Benefit-Cost Analysis of EW2 Segment A

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Prepared for:

CREATE
KEEPING THE GO IN CHICAGO

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TABLES

ACRONYMS

AIS	Abbreviated Injury Scale (AIS)
AADT	Annual Average Daily Traffic
ADA	Americans with Disabilities Act
ATRI	American Transportation Research Institute
BCA	Benefit-Cost Analysis
BRC	Belt Railroad Company
CN	Canadian National
CO_2	Carbon Dioxide
CP	Canadian Pacific
CREATE	Chicago Region Environmental and Transportation Efficiency
FHWA	Federal Highway Administration
GDP	Gross Domestic Product
IMR	Interchange Modification Report
KABCO	Injury classification scale
LOS	Level of Service
mph	Miles per Hour
NO_x	Nitrogen Oxide
NPV	Net Present Value
NS	Norfolk Sothern
O&M	Operating and Maintenance
PDO	Property Damage Only
$PM_{2.5}$	Particulate Matter
PV	Present Value
RTC	Rail Traffic Controller
SO_2	Sulfur Dioxide
UP	Union Pacific
USDOT	United States Department of Transportation
VHT	Vehicle Hours Traveled
VMT	Vehicle Miles Traveled
VOCs	Volatile Organic Compounds
VOT	Value of Time

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I. INTRODUCTION

This report documents the Benefit-Cost Analysis (BCA) that evaluates the benefits to society resulting from the Chicago Region Environmental and Transportation Efficiency (CREATE) Program improvements associated with the EW2 Segment A Project. The BCA demonstrates the cost effectiveness of the Project for which the sponsors are seeking federal support, measured in terms of a Benefit-Cost (B/C) ratio and Net Present Value (NPV).

I.1 EW2 Segment A Project

The EW2 Segment A project (the Project) focuses on implementing the next key phase of construction in the 75th Street Corridor Improvement Project (75th St CIP) by delivering a suite of safety, speed, and state of good repair enhancements at Forest Hill, Belt, and 80th Street Junctions. These enhancements will be implemented along a 3-mile elevated rail corridor on Chicago's South Side that serves the Belt Railroad Company (BRC), Canadian National (CN), CSX, Norfolk Southern (NS), and Union Pacific (UP) railroads, in addition to Amtrak and Metra passenger rail. These enhancements include:

- Reconfiguring the east-west tracks at Forest Hill Junction,
- Adding a third track to the Norfolk Southern line,
- Replacing and restoring aging bridge structures, tracks, and viaducts,
- Modernizing signals, and
- Implementing community mobility improvements on streets throughout the corridor.

As part of the greater 75th St CIP, the EW2A phase will build upon the Forest Hill Flyover (P3) and 71st Street Grade Separation (GS19) projects that are currently under construction. EW2A also serves as foundational for delivering the future phases of the Belt Junction and 80th Street Junction Replacement project (EW2B-D), focused on additional track realignment, reconstruction, and replacement work, and the Metra Rock Island Connection project (P2), which will eliminate passenger and freight rail conflict points and will build a new flyover structure to connect the Metra's SouthWest Service (SWS) to its Rock Island Line. Once fully implemented, the 75th Street CIP will serve to cut rail traffic delay and emissions and increase safety at the most complex and congested rail junction in the Chicago Terminal 1 (Terminal), yielding substantial benefit towards the Chicago region's freight economy, passenger rail service, infrastructure resilience, and the national distribution of commodities and goods.

I.2 BCA Model Development

The Benefit-Cost Analysis is based on freight rail, passenger rail, and traffic data in the Project area.

A spreadsheet-based BCA model was constructed for the purposes of this analysis. The model uses Rail Traffic Controller (RTC) modeling outputs for different scenarios, City of Chicago data, and global parameters. Many of the global parameters were provided by the United States Department of Transportation (USDOT) specifically for the purposes of completing BCAs in support of grant applications.

Using both Project-specific inputs and global parameters, the BCA model calculates life-cycle costs, life-cycle benefits, annual benefits, the NPV of quantifiable costs and benefits, and the resulting B/C ratio, utilizing a methodology that aligns with the most recent USDOT guidance.

I.3 Organization of BCA Memorandum

Section II describes the mechanisms that generate the benefits of the Project and the classes of benefits evaluated.

Section III describes the inputs and parameters to the BCA model

Section IV describes the detailed methodology for computing Project benefits, including an illustration of the benefits calculated for an example year for the Project.

Section IV.8 summarizes the BCA results and the resulting B/C ratio.

Appendix A provides detailed tabulations of annual benefits and costs for the overall Project.

II. PROJECT BENEFITS AND COSTS

II.1 Benefits of the Project

The Project is expected to generate benefits through several mechanisms:

- Avoided rail delay under typical operations
- Avoided additional passenger rail costs resulting from train delay
- Avoided freight delay resulting from track closures
- Avoided passenger rail diversion resulting from track closures
- External benefits of avoided freight diversion to trucks from reduced capacity
- Avoided rail diversion from reduced capacity
- Traffic delay savings resulting from reduced gate down time
- Reduced crashes resulting from improved viaduct lighting
- Reduced crime resulting from improved viaduct lighting

The methodology for evaluating each of these benefits is discussed in Section IV.

Table 1: Project Matrix

Current Status / Baseline & Problem to be Addressed	The project reduces conflicts and congestion between freight trains, passenger rail, and roadway users in Chicago's South Side.
Change to Baseline / Alternatives	Build Scenario includes reconfiguring the east-west tracks at Forest Hill Junction; adding a third track to the Norfolk Southern line; replacing and restoring aging bridge structures, tracks, and viaducts; modernizing signals; and implementing community mobility improvements on surface streets throughout the corridor.
Type of Impacts	Reduced freight delay, reduced idling, travel time savings, reduced vehicle operating costs, reduced crashes, reduced emissions damage, reduced crime, improved freight movement and economic vitality, and improved operational efficiency.
Affected Population	Daily local users and commercial through-traffic.
Economic Benefit	The BCA indicates that the Project will result in travel time savings,traffic delay savings, crash cost reductions, and trip diversion benefits.
Summary of Results	Benefit/Cost ratio greater than 1.0 indicates that the Project generates benefits to society that exceed its costs.

In addition to the benefit classes quantified in this analysis, the Project is expected to generate other benefits including:

- Passenger rail ridership impacts,
- Track usage and pilot fees associated with rerouted freight movement, and
- Reduced community externalities resulting from a more efficient freight network

II.2 Costs of the Project

Construction costs are estimated to be $434,358,680 (2029$) spent between 2027 and 2030. These values are show in Table 2.

Table 2: Project Construction Costs

Year	Project Total	Units
Cost Estimate	$434,358,680	***2029$***
Base Dollar Value	$355,220,867	***2021$***
Discounted Value	$214,467,690	***2021$***

The project will also significantly reduce the maintenance costs of the existing infrastructure. Throughout the duration of this analysis, the Project will likely only incur inspection costs. Because projected maintenance cost estimates are not available, the incremental cost savings are not quantified in this analysis.

III. MODEL INPUTS AND PARAMETERS

III.1 Period of Analysis

Benefits were evaluated for a period of 30 years beginning with the opening of the Project in 2031 and ending in 2056.

Table 3: Project Schedule

Factor	Year
Construction Start	2027
Opening Year	2031

III.2 Base Year of Analysis

Per USDOT BCA guidance, this analysis was conducted in constant 2021 dollars. All benefits and costs are discounted to 2021 at a 7% discount rate, except for carbon-related benefits which are discounted at 3%.

