A Benefit Cost Analysis of the 45th Street at Calumet Avenue Grade Separation Project

Presented to the Town of Munster

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PolicyAnalytics, LLC

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Executive Summary

By realigning 45th Street east of Calumet Avenue, this project would convert two three-spoke intersections into one four-spoke intersection, allowing East-West through traffic on 45th Street to avoid two turning actions and an at-grade railroad crossing when travelling across Calumet Avenue. This reconfiguration would reduce travel time for traffic on both 45th Street and Calumet Avenue, improve safety conditions at the intersection, and provide environmental benefits.

The purpose of this analysis is to quantify the costs and the benefits of the Project over time. Data inputs include modeling from the Northwest Indiana Regional Planning Commission (NIRPC) Travel Demand Model, and other appropriate sources. This report is an independent analysis produced by Policy Analytics, LLC.

The estimated cost of the project is $30.1M in 2015 dollars, and the present value of benefits total $33.6M. This results in a net present value of the project of $3.5M and a benefit to cost ratio of 1.12 (when discounted at 7% annually).

The following tables summarize the changes incorporated in the project, and enumerate the benefits quantified in this analysis.

Summary of Improvements and Project Benefits **Table 1**

Current Status/Baseline & Problem to be Addressed	Changes to Baseline/Alternatives	Type of Impacts	Population Affected by Impacts	Summary of Results (PV in 2015 Dollars; discounted @ 7%)	Page Reference in BCA
The principal need for this project is to eliminate the traffic congestion and reduce motorist delays that exist under the current configuration. The primary purpose of this project is to relocate the east leg of 45th Street to a location south of the railroad tracks to create a 4-way intersection with Calumet Avenue and the west leg of 45th Street. This project should be considered as a realignment project to eliminate congestion caused by the offset intersection of 45th Street and the presence of the CN railroad tracks located between these offset intersections.	Replace two three-spoke intersections with one four-spoke intersection, eliminating the need for through traffic on 45th St. to turn onto Calumet Ave. Construct an underpass to allow 45th St. traffic to avoid the at-grade rail crossing at Calumet Avenue Eliminate a major signalized intersection on Calumet Avenue	Time Travel Benefits	Traffic on 45th Avenue with decreased travel times through Calumet Ave; Traffic on Calumet Avenue experiencing reduced congestion	$15.9M	6
		Personal Injury Benefits	Individuals who avoid injury in auto accidents due to safer intersection conditions	$13.7M	8
		Property Damage Benefits	Individuals who avoid property loss in auto accidents due to safer intersection conditions	$3.9M	8
		Emissions Benefits	Local, Regional Population	$38.6K	10

Executive Summary

Net Present Value and Benefit Cost Ratio of
45th Street at Calumet Avenue Grade Separation Project

