Improved US 70 with Railroad Grade Separation (Highway Overpass)
Valliant, Oklahoma

TIGER III Grant Application
Benefit Cost Analysis Technical Memo

October 31, 2011

The formal benefit-cost analysis (BCA) was conducted for this project using best practices for BCA in transportation planning, and reflecting all TIGER III grant application guidelines. As noted in the application, it is important to note that a formal BCA is not a comprehensive measure of a project's total economic impact, as many benefits cannot be readily quantified or occur under conditions of uncertainty. This broader set of economic benefits and impacts on local and regional economic well-being and competitiveness are described in other sections of the application, particularly section IV.A.ii Economic Competitiveness.

To the maximum extent possible given the available data, the formal BCA prepared in connection with this TIGER grant application reflects quantifiable economic benefits. It covers all five of the primary long-term impact areas identified in the TIGER grant application guidelines:

- State of Good Repair: As US 70 traffic crosses over the Texas Oklahoma & Eastern (TO&E) railroad, damage is caused that requires thousands of dollars annually to repair. This damage will be eliminated by the project, as will TO&E's cost to operate the safety equipment at the crossing. Highway maintenance cost impacts are also calculated in the BCA.
- Economic Competitiveness: Reducing travel times (for highway) and costs (for both rail and highway) will allow local industry and regional forestry and agricultural enterprises to reduce transportation costs, improve their logistics practices, and expand markets for both domestic and international shipments.
- Livability: Reduction of travel times will improve livability for the many individuals in and around Valliant, Oklahoma, who rely on this road for their daily commute, as well as for trips for education, shopping, medical appointments, and other services.
- Environmental Sustainability: Reducing idling at the rail crossings as cars and trucks wait for a train to pass will reduce fuel consumption and vehicle emissions.
- Safety: The current configuration of the road leads to a substantial number of accidents each year. With no center turn lane, high traffic levels for a two-lane road, and an at-grade intersection with a railroad, collisions are quite prevalent. All of these issues will be removed with the project, which will substantially reduce the potential for accidents and injuries.

Given the limitations described above, the computed benefit-cost ratio for the Valliant project is 3.49 to 1.0 using a three percent discount rate, and 1.94 to 1.0 using a discount rate of seven percent. The cost-benefit analysis compares the project's capital and maintenance costs to the quantifiable benefits of the project for a period of 40 years after construction.

The quantified project benefits are:

1. Avoided No Build highway maintenance costs
2. Rail maintenance cost savings
3. Travel time savings for vehicles
4. Fuel cost savings for vehicles
5. Emissions reduction benefits from reduced vehicle idling at grade crossings
6. Safety benefits (reduced vehicle crashes)

Discount Rates

Federal TIGER guidance recommends[1] that applicants discount future benefits and costs to 2011 present values using a real discount rate of seven percent to represent the opportunity cost of money in the private sector. TIGER guidance also allows for an alternate present value analysis using a three percent discount rate when the funds currently dedicated to the project would be other public expenditures. This is the case for this project, which would be 100% publicly funded.

Cost Benefit Results

Table BCA-1 summarizes the cost and the quantifiable benefits of the project in terms of Present Value. As shown in the table, the present value of the project's capital and maintenance costs is valued at $42.5 million using a 3% discount rate and $37.9 million using a 7% discount rate. The benefits have an estimated present value of $105.9 million at a 3% discount rate and $35.7 million at a 7% discount rate, yielding benefit-cost ratios of 3.49 and 1.94, respectively.

[1] Source: TIGER Notice of Funding Availability (Federal Register/Vol 76. No. 156, 8/12/2011):
Applicants should discount future benefits and costs to present values using a real discount rate (i.e., a discount rate that reflects the opportunity cost of money net of the rate of inflation) of 7 percent, following guidance provided by OMB in Circulars A–4 and A– 94 (http://www.whitehouse.gov/omb/ circulars_default/). Applicants may also provide an alternative analysis using a real discount rate of 3 percent. The latter approach should be used when the alternative use of funds currently dedicated to the project would be other public expenditures, rather than private investment.

Table BCA-1: Benefit Cost Analysis Summary Table
Figures in thousands of 2011$, discounted to 2011

Category	Present Value at 3%	Present Value at 7%
Costs		
Construction Cost	$40,884	$37,377
Maintenance Costs (Highway Build)	$1,593	$557
TOTAL COSTS	**$42,477**	**$37,934**
Evaluated Benefits		
Maintenance Costs Avoided (Highway No Build)	$1,499	$1,040
Rail Maintenance Cost Savings	$472	$239
Vehicle Travel Time Savings	$127,745	$63,503
Vehicle Fuel Cost Savings	$7,771	$3,757
Emissions Savings	$3,567	$1,529
Safety Benefits	$7,345	$3,615
TOTAL EVALUATED BENEFITS	**$148,399**	**$73,683**
NET PRESENT VALUE	**$105,922**	**$35,749**
BENEFIT/COST RATIO	**3.49**	**1.94**

Benefit Calculation Assumptions
The benefits of the project are derived by comparing conditions under a Build and No Build scenario. These two scenarios are defined as follows:

No Build
Under the No Build, US 70 would remain in its current configuration through Valliant, at 2 to 4 lanes with an at-grade railroad crossing. Major rehabilitation would be required in the near future (2012).

Build
The proposed project will improve five and one-half miles of US 70, replacing the current (predominantly) two-lane facility with a five-lane facility consisting of four through lanes and a center turn lane. It will include a bridge elevating US 70 over the TO&E railroad and its related switching operation in Valliant, Oklahoma. The project will incorporate sidewalks and a bike path, and three enhanced pedestrian crossings.

Traffic
Traffic projections for US 70 through Valliant with and without the project were completed in September 2011, examining the effect on traffic of the railroad overpass and the additional lanes. In addition to the background traffic growth, the project is expected to attract an additional 5% induced traffic demand, and reduce the number of vehicles using the south bypass (NS 445). This additional traffic is due to the project's center turn lane and the overpass removing the substantial delay factors along this road. The induced growth is assumed to come from two sources:

1. Local and regional trips that would not be made in the No Build due to drivers' reluctance to risk delays on US 70 as it exists now.
2. Diversions from other east-west routes, such as the sometimes-congested I-40 or State Route 3.

The resulting traffic flows were input into a traffic modeling program to determine likely travel time savings over the course of a day, given the typical rail delays:

Rail Delay at TO&E Crossing of US 70

Time of Day	Duration
10:00 AM	10 minutes
2:00 PM	10 minutes
10:00 PM	10 minutes
Midnight	15 minutes
2:00 AM	two 10-mnute blockages

In addition, there are an average of two other crossings per day at 10 minutes each, times vary. Further occasional switching activity may require blocking US 70 for up to an hour at a time.

The results of the traffic modeling were annualized and are attached in Appendix A, and summarized in **Table BCA-2**.

Changes in vehicle miles traveled (VMT) were also analyzed because it was expected that substantially fewer vehicles would use the "south bypass" around the TO&E rail grade crossing on NS 445 once the project was completed – a route that is 2.7 miles longer than traveling along US 70 through Valliant. The results of this analysis for 2012 and 2035 are presented in Appendix B. As it shows, while there is some VMT savings in the early years (152,570 VMT annually), as traffic continues to grow, the additional VMT added with the induced traffic overwhelms the comparatively small VMT saved with the reduced bypass usage. In 2035, the annual VMT for the Build scenario is actually 93,331 miles higher than in the No Build.

Table BCA-2: Travel Time Savings

Scenario	Total Network Travel Time (hours annually)	Difference (hours annually)
2012 No Build	388,776	
2012 Build	123,853	201,558
2035 No Build	510,647	
2035 Build	175,126	335,521

Highway Maintenance

No Build

US 70 is overdue for a major rehabilitation, so it is assumed that without the project an $840,480 rehabilitation would take place. Regular preservation under the No Build scenario would take place every seven years at a cost of $79,104. In 2040 the cycle would begin again, with an $840,480 reconstruction followed by regular maintenance (assumed to be $79,104 divided evenly over seven years).

