Benefit-Cost Analysis

INTERSTATE 215 / AIRPORT CONNECTOR INTERCHANGE

Southern I-215 Bruce Woodbury Beltway
Las Vegas Boulevard to Windmill Lane, and
I-215 / Airport Connector Interchange
Clark County, Nevada

Prepared for:

Clark County Public Works

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Prepared by:

PB Americas, Inc.
3930 Howard Hughes Parkway,
Suite 300
Las Vegas, NV 89109

TEL: (702) 697-8100
FAX: (702) 697-8170

BENEFIT-COST ANALYSIS

Southern I-215 Bruce Woodbury Beltway
Las Vegas Boulevard to Windmill Lane and
I-215 / Airport Connector Interchange Project

This benefit-cost analysis was prepared by PB Americas Inc. (PB) for Clark County Public Works as supporting documentation to the Transportation Investment Generating Economic Recovery (TIGER) discretionary grant application for the I-215/Airport Connector Interchange project. This analysis compares the estimated costs and benefits associated with implementing the build project alternative verses the no-build project alternative. Project costs and benefits are monetized to 2009, present year, values. A discount rate of 7%, per guidance given in OMB Circulars A-4 and A-94, is used to monetize future costs and benefits to 2009 dollars. Project benefits were calculated for an analytic time horizon of 20 years beginning in 2012, after the completion of the proposed improvements, to 2031.

The Southern I-215 Bruce Woodbury Beltway, Las Vegas Boulevard to Windmill Lane and I-215 / Airport Connector Interchange project (Project) includes widening I-215 and the Airport Connector and modification of the I-215/Airport Connector interchange to accommodate Year 2030 forecast traffic volumes. A description of the Project, including and exhibits depicting all improvements, is provided in the Project's Change of Access Report.

A. <u>PROJECT COSTS</u>

Project costs are based on a combination of actual and estimated costs. Actual costs incurred include the preparation of the preliminary engineering, environmental documentation and final engineering. The accumulation of actual costs began in August 2003 with the preparation of the preliminary engineering and environmental document. Estimated costs include construction and construction management, which are scheduled for completion in February, 2012.

Construction Costs
The construction cost estimate has been developed based the "Final Submittal" plan and specifications. Bid item quantities have been are calculated and/or measured from the project plans. Measurements of bid item quantities are defined in the project's special provisions. Unit costs are based on the accepted bid prices from recent Las Vegas Valley area bid summaries for projects awarded by Clark County or the Nevada Department of Transportation. The construction cost estimate is in 2009 dollars. The estimated construction cost included a 3% contingency. The construction is scheduled to begin in March 2010 and will be completed by February 2012. Yearly costs have been prorated over the 24 month construction period.

Right-of-Way Costs
The project improvements are to be constructed within existing public right-of-ways. No additional right-of-way, permanent easements or temporary construction easements are required.

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Engineering Costs

Engineering costs are broken out into three components, Preliminary Engineering and Environmental (PE), Plans Specifications and Estimate (PS&E), and Construction Management (CM).

PE costs include the cost of professional services for conceptual engineering and environmental assessment. The PE costs are actual costs and are show for the year of expenditure. PE began in August 2005 and was completed in March, 2005, with the approval of the project's categorical exclusion.

PS&E costs include the cost of professional services for final design plans, specifications, estimates; design survey, geotechnical reports. The PS&E costs also include substantial design and plan preparation for future improvements to provide additional access to McCarran Airport and preservation of future lanes on I-215. These amounts in table A-1 represent actual cost and are shown in the year of expenditure. PS&E began in February 2006 and will be completed in September, 2009.

CM costs include construction engineering, design support during construction, surveys, administration and inspection. An amount of $18.2 million has been budged by Clark County for these activities. These costs are anticipated to begin in October, 2009 and be completed by February, 2012. Table A-1 summarizes the actual and estimates costs for the project. Section C. Summary of Benefits presents the project's costs in present day, 2009, dollars.

Table A-1 - I-215/Airport Connector Interchange Capital Costs

Year	Construction	PE	PS&E	CM	Total
2003		$250,000			$250,000
2004		$600,000			$600,000
2005		$150,000			$150,000
2006			$2,500,000		$2,500,000
2007			$2,730,000		$2,730,000
2008			$2,730,000		$2,730,000
2009			$2,040,000	$1,880,000	$4,360,000
2010	$58,330,000			$7,530,000	$67,600,000
2011	$70,000,000			$7,530,000	$79,270,000
2012	$11,670,000			$1,260,000	$13,210,000
Total	$140,000,000	$1,000,000	$10,000,000	$18,200,000	$173,400,000