Table 2

All Non-Discounted Costs and Benefits are Denominated in 2015 Dollars

Cal. Year	Proj. Year	Construction Cost	Project Benefits: Travel Time	Property Damage	Personal Injury	Emissions	Non-Discounted Value of Benefits	Discounted Value of Benefits: 7% Discount Rate	3% Discount Rate
2016	0	(30,107,711)							
2017	1								
2018	2		1,107,489	295,583	1,027,659	3,168	2,433,899	2,125,861	2,294,183
2019	3		1,118,153	295,583	1,027,659	3,133	2,444,528	1,995,463	2,237,090
2020	4		1,128,735	295,583	1,027,659	3,098	2,455,075	1,872,965	2,181,303
2021	5		1,139,235	295,583	1,027,659	3,063	2,465,540	1,757,896	2,126,797
2022	6		1,149,653	295,583	1,027,659	3,028	2,475,923	1,649,812	2,073,546
2023	7		1,159,988	295,583	1,027,659	2,994	2,486,223	1,548,295	2,021,527
2024	8		1,170,241	295,583	1,027,659	2,959	2,496,441	1,452,951	1,970,714
2025	9		1,180,411	295,583	1,027,659	2,924	2,506,577	1,363,412	1,921,082
2026	10		1,190,499	295,583	1,027,659	2,889	2,516,630	1,279,327	1,872,609
2027	11		1,200,505	295,583	1,027,659	2,854	2,526,601	1,200,370	1,825,270
2028	12		1,210,428	295,583	1,027,659	2,820	2,536,490	1,126,232	1,779,043
2029	13		1,220,270	295,583	1,027,659	2,785	2,546,296	1,056,622	1,733,904
2030	14		1,230,029	295,583	1,027,659	2,750	2,556,021	991,269	1,689,831
2031	15		1,230,029	295,583	1,027,659	2,750	2,556,021	926,420	1,640,612
2032	16		1,230,029	295,583	1,027,659	2,750	2,556,021	865,813	1,592,828
2033	17		1,230,029	295,583	1,027,659	2,750	2,556,021	809,171	1,546,435
2034	18		1,230,029	295,583	1,027,659	2,750	2,556,021	756,234	1,501,393
2035	19		1,230,029	295,583	1,027,659	2,750	2,556,021	706,761	1,457,663
2036	20		1,230,029	295,583	1,027,659	2,750	2,556,021	660,524	1,415,207
2037	21		1,230,029	295,583	1,027,659	2,750	2,556,021	617,312	1,373,987
2038	22		1,230,029	295,583	1,027,659	2,750	2,556,021	576,928	1,333,968
2039	23		1,230,029	295,583	1,027,659	2,750	2,556,021	539,185	1,295,115
2040	24		1,230,029	295,583	1,027,659	2,750	2,556,021	503,911	1,257,393
2041	25		1,230,029	295,583	1,027,659	2,750	2,556,021	470,945	1,220,770
2042	26		1,230,029	295,583	1,027,659	2,750	2,556,021	440,135	1,185,213
2043	27		1,230,029	295,583	1,027,659	2,750	2,556,021	411,341	1,150,693
2044	28		1,230,029	295,583	1,027,659	2,750	2,556,021	384,431	1,117,177
2045	29		1,230,029	295,583	1,027,659	2,750	2,556,021	359,281	1,084,638
2046	30		1,230,029	295,583	1,027,659	2,750	2,556,021	335,777	1,053,047
	Residual							4,796,815	35,101,555
	Total PV	**(30,107,711)**						**33,581,460**	**82,054,590**
							Net Present Value of Project	**3,473,749**	**51,946,879**
							Benefit/Cost Ratio	**1.12**	**2.73**

1. *Discount rates of 7% and 3% are used per instructions in the TIGER Benefit-Cost Analysis (BCA) Resource Guide*
2. *See following description for detailed discussion of assumptions used in this analysis*

Project Description and Cost

The 45th Street grade separation project is intended to alleviate congestion and improve travel conditions on two busy travel corridors in Munster, Indiana. Currently, 45th Street (East/West traffic) intersects Calumet Avenue (North/South traffic) with two offset "T" (three-spoke) intersections. Through traffic moving East-West on 45th Street must currently make a left turn on to Calumet Avenue, and then a right turn to continue eastbound/westbound on 45th Street. This project will realign the eastern leg of 45th Street, replacing the two three-spoke intersection with one four-spoke intersection, eliminating the need for any turning actions for through traffic on 45th Street.

In addition, 45th Street traffic must currently cross an at-grade rail crossing at Calumet Avenue. This crossing, with 39 minutes of gate-down time daily, causes significant traffic delays. The reconfigured intersection will feature an underpass that will allow East-West traffic on 45th Street bypass the at-grade rail crossing.

Base Case and Alternative Case Scenarios

The base case for this analysis (no build scenario) assumes no modifications to the intersection configurations. The MPO Traffic Demand model was used to produce no-build traffic metrics for the years 2018 and 2030. The alternative case (build scenario) incorporates the intersection reconfiguration, and avoidance of the at-grade rail crossing for 45th Street traffic. The MPO TDM model was also used to generate comparable metrics for the build scenario.