Build

The project would be built between 2012 and 2015, during which no maintenance work is expected. Regular preservation would continue to take place in a seven-year cycle, as with the No Build, but the first year of the cycle would be 2021, seven years after construction is completed. The cost of regular preservation work would be higher than in the No Build ($197,760), as there would be a much larger roadway surface to maintain because of the widening. In addition, the bridge structure over the railroad would require $30,000 in maintenance in 2034, and a further $50,000 in 2051.

As with any road, major rehabilitation would be needed after a few decades. The presumed year for the Build scenario is 2042, and the cost, again, would be larger, at $2.1 million in 2011$.

These costs are shown in **Table BCA-3**. As with the out-years for the No Build, maintenance after 2042 for the Build is assumed to be the cost of the seven-year preservation treatment divided by seven.

Table BCA-3: Highway Maintenance Costs, Build vs. No Build

Year	No-Build			Build				
	Maintenance Costs Highway	Present Value at 3%	Present Value at 7%	Maintenance Costs Highway	Maintenance Costs Biridge	Maintenance Costs TOTAL	Present Value at 3%	Present Value at 7%
2012	$840,480	$816,000	$785,495			$0	$0	$0
2013		$0	$0			$0	$0	$0
2014		$0	$0			$0	$0	$0
2015		$0	$0			$0	$0	$0
2016		$0	$0			$0	$0	$0
2017		$0	$0			$0	$0	$0
2018		$0	$0			$0	$0	$0
2019	$79,104	$62,445	$46,039			$0	$0	$0
2020		$0	$0			$0	$0	$0
2021		$0	$0	$197,760		$197,760	$147,152	$100,531
2022		$0	$0			$0	$0	$0
2023		$0	$0			$0	$0	$0
2024		$0	$0			$0	$0	$0
2025		$0	$0			$0	$0	$0
2026	$79,104	$50,774	$28,671			$0	$0	$0
2027		$0	$0			$0	$0	$0
2028		$0	$0	$197,760		$197,760	$119,648	$62,606
2029		$0	$0			$0	$0	$0
2030		$0	$0			$0	$0	$0
2031		$0	$0			$0	$0	$0
2032		$0	$0			$0	$0	$0
2033	$79,104	$41,284	$17,855			$0	$0	$0
2034		$0	$0		$30,000	$30,000	$15,201	$6,328
2035		$0	$0	$197,760		$197,760	$97,285	$38,988
2036		$0	$0			$0	$0	$0
2037		$0	$0			$0	$0	$0
2038		$0	$0			$0	$0	$0
2039		$0	$0			$0	$0	$0
2040	$840,480	$356,655	$118,140			$0	$0	$0
2041	$35,926	$14,801	$4,720			$0	$0	$0
2042	$35,926	$14,370	$4,411	$2,101,200		$2,101,200	$840,453	$257,971
2043	$35,926	$13,952	$4,122	$89,816		$89,816	$34,879	$10,306
2044	$35,926	$13,545	$3,853	$89,816		$89,816	$33,863	$9,631
2045	$35,926	$13,151	$3,601	$89,816		$89,816	$32,877	$9,001
2046	$35,926	$12,768	$3,365	$89,816		$89,816	$31,919	$8,412
2047	$35,926	$12,396	$3,145	$89,816		$89,816	$30,989	$7,862
2048	$35,926	$12,035	$2,939	$89,816		$89,816	$30,087	$7,348
2049	$35,926	$11,684	$2,747	$89,816		$89,816	$29,211	$6,867
2050	$35,926	$11,344	$2,567	$89,816		$89,816	$28,360	$6,418
2051	$35,926	$11,013	$2,399	$89,816	$50,000	$139,816	$42,862	$9,337
2052	$35,926	$10,693	$2,242	$89,816		$89,816	$26,732	$5,606
2053	$35,926	$10,381	$2,096	$89,816		$89,816	$25,953	$5,239
2054	$35,926	$10,079	$1,958	$89,816		$89,816	$25,197	$4,896
TOTAL	**$2,421,242**	**$1,499,369**	**$1,040,364**	**$3,772,272**	**$80,000**	**$3,852,272**	**$1,592,667**	**$557,347**

Source: Oklahoma Department of Transportation.

Interestingly, the net savings is negative (an additional cost) using the 3% discount rate, and positive (a net savings) using the 7% discount rate. The difference is largely due to the higher discount rate placing more value on the early-year maintenance savings, and placing less emphasis on the higher out-year preservation costs.

Rail Maintenance
Rail maintenance costs were developed in cooperation with the TO&E railroad, and include the following components:

Table BCA-4: Rail Maintenance Costs

Rail Maintenance Component	**Cost/Schedule**
Signal operations	$8,600/year
Crossing repair (replacement of missing gate arms)	$7,200/year
Crossing Surface Maintenance (major)	$31,000 every six years ($5,167 annual average cost)
Surface Maintenance (annual)	$1,500/year
Total Average Annual Cost	**$22,467**

Source: TO&E Railroad, 2011

These costs were discounted to 2011 present values, after a $10 annual track maintenance cost was subtracted out to account for the Build rail maintenance costs (**Table BCA-5**).

Overall, using a discount rate of 3%, the rail maintenance savings is $472,000 over the analysis period, enough to outweigh the additional highway costs using a 3% discount rate. With a 7% discount rate, the present value of the savings is $239,000.

Table BCA-5: Rail Maintenance Cost Savings

Year	No Build				Build	Net Rail Maintenance Savings (Build vs. No Build)	Present Value at 3%	Present Value at 7%
	Signal Operations	Crossing Repair	Major Crossing Surface Maint	NO BUILD Annual Surface Maintenance	Track Maintenance Costs			
2012						-	$0	$0
2013						-	$0	$0
2014						-	$0	$0
2015	8,600	7,200		1,500	10	17,290	$15,362	$13,190
2016	8,600	7,200		1,500	10	17,290	$14,915	$12,328
2017	8,600	7,200		1,500	10	17,290	$14,480	$11,521
2018	8,600	7,200		1,500	10	17,290	$14,058	$10,767
2019	8,600	7,200	31,000	1,500	10	48,290	$38,121	$28,105
2020	8,600	7,200		1,500	10	17,290	$13,251	$9,405
2021	8,600	7,200		1,500	10	17,290	$12,865	$8,789
2022	8,600	7,200		1,500	10	17,290	$12,491	$8,214
2023	8,600	7,200		1,500	10	17,290	$12,127	$7,677
2024	8,600	7,200		1,500	10	17,290	$11,774	$7,175
2025	8,600	7,200	31,000	1,500	10	48,290	$31,925	$18,728
2026	8,600	7,200		1,500	10	17,290	$11,098	$6,267
2027	8,600	7,200		1,500	10	17,290	$10,775	$5,857
2028	8,600	7,200		1,500	10	17,290	$10,461	$5,474
2029	8,600	7,200		1,500	10	17,290	$10,156	$5,115
2030	8,600	7,200		1,500	10	17,290	$9,860	$4,781
2031	8,600	7,200	31,000	1,500	10	48,290	$26,737	$12,479
2032	8,600	7,200		1,500	10	17,290	$9,294	$4,176
2033	8,600	7,200		1,500	10	17,290	$9,024	$3,903
2034	8,600	7,200		1,500	10	17,290	$8,761	$3,647
2035	8,600	7,200		1,500	10	17,290	$8,506	$3,409
2036	8,600	7,200		1,500	10	17,290	$8,258	$3,186
2037	8,600	7,200	31,000	1,500	10	48,290	$22,392	$8,315
2038	8,600	7,200		1,500	10	17,290	$7,784	$2,782
2039	8,600	7,200		1,500	10	17,290	$7,557	$2,600
2040	8,600	7,200		1,500	10	17,290	$7,337	$2,430
2041	8,600	7,200		1,500	10	17,290	$7,123	$2,271
2042	8,600	7,200		1,500	10	17,290	$6,916	$2,123
2043	8,600	7,200	31,000	1,500	10	48,290	$18,753	$5,541
2044	8,600	7,200		1,500	10	17,290	$6,519	$1,854
2045	8,600	7,200		1,500	10	17,290	$6,329	$1,733
2046	8,600	7,200		1,500	10	17,290	$6,145	$1,619
2047	8,600	7,200		1,500	10	17,290	$5,966	$1,513
2048	8,600	7,200		1,500	10	17,290	$5,792	$1,414
2049	8,600	7,200	31,000	1,500	10	48,290	$15,705	$3,692
2050	8,600	7,200	5,167	1,500	10	22,457	$7,091	$1,605
2051	8,600	7,200	5,167	1,500	10	22,457	$6,884	$1,500
2052	8,600	7,200	5,167	1,500	10	22,457	$6,684	$1,402
2053	8,600	7,200	5,167	1,500	10	22,457	$6,489	$1,310
2054	8,600	7,200	5,167	1,500	10	22,457	$6,300	$1,224

Source: TO&E Railroad, 2011.

