ECONOMICS CENTER
RESEARCH AND CONSULTING

Benefit-Cost Analysis of Replacing the Western Hills Viaduct

Prepared for the

city of CINCINNATI

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EXECUTIVE SUMMARY

The Western Hills Viaduct is a major west-east connector for the City of Cincinnati, but the 85-year-old Viaduct is in poor condition.[1] The Viaduct has an Annual Average Daily Traffic (AADT) count of approximately 62,300, according to the Ohio-Kentucky-Indiana Regional Council of Governments (OKI) Travel Demand Model.[2] The Viaduct was among the 10 most traveled roads and was the second most traveled non-interstate road in the City of Cincinnati in 2015.[3] This study evaluates the benefits and costs of replacing the Western Hills Viaduct. All dollar values are reported in 2016 dollars unless otherwise specified.

The undiscounted benefit-cost ratio to replace the Western Hills Viaduct is 9.6. The discounted benefit-cost ratio at 3 and 7 percent is 6.1 and 4.0, respectively. Annual and total undiscounted benefits and costs are shown below in Table 1.

Table 1: Annual and Total Benefits and Costs to Replace the Western Hills Viaduct[4]

Category	Annual Recurring	Total (including Nonrecurring)
Travel Time Savings	$46,583,971	$1,374,227,137
Vehicle Operating Cost Savings	$9,120,081	$269,042,398
Maintenance on Alternate Routes	$6,980,824	$209,424,734
Reduced Injuries from Crashes	$2,923,368	$86,239,358
Reduced Vehicle Damage from Crashes	$364,653	$10,757,262
Emission Reduction	$422,893	$12,475,329
Residual Value after 30 years	-	$174,700,501
Total Benefits	**$66,395,790**	**$2,136,866,720**
Capital Expenditures	-	$217,081,401
Regular Maintenance	$37,746	$1,132,378
Special Maintenance	-	$4,669,164
Total Costs	**$37,746**	**$222,882,943**

Source: Economics Center calculations using OKI Travel Demand Model, GREET Model output, Ohio Department of Transportation, NHTSA, Gibby et al., and U.S. DOT Guidance; all monetary values are in 2016 dollars.

[1] The Western Hills Viaduct received a National Bridge Inspection Standard rating of four out of nine by City of Cincinnati Department of Transportation and Engineering inspectors and is considered to be in poor condition. (City of Cincinnati 2016)
[2] (OKI Regional Council 2015)
[3] (Ohio Department of Transportation 2017)
[4] The existing Viaduct is expected to close for approximately six months during the construction of a replacement Viaduct. These delays are assumed to occur in 2025.

According to the City of Cincinnati Department of Transportation and Engineering (DOTE), the existing Western Hills Viaduct will be operational for the next ten years until 2028, through repair and routine maintenance. For the purposes of this analysis, the Western Hills Viaduct is expected to close in 2029. This closure with no replacement will force motorists to reroute trips, which will cause the following within Hamilton County:

- An increase in Viaduct users' hours traveled of approximately 2.8 million hours annually. The estimated value of this increased travel time is $46.6 million;
- An increase in annual vehicle miles traveled of 21.5 million miles, causing an increase in vehicle operating costs of $9.1 million each year;
- An increase in total maintenance costs on other roads of $7.0 million annually as vehicles are forced to alternative routes;
- An increase of 17 injuries from crashes per year. The resulting medical costs are approximately $2.9 million per year;
- An increase of 43 crashes per year involving 86 vehicles resulting in $365,000 in property damage to vehicles; and
- An increase in vehicle emissions valued at $423,000 per year.

The net benefit of replacing the Viaduct is approximately $66.1 million per year, with a total net benefit totaling $1.9 billion over the first 30 years of the replacement Viaduct's life. In addition, the residual value of the replacement Viaduct after the 30th year of operation is estimated to be $174.7 million. In total, the expected undiscounted benefit of the Viaduct is approximately $2.1 billion.

The cost of constructing the replacement Viaduct and simultaneously maintaining the existing Western Hills Viaduct is estimated to be $252.8 million in 2016 dollars. [5] Of this, $35.7 million is associated with the maintenance of the existing Viaduct[6] and $217.1 million is associated with the construction of a new Viaduct. With the addition of operations and maintenance costs for the new Viaduct, the net cost of constructing a replacement Viaduct is $222.9 million for the first 30 years of the useful life.

[5] Monetary figures displayed here will differ from the Project Phasing and Maintenance Plan to account for inflation.

[6] The ongoing maintenance of the existing Viaduct is assumed to be necessary regardless of a replacement Viaduct and is included in both scenarios under study.

INTRODUCTION

The Western Hills Viaduct (the Viaduct) was built between 1930 and 1932 to replace the Harrison Avenue Viaduct in order to meet the need for increased capacity. The four-lane double-deck structure was built as a part of the Union Terminal project. The 85-year old Viaduct is approximately 0.5 miles long, spanning the Mill Creek Valley and CSX rail yard. It is one of 26 Hamilton County Bridges located in the City of Cincinnati owned by the County but maintained by the City through a contractual agreement.[7]

Since its construction, the Viaduct has gone through many structural changes. In 1961, the eastern portion of the Viaduct was demolished and rebuilt to accommodate the construction of Interstate 75 underneath it. The last major rehabilitation of the Viaduct was completed in 1977, which included restriping the lower deck from four to three lanes. The Western Hills Viaduct has an Annual Average Daily Traffic (AADT) count of approximately 62,300, according to the OKI Travel Demand Model.[8] In addition, the Western Hills Viaduct is one of the top ten most traveled structurally deficient bridges in Ohio, according to a 2017 American Road & Transportation Builders' Association's report.[9]

As is shown in Figure 1, the Western Hills Viaduct is a major west-east connector over the Mill Creek Valley for the City of Cincinnati. Primarily, it connects residential areas on the west side of the Viaduct to major employment centers in Downtown and Uptown areas of the City of Cincinnati while also serving as a major access point to Interstate 75. The permanent closure of the Viaduct will impede and alter transportation activities within the surrounding area, which will lead to new transportation-related issues, including traffic congestion, an increase in travel time and distance, an increase in vehicular emissions, and will likely increase accidents.

[7] (City of Cincinnati 2012).
[8] (OKI Regional Council 2015)
[9] (American Road & Transportation Builders Association 2017)

Figure 1: The Location of the Western Hills Viaduct and Surrounding Neighborhoods

The City of Cincinnati Department of Transportation and Engineering (DOTE), along with the Hamilton County Engineer's Office has identified the need for replacing the Viaduct and has taken initiatives to address this transportation infrastructure issue within the City. The City has conducted public meetings and a survey to engage the community in the project. According to DOTE, the Viaduct is reaching the end of its design life, is functionally obsolete, and needs to be either demolished or replaced for the following reasons:

- Worsening structural condition as the concrete and structural steel has experienced deterioration,
- The Viaduct is difficult to inspect and maintain,
- Poor accessibility for pedestrian and bicycle users, and
- The geometry does not meet current safety standards.[10]

The proposed replacement Viaduct is planned to be constructed just south of the existing Western Hills Viaduct, is expected to traverse 0.5 miles, and last 100 years. The new Viaduct will serve most of the same roads as the current Viaduct with more circuitous traffic patterns built for the entrance from State Avenue. Changes to routes entering the Viaduct are intended to make accessing the replaced Viaduct more safe and intuitive. Further, the first phase of the project will mitigate issues that cause an increased incidence of crashes at Harrison Avenue and State Avenue.

