each airport.

Table 4. Summary of Projected Airport Capacity Needs

Region	Airport	% of Regional Travel	Passengers per Year	Planes per Hour	Gates Needed	Runway Needed?
Los Angeles Basin	BUR	48%	10,194,450	28	20	YES
	ONT	35%	7,281,750	20	14	YES
	LGB	17%	3,640,875	10	7	NO
Bay Area	SJC	42%	10,194,450	28	20	YES
	OAK	58%	13,835,325	38	27	YES
San Diego	SNA	71%	4,369,050	12	9	NO
	SAN	29%	1,820,438	5	4	NO
Monterey	MRY	100%	2,548,613	7	5	NO
San Joaquin Valley	FAT	51%	1,456,350	4	3	NO
	BFL	49%	1,456,350	4	3	NO
Sacramento	SMF	100%	1,456,350	4	3	NO
Total			**58,254,000[5]**	**160**	**115**	**4**

[4] 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.

[5] Note: the total passengers per year is close to 58 million 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.

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)
- 19 hours of operation per day
- 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 close to 50 million because each of the 25 million 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 Department of Transportation (USDOT)-certified 2005 study for the associated improvements considered for the cost estimate.

A. RUNWAY

<u>Runway:</u>
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.

<u>Site Preparation:</u>
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.

<u>Navaids (CAT-1):</u>
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 $29.7 billion (in 2010 $) 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 2010 dollars using the Construction Cost Index from the Engineering News Record[6].

Table 5. Eqivalent Capacity and Costs by Airport

Airport	Gates	Runways	Cost (2010 $)
BUR	20	1	$5,149,000,000
ONT	14	1	$8,105,000,000
LGB	7	0	$344,000,000
SJC	20	1	$9,164,000,000
OAK	27	1	$1,765,000,000
SNA	9	0	$3,321,000,000
SAN	4	0	$1,181,000,000
MRY	5	0	$267,000,000
FAT	3	0	$101,000,000
BFL	3	0	$128,000,000
SMF	3	0	$205,000,000
Total	**115**	**4**	**$29,730,000,000**

[6] Engineering News Record. *Construction Cost Index - August 2011*. McGraw-Hill, 2011. Index from 2003 to 2010 costs was used in this analysis.

7) *Highway Capacity*

The required highway capacity to accommodate about 87 million passengers was divided into required lanes and assigned to specific highway stretches according to the estimates from the 2005 study. 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 highways between Merced and Sacramento were included at ¼ the capacity because some of the travelers through the Central Valley on high-speed rail would also be using rail service in that corridor so without high-speed rail they would be driving the entire distance. The following assumptions were used for estimating a realistic highway capacity at any location:

- 2,300 cars per lane per hour (this is a conservative—more favorable to highways—estimate for highway throughput based on maximum base free-flow conditions from the 2010 Highway Capacity Manual[7]. Most highway planning studies use 1,600 to 1,800 in their estimates of observable conditions.)
- 19 hours of highway operations per day
- 1.9 passengers per car (this is a conservative estimate for inter-city trips based on the FHWA's National Household Travel Survey as it only includes trips over 100 miles. [8] Shorter trips, some of which would take place on high-speed rail, tend to have lower occupancies.)

8) *Cost of Highway Capacity*

Capital costs were estimated for the highway component are based on planning-level cost estimates prepared for freeway widening and interchange improvement projects in urban areas in California. The unit material costs were compiled in the 2005 study based on recent California Department of Transportation (Caltrans) construction cost information from various improvement projects throughout the state. While the costs have been inflated using the Engineering News Record Construction Cost Index[9], they do not reflect the changes in urbanization and development that has occurred across the state since the information was compiled in 2003/2004. Additionally, they do not account for the transition from planning-level cost estimates to construction-level cost estimates, which would likely increase the overall cost due to additional mitigation measures that would be required if the lanes were to actually be built. Thus, these estimates reflect a level of conservatism because they are likely underestimating, not overestimating, the cost of building the projected additional highway capacity.