Vehicle Travel Time Savings

Travel time savings from the project will result from two factors:

1. Removal of grade crossing – Trains block US 70 on the TO&E track for an average of over 40 hours each month (more than one hour a day). Usually the blockages are 10-15 minute each, but sometimes are longer.
2. The addition of a center turn lane – Homes and businesses line both sides of US 70 through the project area, and turning movements to and from US 70 frequently delay traffic, particularly in the two-lane sections of the road.

The data in **Table BCA-2** was used to develop travel time savings for each of the years between 2012 and 2035. Straight-line percentage growth was assumed, using 1.03% annual growth. After 2035, it was assumed that traffic levels would remain constant. Because the project is not scheduled to be built until April 2015, any project benefits for 2011-2014 are zeroed out, and 2015 benefits are assumed to be 75% of the whole-year amounts.

Traffic Composition

Heavy truck traffic is 15% of the traffic flow in all years. The remaining traffic is assumed to be 53% work-related, and 32% personal travel.

Value of Travel Time

Travel time was valued using the time values recommended in the TIGER website guidance (http://www.dot.gov/tiger/application-resources.html):

- The hourly rate of time for trucks is $23.70
- The hourly rate of time for auto business trips is $22.90
- The hourly rate of time for personal auto trips is $12.00

Table BCA-6 shows the calculation of the value of travel time based on the above assumptions. The present value of auto travel time savings from 2015 (the opening year) to 2054 is $127.7 million using a 3% discount rate, and $63.5 million using a 7% discount rate.

Table BCA-6: Travel Time Savings

Year	ANNUAL Travel Time Saved (All Vehicles)	PERSONAL Auto Travel Time Saved	BUSINESS Auto Travel Time Saved	TRUCK Travel Time Saved	Value of PERSONAL Auto Travel Time Savings	Value of BUSINESS Auto Travel Time Savings	Value of TRUCK Travel Time Saved	Total Value of Travel Time Savings	Present Value at 3%	Present Value at 7%
	in hours	in hours	in hours	in hours	at $12/hr	at $22.90/hr	at $23.70/hr	in 2011 $	in 2011 $	in 2011 $
2012	0	0	0	0	$ -	$ -	$ -	$ -	$0	$0
2013	0	0	0	0	$ -	$ -	$ -	$ -	$0	$0
2014	0	0	0	0	$ -	$ -	$ -	$ -	$0	$0
2015	204,910	65,315	108,858	30,737	$ 783,781	$ 2,492,859	$ 728,455	$ 4,005,094	$3,558,475	$3,055,467
2016	276,034	87,986	146,643	41,405	$ 1,055,831	$ 3,358,128	$ 981,301	$ 5,395,260	$4,653,999	$3,846,746
2017	278,884	88,894	148,157	41,833	$ 1,066,732	$ 3,392,799	$ 991,433	$ 5,450,964	$4,565,096	$3,632,207
2018	281,763	89,812	149,687	42,265	$ 1,077,745	$ 3,427,828	$ 1,001,669	$ 5,507,242	$4,477,892	$3,429,634
2019	284,672	90,739	151,232	42,701	$ 1,088,872	$ 3,463,219	$ 1,012,011	$ 5,564,102	$4,392,353	$3,238,358
2020	287,612	91,676	152,794	43,142	$ 1,100,114	$ 3,498,975	$ 1,022,459	$ 5,621,548	$4,308,449	$3,057,750
2021	290,581	92,623	154,371	43,587	$ 1,111,472	$ 3,535,100	$ 1,033,016	$ 5,679,588	$4,226,147	$2,887,215
2022	293,581	93,579	155,965	44,037	$ 1,122,948	$ 3,571,598	$ 1,043,681	$ 5,738,227	$4,145,417	$2,726,190
2023	296,612	94,545	157,575	44,492	$ 1,134,542	$ 3,608,473	$ 1,054,456	$ 5,797,471	$4,066,230	$2,574,147
2024	299,675	95,521	159,202	44,951	$ 1,146,255	$ 3,645,729	$ 1,065,343	$ 5,857,327	$3,988,555	$2,430,583
2025	302,769	96,507	160,846	45,415	$ 1,158,090	$ 3,683,369	$ 1,076,342	$ 5,917,801	$3,912,364	$2,295,025
2026	305,895	97,504	162,506	45,884	$ 1,170,047	$ 3,721,398	$ 1,087,455	$ 5,978,900	$3,837,628	$2,167,028
2027	309,053	98,511	164,184	46,358	$ 1,182,127	$ 3,759,820	$ 1,098,682	$ 6,040,629	$3,764,320	$2,046,170
2028	312,244	99,528	165,879	46,837	$ 1,194,332	$ 3,798,638	$ 1,110,026	$ 6,102,996	$3,692,413	$1,932,052
2029	315,467	100,555	167,592	47,320	$ 1,206,663	$ 3,837,857	$ 1,121,486	$ 6,166,006	$3,621,879	$1,824,299
2030	318,724	101,593	169,322	47,809	$ 1,219,121	$ 3,877,481	$ 1,133,065	$ 6,229,667	$3,552,692	$1,722,555
2031	322,015	102,642	171,070	48,302	$ 1,231,708	$ 3,917,514	$ 1,144,763	$ 6,293,985	$3,484,827	$1,626,485
2032	325,340	103,702	172,837	48,801	$ 1,244,424	$ 3,957,961	$ 1,156,583	$ 6,358,967	$3,418,258	$1,535,774
2033	328,699	104,773	174,621	49,305	$ 1,257,272	$ 3,998,825	$ 1,168,524	$ 6,424,621	$3,352,961	$1,450,121
2034	332,092	105,854	176,424	49,814	$ 1,270,253	$ 4,040,111	$ 1,180,588	$ 6,490,952	$3,288,912	$1,369,246
2035	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$3,226,086	$1,292,881
2036	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$3,132,122	$1,208,300
2037	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$3,040,895	$1,129,252
2038	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$2,952,325	$1,055,376
2039	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$2,866,335	$986,333
2040	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$2,782,850	$921,806
2041	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$2,701,796	$861,501
2042	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$2,623,103	$805,141
2043	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$2,546,702	$752,469
2044	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$2,472,526	$703,242
2045	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$2,400,511	$657,235
2046	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$2,330,593	$614,239
2047	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$2,262,711	$574,055
2048	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$2,196,807	$536,500
2049	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$2,132,823	$501,402
2050	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$2,070,702	$468,600
2051	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$2,010,390	$437,944
2052	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$1,951,835	$409,293
2053	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$1,894,985	$382,517
2054	335,521	106,947	178,246	50,328	$ 1,283,368	$ 4,081,823	$ 1,192,777	$ 6,557,968	$1,839,791	$357,492
	12,677,042	4,040,807	6,734,678	1,901,556	48,489,684	154,224,134	45,066,883	**$247,780,700**	**$127,744,753**	**$63,502,629**

Vehicle Fuel Cost Savings

In addition to travel time savings, vehicle operators will benefit from the reduced fuel usage due to reduced delay and less time spent idling at rail crossings. The fuel savings were calculated using a conservative assumption that 70 percent of the travel time savings shown in Table **BCA-6** was due to idling. (The remaining 30% was assumed to come from delays related to the lack of a center turning lane, or decelerating or accelerating after a train has passed.)