[10] (City of Cincinnati 2012)

This report provides a benefit-cost analysis to assist the City of Cincinnati in obtaining Federal funding through a Transportation Investment Generating Economic Recovery (TIGER) Grant. The Economics Center followed the TIGER guidelines as prescribed by the United States Department of Transportation (U.S. DOT).[11]

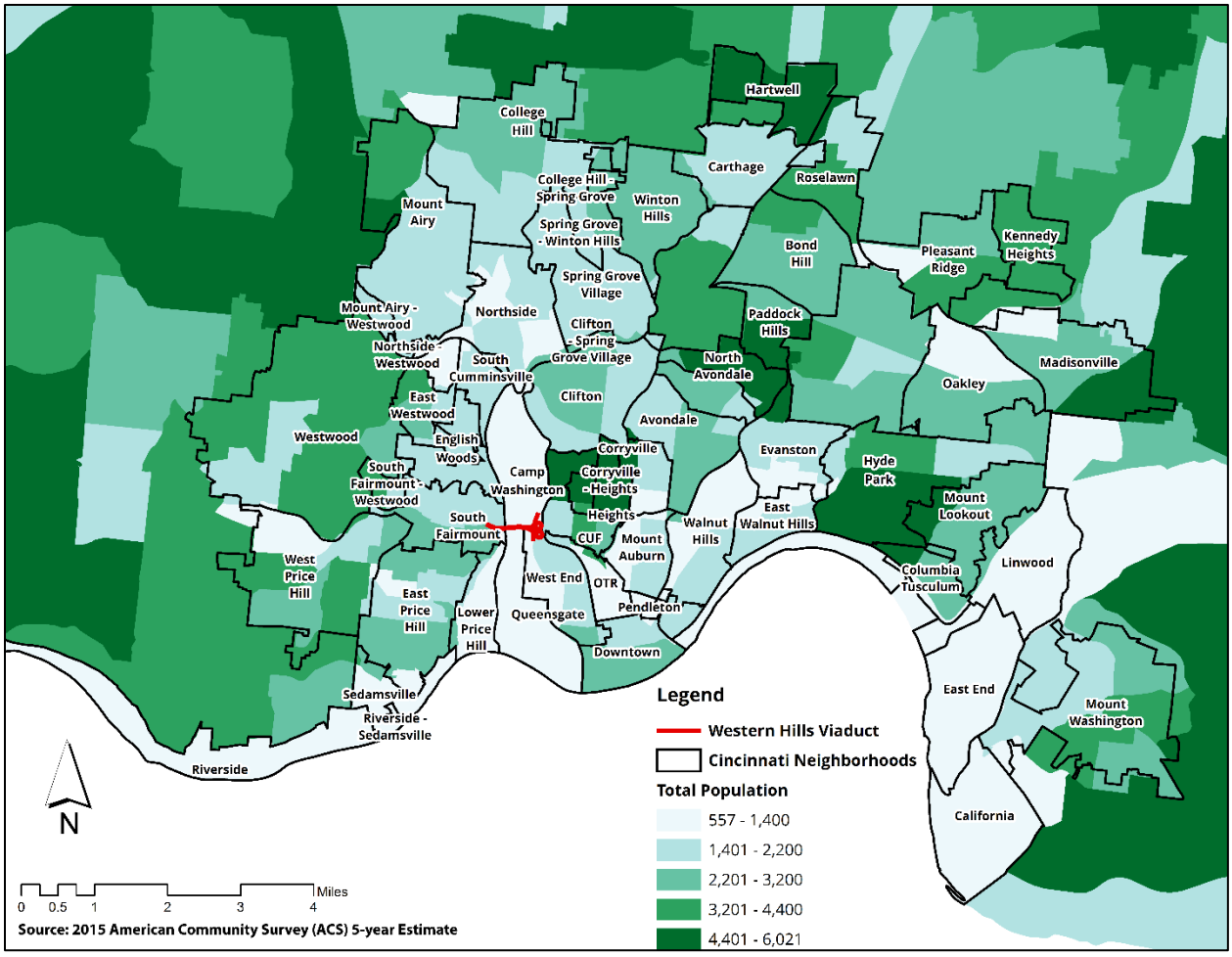
Affected Population

The Western Hills Viaduct is a major thoroughfare for the City of Cincinnati, connecting the largely residential areas in western Cincinnati and Hamilton County to the remainder of the City and the region. The Viaduct serves the immediate neighborhoods of North and South Fairmont but is also crucial for the areas further from the Mill Creek Valley including Westwood, Price Hill, and Cheviot.

As shown in Figure 2, neighborhoods near the Viaduct like CUF[12], the Heights, Westwood, and portions of East and West Price Hill have higher shares of residents relative to the other neighborhoods adjacent to the Viaduct. Closure of the Western Hills Viaduct will affect the daily lives of residents of these neighborhoods as motorists seek alternative routes, which may cause a decline in business activity. Drivers commuting to and from downtown Cincinnati via the Viaduct also pass through the neighborhoods of West End and Over-the-Rhine which may also experience detrimental commercial impacts due to rerouting. Additionally, four Metro bus routes currently utilize the Western Hills Viaduct. Alternative routing for these bus routes could negatively impact local residents who rely on public transportation.

[11] (United States Department of Transportation 2017)
[12] CUF is a neighborhood encompassing the neighborhoods of Clifton, University Heights, and Fairview.

Figure 2: Cincinnati Population Density



Source: U.S. Census American Community Survey 2015 5-year estimates

Alternative Routes

The permanent closure of the Western Hills Viaduct will not only disrupt surrounding neighborhood traffic but will also impact traffic on other streets as motorists are forced to find new commuting patterns. The Western Hills Viaduct is a major west-east connector in the City and has among the highest AADT count compared to the other five west-east connectors, which include Hopple Street, Gest Street, West 8th Street, Interstate 74, and the 6th Street Expressway (also known as River Road). While the 6th Street Expressway carries a similar volume of traffic, the Viaduct hosts more vehicles per day than Hopple Street, Gest Street, and West 8th Street combined.

The Western Hills Viaduct is a primary connector for western Cincinnati to the remainder of Cincinnati. Table 2 shows the daily traffic of the five main west-east connectors.[13] For each year

[13] (Ohio Department of Transportation 2017); (OKI Regional Council 2015)

under analysis, the Economics Center assumed traffic volumes are only affected by the presence or absence of the Viaduct and all other factors that affect commuting patterns would remain static.

If the Viaduct is not replaced and is subsequently closed, existing traffic will be rerouted to alternative connectors in the City, often through a number of secondary streets. The new traffic patterns necessitated by permanently closing the Western Hills Viaduct will give rise to additional traffic-related issues in the area, such as increased traffic congestion, increased time and distance traveled, increased emissions, and increased vehicular accidents. Additionally, these alternate routes will have an increased need for additional maintenance due to amplified demand from the impacted traffic patterns, which is discussed below.

The affected major arterial routes are shown in Table 2, below and affected minor arterial routes are shown in Table 3. The west-east connectors that will be impacted most are the 6th Street Expressway, with an increase of 20,400 vehicles per day, followed by the Hopple Street Viaduct and the 8th Street Viaduct, which will each experience an increase of approximately 11,000 vehicles per day.

While many of the major arterial roads connecting the western to the eastern portion of Cincinnati, such as Interstate 74 and the 6th Street Expressway are capable of hosting large amounts of traffic, the minor arterial roads that connect residential areas to them will be severely negatively impacted. These alternative arterial roads include Elberon Avenue, Warsaw Avenue, and Glenway Avenue, which would together experience an increase in daily vehicles of approximately 57 percent. Because many of the alternative arterial streets are four lanes and do not have turning lanes accompanied by many turns with limited visibility, increased traffic along these routes is expected to significantly increase congestion and crashes. Further, the steep grade of the area makes widening prohibitively expensive, as the cost of widening alternative arterial roads would require investments in large retaining walls and the relocation of large numbers of businesses and homes. Many of the alternative routes that will be affected further west are not displayed here, but are expected to experience increased congestion and worsening safety conditions.[14] Maps of current traffic and relocated traffic flows may be found in Appendix A.