A second phase of the project has been proposed that involves removing the at-rail crossing for North-South traffic on Calumet Avenue. This second phase of the project is outside the scope of this analysis and has not been included in either the costs or the benefits included here.

Project Costs

The estimated construction costs for the project are listed in Table 3. The project costs contain construction items directly related to the roadway and underpass construction. The project costs, as provided by the project engineer, are denominated in 2015 dollars..

Table 3
45th Street at Calumet Avenue Grade Separation Project Construction Costs

Item	Cost
Construction Costs (2015 Dollars)	
Drainage	$3,210,446
Signals and Lighting	1,450,000
Roadway Items	3,769,062
Mobilization	1,692,661
Tunnel	5,872,931
Walls	2,723,616
Railroad Items	6,371,044
Contingency (20%)	5,017,952
Total Construction Cost (2015 Dollars)	**$30,107,711**

Maintenance and Operating Costs

This analysis assumes that there is not a material difference in maintenance costs between the no-build and build scenarios. The project involves the reconfiguration of a current intersection, the elimination of a three-way controlled intersection and the addition of a railroad underpass. The NIRPC MPO modeling estimates similar amounts of traffic (in terms of vehicle miles traveled) between the two scenarios (less than 2% difference). Because estimated maintenance costs in the build scenario do not differ materially from the no-build scenario, ongoing maintenance costs have not been included in this analysis.

Project Timing and Study Period

Both costs and benefits in this analysis are denominated in 2015 dollars. Based on the current project schedule, 2016 is designated as Year 0 in the analysis. All of the construction costs are assumed to be expended in Year 0. Benefits begin accruing in the first year of operations, Year 2 of the analysis. Annual benefits are reported through Year 30 of the project. This project significantly changes the local transportation infrastructure, and long-term benefits are expected. Thus, the residual (discounted) value of benefits beyond Year 30 of the project are included in the analysis.

Benefits of Travel Time Reduction

The reconfiguration of the 45th Street intersection will improve travel efficiencies at that location, leading to reductions in travel time for roadway users. The proposed realignment will allow east/west motorists to proceed through the 45th Street/ Calumet Avenue intersection more quickly, without encountering an at-grade rail crossing, and will reduce north/ south congestion on Calumet Avenue. These benefits were modeled by using the Metropolitan Planning Organization's (NIRPC) traffic demand model (TDM) to simulate the effect of the intersection realignment on the traffic network.

Intersection Reconfiguration

The TDM was used to simulate the effects of the reconfiguration on both traffic travelling east /west on 45th Street and north/south on Calumet Avenue. The output data was filtered so that only the effects attributable to the project were measured. The model was used to estimate 2018 and 2030 traffic impacts. Impacts for intermediate years were interpolated from these two points. Impacts for later years were estimated at the 2030 levels.

In the "Build" scenario, average trip time for traffic on the 45th Street is reduced by approximately 10% in 2018 and 12.5% in 2030. Travel times for through traffic moving north/south on Calumet Avenue are reduced by 2.5% in 2018 and 4.6% in 2030 in the build scenario. In total, this travel time reduction represents an annual savings of nearly 84,000 hours in 2030.

Table 4

Estimate of Time Travel Savings Due to Intersection Reconfiguration

	Daily Traffic No-Build	Avg Trip Time (Minutes) No-Build	Build	Savings	Valuation of Time	Time Savings Daily	Annual
2018 Scenario							
45th St. Corridor	26,438	6.03	5.43	(0.60)	$ 13.27	$3,526	$916,633
Calumet Ave.	17,770	3.16	3.08	(0.08)	$ 13.27	$327	$84,897
Total 2018 Time Savings						**$3,852**	**$1,001,530**
2030 Scenario							
45th St. Corridor	23,067	6.12	5.42	(0.70)	$ 13.27	$3,575	$929,496
Calumet Ave.	21,099	3.26	3.11	(0.15)	$ 13.27	$705	$183,364
Total 2030 Time Savings						**$4,280**	**$1,112,860**