Based on a number of sources[2], it was assumed that most vehicles use 0.4 gallons of gasoline per hour while idling, and 0.6 gallons of diesel fuel are used per hour while trucks are idling.

As shown in Table **BCA-7**, calculations show that an estimated 3.8 million gallons of gasoline would be saved during the 40-year analysis period.

The potential fuel savings from changes in VMT were also analyzed, as shown in **Table BCA-8**. The project would result in some additional fuel savings in the early years from reduced VMT, but this was balanced out by the increased fuel usage resulting from the induced travel on US 70 in years after 2026. The net result is an additional 50,000 gallons of fuel used over 40 years.

The combined value of the fuel use changes due to idling and those resulting from changes in VMT are shown in **Table BCA-9**, using per-gallon fuel cost projections from the Energy Information Administration[3]. Overall, 3.8 million gallons of fuel would be saved over the 40-year analysis period, with a resulting present value of $7.8 million using a 3% discount rate and $3.8 million using a 7% discount rate.

[2] Estimation of Fuel Use by Idling Commercial Trucks by Gaines, Vyas & Anderson, 2006, http://www.transportation.anl.gov/pdfs/TA/373.pdf
Hamilton County Department of Environmental Services (Cincinnati OH) http://www.hcdoes.org/airquality/anti-idling/idlefaq.htm
Fueleconomy.gov http://fueleconomy.gov/feg/driveHabits.shtml
Anti-Idling Primer: Every minute counts, Hinckle Charitable Foundation, http://www.thehcf.org/antiidlingprimer.html .

[3] Fuel costs are from the Energy Information Agency's December 2009 *Annual Energy Outlook 2010*, updated to 2011 dollars using the BLS inflation calculator, http://www.bls.gov/data/inflation_calculator.htm. .

Table BCA-7: Fuel Savings from Reduced Idling

Year	Total Annual Vehicle Time Savings (hours)	Hours of Idling Saved (reduced)	TRUCK Fuel Saved from Idling Reduction	OTHER VEHICLES Fuel Saved from Idling Reduction	Total Fuel Savings from Idling Reduction
			0.6 gals/hr	0.4 gals/hr	gallons/year
2012	-	-	-	-	-
2013	-	-	-	-	-
2014	-	-	-	-	-
2015	204,910	143,437	12,909	48,769	61,678
2016	276,034	193,224	17,390	65,696	83,086
2017	278,884	195,219	17,570	66,374	83,944
2018	281,763	197,234	17,751	67,060	84,811
2019	284,672	199,271	17,934	67,752	85,686
2020	287,612	201,328	18,120	68,452	86,571
2021	290,581	203,407	18,307	69,158	87,465
2022	293,581	205,507	18,496	69,872	88,368
2023	296,612	207,629	18,687	70,594	89,280
2024	299,675	209,772	18,879	71,323	90,202
2025	302,769	211,938	19,074	72,059	91,133
2026	305,895	214,126	19,271	72,803	92,074
2027	309,053	216,337	19,470	73,555	93,025
2028	312,244	218,570	19,671	74,314	93,985
2029	315,467	220,827	19,874	75,081	94,956
2030	318,724	223,107	20,080	75,856	95,936
2031	322,015	225,411	20,287	76,640	96,927
2032	325,340	227,738	20,496	77,431	97,927
2033	328,699	230,089	20,708	78,230	98,938
2034	332,092	232,465	20,922	79,038	99,960
2035	335,521	234,865	21,138	79,854	100,992
2036	335,521	234,865	21,138	79,854	100,992
2037	335,521	234,865	21,138	79,854	100,992
2038	335,521	234,865	21,138	79,854	100,992
2039	335,521	234,865	21,138	79,854	100,992
2040	335,521	234,865	21,138	79,854	100,992
2041	335,521	234,865	21,138	79,854	100,992
2042	335,521	234,865	21,138	79,854	100,992
2043	335,521	234,865	21,138	79,854	100,992
2044	335,521	234,865	21,138	79,854	100,992
2045	335,521	234,865	21,138	79,854	100,992
2046	335,521	234,865	21,138	79,854	100,992
2047	335,521	234,865	21,138	79,854	100,992
2048	335,521	234,865	21,138	79,854	100,992
2049	335,521	234,865	21,138	79,854	100,992
2050	335,521	234,865	21,138	79,854	100,992
2051	335,521	234,865	21,138	79,854	100,992
2052	335,521	234,865	21,138	79,854	100,992
2053	335,521	234,865	21,138	79,854	100,992
2054	335,521	234,865	21,138	79,854	100,992
TOTAL	**12,677,042**	**8,873,929**	**798,654**	**3,017,136**	**3,815,790**