Table 2: OKI Travel Demand Model Western Hills Viaduct Diverted Daily Traffic Volumes to Major Arterial Roads

Roadway Segment	With Western Hills Viaduct	Without Western Hills Viaduct	Increased Totals	Percent Increase
Western Hills Viaduct	62,300	0		
Gest St	2,600	5,600	3,000	115%
6th St Expressway east of Evans	67,900	88,300	20,400	30%
Hopple Street Viaduct	31,300	42,600	11,300	36%
8th Street Viaduct	18,800	29,900	11,100	59%
I-74 Over Millcreek	88,600	94,200	5,600	6%
Total Major Arterial Roads	**209,200**	**260,600**	**51,400**	**25%**

Source: OKI Travel Demand Model

[14] (Kelly 2017)

Table 3: OKI Travel Demand Model Western Hills Viaduct Diverted Daily Traffic Volumes to Minor Arterial Roads

Roadway Segment	With Western Hills Viaduct	Without Western Hills Viaduct	Increased Totals	Percent Increase
Western Hills Viaduct	62,300	0		
Glenway Avenue	12,000	21,000	9,000	75%
Warsaw Avenue	12,000	19,000	7,000	58%
Elberon Avenue	13,000	18,100	5,100	39%
Total Adjacent Arterial Roads	**37,000**	**58,100**	**21,100**	**57%**

Source: OKI Travel Demand Model

APPROACH TO BENEFIT-COST ANALYSIS

Two scenarios were assessed to quantify the resulting costs of viaduct construction, maintenance and repair, emissions, and travel. The long-term benefits because of the replacement of the Western Hills Viaduct were compared to a "no-build" scenario. In the no-build scenario, the Viaduct will be closed permanently by 2028 without being replaced. According to the DOTE, the Viaduct will remain open to traffic for the next ten years until 2028, with repair work occurring in 2020 and again in 2024 in addition to routine maintenance. The City of Cincinnati has estimated that construction of the new Viaduct is scheduled to begin in 2025 and be completed by 2028.

BENEFITS

Decreased Vehicle Miles Traveled

The permanent closure of the Western Hills Viaduct will alter commuting patterns thus resulting in an increase in Vehicle Miles Travelled (VMT) within the surrounding area. This closure will force motorists to seek alternate routes, outlined above. As a result, former Western Hills Viaduct users will be forced to drive additional distances due to changes in commuting patterns. However, if the Viaduct is replaced, thereby preserving a major west-east connection in the City, it will reduce the additional VMT on alternate routes.

Estimates of the additional miles traveled are derived from the OKI Travel Demand Model for the entirety of Hamilton County and are shown below in Table 4. With the replacement Viaduct, the County would experience more than 20.6 million VMT every weekday, while closure of the Viaduct will increase countywide VMT by 0.31 percent to 20.7 million VMT every weekday. Weekend traffic is expected to experience a similar percentage increase in VMT. Annually, the permanent closure of the existing Viaduct will correspond with 21.5 million more VMT than with the use of the replaced Viaduct.

Table 4: Annual Vehicle Miles Traveled with and without the Viaduct

	Weekday	Weekend[15]	Annual[16]
With Viaduct	20,646,000	16,103,880	7,058,867,400
Without Viaduct	20,709,000	16,153,020	7,080,407,100
Difference	**63,000**	**49,140**	**21,539,700**

Source: OKI Travel Demand Model

Value of Travel Time Savings

The largest single monetary benefit of the replacement of the Viaduct results from decreased travel time. The reduction in Vehicle Hours Traveled (VHT) is the difference between average VHT on alternate routes in absence of the Western Hills Viaduct and VHT on a replaced Viaduct. The estimated VHT savings from the replacement of the Viaduct originates from the OKI Travel Demand Model. As shown in Table 5, the closure of the Western Hills Viaduct will result in 6,000 increased vehicle hours traveled (VHT) every weekday and an increase of 4,680 VHT each weekend day. Annually, the permanent closure of the Western Hills Viaduct will result in an increase of approximately 2.1 million VHT.

Table 5: Annual Vehicle Hours Traveled with and without the Viaduct

	Weekday	Weekend[17]	Annual[18]
With Viaduct	606,000	472,680	207,191,400
Without Viaduct	612,000	477,360	209,242,800
Difference	**6,000**	**4,680**	**2,051,400**

Source: Economics Center calculations using OKI Travel Demand Model

To quantify the total value of time savings from the replacement of the Viaduct, total person-hours were estimated to account for increased car occupancy. These calculations are shown below in Table 6. According to the Ohio Department of Transportation, approximately 95.8 percent of vehicles on urban principal arterial roads are cars and light trucks while 4.2 percent are business and commercial trucks.[19] Further, each car has approximately 1.39 occupants and as a result, approximately 2.7 million person hours will be lost to increased traffic and congestion with closure of the existing Viaduct.[20] Approximately 85,749 commercial vehicle person hours will be lost without the Viaduct.[21] Altogether, the inability to replace the Viaduct will result in 2.8 million person hours lost to increased traffic congestion.

[15] Weekend travel was assumed 78 percent of weekday travel to conform to survey responses of users' reason for traveling on the Viaduct. (City of Cincinnati 2012)
[16] Assumes 260 weekdays per year and 105 weekend days.
[17] Weekend travel was assumed to be 78 percent of weekday travel to conform to survey responses of users' reason for traveling on the Viaduct. (City of Cincinnati 2012)
[18] Assumes 260 weekdays per year and 105 weekend days.
[19] (Ohio Department of Transporation 2016)
[20] (United States Department of Transportation 2017)
[21] (United States Department of Transportation 2017)

Table 6: Increased Annual Vehicle and Person Hours without the Western Hills Viaduct[22]

Vehicle Type	Share of Traffic	Vehicle Hours	Occupancy	Person Hours
Cars	95.8%	1,965,651	1.39	2,732,255
Trucks[23]	4.2%	85,749	1	85,749
Total	**100%**	**2,051,400**		**2,818,004**

Source: Economics Center calculations using OKI Travel Demand Model, U.S. DOT Guidance, and Ohio Department of Transportation.

The value of numerous activities (personal and business for cars and truck driving for business and commercial vehicles) were ascribed to the person hours, as is shown in Table 7. According to a survey conducted by the City of Cincinnati, 22 percent of respondents who use the Viaduct indicated they travel on the Viaduct to commute to work while the remaining 78 percent indicated they utilize the Viaduct for personal trips.[24] The U.S. DOT Guidance provides a monetary value for various activities including personal and business travel for private vehicles and the value of time for commercial truck drivers. These values are shown below and were applied to their respective vehicle person hours. Overall, $46.6 million will be lost annually in increased travel times with the permanent closure of the Western Hills Viaduct.

Table 7: Undiscounted Annual Value of Time Costs without the Western Hills Viaduct[25]

Travel Vehicle and Category	Percent of Trips by Category	Person Hours by Category	Value of Time Savings (Hourly)	Value of Time Savings
Cars – business	22%	601,096	$25.40	$15,267,844
Cars – personal	78%	2,131,159	$13.60	$28,983,767
Trucks - business[26]	100%	85,749	$27.20	$2,332,360
Total		**2,818,004**		**$46,583,971**

Source: Economics Center calculations using OKI Travel Demand Model, U.S. DOT Guidance, and Ohio Department of Transportation; all monetary values are in 2016 dollars.

Vehicle Operating Costs Savings

The replacement of the Viaduct will decrease vehicle operating costs (VOC) for the area. Hamilton County will benefit from a reduction in 21.5 million VMT, as discussed above, with approximately 95.8 percent of benefitting vehicles being cars and 4.2 percent of vehicles being commercial and business vehicles, according to the Ohio Department of Transportation's estimates for usage of urban

[22] Due to rounding, some figures may not be equivalent to their component parts.
[23] All commercial vehicles were assumed to be heavy-duty diesel trucks.
[24] Personal trips included visiting friends and family, shopping, going to school, medical trips, and entertainment. (City of Cincinnati 2012)
[25] Due to rounding, some figures may not be equivalent to their component parts.
[26] All commercial vehicles were assumed to be heavy-duty diesel trucks.

principal arterial roads.27 According to the U.S. DOT Benefit-Costs Guidance, the recommended value per mile is $0.40 for cars and $0.96 for commercial trucks. The closure of the Viaduct will result in increased costs of more than $9.1 million annually, as shown in Table 8.