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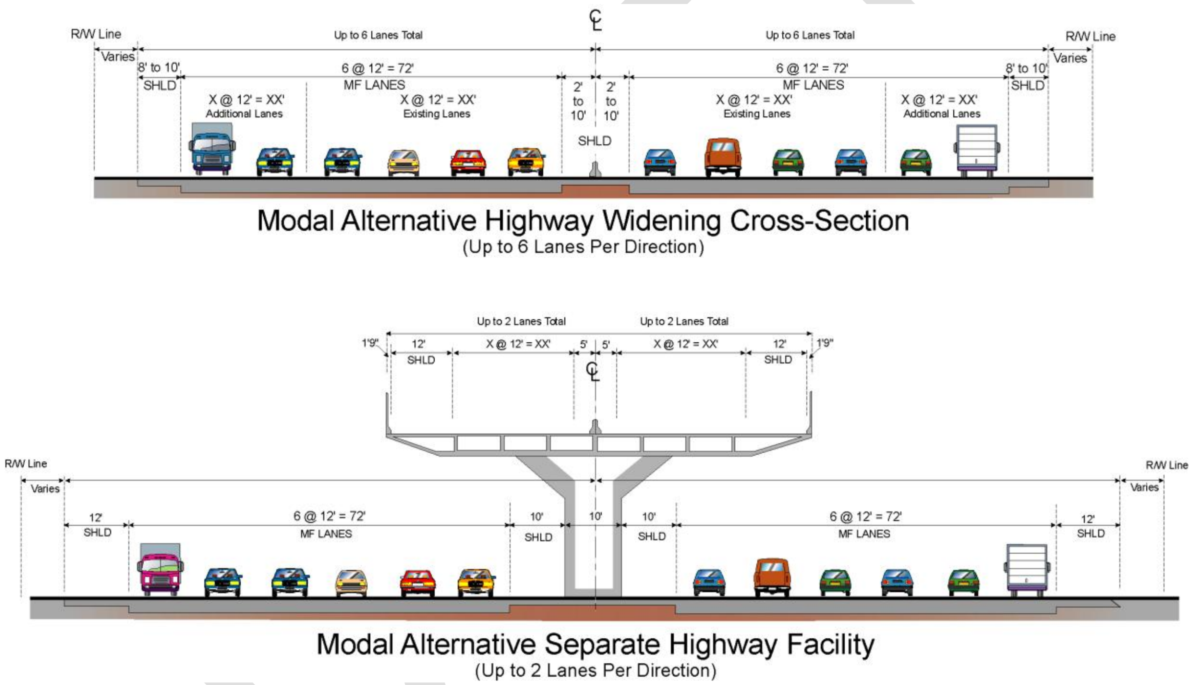
[7] *Highway Capacity Manual*. Transportation Research Board, Washington, D.C. 2010.

[8] Federal Highway Administration. National Household Travel Survey. *Online Analysis Tool.* [Online] 2009. [Cited: October 5, 2011.] http://nhts.ornl.gov/tools.shtml.

[9] Engineering News Record. *Construction Cost Index - August 2011*. McGraw-Hill, 2011. Index from 2003 to 2010 costs was used in this analysis.

The hypothetical highway improvements include a number of additional lanes that varies per highway corridor. These improvements (additional lanes) are assumed to be in specific corridors but they could be made to other parallel highways/roads in some cases. The improvements were compared to the number of lanes that exist currently on each route segment to determine whether the improvement would be described as a widening or a new facility. The additional lanes would widen the existing facility up to a total of 12 lanes, as shown on Figure 1, a typical cross-section of a highway widening. Beyond 12 total lanes, additional lanes are defined as a separate facility. For this analysis, it is assumed that separate facilities in urban areas would be placed on elevated structures above existing facilities because of right-of-way constraints. The vast majority of modal alternative improvements would be widenings rather than separate facilities.

Figure 1
Typical Highway Improvement Cross-Sections



The following other assumptions were carried over from the 2005 study for the highway component:

Pavement-AC (Asphalt Concrete): It is assumed per typical California Department of Transportation (Caltrans) design and construction practices that one-third of all new pavement widening would be AC pavement. This would account for widening existing AC segments that are in good condition. If existing AC pavement is in poor condition, Portland Cement Concrete (PCC) would be used for the new widening.

Pavement-PCC: It is assumed per typical Caltrans design and construction practices that two-thirds of all new pavement widening would be PCC pavement. Segments that have a separate elevated highway facility would be assumed to be PCC.

The unit cost for the structural section for both AC and PCC pavement was based on information from the Caltrans Contract Cost Data Book as applied to other recent studies at the time of the 2005 study.