Table BCA-8: Fuel Savings (Use) from Changes in VMT

Year	VMT Savings	Reduced VMT	LARGE TRUCK VMT reduction (growth)	OTHER VEHICLE VMT reduction (growth)	TRUCK mpg	OTHER VEHICLE MPG	TRUCK Gallons saved (used)	OTHER VEHICLE Gallons saved (used)	TOTAL GALLONS SAVED (Additional Gallons Used)
					Source: Energy Information Administration				
2012	152,570	-	-	-	6.1	21.2	-	-	-
2013	141,879	-	-	-	6.1	21.5	-	-	-
2014	131,187	-	-	-	6.1	21.7	-	-	-
2015	120,496	90,372	13,556	76,816	6.1	22.1	2,214	3,482	5,695
2016	109,805	82,353	12,353	70,000	6.1	22.4	2,014	3,124	5,138
2017	99,113	74,335	11,150	63,185	6.1	22.8	1,814	2,774	4,589
2018	88,422	66,316	9,947	56,369	6.2	23.2	1,614	2,435	4,049
2019	77,731	58,298	8,745	49,553	6.2	23.5	1,414	2,107	3,521
2020	67,039	50,279	7,542	42,738	6.2	23.9	1,215	1,790	3,005
2021	56,348	42,261	6,339	35,922	6.2	24.3	1,016	1,480	2,496
2022	45,657	34,242	5,136	29,106	6.3	24.6	819	1,181	2,000
2023	34,965	26,224	3,934	22,290	6.3	25.0	624	891	1,516
2024	24,274	18,205	2,731	15,475	6.3	25.3	431	611	1,042
2025	13,582	10,187	1,528	8,659	6.4	25.7	240	338	578
2026	2,891	2,168	325	1,843	6.4	26.0	51	71	122
2027	(7,800)	(5,850)	(878)	(4,973)	6.4	26.2	(137)	(190)	(326)
2028	(18,492)	(13,869)	(2,080)	(11,788)	6.5	26.5	(322)	(445)	(767)
2029	(29,183)	(21,887)	(3,283)	(18,604)	6.5	26.8	(507)	(695)	(1,202)
2030	(39,874)	(29,906)	(4,486)	(25,420)	6.5	27.0	(690)	(942)	(1,632)
2031	(50,566)	(37,924)	(5,689)	(32,236)	6.5	27.2	(872)	(1,185)	(2,058)
2032	(61,257)	(45,943)	(6,891)	(39,051)	6.5	27.4	(1,053)	(1,426)	(2,479)
2033	(71,948)	(53,961)	(8,094)	(45,867)	6.6	27.6	(1,233)	(1,664)	(2,897)
2034	(82,640)	(61,980)	(9,297)	(52,683)	6.6	27.7	(1,411)	(1,900)	(3,312)
2035	(93,331)	(69,998)	(10,500)	(59,499)	6.6	27.9	(1,589)	(2,134)	(3,723)
2036	(93,331)	(69,998)	(10,500)	(59,499)	6.6	28.2	(1,584)	(2,110)	(3,694)
2037	(93,331)	(69,998)	(10,500)	(59,499)	6.7	28.5	(1,579)	(2,085)	(3,664)
2038	(93,331)	(69,998)	(10,500)	(59,499)	6.7	28.9	(1,574)	(2,061)	(3,635)
2039	(93,331)	(69,998)	(10,500)	(59,499)	6.7	29.2	(1,569)	(2,037)	(3,606)
2040	(93,331)	(69,998)	(10,500)	(59,499)	6.7	29.5	(1,564)	(2,014)	(3,578)
2041	(93,331)	(69,998)	(10,500)	(59,499)	6.7	29.9	(1,559)	(1,991)	(3,550)
2042	(93,331)	(69,998)	(10,500)	(59,499)	6.8	30.2	(1,554)	(1,968)	(3,522)
2043	(93,331)	(69,998)	(10,500)	(59,499)	6.8	30.6	(1,549)	(1,945)	(3,494)
2044	(93,331)	(69,998)	(10,500)	(59,499)	6.8	31.0	(1,544)	(1,922)	(3,467)
2045	(93,331)	(69,998)	(10,500)	(59,499)	6.8	31.3	(1,540)	(1,900)	(3,440)
2046	(93,331)	(69,998)	(10,500)	(59,499)	6.8	31.7	(1,535)	(1,878)	(3,413)
2047	(93,331)	(69,998)	(10,500)	(59,499)	6.9	32.0	(1,530)	(1,856)	(3,386)
2048	(93,331)	(69,998)	(10,500)	(59,499)	6.9	32.4	(1,525)	(1,835)	(3,360)
2049	(93,331)	(69,998)	(10,500)	(59,499)	6.9	32.8	(1,520)	(1,814)	(3,334)
2050	(93,331)	(69,998)	(10,500)	(59,499)	6.9	33.2	(1,516)	(1,793)	(3,308)
2051	(93,331)	(69,998)	(10,500)	(59,499)	6.9	33.6	(1,511)	(1,772)	(3,283)
2052	(93,331)	(69,998)	(10,500)	(59,499)	7.0	34.0	(1,506)	(1,752)	(3,258)
2053	(93,331)	(69,998)	(10,500)	(59,499)	7.0	34.4	(1,501)	(1,731)	(3,233)
2054	(93,331)	(69,998)	(10,500)	(59,499)	7.0	34.8	(1,497)	(1,711)	(3,208)
TOTAL	**(1,062,421)**	**(1,116,043)**	**(167,406)**	**(948,636)**			**(23,602)**	**(26,475)**	**(50,077)**

Table BCA-9: Total (Net) Value of Fuel Savings

Year	TRUCK TOTAL Fuel Use Reduction (gal/year)	OTHER VEHICLE TOTAL Fuel Use Reduction (gal/year)	Average Projected Diesel Cost per gallon ($2009)	Average Projected Diesel Cost per gallon ($2011)	Average Projected Gasoline Cost per gallon ($2009)	Average Projected Gasoline Cost per gallon ($2011)	Annual Fuel Cost Savings	Present Value (3% Discount Rate)	Present Value (7% Discount Rate)
			Source: Energy Information Administration						
2012	-	-	$ 2.92	$ 3.08	$ 2.82	$ 2.98	$0	$0	$0
2013	-	-	$ 2.97	$ 3.13	$ 2.97	$ 3.14	$0	$0	$0
2014	-	-	$ 3.02	$ 3.19	$ 3.06	$ 3.23	$0	$0	$0
2015	15,123	52,250	$ 3.08	$ 3.26	$ 3.13	$ 3.31	$222,160	$197,386	$169,484
2016	19,404	68,820	$ 3.19	$ 3.37	$ 3.18	$ 3.35	$296,217	$255,519	$211,199
2017	19,384	69,149	$ 3.29	$ 3.48	$ 3.25	$ 3.43	$304,813	$255,276	$203,110
2018	19,365	69,495	$ 3.38	$ 3.57	$ 3.30	$ 3.48	$311,320	$253,132	$193,875
2019	19,349	69,859	$ 3.47	$ 3.66	$ 3.34	$ 3.53	$317,274	$250,459	$184,656
2020	19,335	70,241	$ 3.52	$ 3.72	$ 3.38	$ 3.57	$322,432	$247,118	$175,382
2021	19,323	70,638	$ 3.54	$ 3.74	$ 3.39	$ 3.58	$324,917	$241,769	$165,171
2022	19,315	71,053	$ 3.61	$ 3.81	$ 3.45	$ 3.65	$332,788	$240,413	$158,105
2023	19,311	71,485	$ 3.63	$ 3.83	$ 3.47	$ 3.66	$335,762	$235,497	$149,082
2024	19,311	71,933	$ 3.71	$ 3.92	$ 3.52	$ 3.72	$343,003	$233,568	$142,334
2025	19,315	72,396	$ 3.73	$ 3.93	$ 3.54	$ 3.74	$346,559	$229,116	$134,401
2026	19,322	72,874	$ 3.75	$ 3.96	$ 3.56	$ 3.76	$350,826	$225,182	$127,155
2027	19,334	73,365	$ 3.80	$ 4.01	$ 3.62	$ 3.82	$357,693	$222,902	$121,163
2028	19,349	73,869	$ 3.82	$ 4.03	$ 3.63	$ 3.83	$361,160	$218,507	$114,334
2029	19,368	74,386	$ 3.87	$ 4.09	$ 3.68	$ 3.88	$367,954	$216,134	$108,864
2030	19,390	74,915	$ 3.83	$ 4.05	$ 3.64	$ 3.84	$366,450	$208,981	$101,326
2031	19,415	75,454	$ 3.84	$ 4.05	$ 3.64	$ 3.85	$368,999	$204,306	$95,356
2032	19,443	76,005	$ 3.85	$ 4.06	$ 3.65	$ 3.86	$372,180	$200,065	$89,886
2033	19,475	76,566	$ 3.85	$ 4.07	$ 3.66	$ 3.87	$375,257	$195,844	$84,700
2034	19,510	77,138	$ 3.87	$ 4.09	$ 3.69	$ 3.90	$380,262	$192,676	$80,215
2035	19,549	77,720	$ 3.89	$ 4.11	$ 3.71	$ 3.91	$384,534	$189,165	$75,810
2036	19,554	77,744	$ 3.94	$ 4.16	$ 3.76	$ 3.97	$389,569	$186,060	$71,778
2037	19,559	77,769	$ 3.98	$ 4.21	$ 3.80	$ 4.02	$394,668	$183,005	$67,960
2038	19,564	77,793	$ 4.03	$ 4.26	$ 3.85	$ 4.07	$399,833	$180,000	$64,345
2039	19,569	77,817	$ 4.08	$ 4.31	$ 3.90	$ 4.12	$405,064	$177,044	$60,923
2040	19,574	77,840	$ 4.13	$ 4.36	$ 3.95	$ 4.18	$410,363	$174,136	$57,682
2041	19,579	77,863	$ 4.18	$ 4.41	$ 4.01	$ 4.23	$415,729	$171,275	$54,613
2042	19,584	77,886	$ 4.23	$ 4.46	$ 4.06	$ 4.28	$421,165	$168,461	$51,708
2043	19,589	77,909	$ 4.28	$ 4.52	$ 4.11	$ 4.34	$426,670	$165,692	$48,957
2044	19,593	77,932	$ 4.33	$ 4.57	$ 4.16	$ 4.40	$432,247	$162,968	$46,352
2045	19,598	77,954	$ 4.38	$ 4.63	$ 4.22	$ 4.45	$437,895	$160,289	$43,886
2046	19,603	77,976	$ 4.43	$ 4.68	$ 4.27	$ 4.51	$443,615	$157,654	$41,550
2047	19,608	77,998	$ 4.49	$ 4.74	$ 4.33	$ 4.57	$449,409	$155,061	$39,339
2048	19,613	78,019	$ 4.54	$ 4.79	$ 4.38	$ 4.63	$455,278	$152,510	$37,246
2049	19,618	78,040	$ 4.59	$ 4.85	$ 4.44	$ 4.69	$461,222	$150,002	$35,264
2050	19,622	78,061	$ 4.65	$ 4.91	$ 4.50	$ 4.75	$467,243	$147,534	$33,387
2051	19,627	78,082	$ 4.71	$ 4.97	$ 4.56	$ 4.81	$473,341	$145,106	$31,610
2052	19,632	78,102	$ 4.76	$ 5.03	$ 4.62	$ 4.88	$479,517	$142,718	$29,927
2053	19,637	78,123	$ 4.82	$ 5.09	$ 4.68	$ 4.94	$485,773	$140,369	$28,334
2054	19,641	78,143	$ 4.88	$ 5.15	$ 4.74	$ 5.00	$492,109	$138,058	$26,826
TOTAL	**775,052**	**2,990,660**					**$ 15,483,268**	**$ 7,770,956**	**$ 3,757,297**