Sources:
Trip counts and average trip time: NIRPC Travel Demand Model
Valuation of Time: TIGER Benefit-Cost-Analysis (BCA) Resource Guide; 4/4/2014, adjusted to 2015 dollars using GDP price deflator.
Annual time savings are calculated for weekday road users

Grade Crossing Avoidance

As part of the intersection reconfiguration, east/west 45th Street traffic will no longer encounter the at-grade rail crossing on Calumet Avenue. The NIRPC TDM is not configured to simulate the effects of avoiding at-grade rail crossings. However, an analysis from NIRPC on the estimated impact of at -grade rail crossings was available. This analysis is in draft form, and not yet incorporated into NIRPC's transportation planning process, but is informative for the purposes of this analysis.

Table 5

Estimate of Time Travel Savings for 45th Street Traffic from Avoiding the Calumet Avenue Rail Crossing

	2018	2030
1. Daily Trips (no-build scenario)	29,498	32,619
2. Pct. of autos delayed at crossing	2.7%	2.7%
3. Average delay time (minutes)	2.3	2.3
4. Avg. daily delay (hours)	31	34
5. Value of Time	$13.27	$13.27
Annual Value of Delay (2015 Dollars)	**$105,959**	**$117,169**

Estimate of daily trips is from NIRPC TDM analysis. Estimate of percent of traffic delayed and average delay time for the Calumet Avenue rail

According to the NIRPC analysis, the rail crossing gate is down at the Calumet Avenue crossing for 39 minutes per day, causing an average delay of 2.3 minutes for 2.7% of the road traffic. These parameters were applied to the number of trips attributable to east/west 45th Street traffic (excluding north/ south Calumet Avenue through traffic). Based on these assumptions, the avoidance of the Calumet Avenue rail crossing results in $106K in annual time savings in 2018, and $117K in annual time savings in 2030.

The estimated time travel savings are based on existing (no-build scenario) trips. As the transportation network is improved, traffic will increase as individuals choose more efficient routes. These "induced" savings are not included in this analysis. Thus, this analysis understates the total time savings impact of the project.

Annual Time Travel Benefits

The time travel benefits of the intersection reconfiguration and rail crossing avoidance were aggregated and estimated annually. Annual estimates were produced over a 30 year time horizon. Because the project will produce long-term benefits, the residual value of benefits beyond the initial 30 year period is included in the analysis.

The present value of time travel benefits was calculated using 7% and 3% discount rates. The project produces $15.9M in time travel benefits when discounted at 7%, and $39.1M in time travel benefits when discounted at 3%. Because the project is a long-term public infrastructure project, the 3% discount rate is the more appropriate measure of opportunity cost.