Separate Aerial Structure: Aerial structures are assumed to be required in highway segments that are wider than 12 total lanes. Any additional lanes are defined as a separate aerial facility. The aerial structure is assumed to be 4 total lanes 86 ft (26.21 m) wide, and the unit cost was derived from the Caltrans Comparative Bridge Costs January 2002, inflated to 2010 dollars through the Engineering News Record Construction Cost Index[10].

Earthwork: The general category of earthwork is made up of four constituent activities: excavation, embankment, spoil, and borrow. Earthwork incidental to the construction of a structure, such as the excavation for a bridge foundation, would not be included here; that cost is a part of the interchange unit cost.

For all segments, an average depth of 3.28 ft (1.0 m) of earthwork was assumed for new highway widening.

At this preliminary stage of definition, there is insufficient data regarding the hypothetical highway improvements to estimate the earthwork required on the segments in mountainous terrain. Thus, this estimate does not include the entire earthwork volume necessary to widen certain highway segments through mountain crossings (I-5 Grapevine, SR-152).

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

The unit cost for earthwork was based on information from the Caltrans Contract Cost Data Book as applied to other recent studies at the time of the 2005 study.

Other

Included in the detailed categories below are all of the highway elements and other items related to highway widening. The unit cost for these items was calculated for cost per centerline kilometer. The unit cost used was based on previous experience of the consultant team, which has extensive experience in highway design and construction in

[10] Engineering News Record. *Construction Cost Index - August 2011*. McGraw-Hill, 2011. Index from 2003 to 2010 costs was used in this analysis.

California, the Caltrans Contract Cost Data documents, and previous experience of the consultant team on recent major investment study (MIS) level urban highway improvement projects.

Overhead Signs: The overhead sign quantity was determined by assuming the replacement of two overhead signs per interchange for both directions. Overhead signs at major freeway-to-freeway interchanges were included in major freeway-to-freeway interchange unit cost.

Drainage, Landscape, Signing, Signals, and Lighting: The drainage cost includes culverts and other structures needed for highway widening and cross-drainage purposes only. This was calculated as a percentage of the roadway cost.

Landscape includes areas alongside the highway right-of-way facility. The landscape along the highway includes the seeding of cut slopes and embankments.

The cost for roadside signs, signals, and lighting includes replacement of all minor roadside signs, new lighting, and new street signals. Cost was calculated by taking the average cost per km of these items.

Traffic Handling: The cost for traffic handling includes stage construction costs including temporary signage, striping, and pavement. Cost was calculated as a percentage of the roadway cost.

Miscellaneous Cost: Miscellaneous costs include such items as fencing, curbs, sidewalks, access ramps, and features needed to comply with the Americans with Disabilities Act (ADA). Cost was calculated as a percentage of the roadway cost.

City Street Relocation/Reconstruction: The cost for city street relocation and reconstruction assumed that some city streets would be impacted by the proposed widening. The unit cost is calculated by taking the average cost per km, and it is for construction only. Any right-of-way costs were included in the right-of-way portion of the cost estimate.

Removals: Removals generally include the existing shoulder pavement in areas where the freeway is to be widened. It is assumed that 20 ft (6m) per km of shoulder pavement would be removed for new freeway widening.

Surveillance, Control, and Communications: Items included in the unit cost for this category include CCTV cameras, changeable message signs, fiber-optic cable, and vehicle detection systems. This cost was calculated by taking the average application cost per km of these items.

Interchange

Interchanges along the defined intercity routes were quantified and categorized based on review of published highway maps and aerial images. Four general categories of interchanges were defined: major freeway-to-freeway interchange, overcrossing interchange, undercrossing interchange, and at-grade interchange. Through further review of aerial images, the interchanges were also classified by general land use density: urban, suburban, and undeveloped. While portions of the intercity routes traverse growing areas, no new interchanges are assumed to be added nor closed for this cost estimate, due to the speculative nature of the specific growth and improvement patterns.

The unit costs applied for these interchanges include all of the cost elements necessary to complete the construction of the interchanges, such as bridge cost, earthwork, traffic handling, right-of-way, mobilization, drainage, etc. The unit cost used was based on previous experience of the consultant team, the Caltrans Contract Cost Data documents, and previous experience on recent MIS-level urban highway improvement projects at the time of the 2005 study.