Emissions Reductions

The change in emissions was calculated based on the assumption that 70% of the travel demand savings was due to the elimination of idling at the grade crossing. The emissions impact of the changes in VMT was assumed to be minimal as VMT growth in the later years would balance out the savings in the first 12 years. Emissions reductions from smoother and faster traffic flow (due to the widening) were also not calculated.

An estimate of the emissions reduction resulting from reduced idling delay was developed by using the following factors derived from MOBILE6 Vehicle Emissions Modeling Software:

- Volatile organic compound (VOC) emissions are reduced by 23.59 grams per hour
- Nitrogen oxides (NO_x) emissions are reduced by 5.8 grams per hour
- Carbon monoxide (CO) emissions are reduced by 324.64 grams per hour
- Carbon dioxide (CO_2) emissions are reduced by 13.2 pounds per hour
- Particulate matter (PM_{10}) emissions are reduced by around one gram per hour of truck travel.

The reduction in emissions for each of these compounds is shown in **Table BCA-10**. Values were assigned to the emissions levels using guidance from the TIGER website[4]. The resulting annual savings are shown in **Table BCA-11**.

The present value of the emissions reductions over the 2015-2054 analysis period is $3.6 million using a 3% discount rate and $1.5 million using a 7% discount rate.

[4] Emissions values are from the TIGER website guidance (http://www.dot.gov/tiger/application-resources.html), which cites http://www.nhtsa.gov/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/CAFE_Final_Rule_MY2011_FRIA.pdf.

Table BCA-10: Emissions Reductions

Year	Total Annual Auto & Truck Time Spent Idling	Total Daily TRUCK Time Spent Idling	VOC	NOX	CO	C02	PM	PM	TOTAL
			23.59 grams/hr	5.8 grams/hr	324.64 grams/hr	13.2 lbs/hr	Emissions factor grams/hour (varies)		
UNIT: >>	hours/year	hours/year	lbs/year	lbs/year	lbs/year	lbs/year	grams/hr	lbs/year	lbs/year
2012	-	-	-	-	-	-	*1.0750*	-	-
2013	-	-	-	-	-	-	*1.0639*	-	-
2014	-	-	-	-	-	-	*1.0547*	-	-
2015	143,437	21,516	7,469	1,837	102,793	1,893,369	*1.0272*	48.788	2,005,517
2016	193,224	28,984	10,062	2,474	138,473	2,550,556	*1.0230*	65.453	2,701,630
2017	195,219	29,283	10,166	2,499	139,903	2,576,889	*1.0197*	65.915	2,729,523
2018	197,234	29,585	10,271	2,525	141,347	2,603,494	*1.0040*	65.571	2,757,703
2019	199,271	29,891	10,377	2,551	142,806	2,630,374	*1.0040*	66.248	2,786,175
2020	201,328	30,199	10,484	2,578	144,281	2,657,531	*1.0040*	66.932	2,814,941
2021	203,407	30,511	10,592	2,604	145,770	2,684,969	*1.0040*	67.623	2,844,003
2022	205,507	30,826	10,702	2,631	147,275	2,712,690	*1.0040*	68.321	2,873,366
2023	207,629	31,144	10,812	2,658	148,796	2,740,697	*1.0040*	69.026	2,903,033
2024	209,772	31,466	10,924	2,686	150,332	2,768,993	*1.0040*	69.739	2,933,005
2025	211,938	31,791	11,037	2,714	151,884	2,797,582	*1.0040*	70.459	2,963,287
2026	214,126	32,119	11,151	2,742	153,452	2,826,465	*1.0040*	71.186	2,993,881
2027	216,337	32,451	11,266	2,770	155,037	2,855,647	*1.0040*	71.921	3,024,792
2028	218,570	32,786	11,382	2,798	156,637	2,885,130	*1.0040*	72.664	3,056,021
2029	220,827	33,124	11,500	2,827	158,255	2,914,918	*1.0040*	73.414	3,087,573
2030	223,107	33,466	11,618	2,857	159,888	2,945,013	*1.0040*	74.172	3,119,451
2031	225,411	33,812	11,738	2,886	161,539	2,975,419	*1.0040*	74.938	3,151,657
2032	227,738	34,161	11,859	2,916	163,207	3,006,139	*1.0040*	75.712	3,184,197
2033	230,089	34,513	11,982	2,946	164,892	3,037,176	*1.0040*	76.493	3,217,072
2034	232,465	34,870	12,106	2,976	166,595	3,068,533	*1.0040*	77.283	3,250,287
2035	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2036	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2037	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2038	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2039	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2040	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2041	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2042	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2043	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2044	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2045	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2046	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2047	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2048	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2049	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2050	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2051	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2052	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2053	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
2054	234,865	35,230	12,231	3,007	168,315	3,100,214	*1.0040*	78.081	3,283,844
TOTAL	**8,873,929**	**1,331,089**	**462,110**	**113,618**	**6,359,453**	**117,135,864**			**124,073,999**