Project Travel Time Benefits — Estimated Annually **Table 6**

All Non-Discounted Benefits are Denominated in 2015 Dollars

Year	Proj. Year	Intersection Reconfiguration 45th St.	Intersection Reconfiguration Calumet Ave.	Grade Crossing Avoidance	Non-Discounted Value of Benefits	Discounted Value of Benefits 7% Rate	Discounted Value of Benefits 3% Rate
2016	0						
2017	1						
2018	2	916,633	84,897	105,959	1,107,489	967,324	1,043,915
2019	3	919,153	92,107	106,894	1,118,153	912,746	1,023,269
2020	4	921,409	99,499	107,828	1,128,735	861,107	1,002,867
2021	5	923,402	107,071	108,762	1,139,235	812,259	982,714
2022	6	925,132	114,825	109,696	1,149,653	766,062	962,816
2023	7	926,599	122,759	110,630	1,159,988	722,382	943,176
2024	8	927,802	130,874	111,564	1,170,241	681,091	923,799
2025	9	928,743	139,170	112,498	1,180,411	642,065	904,687
2026	10	929,420	147,647	113,432	1,190,499	605,189	885,843
2027	11	929,834	156,305	114,366	1,200,505	570,351	867,270
2028	12	929,984	165,144	115,300	1,210,428	537,445	848,970
2029	13	929,872	174,164	116,235	1,220,270	506,369	830,944
2030	14	929,496	183,364	117,169	1,230,029	477,026	813,194
2031	15	929,496	183,364	117,169	1,230,029	445,819	789,509
2032	16	929,496	183,364	117,169	1,230,029	416,653	766,513
2033	17	929,496	183,364	117,169	1,230,029	389,396	744,187
2034	18	929,496	183,364	117,169	1,230,029	363,921	722,512
2035	19	929,496	183,364	117,169	1,230,029	340,113	701,468
2036	20	929,496	183,364	117,169	1,230,029	317,863	681,037
2037	21	929,496	183,364	117,169	1,230,029	297,068	661,201
2038	22	929,496	183,364	117,169	1,230,029	277,634	641,943
2039	23	929,496	183,364	117,169	1,230,029	259,471	623,245
2040	24	929,496	183,364	117,169	1,230,029	242,496	605,093
2041	25	929,496	183,364	117,169	1,230,029	226,632	587,468
2042	26	929,496	183,364	117,169	1,230,029	211,805	570,358
2043	27	929,496	183,364	117,169	1,230,029	197,949	553,745
2044	28	929,496	183,364	117,169	1,230,029	184,999	537,617
2045	29	929,496	183,364	117,169	1,230,029	172,896	521,958
2046	30	929,496	183,364	117,169	1,230,029	161,585	506,755
Residual						2,308,361	16,891,849
PV of Benefits						**15,876,077**	**39,139,923**

Safety Benefits

A major objective of the Project is to alleviate traffic congestion and associated consequences at the 45th Street/Calumet Avenue intersection. The configuration of this intersection currently contributes to congestion because through traffic on 45th Street must make a left turn on to Calumet, and then a right turn back onto 45th Street. Eliminating these turning actions in an already congested corridor will lead to more efficient traffic movement, and fewer traffic accidents. This accident reduction represents a benefit of the project in terms of reduced property damage costs and personal injury costs. Additionally, the avoidance of an at-grade rail crossing for East/ West 45th Street traffic reduces the probability of dangerous train/auto collisions.

Accident Data

The NIRPC TDM does not have the capabilities to model the safety benefits of a change in the traffic network. Therefore, historical accident data was used to estimate the safety benefits of this project. The Munster Police Department provided accident reports on all accidents from 2011 to 2013 within a defined area surrounding the project intersection. This area was bounded by Fran Lin to the North, Superior to the South, Kennedy to the East, and Southwood to the West.

Because safety impacts were not available from the TDM analysis, a general assumption was utilized to estimate the reduction in traffic accidents attributable to the project. The "Desktop Reference for Crash Reduction Factors" produced by the Federal Highway Administration provides estimates of the safety improvements of specific safety counter-measures. These include converting an urban offset T intersection into a four-leg intersection (35% crash reduction, p 29.) and implementing double-left turn lanes (20%-75% crash reduction, p.21). Based on the guidelines contained in this resource, the Project is assumed to result in a 60% reduction in the number of accidents within the area of analysis.

Table 8

Valuation of Property Damage Due to Traffic Accidents

Year	Vehicles Involved	Damage per Vehicle	Value of Property Damage
2011	117	$4,016	$469,881
2012	94	$4,016	$377,511
2013	157	$4,016	$630,524
2014 (P)	45	$4,016	$180,723
Total	**413**		**$1,658,639**
Avg '11-13	123	$4,016	$492,639
Est. w/ Project	49	$4,016	$197,055
Estimated benefit of accident reduction			$295,583

1. *Traffic accident data is from the Munster Police Department*
2. *Property damage valuations as provided by TIGER Benefit-Cost (BCA) Resource Guide, adjusted to 2015 dollars.*

Property Damage Savings

Between 2011 and early 2014, 123 vehicles were involved in collisions near the 45th Street/Calumet Avenue intersection, causing an estimated $1.7M in property damage. The network improvement provided by the project will produce an estimated savings of $296K annually due to reduced property damage.