III.3 Residual Value

This analysis estimates the residual value of the Project based on a useful life of 75 years and a project opening year of 2027. The undiscounted residual value in year 2061 is $213,132,520 (2021$).

III.4 Rail Network Performance

RTC modeling was performed by HDR, Inc. on the Project area to understand the impact of the Project to the overall network. All model outputs are provided for years 2022, 2027, 2032, 2037, 2042, and 2047. This analysis extrapolates values for all interim years to asses project benefits on an annual basis.

RTC modeling was used to develop railroad forecasts for five scenarios. Each of the scenarios, as described below, account for the projected growth in rail volumes and their impact on the network

- The **Base** scenario describes the network under typical operations if the Project is not completed.
- The **Build** scenario describes the network after the Project is completed.
- The **Out (1N)** and **Out (1S)** scenarios describe the network if one north or one south track along the alignment must be closed as a result of a critical inspection finding resulting from the deteriorating state of good repair. These scenarios account for any rerouting or slow zones resulting from the track closure. Depending on the type of impact, either a single north track or a single south track is expected to be closed. As a measure of conservativeness, the analysis assumes that the corridor would not close both the north and south track concurrently.
- The **Out (All)** scenario describes the network if the entire rail segment must be closed if the segment is no longer usable. This scenario assumes that all rail traffic will need to be rerouted. As a measure of conservativeness, this scenario is not used in this analysis.

Based on the current conditional of the railroad assets, the risk factors summarized in Table 4 were used in the analysis to estimate the likelihood that one of the three track closure scenarios would occur. This analysis also assumes that after year 2047, the rail infrastructure would reach a level of deterioration that would no longer support single-track closures and would require either a full segment closure or diverting local freight traffic to trucks.

Table 4: Track Closure Risk Factors

Factor	2022	2027	2032	2037	2042	2047	2052	Units
OUT (1N)								
Probability of Impact	0%	0%	10%	30%	50%	50%	50%	*%*
Duration of Impact	365	365	365	365	365	365	365	*days/year*
OUT (1S)								
Probability of Impact	0%	0%	10%	30%	50%	50%	50%	*%*
Duration of Impact	365	365	365	365	365	365	365	*days/year*
OUT (ALL)								
Probability of Impact	0%	0%	0%	0%	0%	0%	0%	*%*
Duration of Impact	-	-	-	-	-	-	-	*days/year*

Table 5 summarizes the projected rail delays by scenario. While the model shows the expected passenger rail delay under the track closure scenarios, this analysis assumes that under that scenario, passenger rail operations would be halted under this scenario.

Table 5: Rail Delay Time (hours/year)

Factor	2022	2027	2032	2037	2042	2047	2052
BASE							
Passenger	1,009	866	1,091	1,660	1,865	1,149	1,480
Freight	11,268	12,561	18,233	20,767	27,844	32,687	45,822
BUILD							
Passenger	906	842	986	1,807	1,131	1,211	1,352
Freight	9,600	10,186	15,232	19,326	22,872	30,367	38,808
OUT (1N)							
Passenger	920	800	735	1,409	1,530	1,530*	1,530*
Freight	13,935	20,788	25,986	33,437	47,600	47,600*	47,600*
OUT (1S)							
Passenger	1,504	1,398	1,239	2,140	2,461	1,947	1,947*
Freight	13,247	14,838	21,198	28,071	33,406	41,571	41,571*

* Denotes model network saturation.

III.5 Gate Down Time

The projected gate down time and traffic volumes at impacted railroad crossings in the Project area were considered to estimate the impact of the Project on local traffic. Table 6 shows the traffic volume and gate down time for each railroad crossing location in the base year. Traffic volume data is collected through Illinois Department of Transportation (IDOT) traffic counts and gate down times and instances are outputs from RTC modeling. This analysis assumes a 0.6% annual growth rate for roadway traffic derived from CMAP traffic forecasts for the project area. The growth for the gate down time is proportional to the projected rail volume growth and resulting network delay under each scenario. The analysis also considers an additional 20 second buffer for gate down time.

Table 6: Traffic Volume and Gate Down Time

Location	Traffic Volume [A] *(vehicles/day)*	Gate Down Duration (*minutes/day*) [B]				Gate Down Occurrences (*times/day*) [B]			
		Base	Build	Out 1N	Out 1S	Base	Build	Out 1N	Out 1S
Broadway St	4,300	48.7	46.9	77.3	123.3	13.5	13.0	19.8	32.0
Chatham St	750	68.4	66.3	100.6	132.6	15.5	15.0	26.0	36.3
Clark Rd	1	119.5	121.2	128.0	129.4	43.0	44.3	45.0	44.3
E 137th St	825	135.9	113.9	208.0	244.8	23.3	17.3	32.5	41.3
E 138th St	9,550	125.6	119.3	178.0	225.4	36.0	42.5	38.8	48.3
Kennedy Ave	1	55.9	56.6	64.5	85.1	25.5	25.8	31.0	40.8
S Perry Ave	575	147.7	129.6	220.5	253.5	23.3	17.3	32.3	40.8

Table 6 (cont.): Traffic Volume and Gate Down Time

Location	Traffic Volume [A] *(vehicles/day)*	Gate Down Duration (*minutes/day*) [B]				Gate Down Occurrences (*times/day*) [B]			
		Base	Build	Out 1N	Out 1S	Base	Build	Out 1N	Out 1S
Union St	950	50.6	38.6	56.8	57.8	14.5	12.5	16.3	16.5
Western Ave	5,750	51.6	54.5	89.4	119.0	15.5	15.3	26.3	36.0
W 103rd St	18,400	36.7	30.6	41.8	42.0	27.3	33.0	22.0	22.3
W 104th St	525	36.6	30.6	41.7	41.8	14.0	12.0	16.0	16.3
W 105th St	1,200	36.6	30.6	41.7	41.8	14.0	12.0	16.3	16.5
W 107th St	1,800	36.5	30.7	41.7	41.8	27.3	33.0	22.5	22.5
W 109th St	1,250	36.4	30.7	41.7	41.8	27.5	33.3	22.8	22.8
W 111th St	13,100	36.7	31.0	42.0	42.0	27.5	33.0	22.8	22.5
W 113th St	725	36.8	31.2	42.2	42.1	14.3	12.3	16.8	16.5
W 115th St	9,600	37.3	31.7	42.9	42.4	27.5	33.3	22.8	22.5
W 119th St	11,800	39.8	33.4	45.8	45.6	14.5	12.5	16.5	16.5
W 123rd St	5,250	43.3	35.2	49.1	49.7	14.5	12.5	16.5	16.8
W 127th St	21,400	48.5	37.6	54.4	55.4	14.5	12.5	16.3	16.5
W 71st St	9,600	300.1	255.3	314.3	349.7	20.5	20.8	17.8	24.5
W 87th St	25,600	54.2	47.6	64.8	69.0	14.3	12.3	16.3	16.0
W 91st St	3,850	46.1	38.2	52.7	53.9	14.3	12.3	16.5	16.3
W 99th St	10,200	38.1	31.4	43.4	43.7	14.0	12.0	16.0	16.3
E 130th St	16,700	49.3	78.0	13.5	13.5	12.8	20.5	6.0	6.0
E 138th St	1,800	47.3	83.0	16.1	16.1	36.0	42.5	38.8	48.3
Lincoln Ave	3,350	48.2	83.3	16.0	16.0	13.0	20.8	6.0	6.0
S State St	2,900	32.0	47.0	9.0	9.0	13.3	21.0	6.0	6.0
S Wentworth Ave	2,450	30.1	45.1	8.8	8.8	13.3	21.0	6.0	6.0
W 101st St	2,150	31.7	44.2	11.5	11.5	13.3	20.8	6.0	6.0
W 103rd St	10,400	28.9	44.1	8.8	8.8	27.3	33.0	22.0	22.3
W 107th St	4,650	28.8	43.8	8.7	8.7	27.3	33.0	22.5	22.5
W 109th St	825	28.9	44.1	8.7	8.7	27.5	33.3	22.8	22.8
W 111th St	8,650	29.2	44.5	8.7	8.7	27.5	33.0	22.8	22.5
W 115th St	8,200	30.4	45.5	8.9	8.9	27.5	33.3	22.8	22.5
W 95th St	19,700	82.8	73.5	45.0	63.5	27.5	33.0	22.3	22.5
W 97th St	725	36.1	45.3	15.1	15.1	13.3	20.8	6.0	6.0

