CALCULATION METHODOLOGY FOR CARBON DIOXIDE EMISSIONS

The value of the Carbon Dioxide (CO_2) emission reductions has been calculated and included in the benefits attributable to the proposed project. The CO_2 emission reductions are based on the travel distance savings resulting from the bypass and fleet fuel consumption.

The travel speed along the existing route and the related fuel consumption were calculated and compared to the anticipated speeds on the proposed route and the related consumption. The basic assumptions relate to the calculated and observed speeds, the number of traffic signals negotiated, known travel patterns, and common termini.

Calculations were performed to determine fuel consumption savings for the partial use of the proposed bypass and for the full use of the proposed bypass. Known travel patterns were the basis for determining the percentage of trucks using the full length of the proposed bypass versus trucks using only a portion of the proposed facility. Approximately ten percent (10%) of the diverted commercial vehicles are expected to use a portion of the proposed bypass and then continue their travel to the west. Another five percent (5%) are anticipated to use a portion of the bypass to access points along the bypass or to the region west of the existing route. The final 85% are likely to have destinations south of Bella Vista and will be likely to use the entire route.

The fuel consumption rates and related emission rates are shown in the table (sustainability calculation.pdf) on page 2. The weighted CO_2 reductions were calculated as 9.53 tons per day for every 1,000 trucks diverted from the existing facility to the proposed bypass.

Traffic estimates developed for the number of commercial vehicle toll transactions over the life of the facility were used to determine the commercial vehicle diversion to the new route for each year. These figures were summed to determine total commercial traffic diverted over the life of the project. The emission savings of 9.53 tons per day/1000 vehicles was applied to determine the tons per day of savings.

TIGER guidance indicates the value of the CO_2 emissions as $33 (2011 value) per metric ton of reductions based on the Final Regulatory Impact Analysis of the National Highway Traffic Safety Administration's rulemaking on Corporate Average Fuel Economy for MY 2011 Passenger Cars adn Light Trucks. This value was reduced by the given 2.4% for the annual growth of the social costs of carbon. When adjusted for growth (reduced because earlier in time) this figure became $31.44 (2009 value). This figure was applied to the total tons per day calculated to obtain a current year daily savings which was then multiplied by 365 days/year to determine the current year annual emission reduction savings. These calculations can be seen on the table on (sustainability value for BVB.pdf) page 3.

The total current year value used for the emission reduction is $4.53 million over the next twenty years.

CARBON DIOXIDE REDUCTION CALCULATION FOR 1,000 TRUCKS ALONG BELLA VISTA BYPASS

Partial Use of the Bypass

Category	Current Miles No Stoplights	Current Miles With Stoplights	Current Total Miles	Future Miles on ByPass	Future Miles NOT on ByPass	Future Total Miles	Diff
Miles	12.10	16.50	28.60	12.76	12.10	24.86	(3.74)
MPG	6.8	3.6		6.8	5		
Gallons Consumed	1.78	4.58	6.36	1.88	2.42	4.30	(2.07)

weekly trips 767 | daily trips 109.58

(226.41) daily gallons saved

Full Use of the Bypass

Category	Current Miles No Stoplights	Current Miles With Stoplights	Current Total Miles	Future Miles on ByPass	Future Miles NOT on ByPass	Future Total Miles	Diff
Miles	4.80	11.20	16.00	19.27	-	19.27	3.27
MPG	6.1	3.6		6.1	3.6		
Gallons Consumed	0.79	3.11	3.90	3.16	-	3.16	(0.74)

weekly trips 286 | daily trips 40.91

(30.23) daily gallons saved

	Partial West	Full Use of the Bypass
Gallons saved	(2,066.27)	(738.98)
CO2 tpd saved	(21.00)	(7.51)

Assume 1000 trucks on Bypass:		**gallons saved**	**CO2 tpd saved**
10%	are bound for west of bypass - using a portion	(2,066.27)	(21.00)
85%	have destinations south of the bypass	(738.98)	(7.51)
5%	have destinations along the bypass	(2,066.27)	(21.00)
100%	percent		

weighted average:

