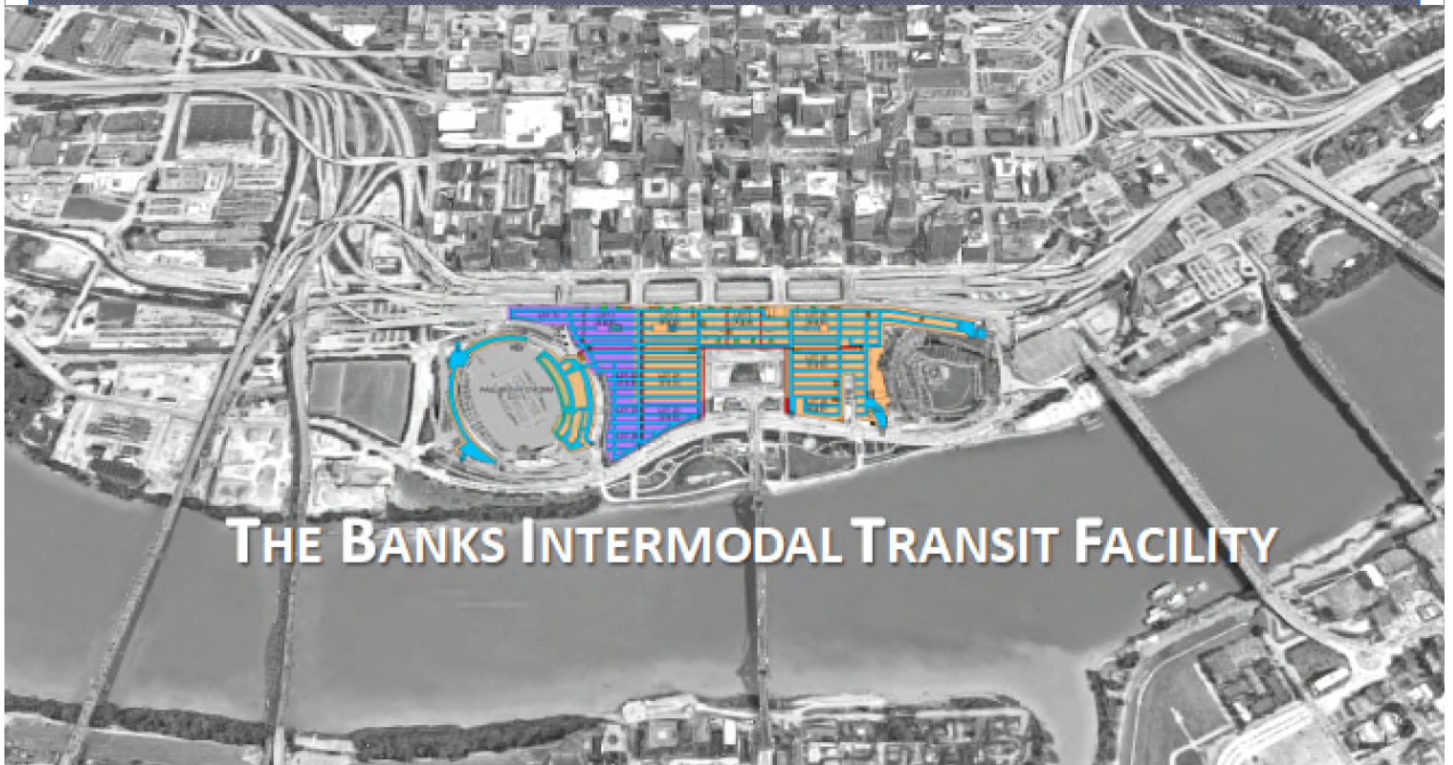


Attachment 3

Benefit Cost Analysis (BCA)



THE BANKS INTERMODAL TRANSIT FACILITY
BUILD GRANT SUBMISSION OF JULY 19, 2018

Banks Intermodal Transit Facility

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Overview

This document describes the benefit-cost analysis (BCA) carried out for the Banks Intermodal Transit Facility Project (the Project), which is required as part of a BUILD 2018 grant application. The Project and its benefits are described in the July 19, 2018 BUILD 2018 Application Narrative Submission. This technical memo provides detail only on those aspects of the Project for which benefits were quantified. The Benefit-Cost ratio includes all Project costs.

Not all Project benefits have been monetized, including the long-term benefits of creating a more walkable, mixed use community in the heart of Cincinnati to attract the region's expected population and job growth to a more transit-oriented live/work/play environment.