Source: A: IDOT 2022 AADT, from https://www.gettingaroundillinois.com/Traffic%20Counts/index.html

Source: B: RTC modeling output

III.6 Diversion Impacts

Based on the RTC model results, the infrastructure is at risk for degraded performance and reduced capacity beyond the track closure scenarios, resulting in the diversion of local freight to trucks and other regional freight diversions. To be conservative, this analysis assessed a five-year diversion beginning in year 2047 which represents when a capacity reduction may be in place and when an alternative long-term solution could be implemented. Table 7 summarizes the avoided truck VMT and tons of avoided non-intermodal freight movements diverted to other regions based on a Cambridge Systematics freight forecast analysis.

Table 7: Rail Diversion Analysis

Year	Truck Diversion VMT (VMT/year)	Non-Intermodal Movement Diversion (tons/year) [A]
2047	15,647,000	94,551,654
2048	31,763,047	95,308,068
2049	48,362,306	96,070,532
2050	65,459,382	96,839,096
2051	83,069,325	97,613,809

Source: Cambridge Systematics Rail Diversion & Truck Diversion Analysis, 2023

Source: A: Based on 2019 outputs and a CAGR of 0.80% derived from Cambridge Systematics Rail and Freight Forecast Analysis for CREATE 75th St. CIP Modeling Calculations, 2023

III.7 Crash Data

To estimate the benefits associated lighting improvements under viaducts, crash history was collected at the locations to be improved, as summarized in Table 8. The analysis applies a crash modification factor of 0.7 as a result of the lighting improvement.

Table 8: Improvement Area Crash History (incidents per year)

Factor	Crashes	Injuries	Fatalities
S Ashland and Belt Railroad	27.56	5.11	0.00
S Morgan and Belt Railroad	2.44	0.22	0.00
Peoria and Belt Railroad	3.33	0.00	0.00
W 72nd and NS/Metra Railroad	3.33	0.44	0.22
W 73rd and NS/Metra Railroad	0.22	0.00	0.00
W 76th and NS Railroad	13.56	2.22	0.00
W 78th and NS Railroad	0.67	0.00	0.00

Source: City of Chicago Data Portal. Traffic Crashes, from https://data.cityofchicago.org/Transportation/Traffic-Crashes-Crashes/85ca-t3if/

Cook County traffic and crash data was also used to estimate the incremental crash risk by severity when traffic volumes increase. The crash rates per 100 million vehicle miles traveled are summarized in Table 9: Cook County Crashes by Severity on page 9

Table 9: Cook County Crashes by Severity

Factor	Value	Units
VMT	102,220	*MVMT/year*
CRASH STATISTICS		
Crashes	295,604	*crashes/year*
Injuries	85,398	*injuries/year*
Fatalities	1,341	*fatalities/year*
CRASH RATES		
Crashes	289.184	*crashes/100MVMT*
Injuries	83.543	*injuries/100MVMT*
Fatalities	1.312	*fatalities/100MVMT*

Source: IDOT 2021 Crash Facts. https://idot.illinois.gov/content/dam/soi/en/web/idot/documents/transportation-system/resources/safety/crash-reports/crash-facts/2021-crash-facts.pdf

III.8 Crime Data

To estimate the benefits associated lighting improvements under viaducts, crime history was collected at the locations to be improved, as summarized in Table 10. The analysis assumes a 4% crime reduction based on a 2016 study.

Table 10: Improvement Area Crime History (incidents per year)

Factor	Burglary	Auto Theft	Larceny	Robbery	Murder	Rape	Assault
S Ashland and Belt Railroad	9.20	1.20	38.20	3.20	0.00	0.00	15.00
S Morgan and Belt Railroad	3.00	1.00	0.80	0.60	0.00	0.20	3.80
Peoria and Belt Railroad	3.60	2.40	2.60	1.00	0.00	0.00	7.80
W 72nd and NS/Metra Railroad	12.00	3.20	7.80	1.80	0.20	0.00	30.60
W 73rd and NS/Metra Railroad	7.80	1.60	5.20	1.40	0.00	0.00	16.00
W 76th and NS Railroad	12.80	4.00	5.40	1.00	0.00	0.40	15.20
W 78th and NS Railroad	9.00	1.40	5.80	2.20	0.00	0.20	14.00

Source: City of Chicago Data Portal. Crimes, from https://data.cityofchicago.org/Public-Safety/Crimes-2001-to-Present-Map/ahwe-kpsy/

III.9 Global Parameters

In addition to the project-specific data described in this section, the analysis also considers the following global parameter, including those provided in the USDOT guidance for completing BCAs.

III.10.i Freight Costs

To estimate the benefits associated with avoided freight delay cost, a real Gross Domestic Product (GDP) growth rate was applied to an hourly unit cost for freight reliability as derived by the Association of American Railroads. Average shipping rates by ton-mile provided by the Congressional Budget Office (CBO) are also used to estimate the impact of rail diversions.

The adjusted freight costs for year 2031 are shown in Table 11.

Table 11: Freight Costs

Factor	Value	Units
Freight Delay	$1,464.77	*2021$/hour*
Shipper Cost	$0.059	*2021$/ton-mile*

Source: A: Association of American Railroads, 2019 Class I Train Delay Cost Worksheet prepared using Public Data, 9/26/2021, aggregate of all train types, converted to 2021 dollars.

Source: B: Congressional Budget Office 2015 Pricing Freight Transport to Account for External Costs, Table A-4. https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/workingpaper/50049-Freight_Transport_Working_Paper-2.pdf

III.10.ii Crime Costs

To convert benefits for reduced crime, the unit values provided by the Federal Emergency Management Agency (FEMA) were inflated to 2021 dollars, as summarized in Table 12.

Table 12: Value of Crimes

Vehicle Type	Value	Units
Burglary	$5,563.60	*2021$/incident*
Auto Theft	$11,659.20	*2021$/incident*
Larceny	$1,881.60	*2021$/incident*
Robbery	$65,077.60	*2021$/incident*
Murder	$11,890,067.00	*2021$/incident*
Rape	$280,051.80	*2021$/incident*
Assault	$156,521.40	*2021$/incident*

Source: FEMA Benefit-Cost Analysis Re-engineering (BCAR). 2011. Accessed at https://files.hudexchange.info/course-content/ndrc-nofa-benefit-cost-analysis-data-resources-and-expert-tips-webinar/FEMA-BCAR-Resource.pdf

III.10.iii Fuel Cost

Diesel fuel costs are considered in this analysis. The valued used in this analysis considers the nation aggregate fuel cost, less state and federal taxes as projected by the US Energy Information Administration. For the year 2031, this unit cost is $2.96 2021$/gallon.

III.10.iv Emissions Rates

All emissions benefit calculations use emissions rates by emission type, vehicle type, and travel speed as derived by Caltrans and summarized in the California Life-Cycle Benefit/Cost Analysis Model's emissions calculator. For this analysis, an assumed travel speed is used to estimate the emissions rate.