(2.10) tpd CO2 reductions (partial west)
(6.38) tpd CO2 reductions using the entire bypass
(1.05) tpd CO2 reductions (partial east)

(9.53) total weighted DAILY TPD CO2 reductions for 1,000 trucks on bypass

SUSTAINABILITY BENEFITS for BELLA VISTA BYPASS BASED ON

PROJECTED TRUCK TRANSACTIONS AND ESTIMATED CO2 SAVINGS

$31.44 2009 value to measure the global benefits of reduction of US CO2 emissions.
This is based on the estimate of $33 per metric ton of carbon cited on page VIII-45 of the Final Regulatory Impact Analysis of the National Highway Traffic Safety Administration's rulemaking on Corporate Average Fuel Economy for MY2011 Passenger Cars and Light Trucks. This value was reduced by the given 2.4% for the annual growth of the social costs of carbon.

$33.00 *2011 value per metric ton*

2.4% annual growth thereafter for the Social Cost of Carbon

Bella Vista Bypass Northbound AADT

	PV	LT	HT	Total
2013	*200*	*0*	*0*	*200*
2014	*2,100*	*100*	*200*	*2,400*
2015	*2,900*	*100*	*300*	*3,300*
2016	*3,600*	*100*	*400*	*4,100*
2017	*3,900*	*100*	*400*	*4,400*
2018	4,400	100	400	4,900
2019	4,500	100	400	5,000
2020	4,600	100	400	5,100
2021	4,700	100	400	5,200
2022	4,700	100	400	5,200
2023	4,800	100	500	5,400
2024	4,900	100	500	5,500
2025	5,000	100	500	5,600
2026	5,100	100	500	5,700
2027	5,200	100	500	5,800
2028	5,200	100	500	5,800
2029	5,300	100	500	5,900
2030	5,400	100	500	6,000
2031	5,500	100	500	6,100
2032	5,500	100	500	6,100
2033	5,600	100	500	6,200
2034	5,600	100	500	6,200
2035	5,700	100	500	6,300
2036	5,700	100	500	6,300
2037	5,800	100	500	6,400
2038	5,800	100	500	6,400
2039	5,900	100	500	6,500
2040	5,900	100	500	6,500
2041	6,000	200	500	6,700
2042	6,100	200	500	6,800
2043	6,100	200	500	6,800
2044	6,400	200	500	7,100
2045	6,500	200	600	7,300
2046	6,500	200	600	7,300
2047	6,600	200	600	7,400
2048	6,700	200	600	7,500
2049	6,700	200	600	7,500
2050	6,800	200	600	7,600

Bella Vista Bypass Southbound AADT

	PV	LT	HT	Total
2013	*200*	*0*	*0*	*200*
2014	*2,100*	*100*	*200*	*2,400*
2015	*2,700*	*100*	*300*	*3,100*
2016	*3,300*	*100*	*300*	*3,700*
2017	*3,600*	*100*	*400*	*4,100*
2018	4,100	100	400	4,600
2019	4,300	100	400	4,800
2020	4,700	100	400	5,200
2021	4,800	100	400	5,300
2022	4,900	100	400	5,400
2023	5,000	100	400	5,500
2024	5,100	100	400	5,600
2025	5,200	100	400	5,700
2026	5,200	100	400	5,700
2027	5,300	100	400	5,800
2028	5,400	100	400	5,900
2029	5,500	100	400	6,000
2030	5,600	100	400	6,100
2031	5,600	100	500	6,200
2032	5,700	100	500	6,300
2033	5,700	100	500	6,300
2034	5,800	100	500	6,400
2035	5,800	100	500	6,400
2036	5,900	100	500	6,500
2037	5,900	100	500	6,500
2038	6,000	100	500	6,600
2039	6,100	100	500	6,700
2040	6,100	100	500	6,700
2041	6,200	100	500	6,800
2042	6,200	100	500	6,800
2043	6,300	100	500	6,900
2044	6,400	100	500	7,000
2045	6,400	100	500	7,000
2046	6,500	100	500	7,100
2047	6,600	100	500	7,200
2048	6,700	100	500	7,300
2049	6,700	100	500	7,300
2050	6,800	100	500	7,400