Table 8: Undiscounted Annual Increased Vehicle Operating Costs from loss of the Western Hills Viaduct[28]

Vehicle Type	Share of Traffic	Annual Increased VMT	Cost per Mile	Increased Costs
Cars	95.8%	20,639,341	$0.40	$8,255,736
Trucks[29]	4.2%	900,359	$0.96	$864,345
Total	**100%**	**21,539,700**		**$9,120,081**

Source: Economics Center calculations using OKI Travel Demand Model, U.S. DOT Guidance, and Ohio Department of Transportation statistics; all monetary values are in 2016 dollars.

Emission Reduction Benefits

The no-build scenario will force motorists to use alternate routes, increasing distance traveled and vehicular emissions. However, replacing the Viaduct will significantly reduce emissions that otherwise will be emitted because of the additional miles traveled on alternate routes. Therefore, when compared to the no-build scenario, the new Viaduct will have a considerable environmental benefit due to reduced vehicle emissions.

Emissions costs were estimated using the monetary values in the U.S. DOT Guidance[30] and emissions rates of gasoline passenger cars and diesel single-unit long-haul trucks from Argonne National Laboratory's Greenhouse Gases, Regulated Emissions, and Energy use in Transportation (GREET) model.[31] The emissions rates were converted into short tons before applying the U.S. DOT monetary assessments. These estimations may be found in Appendix B. The estimated costs per mile were then applied to the increased vehicle miles traveled for cars and trucks, as discussed above.

As shown in Table 9, the increased distance vehicles will need to travel due to the closure of the Western Hills Viaduct will cause approximately $423,000 in increased emissions costs per year. The costliest pollutant, Particulate Matter, will cause more than $328,000 annually in costs from car emissions and more than $32,000 from semi-truck emissions.

[27] (Ohio Department of Transporation 2016)
[28] Due to rounding, some figures may not be equivalent to their component parts.
[29] All commercial vehicles were assumed to be heavy-duty diesel trucks.
[30] (United States Department of Transportation 2017)
[31] (Cai, Burnham and Wang 2013)

Table 9: Undiscounted Annual Increased Vehicle Emissions Costs from loss of the Western Hills Viaduct[32]

Vehicle Type	Pollutant	Annual Increased VMT	Cost per Mile	Increased Costs
	Volatile Organic Compounds		$0.0004	$7,617
	Nitrogen Oxides		$0.0011	$23,074
	Particulate Matter		$0.0159	$328,418
	Sulfur Dioxide		$0.0003	$5,720
	Volatile Organic Compounds		$0.0021	$1,894
	Nitrogen Oxides		$0.0254	$22,872
	Particulate Matter		$0.0354	$31,904
	Sulfur Dioxide		$0.0015	$1,392
Total		**21,539,700**		**$422,893**

Source: Economics Center calculations using OKI Travel Demand Model, GREET Model output, and U.S. DOT Guidance; all monetary values are in 2016 dollars.

Safety Benefits

The dilapidated state of the Viaduct, a lack of room to safely merge, sharp turns on entrances and exits, and a difficulty viewing oncoming exits lead to more accidents than otherwise would occur. The WHV Reconstruction/Replacement survey conducted by the City of Cincinnati indicates that 45 percent of auto users think the current Viaduct is not in an acceptable condition for use.[33]

Crash data from the Ohio Department of Public Safety were assessed to identify the number of crashes, the number of vehicles and occupants involved, and the types of injuries incurred because of vehicular accidents on the Viaduct. The injuries reported in traffic crash reports were on the KABCO (killed, incapacitating, non-incapacitating, possible, property damage only) injury scale, which was developed by the National Safety Council and is used by law enforcement agencies to classify injuries associated with automobile accidents.[34] Therefore, in order to estimate the monetized value of injuries, the records were converted to the Abbreviated Injury Scale (AIS) using the TIGER Grant BCA resource guide.

Overall, 688 occupants and 635 vehicles were involved in crashes on the Viaduct between January 1, 2013 and October 6, 2017, with an estimated total cost of $33.4 million as shown in Table 10. Between January 1, 2013 and October 6, 2017, 144 injuries were recorded on the Western Hills Viaduct, 16 of which were visible incapacitating injuries. One fatality was recorded on August 19, 2017. If the rate of crashes continues through the remainder of 2017, there are expected to be approximately 82 crashes for the year, the second most since 2013. An assessment of injury costs may be found in Appendix C.

[32] Due to rounding, some figures may not be equivalent to their component parts.
[33] (City of Cincinnati 2012)
[34] http://safety.fhwa.dot.gov/hsip/resources/fhwasa09029/sec4.cfm

Table 10: Monetized Injury Costs and Property Damage Resulting from Vehicle Crashes on the Western Hills Viaduct, 2013 – October 6, 2017

Year	Accidents	Vehicles	Occupants	Monetary Costs of Injuries	Costs to Vehicles[35]	Total Costs
2013	54	112	125	$4,476,580	$476,224	**$4,952,804**
2014	55	108	117	$4,331,763	$459,216	**$4,790,979**
2015	65	124	139	$3,824,481	$527,248	**$4,351,729**
2016	89	164	177	$5,223,639	$697,328	**$5,920,967**
2017[36]	63	127	130	$12,877,884	$540,004	**$13,417,888**
Total	**326**	**635**	**688**	**$30,734,347**	**$2,700,020**	**$33,434,367**

Source: Economics Center calculations using data from the Ohio Department of Public Safety Crash Database; All monetary values are in 2016 dollars.

The property damage due to vehicular crashes on the Western Hills Viaduct has been increasing gradually since 2013. In 2016, there were 89 accidents reported on the Viaduct, involving 164 vehicles compared to 54 accidents involving 112 vehicles in 2013. According to the U.S. DOT guidance, vehicle accidents are monetized at $4,252 per vehicle. As a result, traffic accidents on the Western Hills Viaduct caused more than $697,000 in monetary losses to drivers and insurance companies in 2016. Between 2013 and October 6, 2017, accidents involving 635 vehicles created financial losses of approximately $2.7 million.

Expected Monetary Benefits from Reduced Crashes

The monetary benefits to replacing the Western Hills Viaduct are $2.9 million in reduced injuries and approximately $364,000 in reduced property damage. While factors in the replacement Viaduct that will mitigate the incidence of crashes were not available for use in this analysis, the replacement of the Viaduct will eliminate the need of motorists to seek longer alternative routes, thereby reducing total VMT, as discussed above. According to the National Highway Traffic Safety Administration, approximately 201 crashes and 78 injuries occurred for every 100 million VMT in the United States in 2015. As a result of the Viaduct's closure, Hamilton County will experience an increase of approximately 21.5 million VMT, which would result in 43 crashes and 17 injuries per year. Because the severity of injuries incurred is unknown, the assessed value of expected injuries is $174,000 in accordance with U.S. DOT Guidance.[37] The property damage cost per crash is equivalent to the cost per vehicle outlined in the U.S. DOT Guidance ($4,252) multiplied by the average number of vehicles per crash in Hamilton County between January 1, 2013 and October 6, 2017 (1.98).[38]

[35] All vehicle accidents are monetized at $4,252 per vehicle per U.S. DOT Guidance (United States Department of Transportation 2017).
[36] January 1 through June 30, 2017 are included to show half of the most recent year.
[37] (United States Department of Transportation 2017)
[38] (United States Department of Transportation 2017); (National Highway Traffic Safety Administration 2016)

Table 11: Undiscounted Annual Increased Costs from Injuries and Crashes from loss of the Western Hills Viaduct[39]

Incident	Annual Increased VMT	Rate per 100 Million VMT	Annual Expected Incidents	Cost per Incident	Increased Costs
Injury from Crash		78	17	$174,000	**$2,923,368**
Crash		201	43	$8,419	**$364,6532**

Source: Economics Center calculations using data from the NHTSA, OKI Travel Demand Model, and U.S. DOT Guidance; All monetary values are in 2016 dollars.