III.10.v USDOT Parameters

Table 13 summarizes the USDOT-provided values for BCAs used in this analysis

Table 13: USDOT BCA Parameters

Factor	Value	Units
VALUE OF TIME		
In-Vehicle Travel, All Purposes	$18.80	*2021$/person-hour*
Truck Drivers	$32.40	*2021$/person-hour*
VEHICLE OCCUPANCY		
Passenger Vehicles	1.68	*persons/auto*
Trucks	1.00	*persons/truck*
VEHICLE OPERATING COST		
Light Duty Vehicles	$0.46	*2021$/vehicle-mile*
Commercial Trucks	$1.01	*2021$/vehicle-mile*
VALUE OF EMISSIONS (2031 VALUE)		
Nitrogen oxides (NOx)	$18,900	*2021$/metric ton*
Sulfur Oxides (SOx)	$51,300	*2021$/metric ton*
Particulate matter (PM2.5)	$907,600	*2021$/metric ton*
Carbon Dioxide (CO2)	$66	*2021$/metric ton*
CRASH COSTS		
Killed	$11,800,000	*/person*
Injured (Unknown Severity)	$213,900	*/person*
Property Damage	$4,800	*/vehicle*

Source: U.S. Department of Transportation. Benefit Cost Analysis Guidance for Discretionary Grant Programs, January 2023. Accessed at https://www.transportation.gov/sites/dot.gov/files/2023-01/Benefit%20Cost%20Analysis%20Guidance%202023%20Update.pdf

IV. BENEFIT–COST ANALYSIS METHODOLOGY

IV.1 Benefit 1a: Avoided Rail Delay Under Typical Operations

This benefit is a function of the reduced delay time for freight trains when comparing the Base and Build conditions. This analysis assumes a passenger load of 224 persons per train based on the most recent Metra commuter rail ridership data. Amtrak trains typically carry more passengers per train than Metra, but the same occupancy is assumed for this analysis to be conservative. Table 14 summaries the estimation of the undiscounted benefit for the year 2031, the first year of benefits, as an example. Over the analysis period (2031-2061), there are 4,601 hours of avoided delay for passenger trains and 138,963 hours of avoided delay for freight trains in the Terminal.

Table 14: Avoided Rail Delay under Typical Operations

	Input		2031 Value	Units
	DELAY [A]			
	No Build Delay			
a	Passenger		1,041	*hours/year*
b	Freight		16,924	*hours/year*
	Build Delay			
c	Passenger		955	*hours/year*
d	Freight		14,054	*hours/year*
	Avoided Delay			
e	Passenger	a- c	86	*hours/year*
f	Freight	b- d	2,870	*hours/year*
	MONETIZATION			
g	Passenger Train Occupancy		224	*persons/train*
	Value of Time			
h	Passenger [B]		$18.80	*2021$/person-hour*
i	Freight [C]		$1,127.41	*2021$/train-hour*
	VALUE OF BENEFIT			
j	Passenger	e * g * h	$360,929	*2021$/year*
k	Freight	f * i	$3,235,145	*2021$/year*
	Total	j + k	**$3,596,074**	*2021$/year*

Source: A See Section III.4 Rail Network Performance on page 4

Source: B See Section III.10.v USDOT Parameters on page 11

Source: C See Section III.10.i Freight Costs on page 10

IV.2 Benefit 1b: Avoided Passenger Rail Costs Resulting from Train Delay

This benefit estimates the additional cost savings to passenger rail providers resulting from the reduction in idling time. The analysis considers the costs associated with fuel, emissions, and crew costs, as summarized in Table 15 for the year 2031.

Table 15: Avoided Passenger Rail Costs Resulting from Delay

	Input		2031 Value	Units
a	Avoided Metra Delay		47	*train-hours/year*
b	Avoided Amtrak Delay		39	*train-hours/year*
	FUEL CONSUMPTION			
c	Train Idling Fuel Consumption [A]		3.5	*gallons/hour*
d	Diesel [B]		$2.96	*2021$/gallon*
e	Avoided Fuel Consumption	(a + b) * c	300	*gallons/year*
f	Avoided Fuel Cost	d *e	$886.60	*2021$/year*
	EMISSIONS REDUCTION			
	Reduced Emissions [C]			
g	Carbon Dioxide (CO2)		3.0477	*metric tons/year*
h	Nitrogen Oxides (NOx)		0.0168	*metric tons/year*
i	Particulate Matter (PM2.5)		0.0002	*metric tons/year*
	Value of Reduced Emissions [D]			
j	Carbon Dioxide (CO2)		$201	*2021$/year*
k	Nitrogen Oxides (NOx)		$317	*2021$/year*
l	Particulate Matter (PM2.5)		$185	*2021$/year*
m	Total	j + k + l	$703.51	*2021$/year*
	CREW COST			
n	Metra Crew Wage [E]		$175.77	*2021$/hour*
o	Amtrak Crew Wage [F]		$606.40	*2021$/year*
p	Avoided Crew Cost	a * n + b * o	$31,827	*2021$/year*
	Total	e + l + n	**$33,417**	*2021$/year*

Source: A: Argonne National Laboratory. 2002. Railroad and Locomotive Technology Roadmap, from https://publications.anl.gov/anlpubs/2003/02/45512.pdf

Source: B: See Section III.10.iii Fuel Cost on page 11

Source: C: Estimated using Avoided Fuel Consumption and passenger locomotive emissions per gallon of fuel

Source: D: See Section III.10.v USDOT Parameters on page 11

Source: E: Regional Transportation Authority Transportation Portal and Metra Operating Cost data

Source: F: Northern Indiana Passenger Rail Corridor Service Alternatives Report

IV.3 Benefit 2a: Avoided Freight Delay from Track Closures

This benefit estimates the impact of track closures on the rail network using RTC outputs and their respective risks of closures. As described in Section III.4 on page 4, this analysis considers both the reduction in delay under typical network operations as estimated in Benefit 1a and avoided delays resulting from the increasing risk of track closures which are prevented in the Build scenario.

Table 16 summarizes the methodology used to calculate the undiscounted benefit for the year of 2031. During the analysis period (2031-2061), there are 138,963 hours of avoided delay resulting in $156 million in savings.

Table 16: Avoided Freight Delay from Track Closures

Factor			2031 Value	Units
AVOIDED DELAY [A]				
Base				
a	Freight Delay		16,924	*train-hours/year*
Out (1N)				
b	Probability of Impact		8%	*%*
c	Impact Duration		365	*days/year*
d	Freight Delay		24,852	*hours/year*
e	Avoided Extra Delay	(d- a) * b * c / 365	634	*hours/year*
Out (1S)				
f	Probability of Impact		8%	*%*
g	Impact Duration		365	*days/year*
h	Freight Delay		19,739	*hours/year*
i	Avoided Extra Delay	(h- a) * f * g / 365	225	*hours/year*
Total Avoided Delay				
j	All Avoided Delay	e + i	859	*hours/year*
MONETIZATION				
k	Value of Time [B]		$1,127.41	*2021$/train-hour*
	Value of Benefit	j * k	**$968,915**	*2021$/year*

Source: A See Section III.4 Rail Network Performance on page 4

Source: B See Section III.10.v USDOT Parameters on page 11

IV.4 Benefit 2b: Avoided Passenger Trip Diversion from Track Closures

While the RTC output includes delays for passenger rail, it is more likely that Metra service in the project area would be stopped in the event of a track closure, thus resulting in some existing Metra users completing their trips by automobile. This benefit estimates the avoided operating, crash, and emissions impacts resulting from mode shift from passenger rail to automobile in the event of a track closure. This analysis assumes that only 20% of users of the Metra SouthWest Service corridor would drive to their destination if passenger rail service was not available.