Costs for pre-stressed reinforced concrete aerial structures include the bridge, as well as the abutment (for a bridge or viaduct). Cost for that bridge would consist of the excavation for the abutment including all wing walls and transition slabs. The foundation work would also be included, as well as the earthwork needed to construct the foundations. Waterway crossings that were calculated on a per-crossing basis are included under bridge costs. A unit cost was applied per length of aerial structure. Based on other recently constructed structures of similar dimension, a unit cost of $125 per sq ft (in 2003 $) of structure deck was used for all structures requiring spans less than 100 ft (30.48 m) and for heights exceeding 30 ft (9.1 m).

Interchange right-of-way is included in the unit cost of each interchange where appropriate. Right-of-way for each highway segment is calculated separately and is located in the right-of-way cost section.

The cost difference between the different types of interchanges is based on general land use density and the right-of-way unit price. It is assumed the interchange quantities and unit cost remain the same, and the only cost that changes is the right-of-way unit cost.

Highway urban, suburban, and undeveloped right-of-way unit costs for the highway component are the same as dense urban, dense suburban, and undeveloped right-of-way categories used for the airport component.

The types of interchanges and the assumptions made for each are further described below.

<u>Major Freeway-to-Freeway Interchange</u>: A unit cost was developed for the 2005 study based on an average cost of several major-freeway-to-freeway interchanges. This unit cost includes pavement, earthwork, overhead signs, drainage, landscape, light, signals, traffic handling, city streets relocation/reconstruction, removals, surveillance, control

and communications, mobilization, and contingencies. It includes replacement of all structural bridges and aerial ramp connectors.

There is no design information available that indicates the number of bridges that would need to be replaced, so it has been assumed that half of all overcrossings would require bridge replacement due to insufficient span to accommodate the widening improvements or other issues (i.e., vertical clearance limitations and seismic acceptability). The remaining half of the overcrossings are assumed to be in good condition and have enough space and vertical clearance to allow for a highway lane addition where it would be required.

Overcrossings are separated into four types.

Overcrossing Full Interchange Replacement: Includes full replacement of overcrossing bridge, construction of new ramps, and street improvements.

Overcrossing Ramp Modification: No bridge replacement is necessary. Ramps would require minor improvements and modifications at the entrance and exit gore points. Ramp modifications are assumed to require half of the right-of-way, earthwork, and pavement quantities as a full replacement interchange. No street improvements are assumed.

Overcrossing Bridge Replacement: This includes overcrossing bridge replacement. For pavement and earthwork, it is assumed that 1000 ft (304.8 m) would be enough length to replace and connect the new bridge with the existing street. The bridge is assumed to be four lanes wide. For earthwork, it is assumed that 1 ft (0.31 m) of excavation would be required to replace the old pavement. No overhead signs are included in the cost since this overcrossing is not an interchange. Bridge structure quantity is assumed to be the same as quantified in a full replacement interchange, except structure quantity does not included ramp work. Right-of-way is not assumed to be required for this type of overcrossing.

Overcrossing Bridge Modification: Cost includes minor overcrossing bridge modifications. Existing bridge is assumed to be in good condition and would remain in place. However, there is still necessary work (i.e., earthwork, tie-back walls, and retaining walls) that needs to be performed in order to allow any highway widening. It is assumed that the highway would be widened by two lanes, and it would require a tie-back wall or retaining wall of 80ft (24.4 m) long by 12 ft (3.6 m) high. This cost does not include any street improvements, overhead signs, or traffic handling. No right-of-way is assumed to be required to do any bridge modification. The right-of-way required for the highway widening would be accounted for in the right-of-way section.

The assumptions for undercrossing interchanges are a little different than those assumed for an overcrossing. In an undercrossing, the span width of the highway bridge is dependent on the general land use density of the area. For this cost estimate purpose, it is assumed that urban, suburban, and undeveloped have six, four, and two undercrossing lanes, respectively. It is possible that in some cases a highway bridge would require full replacement due to a vertical clearance problem. For this cost estimate, it is assumed that 100% of all undercrossings can be widened without full bridge reconstruction.

Undercrossing interchanges are separated into three categories.

Undercrossing Freeway Widening & Ramp Modification: It is assumed that the bridge is in good condition and meets vertical clearance requirements after the highway bridge is widened to allow for an additional one lane on each side. The length of the bridge is assumed to be 100 ft (30.48 m) long, and the bridge widening is 12 ft (3.6 m) on each side. Ramps would require minor improvements and modification at the entrance and exit gore points. Half of the right-of-way, earthwork, and pavement quantities from the full replacement interchange are assumed to be required to do this type of interchange. No street improvements are necessary.