B. BENEFITS ESTIMATES

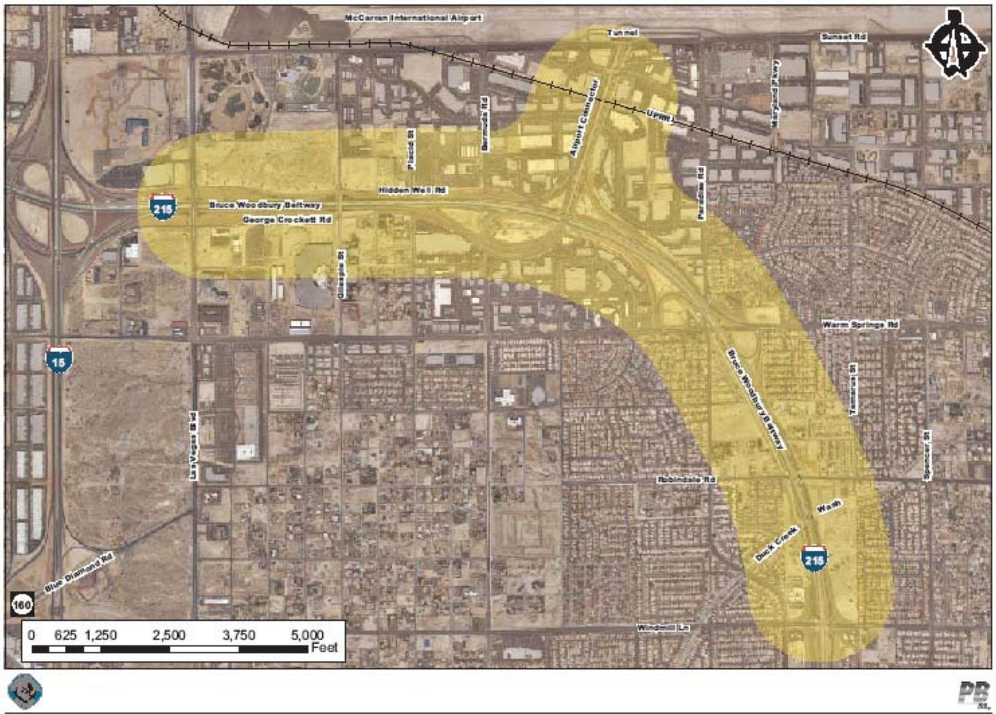
The Southern I-215 Bruce Woodbury Beltway plays an important role in carrying traffic local commuters between residential areas in the southern Las Vegas Valley to the employment and educational centers in the central valley. I-215, within the project limits, is a critical link in the beltway. Similarly the Airport Connector is a critical north south link from I-215 to the Resort Corridor and the McCarran International Airport.

The estimated benefits are based on readily available data. The Project's traffic study provides pertinent volume and travel speed data and intersection delay times for the AM and PM peak hours, within the study area depicted in the figure below. This information was used to calculate the project benefits for travel time and vehicle operating cost savings.

Travel Time Savings

The traffic analysis tabulated AM and PM peak hour speeds and volumes for each link within the project and delay times at each signalized intersection immediately adjacent to the project for both the 2030 build and no-build alternatives. From this tabulated data, daily, volume weighted, travel times were calculated for each alternative. These calculations show a significant travel time savings as a result of this project. Additionally, the peak hour speeds and volumes are calculated based on the average of the peak, 2 hour, period. Hence, the calculated travel time savings can be multiplied by a factor of two for both the AM and PM peaks. This estimated time savings is a conservative measurement due to the limited data available. This project is a regionally significant project that will reduce traffic congestion beyond the limits of the traffic analysis and at times other than the AM and PM peak periods.

The U.S. Department of Transportation guidance for the valuation of travel time in economic analysis, recommends using an hourly value of 50 percent of the local median wage rate. Business travel by truck and bus drivers was valued at 100 percent of the mean wage for these occupations, plus fringe benefits. Clark County's mean wage for all occupations was reported by the Nevada Department of Employment, Training and Rehabilitation to be $18.62 per hour in 2009; hence a value of time equal to $9.31 per hour was used for local personal travel. The state reported that heavy and tractor trailer truck drivers residing in Clark County earned $20.72 per hour in 2009. A fringe benefit rate of 50 percent of the mean wage was assumed by PB for bus and truck drivers, based on an equal mix of employees covered by Teamsters (55.5 percent) and other (44.5 percent) labor agreements. The corresponding value of time for these business travelers was thus estimated to be $31.08 per hour. Further, the Nevada Department of Transportation's (NDOT) vehicle distribution data by functional classification shows the percentage of truck traffic on I-215 and the Airport Connector to be 6.7% for 2003.



Interstate 215 / Airport Connector Interchange

Study Area Map

Computation of benefits also took vehicle occupancy into account for local personnel travel. The following average daily vehicle occupancies were derived from Regional Transportation Commission of Southern Nevada's (RTC) 1996 Household Survey: 1.06 for home-based work trips, 1.70 for home-based other trips, 1.23 for home-based school trips, 1.54 for non-home-based trips, 1.43 for home-based shop trips, and 1.54 for visitor trips of all purposes. Taking these vehicle occupancy rates into account, the average daily vehicle occupancy for all trip purposes in the Las Vegas Valley portion of Clark County is estimated to be 1.46 persons per vehicle. While this average occupancy may be lower or higher during peak periods, the average rate was assumed for the benefits calculation for lack of better data.

The calculated hourly rate, shown in table B-1, for the time value of travel is $14.76. This rate includes mean wages, occupancy and truck traffic volumes.