COSTS

Capital Expenditures

The maintenance and eventual demolition of the existing Viaduct as well as and the construction of a new Viaduct will cost an estimated $252.8 million in expenditures in 2016 dollars. For the no-build scenario, it was assumed the existing Viaduct will undergo the same maintenance, repair, and demolition schedule as would occur under the replacement scenario. In addition to the costs of designing and constructing the new Viaduct, the project requires the purchase of land, relocating businesses, and moving an electric utility distribution line. To conform to U.S. DOT Guidance, the Economics Center deflated the nominal expenditure estimates in the City of Cincinnati's Project Phasing and Maintenance Plan.[40] As a result, capital expenditure estimates will differ between this report and the Project Phasing and Maintenance Plan. The proposed construction schedule is outlined in Appendix D.

Repair and Demolition of the Existing Viaduct

In order to keep the 85-year-old Western Hills Viaduct functioning until 2028, the City of Cincinnati expects to spend approximately $4.4 million in 2020 and $3.8 million in 2024 for deck patching, expansion joint repairs, concrete patching, and beam painting, among other tasks. The planning for these two major maintenance and rehabilitation projects are expected to cost approximately $200,000 each. While the new Viaduct is being constructed, the City cannot close the existing Viaduct for an extended period due to its importance to the City's transportation infrastructure.[41] As a result, it will be necessary for the City to maintain the existing Western Hills Viaduct while the new Viaduct is constructed.

The construction of the new Viaduct is expected to be completed by 2028; consequently, the existing Viaduct will be demolished. The demolition of the current Viaduct will have its planning phase in 2024 with an estimated cost of $759,000 with the demolition occurring over the two-year period of 2028 and 2029 at a cost of $26.5 million which is more than the maintenance of the existing Viaduct between 2017 and 2027. Overall, the City expects to spend $35.7 million in major maintenance

[39] Due to rounding, some figures may not be equivalent to their component parts.
[40] The Project Phasing and Maintenance Plan assumes an annual inflation rate of 3.5 percent.
[41] The existing Viaduct is expected to close for approximately six months during the construction of a replacement Viaduct. These delays are expected to occur in 2025 and have been incorporated in the benefit-cost analysis.

according to the Project Phasing and Maintenance Plan, which is expected to occur regardless of the construction of the new Viaduct.[42]

Construction of a New Viaduct

The construction of a new Viaduct requires demolition of surrounding buildings, eastern and western approach demolition and reconstruction, the relocation of a Duke Energy substation, relocation of a railway bypass track, and the construction of the replacement Viaduct. The total cost is estimated to be $217.1 million, of which $164.4 million is for the construction of new Viaduct.

Operation and Maintenance Expenditures

Operations and Maintenance of existing Viaduct

The existing Western Hills Viaduct will require routine and major maintenance over the next ten years until 2028, after which it will be closed. Between 2005 and 2016, an average of $94,987 was spent annually on routine maintenance, special inspections, and utility work. Further, $1.0 million in major maintenance was performed in 2007 and $1.7 million was performed in 2010. For the purposes of this analysis, the average non-major costs are expected to continue until 2028, when the Viaduct will be demolished, while major maintenance estimates are derived from the Project Phasing and Maintenance Plan.[43]

Routine Operations and Maintenance of New Viaduct

The new Viaduct is estimated to require approximately $38,000 in annual maintenance, based on estimates from the Ohio Department of Transportation.[44] Annual necessary maintenance includes snow and ice control, sign maintenance, and pavement maintenance, among other necessary tasks. The estimated costs per lane mile were adjusted to 2016 dollars, multiplied by the distance of the Viaduct (0.5) miles, and then multiplied by the eight lanes to identify annual required maintenance of the replacement Viaduct.

[42] Monetary figures displayed here will differ from the Project Phasing and Maintenance Plan to account for inflation. All figures are in 2016 dollars. (City of Cincinnati 2017)
[43] (City of Cincinnati 2017)
[44] (Ohio Department of Transporation 2011)

Table 12: Expected Future Annual Maintenance Costs for the Replacement of the Western Hills Viaduct[45]

Maintenance Type	Cost per lane mile ($2011)	Cost per lane mile ($2016)	Cost per lane ($2016[46])	WHV Total
Lane-Mile Maintenance (US and SR)	$3,626	$3,910	$1,955	$15,642
Snow & Ice Control (within Cities)	$3,052	$3,291	$1,646	$13,166
Pavement Maintenance	$475	$512	$256	$2,049
Pavement Marking Maintenance	$46	$50	$25	$198
Sign Maintenance	$141	$152	$76	$608
Miscellaneous	$1,410	$1,521	$760	$6,082
Total	**$8,750**	**$9,436**	**$4,718**	**$37,746**

Source: Economics Center calculations using data from the Ohio Department of Transportation; All monetary values are in 2016 dollars.

Major Operations and Maintenance of New Viaduct

The proposed Viaduct is expected to require significant maintenance and rehabilitation investments over the course of its useful life, amounting to more than $30.1 million by the 50th year of operation. As Table 13 shows, overlays for the existing viaduct deck is expected to occur in the 20th and 35th year of operation with viaduct redecking to occur in the 50th year of operation. In each of these major maintenance years, approximately $2.3 million is necessary to paint the steel on the bridge. The Economics Center utilized cost assessments from the National Cooperative Highway Research Program to estimate the costs of redecking, viaduct deck overlays, and structural steel painting.[47]

Table 13: Undiscounted Major Operations and Maintenance Costs for the Replacement Western Hills Viaduct[48]

Maintenance Type	Year 20	Year 35	Year 50	Total
Viaduct Deck Overlay	$2,354,164	$2,354,164	$0	$4,708,329
Viaduct Redecking	$0	$0	$18,401,571	$18,401,571
Structural Steel Painting	$2,315,000	$2,315,000	$2,315,000	$6,945,000
TOTAL	**$4,669,164**	**$4,669,164**	**$20,716,571**	**$30,054,900**

Source: Economics Center calculations using data from the OKI Travel Demand Model and Gibby et al.; all monetary values are in 2016 dollars.

Additional Maintenance Costs of Diverted Traffic

If a new Viaduct is not constructed, much of the traffic that uses the existing Viaduct will be rerouted to alternative routes, increasing the costs to maintain those roads. As is shown in Table 14, a net increase of 21.5 million VMT is expected to increase annual maintenance costs on alternative connector and arterial roads by approximately $7.0 million. Total increased cost assessments were

[45] Due to rounding, some figures may not be equivalent to their component parts.
[46] The replacement Viaduct is expected to have eight lanes.
[47] (National Cooperative Highway Research Program 2003)
[48] Due to rounding, some figures may not be equivalent to their component parts.

derived from Gibby, Kitamura, and Zhao, who identified the incremental cost of $6.22 per mile per year for heavy trucks and increased costs of $0.07 for cars and light trucks.[49]

Table 14: Marginal Increase in Pavement Maintenance Cost due to Additional Traffic from Closure of the Western Hills Viaduct[50]

Vehicle Type	Share of Traffic	Annual Increased VMT	Increase in Maintenance Cost (cents per mile per year)	Increased Costs
Cars	95.8%	20,639,341	$6.67	$1,377,462
Trucks[51]	4.2%	900,359	$622.34	$5,603,362
Total	**100%**	**21,539,700**		**$6,980,824**

Source: Economics Center calculations using data from the OKI Travel Demand Model and Gibby et al.; all monetary values are in 2016 dollars.