Bella Vista Bypass TOTAL AADT

	PV	LT	HT	Total	Using AHTD 20% for trucking
2013	*200*	*0*	*0*	*400*	**2013**
2014	*2,100*	*100*	*200*	*4,800*	**2014** 960
2015	*2,700*	*100*	*300*	*6,400*	**2015** 1280
2016	*3,300*	*100*	*300*	*7,800*	**2016** 1560
2017	*3,600*	*100*	*400*	*8,500*	**2017** 1700
2018	4,100	100	400	*9,500*	**2018** 1900
2019	4,300	100	400	*9,800*	**2019** 1960
2020	4,700	100	400	*10,300*	**2020** 2060
2021	4,800	100	400	*10,500*	**2021** 2100
2022	4,900	100	400	*10,600*	**2022** 2120
2023	5,000	100	400	*10,900*	**2023** 2180
2024	5,100	100	400	*11,100*	**2024** 2220
2025	5,200	100	400	*11,300*	**2025** 2260
2026	5,200	100	400	*11,400*	**2026** 2280
2027	5,300	100	400	*11,600*	**2027** 2320
2028	5,400	100	400	*11,700*	**2028** 2340
2029	5,500	100	400	*11,900*	**2029** 2380
2030	5,600	100	400	*12,100*	**2030** 2420
2031	5,600	100	500	*12,300*	**2031** 2460
2032	5,700	100	500	*12,400*	**2032** 2480
2033	5,700	100	500	*12,500*	**2033** 2500
2034	5,800	100	500	*12,600*	**2034** 2520
2035	5,800	100	500	*12,700*	**2035** 2540
2036	5,900	100	500	*12,800*	**2036** 2560
2037	5,900	100	500	*12,900*	**2037** 2580
2038	6,000	100	500	*13,000*	**2038** 2600
2039	6,100	100	500	*13,200*	**2039** 2640
2040	6,100	100	500	*13,200*	**2040** 2640
2041	6,200	100	500	*13,500*	**2041** 2700
2042	6,200	100	500	*13,600*	**2042** 2720
2043	6,300	100	500	*13,700*	**2043** 2740
2044	6,400	100	500	*14,100*	**2044** 2820
2045	6,400	100	500	*14,300*	**2045** 2860
2046	6,500	100	500	*14,400*	**2046** 2880
2047	6,600	100	500	*14,600*	**2047** 2920
2048	6,700	100	500	*14,800*	**2048** 2960
2049	6,700	100	500	*14,800*	**2049** 2960
2050	6,800	100	500	*15,000*	**2050** 3000

cumulative truck traffic present - 2033: 41480 AADT

this is from Sustainabiliy calculation - BVB

(395.47) 9.53 tpd CO2 reduction / 1000 trucks

2009 value of tpd reduction $ 31.44

365 days/year

Total value of CO2 reductions using global impact over the life of the project (2009) $ (4,537,522.40)

CALCULATION METHODOLOGY FOR VOLATILE ORGANIC COMPOUNDS and NITROGEN OXIDE

The amount of the Volatile Organic Compounds (VOCs) and Nitrogen Oxide (NOx) emission reductions has been calculated. There is not a monetary value associated with these emissions.

VOC and NOx emissions rates were calculated using MOBILE6.0 and all default data to determine a comparison between the existing and proposed routes and the relative travel speeds. The MOBILE6.0 program produces VOC and NOx emission rates by speed and vehicle type for non-ramp freeway facilities and arterials. Existing travel speeds were calculated based on the Travel Time Study performed in July, 2009.

The spreadsheet {hyperlink to VOX_NOx_calculation.pdf} displays the length of each segment, the average daily traffic along the segment, and the truck percentage. Emission rates for VCs and NOx were provided from the MOBILE6.0 output files for both passenger vehicles (PV) and commercial vehicles (HDDV).

The emissions for each segment were calculated and then summed for total emissions of that option. The two options compared were the Do-Nothing scenario with all of the existing traffic remaining on the facility. The Build scenario used the same traffic diversion as the other analyses.

The total emissions for the No-Build and the Build (bypass) scenario were compared to determine the following.