Table B-1 - Time Value of Travel Calculation

Vehicle Type	Hourly Rate	Adjustment Factor*	Occupancy Factor	Percent of Volume	Weighted Rate
Auto	$ 18.62	0.5	1.46	93.3%	$ 12.68
Truck	$ 20.72	1.5	1	6.7%	$ 2.08
			Weighted Hourly Rate All Vehicle Types:		$ 14.76

* Adjustment factors: Autos - 50% of local median wage; Trucks - 50% increase for fringe benefits

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Overall, the Build Alternative provides $20.9 million in travel time savings annually for peak period travel in 2030, using year 2009 wage rates. See Table B-2 for a summary of travel time saving for the year 2030. Assuming a linear year-to-year increase in traffic volumes between the traffic analysis base year of 2003, and the 20 year analytic time horizon from 2012 to 2031, the build alternative would produce $286.5 million of travel time savings from the delivery of capacity enhancements in 2012. Table B-6 shows the prorated yearly travel time, fuel and fuel revenue savings between 2003 and 2031. Table B-7 shows the summary of savings of loss for the 20 year analytic time horizon from completion of improvements, 2012 to 2031.

Table B-2 – 2030 Build vs. No-Build AM and PM Peak Hour Travel Time Savings

Peak Hour	Location	No-Build - Travel Time x Volume	Build - Travel Time x Volume	Time Savings	Weighted Hourly Rate	Days per Year*	Savings (2030)
		(Hrs/Day)	(Hrs/Day)	Hrs./Day	($)		($)
	Freeway / Expressway Links						
AM	EB I-215 and on and off ramps	1115.32	443.87	671.5	$ 14.76	250	$ 2,477,661
AM	WB I-215 and on and off ramps	1078.78	529.84	548.9	$ 14.76	250	$ 2,025,605
AM	Airport Connector	102.51	116.19	-13.7	$ 14.76	250	$ (50,503)
PM	EB I-215 and on and off ramps	877.92	801.09	76.8	$ 14.76	250	$ 283,501
PM	WB I-215 and on and off ramps	911.93	589.37	322.6	$ 14.76	250	$ 1,190,247
PM	Airport Connector	337.19	163.46	173.7	$ 14.76	250	$ 641,095
	Intersections					250	
AM	Intersections Delays	1081.26	553.59	527.7	$ 14.76	250	$ 1,947,117
PM	Intersections Delays	1275.94	750.36	525.6	$ 14.76	250	$ 1,939,395
					Peak Hour Total		$ 10,454,116
					Peak Period Total		**$ 20,908,233**

* Assuming 250 working days per year

Vehicle Operating Costs

Vehicle operating costs were calculated for the build and no build alternatives using the available data in the traffic report.

For the Project's evaluation of benefits and costs, fuel consumption was based on estimates of average fuel consumption for the year 2002/03 obtained from the California Air Resources Board's Motor Vehicle Emission Inventory models. These rates, used in the California Life-Cycle Benefit/Cost Analysis Model, are reported in table B-3.

Table B-3 - Fuel Consumption Rates (gallons/mile)

Speed	Auto	Truck	Weighted Rate*
5	0.150	0.218	0.154
10	0.112	0.202	0.118
15	0.087	0.182	0.093
20	0.070	0.169	0.076
25	0.058	0.162	0.065
30	0.050	0.157	0.057
35	0.045	0.154	0.053
40	0.042	0.152	0.050
45	0.041	0.151	0.048
50	0.041	0.151	0.048
55	0.042	0.152	0.049
60	0.045	0.154	0.052
65	0.050	0.157	0.057
70	0.053	0.163	0.061

Source: Cal-B/C, California Air Resources Board, 2002/2003 Consumption Rates
* Weighted rate is based on 6.7% Truck and 93.3% Auto volumes

The price-per-gallon of regular grade gasoline was assumed to be $2.526 per gallon, based on average price in Las Vegas, Nevada, in July 2009. The analysis separates fuel costs into tax and non-tax components, using the tax portion to compute “revenue transfers.” The tax rate per gallon of gasoline was assumed to be 18.4 cents Federal, 18.455 cents State, 6.35 cents County mandatory, and 9.0 cents County optional for Clark County. These taxes total 52.2 cents per gallon.

The resulting vehicle operating cost benefits for the project, computed for 20 year analysis period, are estimated to be $6.45 million. Revenue transfers and fuel taxes not collected as a result of these benefits amount to $1.33 million. See Table B-4 for a summary of vehicle operating benefits and fuel revenue losses for the year 2030. Also, see tables B-6 and B-7 yearly prorated savings and analytic time horizon summary.

Table B-4 – 2030 Build vs. No-Build Fuel Consumption Savings and Fuel Revenue Loss

Freeway / Expressway Links	**No-Build** (gallons)	**Build** (gallons)	**Savings** (gallons)	**Fuel Cost** $/gallon	**Days***	**2030 Peak Hour Savings** ($)	**Fuel Revenue (Loss)** ($)
AM - EB I-215 and on and off ramps	1,255.63	1,249.47	6.15	$ 2.526	250	$ 3,888	$ 804
AM - WB I-215 and on and off ramps	1,935.00	1,549.33	385.66	$ 2.526	250	$ 243,545	$ 50,329
AM - Airport Connector	249.37	306.54	(57.17)	$ 2.526	250	$ (36,103)	$ (7,461)
PM - EB I-215 and on and off ramps	1,633.38	1,846.11	(212.72)	$ 2.526	250	$ (134,335)	$(27,760)
PM - WB I-215 and on and off ramps	1,709.52	1,541.58	167.94	$ 2.526	250	$ 106,056	$ 21,917
PM - Airport Connector	485.66	402.76	82.90	$ 2.526	250	$ 52,351	$ 10,818
					AM and PM Peak Hour Total	$ 235,402	$ 48,646
					AM and PM Peak Period Total	**$ 470,805**	**$ 97,292**