Table 17 summarizes the methodology used to calculate the undiscounted benefit for the year of 2031. During the analysis period (2031-2061) there are 52,412 hours of avoided delay.

Table 17: Avoided Passenger Trip Diversion from Track Closures

Factor			2031 Value	Units
METRA STATISTICS [A]				
a	Ridership		224	*persons/train*
b	Average Trip Distance		19	*miles/trip*
c	Train Count		30	*train-trips/day*
CONVERSION FACTORS				
d	Share of Passengers Diverting to Auto		20%	*percent of persons*
e	Annualization Factor		260	*days/year*
f	Vehicle Occupancy [B]		1.67	*persons/vehicle*
Out (1N) [C]				
g	Probability of Impact		8%	*%*
h	Impact Duration		365	*days/year*
i	Avoided Diversion	a * b * c * d * e * f * g * h / 365	887,018	*vehicle-miles/year*
Out (1S) [C]				
j	Probability of Impact		8%	*%*
k	Impact Duration		365	*days/year*
l	Avoided Diversion	a * b * c * d * e * f * j * k / 365	887,018	*vehicle-miles/year*
m	Total Avoided Diversion	i + l	1,774,037	*vehicle-miles/year*
OPERATING COST				
n	Automobile Operating Cost [B]		$0.46	*2021$/vehicle-mile*
o	Avoided Operating Cost	m * n	$816,057	*2021$/year*

Table 17 (cont.): Avoided Passenger Trip Diversion from Avoided Track Closures

Factor			2031 Value	Units
CRASH COST				
	Crash Rates [D]			
p	Crashes		289.184	*crashes/100MVMT*
q	Injuries		83.543	*injuries/100MVMT*
r	Fatalities		1.312	*fatalities/100MVMT*
s	Average Vehicles per Crash		1.798	*vehicles/crash*
	Monetization [B]			
t	PDO		$4,800	*2021$/vehicle*
u	Injuries		$213,900	*2021$/person*
v	Fatalities		$11,800,000	*2021$/person*
	Value of Benefit			
w	PDO	m / 100,000,000 * p * s * t	$44,268	*2021$/year*
x	Injuries	m / 100,000,000 * q * u	$317,019	*2021$/year*
y	Fatalities	m / 100,000,000 * r * v	$274,623	*2021$/year*
z	All Crashes	w + x + y	$635,910	*2021$/year*
EMISSIONS COST				
	Emissions Rate (Auto at 30mph) [E]			
aa	Nitrogen oxides (NOx)		0.0458	*g/mi*
ab	Sulfur Oxides (SOx)		0.0025	*g/mi*
ac	Particulate matter (PM2.5)		0.0011	*g/mi*
ad	Carbon Dioxide (CO2)		255.28	*g/mi*
	Emissions Monetization [B]			
ae	Nitrogen oxides (NOx)		$18,900	*2021$/metric ton*
af	Sulfur Oxides (SOx)		$51,300	*2021$/metric ton*
ag	Particulate matter (PM2.5)		$907,600	*2021$/metric ton*
ah	Carbon Dioxide (CO2)		$66	*2021$/metric ton*
	Value of Benefit			
ai	Nitrogen oxides (NOx)	m * aa * ae / 1,000,000	$1,536	*2021$/year*
aj	Sulfur Oxides (SOx)	m * ab * af / 1,000,000	$228	*2021$/year*
ak	Particulate matter (PM2.5)	m * ac * ag / 1,000,000	$1,766	*2021$/year*
al	Carbon Dioxide (CO2)	m * ad * ah / 1,000,000	$29,889	*2021$/year*
am	All Emissions	ai + aj + ak + al	$33,420	*2021$/year*
TOTAL BENEFIT		o + z + am	$1,485,387	*2021$/year*

Source: A: Metra SouthWest Service Statistics

Source: B: See Section III.10.v USDOT Parameters on page 11

Source: C: See Table 4: Track Closure Risk Factors on page 5

Source: D: See Table 9: Cook County Crashes by Severity on page 9

Source: E: See Section III.10.iv Emissions Rates on page 11

IV.5 Benefit 3: Avoided Freight Diversion to Trucks from Reduced Capacity

This benefit quantifies the value of avoided external impacts associated with truck diversions resulting from degraded performance and reduced capacity on the network. To be conservative, this analysis considers 5 years of freight diversion risk between 2047 and when an alternative solution could be implemented.

To estimate the avoided truck VMT, the analysis considers the volume of local freight movement that would be most likely diverted when capacity is constrained. The analysis estimates that 50% of freight tonnage will be diverted to trucks and applies a weighted average trip distance of 255 miles which accounts for rail traffic to or from Chicago from Midwest markets that are less than 500 roadway miles away. Between 2047 and 2051, over 187 million vehicle miles traveled are avoided, saving 128,121 metric tons of harmful emissions. Table 18 summarizes the benefit in year 2047.

Table 18: External Benefits of Avoided Truck Diversion

Factor			2047 Value	Units
AVOIDED TRUCK DIVERSIONS [A]				
a	Vehicle Miles		7,823,500	*persons/train*
EMISSIONS COST				
	Emissions Rate (Trucks at 30mph) [E]			
b	Nitrogen oxides (NOx)		1.0414	*g/mi*
c	Sulfur Oxides (SOx)		0.0067	*g/mi*
d	Particulate matter (PM2.5)		0.0027	*g/mi*
e	Carbon Dioxide (CO2)		707.07	*g/mi*
	Emissions Monetization [B]			
f	Nitrogen oxides (NOx)		$18,900	*2021$/metric ton*
g	Sulfur Oxides (SOx)		$51,300	*2021$/metric ton*
h	Particulate matter (PM2.5)		$907,600	*2021$/metric ton*
i	Carbon Dioxide (CO2)		$66	*2021$/metric ton*
	Value of Benefit			
j	Nitrogen oxides (NOx)	a * b * f / 1,000,000	$153,980	*2021$/year*
k	Sulfur Oxides (SOx)	a * c * g / 1,000,000	$2,672	*2021$/year*
l	Particulate matter (PM2.5)	a * d * h / 1,000,000	$19,084	*2021$/year*
m	Carbon Dioxide (CO2)	a * e * i / 1,000,000	$470,203	*2021$/year*
n	All Emissions	j + k + l + m	$645,938	*2021$/year*

Factor			2047 Value	Units
EXTERNAL BENEFITS				
	Unit Value [B]			
o	Congestion		$0.324	*2021$/VMT*
p	Noise		$0.041	*2021$/VMT*
q	Safety		$0.014	*2021$/VMT*
	Unit Value			
r	Congestion	a * o	$2,534,814	*2021$/metric ton*
s	Noise	a * p	$321,546	*2021$/metric ton*
t	Safety	a * q	$109,529	*2021$/metric ton*
u	All External Benefits	r + s + t	$2,965,889	*2021$/metric ton*
TOTAL BENEFITS		n + u	$3,611,827	*2021$/metric ton*

Source: A: See Section III.6 Diversion Impacts on page 8

Source: B: See Section III.10.v USDOT Parameters on page 11

IV.6 Benefit 4: Avoided Rail Diversions from Reduced Capacity

This benefit quantifies the value of avoided rail rerouting impacts associated with diversions in non-intermodal freight movements in other regions. An analysis was completed using the public use waybill sample, looking at US traffic originating and destined west of the Mississippi (Freight Territories 3, 4, and 5). Traffic was assumed to switch in Chicago from UP or BNSF to NS or CSX (and vice versa) for freight traveling east and west in these territories, being rerouted the distances shown in Table 19. To be conservative, this analysis considers 5 years of freight diversions beginning in 2047 until when an alternative solution could be implemented. As additional measures of conservativeness, only 5% of the traffic is assumed to be diverted and no empty equipment movements were considered.