Freeway Bridge Widening (No Interchange): The highway bridge is assumed to be in good condition and meet vertical clearance after widening of the bridge for an additional one lane on each side of the highway. The length of bridge is assumed to be 100 ft (30.48 m), and the bridge widening is 12 ft (3.6 m) on each side. Pavement and earthwork is assumed to be 100 ft (30.48 m) long by 24 ft (7.3 m) wide by 1 ft (0.31m) deep. No additional right-of-way is necessary to widen the bridge. Right-of-way for highway widening would be accounted for in the right-of-way section.

There are a few interchanges that do not have an overcrossing or undercrossing bridge. For these types of interchanges, an at-grade interchange type was developed. An at-grade interchange cost includes cost for highway ramp connectors but does not include any bridge cost. Only one option was developed for each general land use density region.

At-Grade Interchange Modification: Pavement and earthwork are required to modify ramp connections. No additional right-of-way is assumed to be needed to perform ramp modifications. Unit cost includes street improvement, traffic handling, drainage, landscape, and lighting.

Utility Relocation: This is estimated at a per center-line km cost. 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.

Based on the same general land use density classification used in differentiating interchange types, each highway segment was proportionally divided into urban, suburban, or undeveloped, based on the number of interchanges located in that particular highway segment. For consistency purposes, the utility relocation unit cost applied is the same as that applied in estimation of cost for the HST Alternative.

Highway urban, suburban, and undeveloped utility relocation cost is the same as the dense urban, dense suburban, and undeveloped categories for the HST Alternative.

B. RIGHT-OF-WAY ITEMS

This is the total cost associated with the purchase of land and/or easement rights for the highway widening. This includes relocation assistance and demolition costs. Property values and acquisition costs can range from quite modest in undeveloped areas to quite significant in areas where there are high-value commercial properties. These costs include those for title searches, appraisals, legal fees, title insurance, surveys, and various other processes.

Right-of-way unit cost was developed as a per-ha unit price. The basic unit cost assumes a minimum right-of-way width of 12 ft (3.6 m) for each required lane throughout the length of each highway segment. The length of each highway segment and the general land use category is based on the lengths derived in the utility relocation cost.

For consistency, the unit costs applied for highway urban, suburban, and undeveloped right-of-way are the same as the unit costs applied for dense urban, dense suburban, and undeveloped categories for the airport component in the 2005 study.

Right-of-way for interchange replacement and modification is not included as part of this cost but is included as an item in the interchange cost.

C. 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. This cost does not include noise mitigation (walls, barriers).

The total cost of environmental mitigation is estimated to be 3% of the construction costs (i.e., highway segment, pavement, earthwork, structures, etc.) for each segment. This factor is applied on the average to estimate a total cost of potential mitigation.

D. PROGRAM IMPLEMENTATION COSTS

Costs for these elements are computed as a percentage of total construction and procurement costs. While specific percentage allocations may vary per type of infrastructure, total implementation costs as a percentage of the total project costs are similar. Therefore, the percentages applied are the same as those applied in the estimation of cost for the airport component for consistency. The percentages are intended to represent the average overall cost of these implementation items, based on implementation of highway and other related improvement projects throughout the state. These costs are included in the cost estimates for overall consistency in the order of magnitude.

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

Program and Design Management
These costs represent the 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%)

Final Design
This includes costs for final design and preparation of construction and procurement documents for all facilities and systems. This would include 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%)

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

Agency Costs
This includes costs of maintaining the owner's organization (probably Caltrans) (administrative and overhead) during the entire program, whether that owner is a franchisee or a government agency. (1%)

Force Account Costs
This includes costs for the services of other organizations or agencies of local, state, or federal government that may be required to support the project. (1%)

Risk Management
The costs of owner (probably Caltrans)-supplied insurance or any other allowances decided to be applied for the management of risk to the owner. (6%)

E. 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.

9) Full Cost Estimate

Table 6 Summary of Highway Segments and Costs (2010 $)