* Assuming 250 working days per year

Non-Fuel Costs

The Regional Transportation Commission of Southern Nevada ran the TDM models for the 2032 build and no-build scenarios to determine the total daily vehicle miles traveled. This analysis showed that the build scenario added 39,281 vehicle miles daily. It is assumed that this increase is due to the gravity flow model analysis redistributing traffic onto the improved I-215 and Airport Connector.

Non-fuel costs for vehicle maintenance and tire expense were assumed to be $0.061 per mile for automobiles based on Center for transportation Analysis, Department of Energy Statistics for calendar year 2004; and $0.121 for trucks.

The net increase to vehicle miles traveled for the entire system will result in an added yearly cost of $900,000 for the year 2031. The 2032 daily miles traveled were prorated the 2003 base year and the sum of additional miles traveled over the 20 year analytic time horizon results in a total cost for the project of $11.89 million. See table B-5, below for a summary of non fuel costs.

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Table B-5 - Non Fuel Costs

Year	Additional Miles per day Total	Autos (93.3%)	Trucks (6.7%)
2032	39,281	36,649	2,632
2031	**37,926**	**35,385**	**2,541**
2030	**36,572**	**34,122**	**2,450**
2029	**35,217**	**32,858**	**2,360**
2028	**33,863**	**31,594**	**2,269**
2027	**32,508**	**30,330**	**2,178**
2026	**31,154**	**29,067**	**2,087**
2025	**29,799**	**27,803**	**1,997**
2024	**28,445**	**26,539**	**1,906**
2023	**27,090**	**25,275**	**1,815**
2022	**25,736**	**24,012**	**1,724**
2021	**24,381**	**22,748**	**1,634**
2020	**23,027**	**21,484**	**1,543**
2019	**21,672**	**20,220**	**1,452**
2018	**20,318**	**18,956**	**1,361**
2017	**18,963**	**17,693**	**1,271**
2016	**17,609**	**16,429**	**1,180**
2015	**16,254**	**15,165**	**1,089**
2014	**14,900**	**13,901**	**998**
2013	**13,545**	**12,638**	**908**
2012	**12,191**	**11,374**	**817**
2011	10,836	10,110	726
2010	9,482	8,846	635
2009	8,127	7,583	545
2008	6,773	6,319	454
2007	5,418	5,055	363
2006	4,064	3,791	272
2005	2,709	2,528	182
2004	1,355	1,264	91
2003	(0)	(0)	(0)
Daily Miles - 2012 to 2031		467,593	33,578
Yearly Miles - 2012 to 2031		170,671,407	12,256,146
Cost per mile		0.061	0.121
Cost		$10,410,956	$1,482,994
Total Cost			**$11,893,950**

Table B-6 – Prorated Yearly Savings for Peak Periods

Year	Travel Time	Fuel Savings	Fuel Revenue (Loss)
2031	**$21,682,612**	**$488,242**	**$100,896**
2030	**$20,908,233**	**$470,805**	**$97,292**
2029	**$20,133,854**	**$453,368**	**$93,689**
2028	**$19,359,475**	**$435,930**	**$90,085**
2027	**$18,585,096**	**$418,493**	**$86,482**
2026	**$17,810,717**	**$401,056**	**$82,879**
2025	**$17,036,338**	**$383,619**	**$79,275**
2024	**$16,261,959**	**$366,182**	**$75,672**
2023	**$15,487,580**	**$348,744**	**$72,068**
2022	**$14,713,201**	**$331,307**	**$68,465**
2021	**$13,938,822**	**$313,870**	**$64,861**
2020	**$13,164,443**	**$296,433**	**$61,258**
2019	**$12,390,064**	**$278,995**	**$57,655**
2018	**$11,615,685**	**$261,558**	**$54,051**
2017	**$10,841,306**	**$244,121**	**$50,448**
2016	**$10,066,927**	**$226,684**	**$46,844**
2015	**$9,292,548**	**$209,247**	**$43,241**
2014	**$8,518,169**	**$191,809**	**$39,638**
2013	**$7,743,790**	**$174,372**	**$36,034**
2012	**$6,969,411**	**$156,935**	**$32,431**
2011	$6,195,032	$139,498	$28,827
2010	$5,420,653	$122,061	$25,224
2009	$4,646,274	$104,623	$21,620
2008	$3,871,895	$87,186	$18,017
2007	$3,097,516	$69,749	$14,414
2006	$2,323,137	$52,312	$10,810
2005	$1,548,758	$34,874	$7,207
2004	$774,379	$17,437	$3,603
2003	$0	$0	$0

Table B-7 - Total Savings - 20 Years Analytic Time Horizon: 2012 to 2031

Travel	**$286,520,229**
Fuel	**$6,451,769**
Fuel Revenue (loss)	**($1,333,264)**

Crash Benefits

The I-215/Airport Connector Interchange project is the result of identified capacity related deficiencies. It is not the result of safety concerns nor does it have a history of high accident rates. Analysis of the crash data, within the project limits, shows that both the I-215 and the Airport Connector are currently operating below the average crash rate for Nevada. However, accident rates are trending upwards as traffic volumes increase. This trend is expected to continue as congestion on the roadway continues to increase.