To estimate the avoided non-intermodal tonnage, the analysis considers the volume of freight moving through Chicago and a 0.80% cumulative annual growth rate for through traffic. The distance used to represent the minimum diversion distance based on the average non-intermodal movement distances through Chicago. Table 19 summarizes the benefit in year 2047. Between 2047 and 2051, over 13 billion ton-miles of freight rail shipments would be diverted.

Table 19: Avoided Rail Diversion Cost Savings

Factor		2047 Value	Units
AVOIDED DELAY [A]			
	Avoided Tons		
a	BNSF/CSX	22,904,957	*tons/year*
b	BNSF/NS	20,788,391	*tons/year*
c	UP/CSX	16,749,170	*tons/year*

Factor			2047 Value	Units
d	UP/NS		15,201,438	*tons/year*
	Distance Rerouted			
e	BNSF/CSX		325	*miles*
f	BNSF/NS		274	*miles*
g	UP/CSX		1,019	*miles*
h	UP/NS		844	*miles*
MONETIZATION				
i	Percent Rerouted		5	*percent*
j	Shipper Cost [B]		$0.0587	*2021$/ton-mile*
	Value of Benefit	(a*e + b*f + c*g + d*h) * i * j	**$157,754,021**	*2021$/year*

Source: A: See Section III.6 Diversion Impacts on page 8

Source: B: See Section III.10.i Freight Costs on page 10

IV.7 Benefit 5: Traffic Delay Savings

This benefit assesses the Project's impact on local roadway traffic by reducing the amount of gate down time at railroad crossings. The analysis considers both delays associated with typical rail operations and when track closures are required. The analysis also assumes a 9% truck percentage and that the average impacted user experiences half the total gate down time, which includes a 20-second warning buffer. Table 20 summarizes the benefit in year 2031.

Table 20: Traffic Delay Savings

Input	2031 Value	Units
TYPICAL OPERATIONS		
Avoided Gate Down Time by Vehicle Type		
Auto	46,374	*vehicle-hours/year*
Truck	4,759	*vehicle-hours/year*
CRITICAL IMPACTS		
Total Delay		
1N Out	66.5	*vehicle-hours/day*
1S Out	42.8	*vehicle-hours/day*
Avoided Gate Down Time by Vehicle Type		
Auto	29,077	*vehicle-hours/year*
Truck	2,984	*vehicle-hours/year*
VALUE OF BENEFIT		
Auto	$2,368,847	*2021$/hour*
Truck	$243,079	*2021$/year*
Total	**$2,611,926**	*2021$/year*

Source: See Section III.4 on page 4

IV.8 Benefit 6: Reduced Crashes

This benefit estimates the reduction in crashes in the project area resulting from the improve lighting under viaducts. A crash modification factor of 0.7 was applied to existing crash rates by severity, as summarized in Table 21 for year 2031.

Table 21: Reduced Crashes

	Input		2031 Value	Units
	EXISTING CRASH RATES [A]			
a	Fatalities		0.22	*persons/year*
b	Injuries		8.0	*persons/year*
c	Property Damage		51.11	*crashes/year*
	CRASH REDUCTION			
d	Crash Modification Factor		0.70	
e	Average Vehicles per Crash [B]		1.80	*vehicles/crash*
	Avoided Crashes			
f	Fatalities	a * d	0.07	*persons/year*
g	Injuries	b * d	2.40	persons/year
h	Property Damage	c * d * e	27.56	*vehicles/year*
	CRASH UNIT VALUE [C]			
i	Fatalities		$11,800,000	*2021$/person*
j	Injuries		$213,900	2021$/person
k	Property Damage		$4,800	*2021$/vehicle*
	VALUE OF BENEFIT			
l	Fatalities	f * i	$786,667	*2021$/year*
m	Injuries	g * m	$513,360	2021$/year
n	Property Damage	h * k	$132,308	*2021$/year*
	Total	l + m + n	**$1,432,335**	*2021$/year*

Source: A. See Section III.7 Crash Data on page 8

Source: B: Estimated from crash data from the National Highway Traffic Safety Administration.

Source: C: See Section III.10.v USDOT Parameters on page 11

IV.9 Benefit 7: Reduced Crime

This benefit estimates the reduction in crime in the project area resulting from the improve lighting under viaducts. The analysis assumes a 4% reduction in crime, as summarized in Table 22 for year 2031.

Table 22: Reduced Crime

Input	2031 Value	Units
EXISTING CRIME RATES [A]		
Burglary	57.4	*incidents/year*
Auto Theft	14.8	*incidents/year*
Larceny	65.8	*incidents/year*
Robbery	11.2	*incidents/year*
Murder	0.2	*incidents/year*
Rape	0.8	*incidents/year*
Assault	102.4	*incidents/year*
CRIME REDUCTION		
Crime Reduction	4.0%	
AVOIDED CRIME		
Burglary	2.30	*incidents/year*
Auto Theft	0.59	incidents/year
Larceny	2.63	incidents/year
Robbery	0.45	incidents/year
Murder	0.01	incidents/year
Rape	0.03	incidents/year
Assault	4.10	*incidents/year*
VALUE OF BENEFIT		
Burglary	$12,774	*2021$/year*
Auto Theft	$6,902	*2021$/year*
Larceny	$4,952	*2021$/year*
Robbery	$29,155	*2021$/year*
Murder	$95,121	*2021$/year*
Rape	$8,962	*2021$/year*
Assault	$641,112	*2021$/year*
Total	**$798,977**	*2021$/year*

Source: A. See Section III.8 Crime Data on page 9

V. BENEFIT–COST ANALYSIS RESULTS

The BCA indicates that the Project will result in avoided delay for rail and traffic, avoided rail idling, reduced crashes, and reduced crime. All values are discounted at 7% with the exception of carbon-related benefits which are discounted at 3%.

The Project produces a Benefit/Cost ratio of 1.52, shown in Table 23, indicating that the benefits to society exceed the Project's costs.

Appendix A provides detailed tabulations of annual benefits and costs for the Project.

Table 23: Discounted Benefits and Costs for the Project (in millions)

	Total
PROJECT BENEFITS	
Avoided Delay under Typical Operations	$30.9
Avoided Passenger Rail Cost from Train Delay *	$0.2
Avoided Freight Delay from Track Closure	$40.2
Avoided Passenger Trip Diversion from Track Closure *	$43.7
Avoided Truck Diversion from Reduced Capacity *	$15.4
Avoided Rail Diversion from Reduced Capacity	$121.0
Traffic Delay Savings from Reduced Gate Down Time	$69.5
Reduced Crashes from Improved Viaduct Lighting	$9.7
Reduced Crime from Improved Viaduct Lighting	$5.4
ALL BENEFITS	$0.0
plus Residual Value	$14.2
Net Benefits	**$350.2**
TOTAL COSTS	**$214.5**
B/C RATIO	**1.63**
NET PRESENT VALUE	**$135.8**