Highway Corridor	Segment (From–To)	Urban/Rural	Miles	Lane-miles	Cost per lane-mile (2010 $)
Bay Area to Merced					
US-101	San Francisco to SFO	Urban	11.3	33.9	$ 75,737,000
US-101	SFO to Redwood City	Urban	13.8	41.4	$ 47,272,000
US-101	Redwood City to I-880	Urban	19.7	59.1	$ 46,436,000
I-880	US-101 to San Jose	Urban	0.9	2.7	$ 68,020,000
US-101	San Jose to Gilroy	Urban	31.2	93.6	$ 30,439,000
US-101	Gilroy to SR-152	Urban	1.4	4.2	$ 27,233,000
SR-152	US-101 to I-5	Rural	40.8	122.4	$ 11,480,000
SR-152	I-5 to SR-99	Rural	42.8	128.4	$ 14,071,000
I-80	San Francisco to I-880	Urban	9.2	27.6	$ 41,416,000
I-880	I-80 to I-238	Urban	13.8	41.4	$ 51,185,000
I-580	I-880 to I-5 (via I-238)	Rural	52.7	158.1	$ 29,736,000
I-880	I-238 to Fremont/Newark	Urban	14.5	43.5	$ 44,874,000
I-880	Fremont/Newark to US-101	Urban	12.4	37.2	$ 41,612,000
Merced to Bakersfield					
I-5	SR-152 to SR-99	Rural	186	558	$ 9,804,000
SR-99	Merced to SR-152	Rural	21.5	64.5	$ 12,489,000
SR-99	SR-152 to Fresno	Urban	33.4	100.2	$ 25,964,000
SR-99	Fresno to Tulare/Visalia	Urban	46.4	139.2	$ 19,969,000
SR-99	Tulare/Visalia to SR-58	Urban	68.9	206.7	$ 22,044,000
Bakersfield to Los Angeles					
I-5	SR-99 to SR-14	Rural	65	195	$ 21,981,000
I-5	SR-14 to I-405	Urban	2.5	7.5	$109,828,000
I-5	I-405 to Burbank	Urban	15.3	45.9	$ 28,677,000
I-5	Burbank to Los Angeles Union Station (LAUS)	Urban	7.4	22.2	$ 57,303,000
SR-14	Palmdale to I-5	Urban	34.8	104.4	$ 23,704,000
Los Angeles to Anaheim					
I-5	LAUS to I-10	Urban	0.8	2.4	$271,834,000
I-5	I-10 to Norwalk	Urban	20.7	62.1	$ 60,231,000
I-5	Norwalk to Anaheim	Urban	8.1	24.3	$ 75,534,000
Total			**775**	**2326**	

From the capacity estimate, each stretch of highway listed in Table 6, would require a total of three lanes. The total lane-miles required to match the capacity for HSR assigned to highways is 2,326 lane-miles. It is important to note that the assumption of three total lanes adds a level of conservatism because if the highways were to actually be built, they would most likely add two lanes in each direction, for four lanes total. The reason that this analysis uses the three lanes is for the estimate to provide a more apples-to-apples comparison with the capacity provided by high-speed rail.

The analysis used the per-mile costs in the 2005 study to create aggregate per-mile costs for urban and rural highway lanes. Segments of highway that were primarily urban or suburban in the 2005 study were grouped to create an average per-lane-mile cost for urban highways and rural highways were used to create the average per-lane-mile cost for rural highways. Since costs don't scale directly as new lanes are added, averaging the costs into urban and rural stretches makes them more applicable across the numerous circumstances found in California. The lane-mile cost in 2010 dollars was $58.5 million for urban highways and $16.6 million for rural highways. Under this scenario, the cost was $84.6 billion for the highway component.

It is important to acknowledge that this provides an estimate that is grounded in the 2005 study but does not reflect the same level of detailed analysis as the previous study did. Some of the costs of highway construction do not scale as easily as others. For example, in some scenarios adding three lanes instead of two would only cost the marginal cost of the civil works and materials for the extra lane. However, in other cases, there might not be enough space in the existing right of way for the new lane and the right of way might need to be expanded. In that case, the extra lane might require the reconstruction of significant numbers of highway interchanges and bridges, greatly increasing the overall cost. Most segments in the 2005 study required two lanes while a few required four. The direct scaling from the two or four lanes to three lanes across each segment does not account for the possible differences in costs as described above. It is reasonable to assume that given the relatively large sample of segments, the estimates are likely to, on average, even out.

10) Built-in Conservatism in this Analysis

The analysis presented here has several sets of assumptions that, if less conservatism assumptions were used, would make the results more favorable to high-speed rail. The following are the main assumptions that make this analysis deliberately conservative:

- The land-use that is used to estimate the costs of the highways and runways assumes no change in land use from the time of the original analysis in 2003/2004. In reality, California has seen tremendous growth in the mean time, which would make highway and airport construction throughout the state more expensive
- The level of design in this analysis is still planning-level and thus does not account for some of the cost increases from mitigation that would be required if these highways and airports were to advance toward construction.