Residual Value of Remaining Service Life

While this benefit-cost analysis was conducted with a 30-year assessment period, the replacement Viaduct is expected to last 100 years. The Guidance provided by the U.S. DOT suggests that the residual value of the bridge be considered in the benefit-cost analysis. The Viaduct was assumed to depreciate linearly for the entirety of its lifespan, and the costs of routine and major maintenance were removed from the remaining value, as is prescribed by the U.S. DOT Guidance. This major maintenance includes periodic deck overlaying and viaduct redecking. Overall, an expected $174.7 million in residual value is expected at the 31st year of operation. Please refer to the attached spreadsheet for more information.

Table 15: Undiscounted and Discounted Residual Value of Replacement Western Hills Viaduct

Discount Rate	Residual Value
No Discounting	$174,700,501
3% Discount Rate	$162,670,917
7% Discount Rate	$156,099,065

Source: Economics Center calculations using U.S. DOT Guidance and data provided by the City of Cincinnati; All monetary values are in 2016 dollars.

[49] These values are in 2016 dollars. The 1990 values in the original report are $3.73 for heavy trucks and $0.04 for cars and light trucks. (Gibby, Kitamura and Zhao 1990)
[50] Due to rounding, some figures may not be equivalent to their component parts.
[51] All commercial vehicles were assumed to be heavy-duty diesel trucks.

TOTAL BENEFITS AND COSTS

Discounting helps to compare the dollar value of benefits and costs received in different periods to present values. According to the TIGER Grant BCA Resource Guide, discounting of benefits and costs should be carried out at real discount rates of three and seven percent. The undiscounted and discounted future benefits and costs are quantified for the new Viaduct compared to the no-build scenario, over the period between 2017 and 2057, when the replacement Viaduct would reach its 30th year of service. The residual net value of the replacement Viaduct for the remainder of the Viaduct's useful life is included in the benefits of the project.

The construction of a new Viaduct, and repair and maintenance of the existing Viaduct is subject to grant funding. An estimated cost of replacing the Western Hills Viaduct from its inception until 30 years after its construction is approximately $217.1 million.[52] This total estimated cost of $217.1 million includes the initial costs of construction, design, and right-of-way acquisition for the new Viaduct. Additionally, the maintenance costs of the new Viaduct from 2028 through 2058 is estimated to be $5.8 million, which includes viaduct deck overlay and structural steel painting completed every 20 years. However, the construction of a new Viaduct will reduce the increased maintenance on alternative routes resulting from increased traffic, which is estimated to be $7.0 million each year, or $209.4 million between 2028—when the new Viaduct would open—and 2057.

The net benefit due to replacing the Western Hills Viaduct is estimated to be $2.1 billion. The net benefit is the difference between the benefit savings for a replaced Western Hills Viaduct compared to the no-build scenario, due to the reduction in vehicle hours traveled, emissions, vehicle miles traveled, reductions in maintenance costs to other roads, and other factors. The undiscounted benefit-cost ratio is 9.6 while the benefit-cost ratio is 6.1 and 4.0 at a 3 and 7 percent discount rate, respectively. This indicates that replacing the Western Hills Viaduct will yield significantly higher benefits compared to its costs.

Table 16: Undiscounted and Discounted Future Benefits and Costs

	Undiscounted	3% Discount Rate	7% Discount Rate
Total Net Benefits	$2,136,866,720	$1,080,052,111	$531,372,963
Total Net Costs	$222,882,943	$175,960,824	$132,065,540
Benefit Cost Ratio	**9.6**	**6.1**	**4.0**

Source: Economics Center calculations using U.S. DOT Guidance, data provided by the City of Cincinnati, Ohio DOT; All monetary values are in 2016 dollars.

[52] The construction of the new Viaduct does not include maintenance, rehabilitation, and demolition of the current Viaduct, which is assumed necessary regardless of the construction of a new Viaduct.

CONCLUSION

The Western Hills Viaduct provides a valuable west-east connection in the City of Cincinnati. Permanent closure of the Viaduct will alter transportation activities within the surrounding region, leading to new transportation-related issues in the area, including additional traffic congestion, an increase in travel time and distance, and more vehicular emissions. Additionally, the existing Western Hills Viaduct has poor bicycle and pedestrian accessibility.

The construction of a new Viaduct will have an undiscounted benefit-cost ratio of 9.6, which means the new Viaduct will yield higher benefits compared to its costs. The discounted benefit-cost ratio at the real discount rates of 3 and 7 percent is 6.1 and 4.0 respectively.

The City of Cincinnati has benefitted from the Western Hills Viaduct for 85 years. It connects the City and allows Cincinnati and Hamilton County's residents the ability to travel throughout the region. However, the Viaduct is in poor condition[53] and the Viaduct will soon require demolition. Without a replacement Viaduct, safety, congestion, and vehicular emissions will be severely impacted. The replacement of the Viaduct will substantially increase the safety and quality of life of residents of the City of Cincinnati and Hamilton County.

ABOUT THE ECONOMICS CENTER

The work of the Economics Center provides tools that help clients make better financial, policy, economic, and workforce development decisions. The critical data analyses empower business and civic leaders to respond to changing economic conditions, strengthen local economies, and improve the quality of life for their communities.

[53] (City of Cincinnati 2016)