	POLLUTANT	
Scenario	**Volatile Organic Compounds**	**Nitrogen Oxide**
Existing (No-Build)	68.5 tons/year	45.4 tons/year
Bella Vista Bypass	65.0 tons/year	47.4 tons/year
Reduction/(Increase)	3.5 tons/year	(2.0) tons/year

conversion grams/mile --> Tons/day 1 ton = 907184.74 grams 907184.74
Conversion Factor (grams to tons) 1 ton = 2000 lbs. 2.2 lbs = 1kg 1kg = 1000 gr 1 ton = 1.1x10-6 gram 0.0000011 909090.9091

Existing Highway 71 - No Build

Truck and PV Segregated

				2013		Emission Factors - PV		Emission Factors - HDDV		Daily Emissions			
Segment		**Length**	**ADT**	**truck %**	**avg speed**	**VOC**	**NO_x**	**VOC***	**NOx ***	**VOC**	**NO_x**	**VMT Source**	**Speed Source**
US 71B	Highway 340	4.9	46100.0	0.12	38	0.373	0.209	0.257	0.522	0.0935	0.0547	unit	travel time study
Highway 340	State line	2.1	25200.0	0.29	48	0.336	0.215	0.199	0.517	0.0214	0.0169	unit	travel time study
State Line	Missouri 90	4.4	25000.0	0.25	47	0.339	0.214	0.203	0.515	0.0421	0.0293	unit	travel time study
Missouri 90	H St (Pineville)	4.9	17200.0	0.25	54	0.323	0.22	0.177	0.683	0.0305	0.0235	unit	travel time study
71B - 72		0.0		-									
72 - 72		0.0		-									
72 - CR 34		0.0		-									
CR 34 - Route H		0.0		-									
Route H - Pineville Bypass		0.0		-									

* reduce speed by 10 MPH for emissions due to signals and congestion

Tons/Day	0.1876	0.1243	
Tons/Year	68.47	45.35	

conversion grams/mile --> Tons/day 1 ton = 907184.74 grams 907184.74
Conversion Factor (grams to tons) 1 ton = 2000 lbs. 2.2 lbs = 1kg 1kg = 1000 gr 1 ton = 1.1x10-6 gram 0.0000011 909090.9091

Existing - with Bypass in Place

Truck and PV Segregated

				2013		Emission Factors - PV		Emission Factors - HDDV		Daily Emissions			
Segment		**Length**	**ADT**	**truck %**	**avg speed**	**VOC**	**NO_x**	**VOC**	**NO_x**	**VOC**	**NO_x**	**VMT Source**	**Speed Source**
US 71B	Highway 340	4.9	41500.0	0.14	44	0.349	0.212	0.177	0.55	0.0786	0.0505	unit	travel time study
Highway 340	State line	2.1	21000.0	0.14	54	0.323	0.22	0.158	0.683	0.0164	0.0130	unit	travel time study
State Line	Missouri 90	4.4	20900.0	0.14	53	0.324	0.219	0.159	0.667	0.0331	0.0241	unit	travel time study
Missouri 90	H St (Pineville)	4.9	13300.0	0.14	60	0.313	0.224	0.153	0.828	0.0226	0.0176	unit	travel time study
US 71B	Highway 72	5.7	4600.0	0.20	65	0.307	0.228	0.153	1.015	0.0090	0.0076		
Highway 72	Highway 72	3.0	4400.0	0.20	65	0.307	0.228	0.153	1.015	0.0046	0.0043		
Highway 72	CR 34	2.4	4200.0	0.20	65	0.307	0.228	0.153	1.015	0.0035	0.0035		
CR 34	Route 90	4.9	4100.0	0.20	65	0.307	0.228	0.153	1.015	0.0069	0.0060		
Route 90	Highway 71 - p'vil	2.4	3900.0	0.20	65	0.307	0.228	0.153	1.015	0.0033	0.0032		
		18.4											

Tons/Day	0.1780	0.1299	
Tons/Year	64.96	47.41	

Difference in Emissions	No-Build	68.47	45.35
	Build	(64.96)	(47.41)
	Emission Reduction	3.52	(2.06)
	(Increase)	5%	-5%