- 12 high-speed rail trains per hour, instead of as many as 15 or 20, as is currently running on parts of the Shinkansen system and what the signaling system is capable of accommodating for CHSR.
- While the 2,300 cars per lane per hour estimate is based on free-flow conditions in the 2010 Highway Capacity Manual, these are an absolute maximum and are not usually observed in reality over a longer period of time. Most highway studies, including an analysis by the Legislative Analyst's Office which cites Caltrans, use 1,600 to 1,800 thus using 2,300 is very favorable to highways[11].
- 1.9 passengers per car for auto inter-city trips. Although inter-city trips tend to have more passengers per car than intra-city trips, most estimates for inter-city travel are lower than 1.9, which would mean that more cars and lanes would be required to accommodate the capacity.
- Given that the highway component of the equivalent capacity calls for a total of three lanes combined in the two directions, it is conservative to assume that an odd number of lanes would be built. More likely, if the highways were to actually be built, they would be built with an equal number of lanes in each direction, which would require four lanes instead of three.

Each of these assumptions, if changed, would significantly increase the cost of the other modes relative to high-speed rail. Thus, this analysis has remained very conservative throughout, to provide an apples-to-apples comparison between the modes and, when possible, give the benefit of the doubt to the other modes.

[11] Legislative Analyst's Office. *HOV Lanes in California: Are They Achieving Their Goals?* Sacramento, 2000.

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)	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	$	154,561,335
Apron	ea	$750,000	27.00	$	20,250,000
Apron Site Preparation	Hectares	$12,355	11.29	$	139,439
Passenger Landing Bridge	ea	$400,000	27.00	$	10,800,000
Parking					
Parking Spaces	ea	$15,000	19,369	$	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	144.23	$	564,083
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	131.61	$	38,376,276
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				**$**	**814,328,837**
Total Construction and Right of Way				**$**	**891,854,481**
Grand Total				**$**	**1,342,240,994**

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	8.36	$ 103,288
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				**$ 3,408,828,874**
Total Construction and Right of Way				**$ 4,630,917,804**
Grand Total				**$ 6,969,531,295**

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	149.73	$ 1,849,970
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	149.73	$ 585,612
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	149.73	$ 43,661,233
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				**$ 58,136,334**
Total Construction and Right of Way				**$ 103,541,656**
Grand Total				**$ 155,830,192**

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	$ 15,567
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				**$ 49,648,908**
Total Construction and Right of Way				**$ 51,138,376**
Grand Total				**$ 76,963,255**

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				**$**	**3,916,057,103**

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	$ 72,215
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				**$ 3,207,314,051**
Total Construction and Right of Way				**$ 4,095,729,382**
Grand Total				**$ 6,164,072,720**

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	2.92	$ 36,132
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				**$ 168,896,348**
Total Construction and Right of Way				**$ 173,963,238**
Grand Total				**$ 261,814,674**

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	$	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	2,549	$	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	21.22	$	262,173
Clearing of Developed Land	Hectares	$8,611,128	43.17	$	371,713,692
Utility Relocation					
Major Utility Relocations - Dense Urban	Hectares	$497,711	-	$	-
Major Utility Relocations - Urban	Hectares	$380,393	43.17	$	16,420,298
Major Utility Relocations - Dense Suburban	Hectares	$266,631	-	$	-
Major Utility Relocations - Suburban	Hectares	$76,434	21.22	$	1,621,929
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	43.17	$	100,696,135
Right-of-way - Dense Suburban	Hectares	$1,166,364	-	$	-
Right-of-way - Suburban	Hectares	$408,227	21.22	$	8,662,577
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				**$**	**473,219,841**
Total Construction and Right of Way				**$**	**596,775,148**
Grand Total				**$**	**898,146,598**

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	210.00	$ 2,594,550
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				**$ 108,212,483**
Total Construction and Right of Way				**$ 134,787,678**
Grand Total				**$ 202,855,456**

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	126.00	$ 1,556,730
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				**$ 62,617,503**
Total Construction and Right of Way				**$ 64,496,028**
Grand Total				**$ 97,066,522**

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	378.00	$	4,670,190
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				**$**	**1,466,334,229**
Total Construction and Right of Way				**$**	**1,678,291,764**
Grand Total				**$**	**2,525,829,105**