Table 7

Conversion of Accident Data to AIS Scale and Valuation of Injury Accidents

Historical Accident Data from Munster Police Department (2011 to 2013)

Code	Description	Economic Value	Possible Injury Probability	Possible Injury Value	Non-Incapacitating Probability	Non-Incapacitating Value	Incapacitating Probability	Incapacitating Value	Unknown if Injured Probability	Unknown if Injured Value	Total Value
	Accident Count (2011 to 2014)		**4**		**31**		**2**		**1**		
AIS 0	No Injury	-	0.234	-	0.083	-	0.034	-	0.437	-	-
AIS 1	Minor	28,226	0.689	77,843	0.768	672,382	0.554	31,302	0.417	11,781	793,308
AIS 2	Moderate	442,208	0.064	113,046	0.109	1,493,947	0.209	184,914	0.089	39,233	1,831,139
AIS 3	Serious	987,912	0.011	42,322	0.032	977,252	0.144	285,250	0.048	47,588	1,352,411
AIS 4	Severe	2,502,709	0.001	14,215	0.006	481,021	0.040	199,516	0.006	15,442	710,194
AIS 5	Critical	5,579,348	0.000	2,901	0.001	174,689	0.018	198,960	0.003	15,566	392,117
AIS 6	Unsurvivable	9,408,681	-	-	-	-	-	-	-	-	
	Total: 2011 to 2013			**250,328**		**3,799,291**		**899,941**		**129,610**	**5,079,169**
									Average annual personal injury cost		1,693,056
									Estimated benefit of accident reduction (60%)		1,015,834

1. *Traffic accident data (including severity information) is from the Munster Police Department*
2. *Valuations for accident severity as provided by TIGER Benefit-Cost (BCA) Resource Guide, adjusted to 2015 dollars using the GDP deflator.*

Safety Benefits

Personal Injury Savings

From the period from 2011 to 2013, there were a total of 38 accidents involving personal injury within the area of analysis. When evaluated with the AIS incident scale, these accidents resulted in approximately $5.0M in personal injury costs, or $1.7M annually. Using the methodology previously described, the project will produce an estimated $1.0M annually in personal injury avoidance benefits.

Though there have been historically few train-vehicle collisions at the Calumet Avenue crossing, the Federal Railroad Administration predicts a 1.7% chance of a collision at this specific crossing in a given year. Eliminating the at-grade crossing for east/west 45th Street traffic produces an annual personal injury benefit of $11,825 annually.

When these safety benefits are aggregated the Project produces a total safety benefit of $17.7M when discounted at 7%, or $42.8M when discounted at 3%.