* includes carbon-related benefits discounted at 3%

APPENDIX A
Detailed Benefit–Cost Analysis Results

TABLE A-1: EW2 SEGMENT A PROJECT BCA SUMMARY- UNDISCOUNTED

		Undiscounted Benefits					
Year	Calendar Year	Initial Construction Costs	Residual Value	Avoided Delay	Avoided Passenger Rail Cost	Avoided Freight Delay: Avoided Critical Impact	Avoided Passenger Rail Diversion: Avoided Critical Impact
0	2021	$0	$0	$0	$0	$0	$0
1	2022	$0	$0	$0	$0	$0	$0
2	2023	$0	$0	$0	$0	$0	$0
3	2024	$0	$0	$0	$0	$0	$0
4	2025	$0	$0	$0	$0	$0	$0
5	2026	$0	$0	$0	$0	$0	$0
6	2027	$88,805,217	$0	$0	$0	$0	$0
7	2028	$88,805,217	$0	$0	$0	$0	$0
8	2029	$88,805,217	$0	$0	$0	$0	$0
9	2030	$88,805,217	$0	$0	$0	$0	$0
10	2031	$0	$0	$3,596,074	$33,417	$968,915	$1,485,387
11	2032	$0	$0	$3,826,970	$41,469	$1,208,305	$1,856,330
12	2033	$0	$0	$3,386,300	$30,852	$1,945,318	$2,598,303
13	2034	$0	$0	$2,891,609	$19,221	$2,850,617	$3,339,965
14	2035	$0	$0	$2,335,520	$6,274	$3,941,488	$4,081,321
15	2036	$0	$0	$1,709,633	-$8,298	$5,236,601	$4,823,710
16	2037	$0	$0	$1,004,368	-$24,848	$6,756,108	$5,564,643
17	2038	$0	$0	$2,535,575	$14,353	$8,014,242	$6,305,275
18	2039	$0	$0	$4,058,919	$50,393	$9,383,330	$7,045,611
19	2040	$0	$0	$5,585,811	$83,557	$10,874,320	$7,785,653
20	2041	$0	$0	$7,127,245	$114,365	$12,499,333	$8,527,543
21	2042	$0	$0	$8,693,884	$142,929	$14,271,785	$9,267,149
22	2043	$0	$0	$7,407,227	$104,071	$14,090,606	$9,265,244
23	2044	$0	$0	$6,141,499	$68,432	$13,913,723	$9,263,354
24	2045	$0	$0	$4,884,668	$35,678	$13,741,732	$9,261,479
25	2046	$0	$0	$3,625,244	$5,525	$13,575,269	$9,261,723
26	2047	$0	$0	$2,352,180	-$22,406	$13,415,012	$9,259,833
27	2048	$0	$0	$3,344,440	-$14,754	$10,839,442	$9,257,957
28	2049	$0	$0	$4,440,786	-$6,540	$8,083,864	$9,256,094
29	2050	$0	$0	$5,650,086	$2,272	$5,135,696	$9,254,243
30	2051	$0	$0	$6,981,905	$11,711	$1,981,480	$9,250,496
31	2052	$0	$0	$8,446,556	$21,813	-$1,393,187	$9,246,836
32	2053	$0	$0	$8,446,556	$21,813	-$1,393,187	$9,243,260
33	2054	$0	$0	$8,446,556	$21,813	-$1,393,187	$9,239,765
34	2055	$0	$0	$8,446,556	$21,813	-$1,393,187	$9,236,350
35	2056	$0	$0	$8,446,556	$21,813	-$1,393,187	$9,233,013
36	2057	$0	$0	$8,446,556	$21,813	-$1,393,187	$9,229,750
37	2058	$0	$0	$8,446,556	$21,813	-$1,393,187	$9,226,561
38	2059	$0	$0	$8,446,556	$21,813	-$1,393,187	$9,223,443
39	2060	$0	$0	$8,446,556	$21,813	-$1,393,187	$9,220,395
40	2061	$0	$213,132,520	$0	$0	$0	$0
Total		**$355,220,867**	**$213,132,520**	**$167,598,945**	**$883,989**	**$160,188,503**	**$229,110,684**

TABLE A-1: CONTINUED

		Undiscounted Benefits					
Year	Calendar Year	Avoided Truck Diversion: Network Saturation	Avoided Rail Diversion: Network Saturation	Traffic Delay Savings	Reduced Crashes	Reduced Crime	Total Benefits
0	2021	$0	$0	$0	$0	$0	$0
1	2022	$0	$0	$0	$0	$0	$0
2	2023	$0	$0	$0	$0	$0	$0
3	2024	$0	$0	$0	$0	$0	$0
4	2025	$0	$0	$0	$0	$0	$0
5	2026	$0	$0	$0	$0	$0	$0
6	2027	$0	$0	$0	$0	$0	$0
7	2028	$0	$0	$0	$0	$0	$0
8	2029	$0	$0	$0	$0	$0	$0
9	2030	$0	$0	$0	$0	$0	$0
10	2031	$0	$0	$2,611,926	$1,432,335	$798,977	$8,695,720
11	2032	$0	$0	$3,055,786	$1,432,335	$798,977	$9,988,860
12	2033	$0	$0	$3,529,063	$1,432,335	$798,977	$11,489,836
13	2034	$0	$0	$4,075,441	$1,432,335	$798,977	$13,176,853
14	2035	$0	$0	$4,704,891	$1,432,335	$798,977	$15,069,495
15	2036	$0	$0	$5,428,755	$1,432,335	$798,977	$17,190,400
16	2037	$0	$0	$6,259,939	$1,432,335	$798,977	$19,560,210
17	2038	$0	$0	$7,649,251	$1,432,335	$798,977	$24,518,697
18	2039	$0	$0	$9,188,786	$1,432,335	$798,977	$29,727,038
19	2040	$0	$0	$10,895,643	$1,432,335	$798,977	$35,224,984
20	2041	$0	$0	$12,789,105	$1,432,335	$798,977	$41,057,592
21	2042	$0	$0	$14,890,943	$1,432,335	$798,977	$47,266,690
22	2043	$0	$0	$15,366,447	$1,432,335	$798,977	$46,233,595
23	2044	$0	$0	$15,883,516	$1,432,335	$798,977	$45,270,524
24	2045	$0	$0	$16,446,352	$1,432,335	$798,977	$44,369,909
25	2046	$0	$0	$17,059,681	$1,432,335	$798,977	$43,527,443
26	2047	$3,611,827	$157,754,021	$17,728,823	$1,432,335	$798,977	$204,099,290
27	2048	$8,779,736	$159,016,053	$17,876,133	$1,432,335	$798,977	$209,099,006
28	2049	$15,564,152	$160,288,182	$18,017,476	$1,432,335	$798,977	$215,644,013
29	2050	$24,028,296	$161,570,487	$18,151,794	$1,432,335	$798,977	$223,792,873
30	2051	$34,188,060	$162,863,051	$18,277,894	$1,432,335	$798,977	$233,554,597
31	2052	$0	$0	$18,394,442	$1,432,335	$798,977	$34,716,460
32	2053	$0	$0	$18,394,442	$1,432,335	$798,977	$34,712,884
33	2054	$0	$0	$18,394,442	$1,432,335	$798,977	$34,709,389
34	2055	$0	$0	$18,394,442	$1,432,335	$798,977	$34,705,974
35	2056	$0	$0	$18,394,442	$1,432,335	$798,977	$34,702,637
36	2057	$0	$0	$18,394,442	$1,432,335	$798,977	$34,699,374
37	2058	$0	$0	$18,394,442	$1,432,335	$798,977	$34,696,185
38	2059	$0	$0	$18,394,442	$1,432,335	$798,977	$34,693,067
39	2060	$0	$0	$18,394,442	$1,432,335	$798,977	$34,690,019
40	2061	$0	$0	$0	$0	$0	$0
Total		**$86,172,071**	**$801,491,795**	**$405,437,626**	**$42,970,036**	**$23,969,318**	**$1,850,883,613**