Although, no safety concerns are evident in the existing or proposed project, the build alternative includes a number of operational improvements anticipated to reduce the number of accidents. These improvements correspond with countermeasures and crash reductions factors (CRF) found in the FHWA's "Desktop Reference for Crash Reduction Factors". This desktop reference provides estimates for the crash reduction that might occur after the implementation of the countermeasures.

The improvements/countermeasures include the elimination of weave/merge operations and the addition of travel lanes and acceleration/deceleration lanes. Specifically, these countermeasures are located at the following locations and are shown with the corresponding CRF:

- Addition of basic lanes in both directions on I-215, (CRF 10% to 31%)
- Auxiliary lanes between I-215 interchange ramps, (CRF 10% to 75%; acting as acceleration / deceleration lanes)
- Additional lanes in both directions on the Airport Connector, (CRF 10% to 75%; acting as acceleration / deceleration lanes)
- Additional lane on the ramp connection between the Airport Connector and Sunset Road, (CRF 10% to 31%)
- Additional lane on the westbound I-215 off ramp to the Airport Connector, (CRF 10% to 31%)
- Improve pavement friction on the I-215 with the rubberized asphalt overlay, (CRF 13%)
- Elimination of weaving areas where an on ramp is followed closely by and off ramp, (This freeway condition does not have a CRF, however, the "Highway Safety Design and Operations Guide" identifies these weaving areas as potential safety problems.).
    - I-215 - Airport Connector on-ramp followed by Warm Springs Road off-ramp, will be replaced with a directional ramp and auxiliary lane for the Airport Connector and a deceleration lane will be added to the Warm Springs Road off-ramp, and
    - Northbound Airport Connector – the I-215 ramp followed by Sunset Road off-ramp will be modified to minimize the existing merge/weave condition.

For the purpose of this benefit-cost analysis, a CRF of 20% will be applied to the I-215 and a 10% to the Airport Connector. I-215 will benefit from the additional travel lanes, auxiliary lanes and the improved pavement friction provided by the rubberized asphalt wearing surface. The cumulative effect of these three countermeasures is a CRF of 33%. However, this high of a CRF seems unreasonable. The conservative CRF of 20% is for this analysis. This CRF is in the lower range of values given for the additional lane CRF. Similarly, the operational improvements to the Airport Connector are best characterized as the addition of an acceleration lane southbound and a deceleration lane north bound. A conservative CRF of 10% was selected for this analysis.

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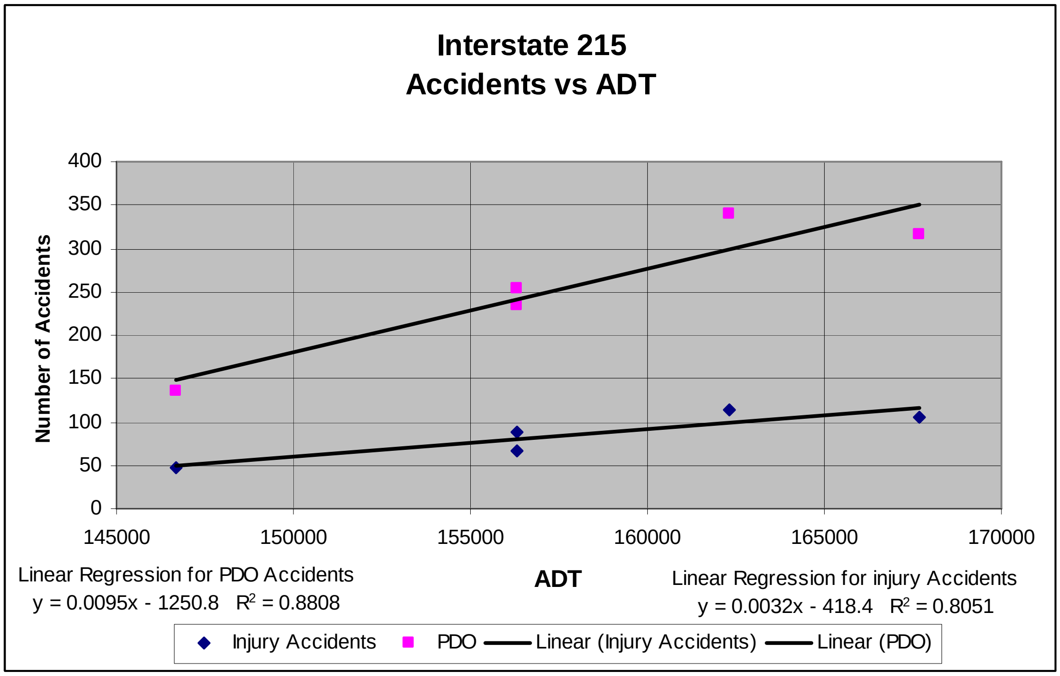
In this benefit-cost analysis, the benefit of the build alternative's reduction in the number of crashes will focus on the anticipated reduction in injury and property damage only accidents and not fatalities. While these improvements are just as likely to reduce the number of fatalities as other types of crashes, the limited number fatalities in the available data limited the analysis.