Table BCA-11: Value of Emissions Reductions

Pollutant >	VOC	NOX	CO	C02			PM	TOTAL VALUE	Present Value (3% Discount Rate)	Present Value (7% Discount Rate)
Price/ton 2007$ >	$1,700	$4,000	$68	Value per long ton		Annual Value of CO2 reduction	$168,000			
Price/ton 2011$ >	$1,857	$4,370	$74	2007$	2011$		$183,560	2011$	2011$	2011$
Year										
2013										
2014										
2015	$6,194	$3,583	$3,384	$ 46.79	$51.12	$43,895	$3,998	**$61,055**	$54,246	$46,578
2016	$8,344	$4,827	$4,559	$ 48.71	$53.22	$61,557	$5,364	**$84,650**	$73,020	$60,354
2017	$8,430	$4,877	$4,606	$ 50.82	$55.53	$64,891	$5,402	**$88,206**	$73,871	$58,775
2018	$8,517	$4,927	$4,654	$ 53.01	$57.92	$68,385	$5,373	**$91,856**	$74,687	$57,203
2019	$8,605	$4,978	$4,702	$ 55.14	$60.25	$71,870	$5,429	**$95,584**	$75,455	$55,631
2020	$8,694	$5,029	$4,750	$ 57.48	$62.81	$75,698	$5,485	**$99,656**	$76,378	$54,207
2021	$8,783	$5,081	$4,799	$ 60.05	$65.61	$79,896	$5,541	**$104,101**	$77,461	$52,920
2022	$8,874	$5,134	$4,849	$ 63.00	$68.84	$84,685	$5,599	**$109,141**	$78,846	$51,852
2023	$8,966	$5,187	$4,899	$ 65.62	$71.69	$89,110	$5,656	**$113,818**	$79,830	$50,537
2024	$9,058	$5,240	$4,950	$ 68.47	$74.81	$93,951	$5,715	**$118,914**	$80,975	$49,345
2025	$9,152	$5,294	$5,001	$ 71.59	$78.22	$99,240	$5,774	**$124,461**	$82,283	$48,268
2026	$9,246	$5,349	$5,052	$ 74.66	$81.57	$104,562	$5,833	**$130,043**	$83,470	$47,134
2027	$9,342	$5,404	$5,105	$ 77.83	$85.04	$110,138	$5,894	**$135,882**	$84,677	$46,028
2028	$9,438	$5,460	$5,157	$ 81.29	$88.82	$116,218	$5,955	**$142,228**	$86,050	$45,026
2029	$9,536	$5,516	$5,211	$ 84.70	$92.55	$122,342	$6,016	**$148,621**	$87,299	$43,972
2030	$9,634	$5,573	$5,264	$ 88.23	$96.40	$128,756	$6,078	**$155,306**	$88,569	$42,943
2031	$9,734	$5,631	$5,319	$ 92.06	$100.59	$135,737	$6,141	**$162,561**	$90,006	$42,009
2032	$9,834	$5,689	$5,374	$ 95.85	$104.73	$142,777	$6,204	**$169,878**	$91,318	$41,028
2033	$9,936	$5,748	$5,429	$ 99.77	$109.01	$150,145	$6,268	**$177,526**	$92,649	$40,070
2034	$10,038	$5,807	$5,485	$ 104.01	$113.65	$158,153	$6,333	**$185,816**	$94,152	$39,197
2035	$10,142	$5,867	$5,542	$ 108.21	$118.23	$166,234	$6,398	**$194,183**	$95,525	$38,283
2036	$10,142	$5,867	$5,542	$ 112.55	$122.98	$172,905	$6,398	**$200,854**	$95,929	$37,007
2037	$10,142	$5,867	$5,542	$ 117.25	$128.11	$180,127	$6,398	**$208,077**	$96,484	$35,830
2038	$10,142	$5,867	$5,542	$ 121.91	$133.20	$187,273	$6,398	**$215,222**	$96,891	$34,636
2039	$10,142	$5,867	$5,542	$ 126.72	$138.45	$194,663	$6,398	**$222,612**	$97,299	$33,481
2040	$10,142	$5,867	$5,542	$ 131.92	$144.14	$202,653	$6,398	**$230,602**	$97,855	$32,414
2041	$10,142	$5,867	$5,542	$ 136.60	$149.26	$209,853	$6,398	**$237,802**	$97,971	$31,239
2042	$10,142	$5,867	$5,542	$ 141.68	$154.80	$217,652	$6,398	**$245,601**	$98,237	$30,153
2043	$10,142	$5,867	$5,542	$ 146.93	$160.53	$225,709	$6,398	**$253,658**	$98,505	$29,105
2044	$10,142	$5,867	$5,542	$ 152.09	$166.18	$233,650	$6,398	**$261,599**	$98,630	$28,052
2045	$10,142	$5,867	$5,542	$ 157.69	$172.29	$242,239	$6,398	**$270,188**	$98,901	$27,078
2046	$10,142	$5,867	$5,542	$ 163.46	$178.60	$251,112	$6,398	**$279,061**	$99,174	$26,138
2047	$10,142	$5,867	$5,542	$ 169.16	$184.83	$259,865	$6,398	**$287,814**	$99,305	$25,194
2048	$10,142	$5,867	$5,542	$ 175.31	$191.55	$269,321	$6,398	**$297,270**	$99,580	$24,319
2049	$10,142	$5,867	$5,542	$ 181.67	$198.50	$279,088	$6,398	**$307,037**	$99,856	$23,475
2050	$10,142	$5,867	$5,542	$ 187.95	$205.36	$288,730	$6,398	**$316,679**	$99,993	$22,628
2051	$10,142	$5,867	$5,542	$ 187.95	$205.36	$288,730	$6,398	**$316,679**	$97,080	$21,148
2052	$10,142	$5,867	$5,542	$ 187.95	$205.36	$288,730	$6,398	**$316,679**	$94,253	$19,764
2053	$10,142	$5,867	$5,542	$ 187.95	$205.36	$288,730	$6,398	**$316,679**	$91,507	$18,471
2054	$10,142	$5,867	$5,542	$ 187.95	$205.36	$288,730	$6,398	**$316,679**	$88,842	$17,263
TOTAL	**$ 383,191**	**$ 221,680**	**$ 209,385**		**$ 4,941**	**$ 6,737,997**	**$ 242,027**	**$ 7,794,280**	**$ 3,567,060**	**$ 1,528,756**

Note that all value-per-ton figures are in metric tons except for CO_2 which is in long tons.

Safety Benefits

The project will improve safety in two ways, by eliminating the at-grade rail crossing, and also by adding a center turn lane that will reduce accidents caused by drivers turning to or from US 70 from the many businesses and residences along this highway. The accident analysis has therefore been completed in two sections, as described below.

Safety Benefit from Eliminated Rail Grade Crossing

To estimate the benefit of the grade separation, it was assumed that 80 percent of the accidents that currently occur near the rail line (specifically within 0.5 miles to the west and 0.75 miles to the east of the crossing) would be eliminated by the overpass. The 1.25-mile range was due to the long backups often caused by the train traffic. Rail-vehicle crashes are rare here, but the presence of a grade separation can cause crashes between vehicles. Cars, trucks and buses must often stop or slow down at the crossing, often in a manner not anticipated by surrounding drivers.

To establish a No Build baseline accident rate, local and state crash data from 2006-2010 were examined. Over the past five years, 19 crashes were observed along this 1.25-mile section of US 70. Of these 19, 14 were "property damage only" (PDO), three were "possible injury" (2-PI using the KABCO scale), and three involved injuries, but the severity was not known or not recorded.

Safety Benefit from Widening

As noted above, the center turn lane will provide protection for drivers entering or exiting US 70 from the many commercial and residential driveways lining the road. In a study[5] of a similar roadway in Florida where additional through lanes and turning lanes were added, an accident reduction rate of 56.8% was observed.

For the 4.25 miles of the project length that is not within the 0.5 miles west and 0.75 east threshold of the rail crossing, the current accident rate is therefore assumed to be reduced by 56.8%.

Local and state crash data from 2006-2010 indicated that there were 25 crashes on this 4.25-mile segment of US 70. Of these, 14 were "property damage only" (PDO), three were "possible injury" (2-PI using the KABCO scale), four were "Non-Incapacitating Injuries" (3-NII on the KABCO scale), and four were Incapacitating Injuries (4-II on the KABCO scale).

Valuation

The value for each crash type is derived from the Maximum Abbreviated Injury Scale (MAIS) scale using the KABCO-to-MAIS conversion table in the TIGER Notice of Funding Availability. The MAIS values are also from the NOFA, which cites the original source as *Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses – 2011 Revisions (http://ostpxweb.dot.gov/policy*).

[5] Gan, Albert, Joan Shen and Adriana Rodriguez, April 2005, "Update of Florida Crash Reduction Factors and Countermeasures to Improve the Development of District Safety Improvement Projects: Final Report." Florida Department of Transportation, Tallahassee, FL. Accessed October 2011. http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_SF/FDOT_BD015_04_rpt.pdf.

Table BCA-12 shows the calculations used to evaluate accident reduction over the 40-year analysis period. The No Build baseline accident data examined over the five-year (2006-2010) period were divided by five to provide an average annual accident rate at current traffic levels. These rates were reduced as noted above: 80% reduction for accidents near the rail crossing, and 56.8% reduction for other segments of US 70 in the project area. The sum of the reduction in these rates, that is, the difference between No Build accidents and expected Build accidents, is shown in the row labeled "Reduction (Annual)" of **Table BCA-12**.