TABLE A-2: EW2 SEGMENT A PROJECT BCA SUMMARY- DISCOUNTED

		Discounted Benefits					
Year	Calendar Year	Initial Construction Costs	Residual Value	Avoided Delay	Avoided Passenger Rail Cost *	Avoided Freight Delay: Avoided Critical Impact	Avoided Passenger Rail Diversion: Avoided Critical Impact *
0	2021	$0	$0	0	$0	$0	$0
1	2022	$0	$0	$0	$0	$0	$0
2	2023	$0	$0	$0	$0	$0	$0
3	2024	$0	$0	$0	$0	$0	$0
4	2025	$0	$0	$0	$0	$0	$0
5	2026	$0	$0	$0	$0	$0	$0
6	2027	$59,174,666	$0	$0	$0	$0	$0
7	2028	$55,303,426	$0	$0	$0	$0	$0
8	2029	$51,685,445	$0	$0	$0	$0	$0
9	2030	$48,304,154	$0	$0	$0	$0	$0
10	2031	$0	$0	$1,828,062	$17,035	$492,547	$762,142
11	2032	$0	$0	$1,818,166	$19,763	$574,057	$891,126
12	2033	$0	$0	$1,503,558	$13,743	$863,745	$1,167,011
13	2034	$0	$0	$1,199,915	$7,995	$1,182,905	$1,403,594
14	2035	$0	$0	$905,755	$2,420	$1,528,577	$1,604,826
15	2036	$0	$0	$619,650	-$3,063	$1,897,985	$1,775,166
16	2037	$0	$0	$340,214	-$8,526	$2,288,527	$1,916,267
17	2038	$0	$0	$802,698	$4,588	$2,537,104	$2,031,877
18	2039	$0	$0	$1,200,888	$15,101	$2,776,189	$2,124,716
19	2040	$0	$0	$1,544,523	$23,439	$3,006,840	$2,197,255
20	2041	$0	$0	$1,841,816	$30,032	$3,230,065	$2,252,923
21	2042	$0	$0	$2,099,687	$35,129	$3,446,823	$2,291,432
22	2043	$0	$0	$1,671,909	$23,947	$3,180,435	$2,144,229
23	2044	$0	$0	$1,295,530	$14,749	$2,935,056	$2,006,556
24	2045	$0	$0	$962,996	$7,215	$2,709,136	$1,877,792
25	2046	$0	$0	$667,948	$1,078	$2,501,232	$1,758,363
26	2047	$0	$0	$405,035	-$3,913	$2,310,005	$1,645,667
27	2048	$0	$0	$538,222	-$2,401	$1,744,395	$1,540,253
28	2049	$0	$0	$667,904	-$979	$1,215,831	$1,441,649
29	2050	$0	$0	$794,192	$358	$721,888	$1,349,411
30	2051	$0	$0	$917,193	$1,612	$260,301	$1,262,340
31	2052	$0	$0	$1,037,009	$2,789	-$171,046	$1,180,910
32	2053	$0	$0	$969,167	$2,612	-$159,856	$1,104,755
33	2054	$0	$0	$905,764	$2,447	-$149,398	$1,033,532
34	2055	$0	$0	$846,508	$2,293	-$139,624	$966,921
35	2056	$0	$0	$791,129	$2,148	-$130,490	$904,621
36	2057	$0	$0	$739,373	$2,013	-$121,953	$846,353
37	2058	$0	$0	$691,003	$1,886	-$113,975	$791,855
38	2059	$0	$0	$645,797	$1,767	-$106,519	$740,881
39	2060	$0	$0	$603,549	$1,657	-$99,550	$693,204
40	2061	$0	$14,233,071	$0	$0	$0	$0
Total		**$214,467,690**	**$14,233,071**	**$30,855,158**	**$218,936**	**$40,211,233**	**$43,707,627**

TABLE A-2: CONTINUED

		Discounted Benefits					
Year	Calendar Year	Avoided Truck Diversion: Network Saturation *	Avoided Rail Diversion: Network Saturation	Traffic Delay Savings	Reduced Crashes	Reduced Crime	Total Benefits
0	2021	$0	$0	$0	$0	$0	$0
1	2022	$0	$0	$0	$0	$0	$0
2	2023	$0	$0	$0	$0	$0	$0
3	2024	$0	$0	$0	$0	$0	$0
4	2025	$0	$0	$0	$0	$0	$0
5	2026	$0	$0	$0	$0	$0	$0
6	2027	$0	$0	$0	$0	$0	$0
7	2028	$0	$0	$0	$0	$0	$0
8	2029	$0	$0	$0	$0	$0	$0
9	2030	$0	$0	$0	$0	$0	$0
10	2031	$0	$0	$1,327,771	$728,126	$406,160	$5,561,843
11	2032	$0	$0	$1,451,782	$680,492	$379,588	$5,814,975
12	2033	$0	$0	$1,566,946	$635,974	$354,755	$6,105,732
13	2034	$0	$0	$1,691,163	$594,368	$331,547	$6,411,487
14	2035	$0	$0	$1,824,638	$555,484	$309,857	$6,731,558
15	2036	$0	$0	$1,967,631	$519,144	$289,586	$7,066,098
16	2037	$0	$0	$2,120,458	$485,181	$270,641	$7,412,763
17	2038	$0	$0	$2,421,557	$453,440	$252,936	$8,504,200
18	2039	$0	$0	$2,718,630	$423,776	$236,389	$9,495,689
19	2040	$0	$0	$3,012,736	$396,052	$220,924	$10,401,769
20	2041	$0	$0	$3,304,948	$370,142	$206,471	$11,236,396
21	2042	$0	$0	$3,596,358	$345,928	$192,963	$12,008,319
22	2043	$0	$0	$3,468,409	$323,297	$180,340	$10,992,566
23	2044	$0	$0	$3,350,578	$302,147	$168,542	$10,073,158
24	2045	$0	$0	$3,242,343	$282,380	$157,516	$9,239,377
25	2046	$0	$0	$3,143,232	$263,906	$147,211	$8,482,971
26	2047	$759,004	$27,164,531	$3,052,823	$246,642	$137,580	$35,717,374
27	2048	$1,743,803	$25,590,512	$2,876,813	$230,506	$128,580	$34,390,683
28	2049	$2,922,538	$24,107,697	$2,709,868	$215,426	$120,168	$33,400,102
29	2050	$4,266,741	$22,710,803	$2,551,467	$201,333	$112,306	$32,708,499
30	2051	$5,730,333	$21,394,850	$2,401,114	$188,162	$104,959	$32,260,864
31	2052	$0	$0	$2,258,341	$175,852	$98,093	$4,581,948
32	2053	$0	$0	$2,110,599	$164,348	$91,676	$4,283,301
33	2054	$0	$0	$1,972,522	$153,596	$85,678	$4,004,142
34	2055	$0	$0	$1,843,479	$143,548	$80,073	$3,743,197
35	2056	$0	$0	$1,722,878	$134,157	$74,835	$3,499,277
36	2057	$0	$0	$1,610,166	$125,380	$69,939	$3,271,270
37	2058	$0	$0	$1,504,828	$117,178	$65,363	$3,058,137
38	2059	$0	$0	$1,406,381	$109,512	$61,087	$2,858,907
39	2060	$0	$0	$1,314,375	$102,347	$57,091	$2,672,672
40	2061	$0	$0	$0	$0	$0	$0
Total		**$15,422,419**	**$120,968,393**	**$69,544,835**	**$9,667,823**	**$5,392,854**	**$335,989,277**

* includes carbon-related benefits discounted at 3%


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