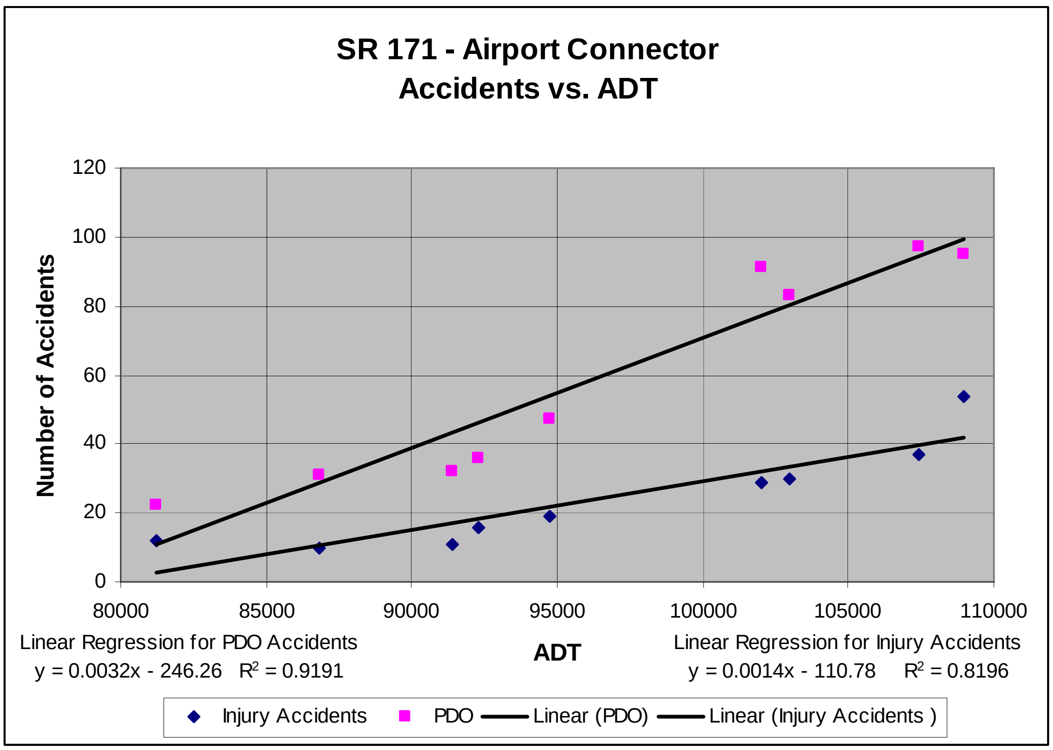
Accident data for I-215 and the Airport Connector was obtained from NDOT. This data is summarized in table B-8 below. This table also includes average daily traffic (ADT) volumes from NDOT by year for each roadway. I-215 ADTs are an average of count stations 129, 131 and 959 which are located within the project limits. ADT data for the Airport Connector was taken from station 887.

Table B-8 - I-215 and Airport Connector Accident Data

Year	Interstate 215					SR 171 - Airport Connector				
	ADT	Fatality	Injury Crash	Injuries	PDO	ADT	Fatality	Injury Crash	Injuries	PDO
2000						86,800	0	10	13	31
2001						81,200	0	12	14	22
2002						91,400	0	11	12	32
2003						92,300	0	16	23	36
2004	146,667	1	47	64	136	94,750	1	19	25	47
2005	156,333	0	89	113	253	103,000	0	30	40	83
2006	162,333	1	114	154	339	107,400	1	37	40	97
2007	167,333	0	106	149	317	109,000	0	54	74	95
2008	156,333	0	66	87	235	102,000	1	29	34	91

The upward trend in the accident rate for property damage only (PDO) and injury crashes as compared to ADT for the I-215 and the Airport Connector is shown in the following figures. These figures also show that there is a strong linear relationship between the crash rate and average daily traffic. This relationship was used to predict the accident rate on I-215 and the Airport Connector as traffic volumes increase. Table 10, below, shows the predicted accident rates and reduction in crashes due to the project's CRFs. These tables show only the predicted crashes and crash reductions. It should be noted that the average number of injuries per injury crash is 1.32. This injury factor is applied to the cost of injury accidents.





The average value for each PDO and injury accident was derived from 2003 data available from the California Life Cycle Benefit Model. These per accident costs were inflated to 2009, present day dollars by applying a 2.4% annual inflation factor. The savings in crash related costs, over the 20-year analytic time horizon used for this benefit-cost analysis, are $194.71 million. A summary of the benefits due to the predicted reductions in crashes is shown in table 9 below.