Project Safety Benefits — Estimated Annually **Table 9**

All Non-Discounted Benefits are Denominated in 2015 Dollars

		Safety Savings				Discounted Value of Benefits	
Year	Proj. Year	Intersection	Rail Crossing	Property Damage Savings	Non-Discounted Value of Benefits	7% Rate	3% Rate
2016	0						
2017	1						
2018	2	1,015,834	11,825	295,583	1,323,242	1,155,771	1,247,282
2019	3	1,015,834	11,825	295,583	1,323,242	1,080,159	1,210,954
2020	4	1,015,834	11,825	295,583	1,323,242	1,009,495	1,175,683
2021	5	1,015,834	11,825	295,583	1,323,242	943,453	1,141,440
2022	6	1,015,834	11,825	295,583	1,323,242	881,732	1,108,194
2023	7	1,015,834	11,825	295,583	1,323,242	824,048	1,075,917
2024	8	1,015,834	11,825	295,583	1,323,242	770,139	1,044,579
2025	9	1,015,834	11,825	295,583	1,323,242	719,756	1,014,155
2026	10	1,015,834	11,825	295,583	1,323,242	672,669	984,616
2027	11	1,015,834	11,825	295,583	1,323,242	628,663	955,938
2028	12	1,015,834	11,825	295,583	1,323,242	587,535	928,095
2029	13	1,015,834	11,825	295,583	1,323,242	549,098	901,063
2030	14	1,015,834	11,825	295,583	1,323,242	513,176	874,819
2031	15	1,015,834	11,825	295,583	1,323,242	479,604	849,339
2032	16	1,015,834	11,825	295,583	1,323,242	448,228	824,601
2033	17	1,015,834	11,825	295,583	1,323,242	418,904	800,583
2034	18	1,015,834	11,825	295,583	1,323,242	391,500	777,265
2035	19	1,015,834	11,825	295,583	1,323,242	365,887	754,626
2036	20	1,015,834	11,825	295,583	1,323,242	341,951	732,647
2037	21	1,015,834	11,825	295,583	1,323,242	319,580	711,308
2038	22	1,015,834	11,825	295,583	1,323,242	298,673	690,590
2039	23	1,015,834	11,825	295,583	1,323,242	279,134	670,476
2040	24	1,015,834	11,825	295,583	1,323,242	260,873	650,947
2041	25	1,015,834	11,825	295,583	1,323,242	243,806	631,988
2042	26	1,015,834	11,825	295,583	1,323,242	227,856	613,580
2043	27	1,015,834	11,825	295,583	1,323,242	212,950	595,709
2044	28	1,015,834	11,825	295,583	1,323,242	199,018	578,358
2045	29	1,015,834	11,825	295,583	1,323,242	185,999	561,513
2046	30	1,015,834	11,825	295,583	1,323,242	173,830	545,158
	Residual					2,483,292	18,171,937
PV of Benefits						**17,666,780**	**42,823,359**

Air Quality Benefits

By alleviating congestion, the 45th Street intersection reconfiguration project will have measurable impacts on local air quality. NIRPC's travel demand model produces estimates of the difference in emissions levels for various road network configurations. The model estimates emissions levels for three common pollutants Volatile Organic Compounds (VOC), Nitrous Oxide (NOx), and Carbon Monoxide (CO).

The TIGER Benefit Cost Analysis (BCA) Resource Guide provides standard valuations for VOC and NOx emissions. These valuations were applied the estimated air quality impact of the Project to estimate annual benefits.

When the emissions benefits estimated by the TDM are monetized using the proscribed valuations, the Project produces an estimated air quality benefit of $3,168 annually in 2018, and $2,750 annually in 2030. In cumulative discounted terms, the project generates $38,603 in total emissions benefits when discounted at 7%, and $91,308 when discounted at 3%.

Valuation of Air Quality Benefits in Build Scenario **Table 10**

	Reduction in Emissions (grams daily)			Value per	Annual
	45th St	Calumet Ave	Total	Metric Ton	Benefit ($)
2018 Scenario					
Volatile Organic Compounds (VOC)	1,172	91	1,263	$2,044	$671
Nitrous Oxide (NOx)	1,187	5	1,192	$8,056	$2,497
Total Annual Benefit					**$3,168**
2030 Scenario					
Volatile Organic Compounds (VOC)	1,098	154	1,252	$2,044	$666
Nitrous Oxide (NOx)	986	10	995	$8,056	$2,085
Total Annual Benefit					**$2,750**

Source: NIRPC Travel Demand Model

Benefit-Cost Ratio

Net Present Value and Benefit Cost Ratio of
45th Street at Calumet Avenue Grade Separation Project