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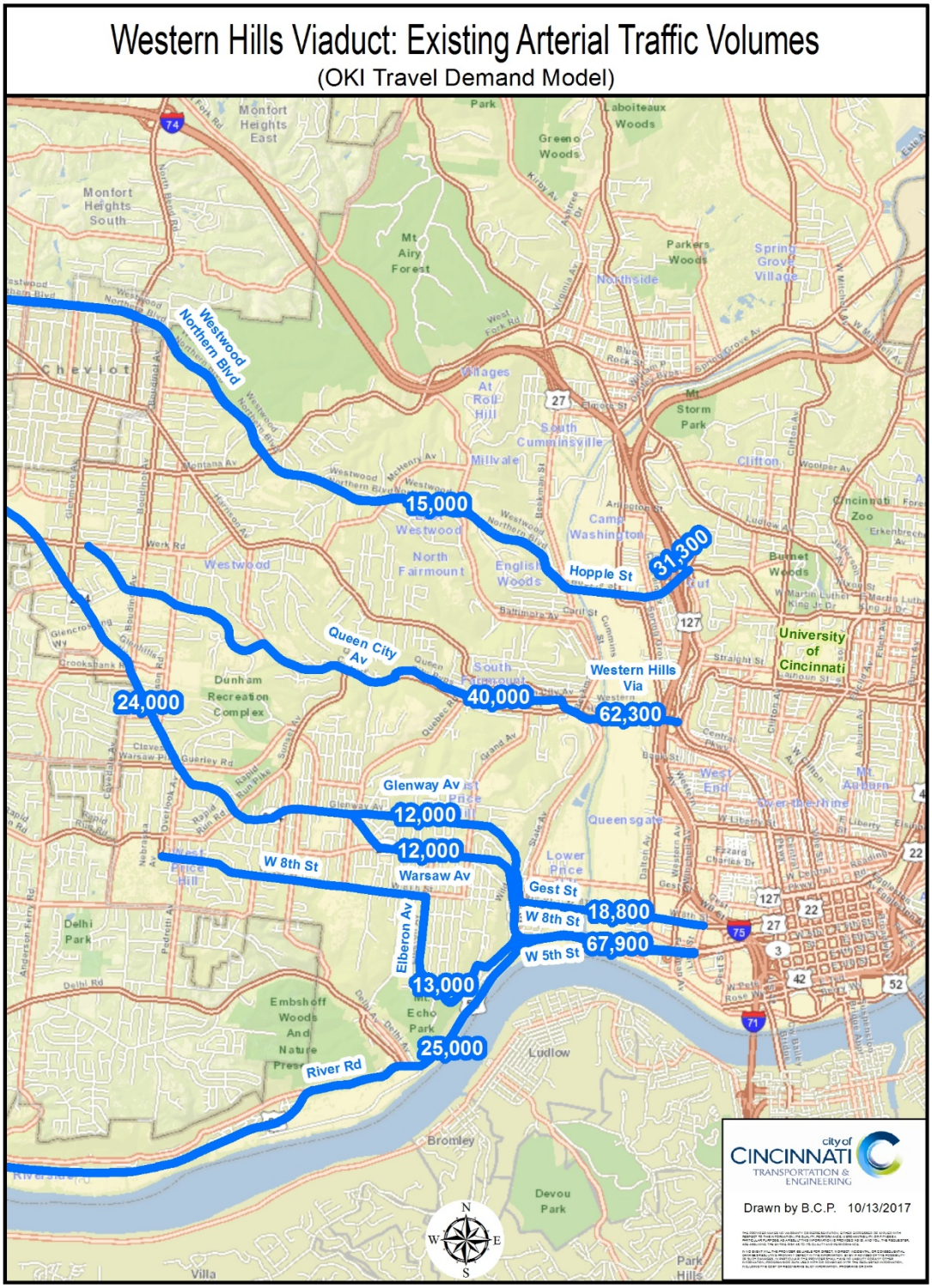
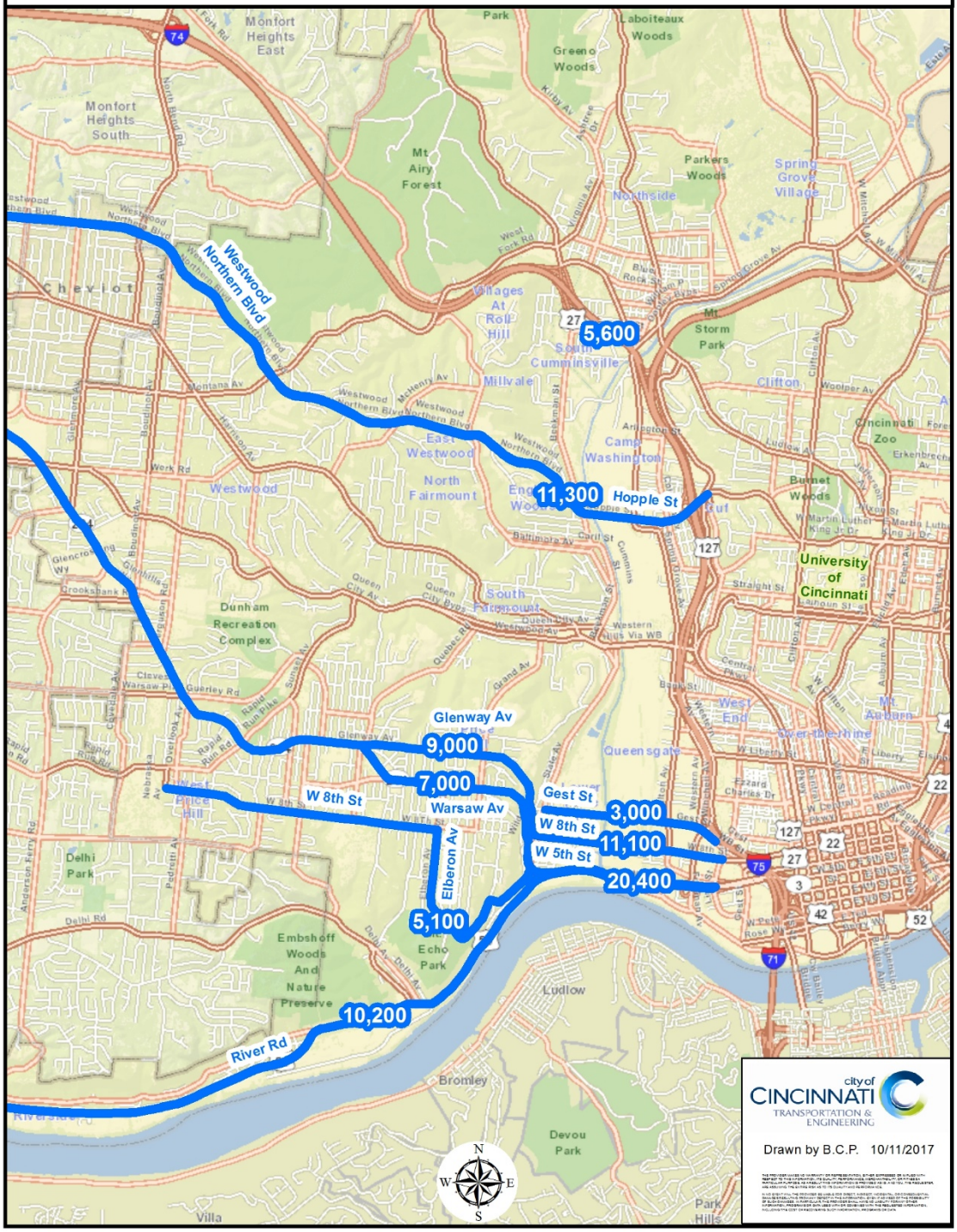
APPENDIX A: EXISTING AND RELOCATED TRAFFIC VOLUMES



Without Western Hills Viaduct: Relocated Traffic Volumes



APPENDIX B: EMISSIONS CALCULATIONS

Recommended Monetized Value ($2016)		Grams per Mile Driven		Short Tons per Mile		Dollars per Mile	
Emission Type	$/short ton	Passenger Cars	Heavy-duty Trucks	Passenger Cars	Heavy-duty Trucks	Cars	Heavy-duty Trucks
Volatile Organic Compounds	$1,872	0.17885	0.19588	1.97E-07	2.16E-07	$0.0004	$0.0004
Nitrogen Oxides	$7,377	0.13748	2.29507	1.52E-07	2.53E-06	$0.0011	$0.0187
Sulfur Dioxide	$43,600	0.00577	0.01243	6.36E-09	1.37E-08	$0.0003	$0.0006
Particulate Matter (PM 2.5)	$337,459	0.01403	0.16836	1.55E-08	1.86E-07	$0.0052	$0.0626
Particulate Matter (PM 10)	$337,459	0.02875	0.22915	3.17E-08	2.53E-07	$0.0107	$0.0852
PM (all)						$0.0159	$0.1479

Source: Economics Center calculations using GREET Model output and U.S. DOT Guidance; all monetary values are in 2016 dollars.

APPENDIX C: SAFETY CALCULATIONS

Table 17: Injuries on the Western Hills Viaduct by Type, 2013 – October 6, 2017

Year	Total Occupants	O (No Injury)	C (Possible Injury)	B (Non-incapacitating)	A (Incapacitating)	K (Killed)
2013	125	94	17	10	4	0
2014	117	92	7	14	4	0
2015	139	106	16	16	1	0
2016	177	146	13	13	5	0
2017	130	106	12	10	2	1
Total	**688**	**544**	**65**	**63**	**16**	**1**

Source: Economics Center calculations using data from the Ohio Department of Public Safety Crash Database

Table 18: KABCO/Unknown - AIS Data Conversion Matrix

KABCO Scale	O	C	B	A	K	U	# Non-fatal Accidents	
AIS	No Injury	Possible Injury	Non-incapacitating	Incapacitating	Killed	Injured Severity Unknown	Unknown if injured	Unit Value ($2016)
0	0.92534	0.23437	0.08347	0.03437	0.00000	0.21538	0.43676	
1	0.07257	0.68946	0.76843	0.55449	0.00000	0.62728	0.41739	$28,800
2	0.00198	0.06391	0.10898	0.20908	0.00000	0.10400	0.08872	$451,200
3	0.00008	0.01071	0.03191	0.14437	0.00000	0.03858	0.04817	$1,008,000
4	0.00000	0.00142	0.00620	0.03986	0.00000	0.00442	0.00617	$2,553,600
5	0.00003	0.00013	0.00101	0.01783	0.00000	0.01034	0.00279	$5,962,800
Fatality	0.00000	0.00000	0.00000	0.00000	1.00000	0.00000	0.00000	$9,600,000
Sum (Prob)	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	

Source: (United States Department of Transportation 2015) *and* (United States Department of Transportation 2017)*;*
All monetary values are in 2016 dollars.