Table 9 – Summary of Crash Reduction Benefits

Accident Type	Location		Total	Average Injury rate	Cost per Accident		Cost
	I-215	AC			2003	2009*	
PDO	3197	413	3610		$ 7,198	$ 8,299	$ 29,958,412
Injury	1089	174	1263	1.32	$ 85,716	$ 98,824	$ 164,755,119
						Total Benefit	**$ 194,713,531**

* 2.4% per year increase

Table 10 - Predicted Crash Rate and Crash Reduction

Year	Interstate 215					Airport Connector				
	Average ADT	Injury Crash	PDO Crash	Reduction (20% CRF)		Average ADT	Injury Crash	PDO Crash	Reduction (20% CRF)	
				Injury	PDO				Injury	PDO
2004	146,667	51	143			94,395	21	56		
2005	149,857	61	173			96,537	24	63		
2006	153,118	72	204			98,728	27	70		
2007	156,452	82	235			100,968	31	77		
2008	159,861	93	268			103,260	34	84		
2009	163,346	104	301			105,603	37	92		
2010	166,908	116	335			108,000	40	99		
2011	170,551	127	369			110,451	44	107		
2012	174,274	139	405	28	81	112,958	47	115	5	12
2013	178,082	151	441	30	88	115,521	51	123	5	12
2014	181,974	164	478	33	96	118,143	55	132	5	13
2015	185,954	177	516	35	103	120,824	58	140	6	14
2016	190,023	190	554	38	111	123,566	62	149	6	15
2017	194,183	203	594	41	119	126,371	66	158	7	16
2018	198,437	217	634	43	127	129,238	70	167	7	17
2019	202,786	231	676	46	135	132,171	74	177	7	18
2020	207,232	245	718	49	144	135,171	78	186	8	19
2021	211,779	259	761	52	152	138,239	83	196	8	20
2022	216,428	274	805	55	161	141,376	87	206	9	21
2023	221,182	289	850	58	170	144,585	92	216	9	22
2024	226,042	305	897	61	179	147,866	96	227	10	23
2025	231,013	321	944	64	189	151,222	101	238	10	24
2026	236,095	337	992	67	198	154,654	106	249	11	25
2027	241,291	354	1,041	71	208	158,163	111	260	11	26
2028	246,605	371	1,092	74	218	161,753	116	271	12	27
2029	252,039	388	1,144	78	229	165,424	121	283	12	28
2030	257,595	406	1,196	81	239	169,178	126	295	13	30
2031	263,152	424	1,249	85	250	172,932	131	307	13	31
Reduction of Accidents on I-215				**1,089**	**3,197**	**Reduction of Accidents on the Airport Connector**			**174**	**413**

BENEFIT-COST ANALYSIS

Motor Vehicle Emissions and Costs

The RTC ran the TDM and emissions calculation models for the Airport Connector Interchange project for the 2032 build and no-build alternatives. This analysis showed a reduction in the quantity of Ozone emissions, no change to PM_{10} and an increase in the CO emissions. These changes are summarized in the table below. The relationship between CO emissions and vehicle speeds is convex. The vertex of the CO emissions curve is at a speed of 55mph per the model used by the RTC, where traffic speeds above 55 mph result in an increased rate of CO emissions. Even with this increase in CO emissions for the year 2032, the total CO emissions for the Las Vegas Valley are 457 tons per day and are far below the budget of 817 tons per day. Table 11 summarizes these results.

Table 11 - 2032 Horizon Year Emissions for TDF Modeling Area

Emission	Build (tons/day)	No-build (tons/day)	Change (tons/day)	
NOx	15.47	15.50	0.03	Reduction
VOC	40.75	40.86	0.11	Reduction
CO	457.18	456.48	0.70	Increase
PM_{10}	107.5	107.5	0.00	*No Change

* PM10 will be reduced by 0.075 kg/day.

Monetary values for emissions rate were taken from the NATSA report. Reported values were for 2006. These values were increased by 2.4% annually to estimate the present day, 2009, unit costs. This information is presented in table 12 below.

Table 12 – Emissions Unit Costs per Ton

Year	NOx	VOC	CO*	PM10
2006	$ 3,900.00	$ 1,700.00	$ 36.26	$ 164,000.00
2009**	$ 4,187.59	$ 1,825.36	$ 38.94	$ 176,093.66

*CO emissions Cost $ 33.00 per metric ton, there are 0.91 tons per metric ton.
** NATSA Report uses 2.4% annual increase in CO2 damage costs. This same cost factor is applied to all other emissions.

Table 13 shows the estimated project benefits due to the reduction of emissions. The daily emission rates have been prorated back to 2003, the base year of the analysis and the total tons of emissions have been calculated for the 20-year analytic horizon. The estimated value of emissions reductions over this 20 year period is $1.36 million.