The values from MAIS (converted from the KABCO data) are also shown in the table, along with the resulting annual cost of the accident reduction at current traffic levels ($280,026).

Table BCA-12: Calculation of Baseline Annual Safety Benefit

Accident Type>	**PDO**	**2-PI**	**3-NII**	**4-II**	**SUI***
Current annual rate near RR	2.8	0.6	0	0	0.6
New rate (Reduce 80%)	0.56	0.12	0	0	0.12
Current annual rate not near RR	2.8	0.6	0.8	0.8	0
New rate (Reduce 56.8%)	1.2096	0.2592	0.3456	0.3456	0
Reduction (Annual)	3.8304	0.8208	0.4544	0.4544	0.48
Value of accident type	$5,129	$42,009	$81,036	$296,628	$113,102
Annual Value of Crash Reduction	$19,646	$34,481	$36,823	$134,788	$54,289
TOTAL VALUE OF ANNUAL ACCIDENT REDUCTION (2012)					**$280,026**

PDO = Property Damage Only
PI = Possible Injury
NII = Non-Incapacitating Injury
II = Incapacitating Injury
SUI = Severity unknown injury.

The accident reduction value was then increased each year by the 1.41% annual No Build traffic growth rate[6]. No Build growth was used because there can be no safety reduction benefits for induced travel (trips that would not be taken in the absence of the project).

Traffic growth is assumed to level off after 2035, so the annual safety benefits do not increase after that year. In addition, as with the other benefit calculations, there are no benefits assumed before construction is complete in April 2015, and 2015 benefits are reduced to 75% of the whole-year benefit level.

The resulting present value, as shown in **Table BCA-13,** is $7.3 million using the 3% discount rate, and $3.6 million using the 7% discount rate.

[6] This rate was developed by subtracting No Build 2012 traffic counts form No Build 2035 traffic levels.

Table BCA-13: Value of Crash Reduction

Year	Value of Accident Reduction	Present Value at 3%	Present Value at 7%
2012	$0	$0	$0
2013	$0	$0	$0
2014	$0	$0	$0
2015	$219,042	$194,616	$167,106
2016	$296,179	$255,487	$211,172
2017	$300,361	$251,548	$200,143
2018	$304,602	$247,670	$189,691
2019	$308,903	$243,851	$179,784
2020	$313,265	$240,091	$170,395
2021	$317,688	$236,390	$161,496
2022	$322,173	$232,745	$153,062
2023	$326,722	$229,156	$145,069
2024	$331,335	$225,623	$137,492
2025	$336,014	$222,145	$130,312
2026	$340,758	$218,720	$123,506
2027	$345,569	$215,347	$117,056
2028	$350,449	$212,027	$110,943
2029	$355,397	$208,758	$105,149
2030	$360,415	$205,539	$99,658
2031	$365,504	$202,370	$94,453
2032	$370,664	$199,250	$89,520
2033	$375,898	$196,178	$84,845
2034	$381,205	$193,154	$80,414
2035	$386,588	$190,176	$76,214
2036	$386,588	$184,636	$71,228
2037	$386,588	$179,259	$66,569
2038	$386,588	$174,038	$62,214
2039	$386,588	$168,969	$58,144
2040	$386,588	$164,047	$54,340
2041	$386,588	$159,269	$50,785
2042	$386,588	$154,630	$47,463
2043	$386,588	$150,126	$44,358
2044	$386,588	$145,754	$41,456
2045	$386,588	$141,508	$38,744
2046	$386,588	$137,387	$36,209
2047	$386,588	$133,385	$33,840
2048	$386,588	$129,500	$31,626
2049	$386,588	$125,728	$29,557
2050	$386,588	$122,066	$27,624
2051	$386,588	$118,511	$25,816
2052	$386,588	$115,059	$24,128
2053	$386,588	$111,708	$22,549
2054	$386,588	$108,454	$21,074
Total	**$14,353,898**	**$7,344,877**	**$3,615,205**

Other Non-Quantifiable Costs and Benefits

There are a number of other project benefits, as well as costs that could not be reasonably quantified for the benefit-cost analysis. Among these are:

- Noise reduction – Safety demands that for a busy road like US 70, "active" crossing protection be in place, including a crossing gate with bells and lights to warn of the approach of a train, and the train is required to sound its horn. Train horns can sometimes be heard at the far other end of Valliant, as train horns are designed to be loud at a distance of a quarter mile, but can often be heard a mile or more away. The daily sound of the bells and the train horn would be eliminated with the project, as would the engine noise from cars and trucks starting up at the crossing after a train has cleared the tracks.
- Benefits to employers – In addition to increased worker productivity from reduced commute and work trip travel times (already included in the travel time savings benefit calculated above), businesses would also gain from the ability to recruit workers from further away, and possibly from reduced employee lateness.
- Increased sales – Local businesses are likely to experience additional sales resulting from increased pedestrian and auto traffic.
- Health benefits – Safe, marked pedestrian and bicycle facilities make it more likely that local residents will use these modes and realize the related exercise and health benefits.
- Impacts on relocated businesses – Eight businesses will need to be relocated to make room for the overpass. Changes of location, particularly when involuntary, always involve costs in reduced productivity, as well as lost sales as customers adjust to new locations. However, due to the lack of suitable vacant commercial structures in the vicinity of this project, the commercial relocations for this project will result in new, possibly custom-designed, structures for each of the relocated businesses. The resulting improvement in the visual appeal of these businesses, as well as the likely reduction in maintenance and energy costs from more modern structures, could have a long term economic benefit for these businesses. Benefits may even spill over to neighboring businesses, as many are currently located near vacant lots or dilapidated buildings (see photo).

- Improved emergency access – It is likely that over the many decades that the US 70 overpass project will serve the area, faster and more reliable travel times for police, fire and ambulance services needing to travel from one side of the rail line to the other will save lives and reduce property damage and injuries.

Because transportation is involved in so many aspects of our lives, the benefits of the project are potentially far-reaching, making trips for any purpose easier, safer and more reliable, whether for

work, recreation, shopping, higher education, or to visit an elderly relative or sick friend. While most of this value is measured in the travel time savings calculations, there are some aspects that do not make it into the benefit-cost ratio. The project's measurable reduction in travel costs has a similar potential, as funds not spent on fuel purchases could be used for a wide range of purposes, from making local manufacturing, forestry and agricultural businesses more competitive to increasing disposable income for residents of a county with a 27 percent poverty rate.

APPENDIX A: Travel Model Results

Source: Parsons Brinckerhoff, 10/17/2011

Estimate of VMT saving - US 70 in Valliant Annual				
Scenarios	Approx Distance	AADT	VMT	VMT Savings
	miles	Vehicles		
No Build 2012	2	7196	5,253,080	152,570
	4.7	300	514,650	
Alternative 2 2012	2	7504	5,477,920	
	4.7	80	137,240	
No Build 2035	2	10175	7,427,750	(93,331)
	4.7	368	631,304	
Alternative 2 2035	2	10935	7,982,550	
	4.7	99	169,835	
			Total Savings	245,901

Estimate of average delay and travel time saving - US 70 in Valliant Annual		
Scenarios	Overall Network Avg Delay /veh	Overall Network Total Travel Time
	(minutes)	(hours)
No Build 2012 - 2 lanes (Do Nothing)	21,927	388,776
Alternative 2 2012 - 2 lanes (RR Grade Sep)	1,179	187,218
Reduction	20,748	201,558
No Build 2035 - 2 lanes (No RR Grade Sep)	24,044	510,647
Alternative 2 2035 - 2 lanes (RR Grade Sep)	1,652	175,126
Reduction	22,392	335,522

Note that the 187,218 Overall Network Travel Time for 2012 with railroad grade separation was not used in the BCA analysis because it assumed a two-lane US 70 in 2012 (the Build would be five lanes). Instead the 2035 Overall Network Travel Time (175,126) was adjusted to 2012 traffic levels, resulting in an Overall Network Travel Time for the 2012 Build of 175,126.