Table 19: Converted Monetary Value of Crash Injuries, 2013

AIS	O (No Injury)	C (Possible Injury)	B (Non-incapacitating)	A (Incapacitating)	Total Cost
0	$0	$0	$0	$0	$0
1	$196,462	$337,560	$221,308	$63,877	**$819,207**
2	$83,977	$490,215	$491,718	$377,348	**$1,443,258**
3	$7,580	$183,527	$321,653	$582,100	**$1,094,860**
4	$0	$61,644	$158,323	$407,146	**$627,113**
5	$16,054	$12,581	$57,497	$406,010	**$492,142**
Total	**$304,073**	**$1,085,527**	**$1,250,499**	**$1,836,481**	**$4,476,580**

Source: Economics Center calculations using data from the Ohio Department of Public Safety Crash Database, U.S. DOT BCA Guidance and Resource Guide; All monetary values are in 2016 dollars.

Table 20: Converted Monetary Value of Crash Injuries, 2014

AIS	O (No Injury)	C (Possible Injury)	B (Non-incapacitating)	A (Incapacitating)	Total Cost
0	$0	$0	$0	$0	**$0**
1	$192,281	$138,995	$309,831	$63,877	**$704,984**
2	$82,191	$201,853	$688,405	$377,348	**$1,349,797**
3	$7,419	$75,570	$450,314	$582,100	**$1,115,403**
4	$0	$25,383	$221,652	$407,146	**$654,181**
5	$15,712	$5,180	$80,496	$406,010	**$507,398**
Total	**$297,603**	**$446,981**	**$1,750,698**	**$1,836,481**	**$4,331,763**

Source: Economics Center calculations using data from the Ohio Department of Public Safety Crash Database, U.S. DOT BCA Guidance and Resource Guide; All monetary values are in 2016 dollars.

Table 21: Converted Monetary Value of Crash Injuries, 2015

AIS	O (No Injury)	C (Possible Injury)	B (Non-incapacitating)	A (Incapacitating)	Total Cost
0	$0	$0	$0	$0	**$0**
1	$221,542	$317,703	$354,093	$15,969	**$909,307**
2	$94,698	$461,379	$786,748	$94,337	**$1,437,162**
3	$8,548	$172,731	$514,644	$145,525	**$841,448**
4	$0	$58,018	$253,317	$101,786	**$413,121**
5	$18,103	$11,841	$91,996	$101,503	**$223,443**
Total	**$342,891**	**$1,021,672**	**$2,000,798**	**$459,120**	**$3,824,481**

Source: Economics Center calculations using data from the Ohio Department of Public Safety Crash Database, U.S. DOT BCA Guidance and Resource Guide; All monetary values are in 2016 dollars.

Table 22: Converted Monetary Value of Crash Injuries, 2016

AIS	O (No Injury)	C (Possible Injury)	B (Non-incapacitating)	A (Incapacitating)	Total Cost
0	$0	$0	$0	$0	**$0**
1	$305,142	$258,134	$287,700	$79,847	**$930,823**
2	$130,433	$374,870	$639,233	$471,684	**$1,616,220**
3	$11,773	$140,344	$418,149	$727,625	**$1,297,891**
4	$0	$47,139	$205,820	$508,932	**$761,891**
5	$24,934	$9,621	$74,746	$507,513	**$616,814**
Total	**$472,282**	**$830,108**	**$1,625,648**	**$2,295,601**	**$5,223,639**

Source: Economics Center calculations using data from the Ohio Department of Public Safety Crash Database, U.S. DOT BCA Guidance and Resource Guide; All monetary values are in 2016 dollars.

Table 23: Converted Monetary Value of Crash Injuries, January 1, 2017 - October 6, 2017

AIS	O (No Injury)	C (Possible Injury)	B (Non-incapacitating)	A (Incapacitating)	K (Killed)	Total Cost
0	$0	$0	$0	$0	$0	**$0**
1	$221,542	$238,277	$221,308	$31,939	$0	**$713,066**
2	$94,698	$346,034	$491,718	$188,674	$0	**$1,121,124**
3	$8,548	$129,548	$321,653	$291,050	$0	**$750,799**
4	$0	$43,513	$158,323	$203,573	$0	**$405,409**
5	$18,103	$8,881	$57,497	$203,005	$0	**$287,486**
Fatality	$0	$0	$0	$0	$9,600,000	**$0**
Total	**$342,891**	**$766,253**	**$1,250,499**	**$918,241**	**$9,600,000**	**$12,877,884**

Source: Economics Center calculations using data from the Ohio Department of Public Safety Crash Database, U.S. DOT BCA Guidance and Resource Guide; All monetary values are in 2016 dollars.

APPENDIX D: WESTERN HILLS VIADUCT REPLACEMENT PROJECT PHASING AND MAINTENANCE PLAN

Construction Year	Project	Scope
2019	**Phase 1:** Western Approach Demolition and Reconstruction	Demolish buildings and remove billboard. Remove western plaza. Fill and grade the western approach. Construct new retaining walls.
2020	**Phase 2:** Eastern Approach Demolition and Reconstruction	Demolish building. Fill and grade the eastern approach. Construct new retaining walls.

2020	**Phase 2:** Remove South Utility Trough	Remove south utility trough. (Bid as a separate contract from the Viaduct Repairs contract.)
2020	**Phase 2:** Viaduct Repair	Viaduct repairs as needed: Deck Patching, Expansion Joint Repairs, Concrete Patching, Beam Painting, Misc. Structural Repairs, etc.
2021	**Phase 2:** Remove North Utility Trough	Remove Duke distribution lines from under the north utility trough and relocate to the south side of the viaduct if they cannot be removed entirely. Relocate water main and fiber optic cables out of the north trough. Remove north utility trough.
2021	**Phase 3:** Duke Brighton Substation Relocation	Relocate the Duke Brighton Substation and Duke's high voltage transmission lines and towers to the north side of existing viaduct. Assumes $16M Duke Relocation ($10M WHV & $6M ODOT). This work is in the same PID as the larger viaduct replacement project, but has garnered its own phase, as the work needs to be completed well in advance of the replacement project.
2023	**Phase 4:** Mill Creek Bridge & Bypass Track Relocation	Construct a bridge over Mill Creek and relocate bypass track on the east bank of the Mill Creek to create space on the east bank of the Mill Creek to construct long span bridge tower without the need to cross any railroad tracks. Relocate utilities in the rail yard for future Viaduct construction.
2024	**Phase 4:** Viaduct Repairs	Viaduct repairs as needed: Deck overlays, Expansion Joint Repairs, Concrete Patching, Beam Painting, etc.
2025	**Phase 5:** Viaduct Construction	Develop Plans for the replacement of the Viaduct in order to fix the exact horizontal and vertical location of the proposed new viaduct, approach pavements and walls, utility relocations, track relocations, etc. to allow for the development of detailed plans. Develop plans for the Viaduct construction project, and submit Final Tracings. Construct Tower Piers. Construct approach bridge substructure. Construct large span and approach span superstructures, decks, and remaining approach roadway.
2028	**Phase 6:** Demolition of Existing Viaduct	Demolish existing Viaduct.

Source: City of Cincinnati Department of Transportation and Engineering.