BENEFIT-COST ANALYSIS

Table 13 – Emissions Reduction

Year	NOx Ton/day	VOC Ton/day	CO Ton/day	PM10 kg/day
2032	0.030	0.106	-0.703	0.075
2031	**0.029**	**0.102**	**-0.679**	**0.072**
2030	**0.028**	**0.099**	**-0.655**	**0.070**
2029	**0.027**	**0.095**	**-0.630**	**0.067**
2028	**0.026**	**0.091**	**-0.606**	**0.065**
2027	**0.025**	**0.088**	**-0.582**	**0.062**
2026	**0.024**	**0.084**	**-0.558**	**0.059**
2025	**0.023**	**0.080**	**-0.533**	**0.057**
2024	**0.022**	**0.077**	**-0.509**	**0.054**
2023	**0.021**	**0.073**	**-0.485**	**0.052**
2022	**0.020**	**0.069**	**-0.461**	**0.049**
2021	**0.019**	**0.066**	**-0.436**	**0.047**
2020	**0.018**	**0.062**	**-0.412**	**0.044**
2019	**0.017**	**0.058**	**-0.388**	**0.041**
2018	**0.016**	**0.055**	**-0.364**	**0.039**
2017	**0.014**	**0.051**	**-0.339**	**0.036**
2016	**0.013**	**0.048**	**-0.315**	**0.034**
2015	**0.012**	**0.044**	**-0.291**	**0.031**
2014	**0.011**	**0.040**	**-0.267**	**0.028**
2013	**0.010**	**0.037**	**-0.242**	**0.026**
2012	**0.009**	**0.033**	**-0.218**	**0.023**
2011	0.008	0.029	-0.194	0.021
2010	0.007	0.026	-0.170	0.018
2009	0.006	0.022	-0.145	0.016
2008	0.005	0.018	-0.121	0.013
2007	0.004	0.015	-0.097	0.010
2006	0.003	0.011	-0.073	0.008
2005	0.002	0.007	-0.048	0.005
2004	0.001	0.004	-0.024	0.003
2003	0.000	0.000	0.000	0.000
Total (2012 to 2031)	**0.383**	**1.352**	**-8.969**	0.957
	Total PM10 Tons/day (907.1847 kg/ton)			**0.0011**
Yearly (Tons)	**139.71**	**493.63**	**-3273.80**	**0.39**
Cost Per Ton	**$ 4,187.59**	**$ 1,825.36**	**$ 38.94**	**$ 176,093.66**
Savings	**$ 585,035.64**	**$ 901,054.89**	**$ (127,474.80)**	***$ 67,796.28**

* PM10 savings is discounted due to minimal daily savings.

C. SUMMARY OF BENEFITS

The build alternative will produce a net savings in travel time, fuel, crashes and emissions when compared to the no-build alternative. Collectively, these benefits will amount to $147.49 million annually by the year 2031. The present day, 2009, value of these benefits for the 20-year time horizon is estimated to be $ 475.82 million. The cost of the improvements is estimated to be $169.20 million dollars. Monetized to 2009 dollars using a 7% discount rate, the present day value of the improvements is $154.28 million. A summary of the build alternative benefits and costs is in table C-1 below. The life cycle benefits and costs are shown in table C-2. The present year benefit-cost ratio is 3.08. The payback period, using the 7% discount rate is 12 years.

Table C-2 – Present Year (2009) Benefit Cost Summary

Build Alternative Capitol Costs	**$154,270,000.00**
Project Benefits	
Travel Time Savings	$ 286,520,000
Fuel Cost Savings	$ 6,450,000
Non-fuel operating costs	$ (11,890,000)
Accident Costs Savings	$ 194,710,000
Revenue Transfers	$ (1,330,000)
Emissions	
NOx	$ 590,000
VOC	$ 900,000
CO	$ (130,000)
Total Benefits	**$ 475,820,000**
Benefit-Costs Ratio	**3.08**

BENEFIT-COST ANALYSIS

Table C-1 – Life Cycle Benefits and Costs

Year	Total Benefits	Total Costs	Net Present Value	Net Present Value Benefits	Net Present Value Costs.
2003		$250,000	1.501		$375,183
2004		$600,000	1.403		$841,531
2005		$150,000	1.311		$196,619
2006		$2,500,000	1.225		$3,062,608
2007		$2,730,000	1.145		$3,125,577
2008		$2,730,000	1.070		$2,921,100
2009		$3,920,000	1.000		$3,920,000
2010		$65,860,000	0.935		$61,551,402
2011		$77,530,000	0.873		$67,717,705
2012	$ 14,595,404	$12,930,000	0.816	$ 11,914,198	$10,554,732
2013	$ 17,031,071		0.763	$ 12,992,923	
2014	$ 19,942,452		0.713	$ 14,218,692	
2015	$ 23,165,519		0.666	$ 15,436,163	
2016	$ 26,755,424		0.623	$ 16,661,933	
2017	$ 30,958,537		0.582	$ 18,018,151	
2018	$ 35,139,340		0.544	$ 19,113,473	
2019	$ 40,010,369		0.508	$ 20,339,243	
2020	$ 45,683,199		0.475	$ 21,703,759	
2021	$ 51,641,691		0.444	$ 22,929,529	
2022	$ 58,544,882		0.415	$ 24,294,045	
2023	$ 65,825,111		0.388	$ 25,528,113	
2024	$ 74,197,612		0.362	$ 26,892,629	
2025	$ 83,059,116		0.339	$ 28,134,996	
2026	$ 93,183,508		0.317	$ 29,499,512	
2027	$ 104,346,374		0.296	$ 30,872,327	
2028	$ 116,615,443		0.277	$ 32,245,142	
2029	$ 130,122,997		0.258	$ 33,626,255	
2030	$ 144,950,193		0.242	$ 35,007,369	
2031	$ 161,215,594		0.226	$ 36,388,482	
Total	**$1,336,983,837**	**$169,200,000**		**$ 475,816,933**	**$154,266,456**