Table 11

All Non-Discounted Costs and Benefits are Denominated in 2015 Dollars

Cal. Year	Proj. Year	Construction Cost	Project Benefits: Travel Time	Project Benefits: Property Damage	Project Benefits: Personal Injury	Project Benefits: Emissions	Non-Discounted Value of Benefits	Discounted Value of Benefits: 7% Discount Rate	Discounted Value of Benefits: 3% Discount Rate
2016	0	(30,107,711)							
2017	1								
2018	2		1,107,489	295,583	1,027,659	3,168	2,433,899	2,125,861	2,294,183
2019	3		1,118,153	295,583	1,027,659	3,133	2,444,528	1,995,463	2,237,090
2020	4		1,128,735	295,583	1,027,659	3,098	2,455,075	1,872,965	2,181,303
2021	5		1,139,235	295,583	1,027,659	3,063	2,465,540	1,757,896	2,126,797
2022	6		1,149,653	295,583	1,027,659	3,028	2,475,923	1,649,812	2,073,546
2023	7		1,159,988	295,583	1,027,659	2,994	2,486,223	1,548,295	2,021,527
2024	8		1,170,241	295,583	1,027,659	2,959	2,496,441	1,452,951	1,970,714
2025	9		1,180,411	295,583	1,027,659	2,924	2,506,577	1,363,412	1,921,082
2026	10		1,190,499	295,583	1,027,659	2,889	2,516,630	1,279,327	1,872,609
2027	11		1,200,505	295,583	1,027,659	2,854	2,526,601	1,200,370	1,825,270
2028	12		1,210,428	295,583	1,027,659	2,820	2,536,490	1,126,232	1,779,043
2029	13		1,220,270	295,583	1,027,659	2,785	2,546,296	1,056,622	1,733,904
2030	14		1,230,029	295,583	1,027,659	2,750	2,556,021	991,269	1,689,831
2031	15		1,230,029	295,583	1,027,659	2,750	2,556,021	926,420	1,640,612
2032	16		1,230,029	295,583	1,027,659	2,750	2,556,021	865,813	1,592,828
2033	17		1,230,029	295,583	1,027,659	2,750	2,556,021	809,171	1,546,435
2034	18		1,230,029	295,583	1,027,659	2,750	2,556,021	756,234	1,501,393
2035	19		1,230,029	295,583	1,027,659	2,750	2,556,021	706,761	1,457,663
2036	20		1,230,029	295,583	1,027,659	2,750	2,556,021	660,524	1,415,207
2037	21		1,230,029	295,583	1,027,659	2,750	2,556,021	617,312	1,373,987
2038	22		1,230,029	295,583	1,027,659	2,750	2,556,021	576,928	1,333,968
2039	23		1,230,029	295,583	1,027,659	2,750	2,556,021	539,185	1,295,115
2040	24		1,230,029	295,583	1,027,659	2,750	2,556,021	503,911	1,257,393
2041	25		1,230,029	295,583	1,027,659	2,750	2,556,021	470,945	1,220,770
2042	26		1,230,029	295,583	1,027,659	2,750	2,556,021	440,135	1,185,213
2043	27		1,230,029	295,583	1,027,659	2,750	2,556,021	411,341	1,150,693
2044	28		1,230,029	295,583	1,027,659	2,750	2,556,021	384,431	1,117,177
2045	29		1,230,029	295,583	1,027,659	2,750	2,556,021	359,281	1,084,638
2046	30		1,230,029	295,583	1,027,659	2,750	2,556,021	335,777	1,053,047
	Residual							4,796,815	35,101,555
	Total PV	**(30,107,711)**						**33,581,460**	**82,054,590**
							Net Present Value of Project	**3,473,749**	**51,946,879**
							Benefit/Cost Ratio	**1.12**	**2.73**

The 45th Street Corridor Project produces $33.6M in total benefits once completed (present dollars, 7% discount rate), while project costs total $30.1M in 2015 dollars.

The resulting net present value of the project is $3.5M, with a benefit to cost ratio of 1.12. Using a 3% discount rate, the net present value of the project is $51.9M, and the benefit to cost ratio is 2.73.