The Executive Summary Matrix (Table 1) describes the Project benefits assessed in this BCA. Additional non-quantified project benefits are summarized in the last section

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Table 1: Executive Summary Matrix

Existing Baseline Condition & Problem to be Addressed	Change to Existing Baseline Condition	Type of Impacts	Economic Benefit Discounted at 7%	Page Reference in BCA
Need for more living/working/entertainment environments that are walkable and bike-friendly	Construction of the Project would provide a new developable area raised up above the floodplain in the Banks area of Cincinnati. This would enable creation of new greenspace, office, residential, and commercial development. It also includes the construction of a new music venue.	Increased walking opportunities (recreational, commute-related, and destination-driven) Increased biking opportunities (recreational, commute-related, and destination-driven)	Health benefits of walking: \$465,500 Health benefits of biking: \$406,500 Enhanced property value: \$95.4 million	Walking, page 5 Biking, page 7
Repairs and cleanup costs after flooding along Cincinnati's Ohio River waterfront	Construction of a new developable area raised up above the floodplain in the Banks area of Cincinnati.	Platforms are raised up above the floodplain. The parking areas below the platform are designed to be flood-resistant.	Reduced flood damage clean-up costs \$67,458	Page 8
Congestion and lack of parking in downtown Cincinnati	Creation of additional parking within easy walking access of the Cincinnati Bell Connector (streetcar), buses, and the Banks and downtown destinations	More individuals parking at the Banks and: - Walking/biking to events in the Banks and in other parts of downtown - Walking to transit	Increased walking and biking opportunities (value included in first row)	Pages 5 & 7
Lack of electric charging stations	Provision for 150-200 parking spots with electric charging stations on Lot 25 (see map in Narrative).	Shift of some downtown VMT to streetcar – specifically encouraging electric vehicle drivers to park in the new Banks electric charging lots, and use the Cincinnati Bell Connector to reach their final destinations.	Reduced pavement damage: \$125 Reduced emissions: \$55,300 Increased walking and biking, including walking to transit (value included in first row)	Pavement, page 10 Emissions, page 13 Walk & Bike, pages 5 & 7

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Benefit-Cost Analysis

A formal benefit-cost analysis (BCA) was conducted for the Banks Intermodal Transit Facility Project (the Project) using best practices for BCA in transportation planning, and reflecting the 2018 USDOT *Benefit-Cost Analysis Guidance for Discretionary Grant Programs* (“USDOT BCA Guidance”). The quantified project benefits are:

- Health benefits of additional miles walked
- Health benefits of additional miles traveled by bicycle
- Enhanced property value
- Reduced flood damage clean-up costs
- Reduced vehicle-miles traveled (VMT) leading to:
 - o Reduced pavement damage
 - o Reduced emissions

Table 2 summarizes the cost and the quantifiable benefits of the Project in terms of Present Value. As shown in the table, the present value of the Project’s capital and maintenance costs (at 7%) is valued at approximately \$49.7 million. The benefits have an estimated present value of approximately \$99.8 million, yielding the 2.01 BCA ratio.

Table 2: Summary of Quantified Benefits and Costs

Category	UNDISCOUNTED	Present Value (Discounted at 7%)
Costs		
Construction Cost	\$53,300,000	\$48,183,684
Net increase in Maintenance Costs	\$4,443,000	\$1,525,407
TOTAL COSTS	\$57,743,000	\$49,709,091
Evaluated Benefits		
Flood Damage Repair Cost Savings	\$178,552	\$67,458
Property Value Growth from Building Platforms	\$124,815,786	\$95,366,719
Health Benefits (Pedestrian)	\$1,304,050	\$465,498
Health Benefits (Bicycle)	\$1,149,272	\$406,499
Pavement Damage	\$483	\$125
Emissions Reduction	\$212,883	\$55,295
Residual Value	\$31,980,000	\$3,429,366
TOTAL EVALUATED BENEFITS	\$159,641,026	\$99,790,960
NET PRESENT VALUE	\$101,898,026	\$50,081,869
BENEFIT/COST RATIO	2.76	2.01

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BCA Assumptions

Discount Rate

Federal BUILD guidance recommends that applicants discount future benefits and costs to 2018 present values using a real discount rate of 7% to represent the opportunity cost of money in the private sector.

Year 2017 Dollars

All dollar figures in this analysis are expressed in 2017 dollars, per the 2018 USDOT BCA Guidance.

Build and No-Build Scenario

The BCA analysis was set up to compare the following two scenarios:

1. Build scenario – where the Project is built, allowing private development to occur on the platforms, including residential, office, commercial (retail/restaurant), greenspace, and a music venue
2. No Build scenario (base case) – where the Project does not occur and the parcels of land remain in their current condition as surface parking

Length of Analysis

The analysis includes two years of construction, 2019 and 2020, followed by 30 years of benefits (2021-2050). Residual benefits are calculated for some project elements, and discounted for the year 2051.

Project Costs

Capital Cost

The Project components have a total capital cost of \$53.3 million in 2017 dollars. Table 3 shows the present value by year of expenditure for the Build scenario, showing the derivation of the \$48.2 million present value.

Table 3: Capital Costs

Year	Undiscounted Cost	Discounted at 7%
2018		\$0
2019	\$26,650,000	\$24,906,542
2020	\$26,650,000	\$23,277,142
2021		\$0
2022		\$0
TOTALS	\$53,300,000	\$48,183,684

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Maintenance Costs

No Build operations and maintenance (O&M) costs for the existing surface parking at the Project site is estimated at \$147,000 annually. With the Project in place, O&M costs will be higher, at an estimated \$300,000 per year. These costs were developed by the company currently managing the parking facilities at the Banks.

During the two years of construction, it is assumed that O&M will be half of the No Build scenario, as the parking lots will be closed for construction at least part of those years.

The “Project Costs” tab in the BCA spreadsheet shows the year by year calculations and the derivation of the \$1.5 million present value of the O&M costs.

Residual Value

The Residual Value benefits result from the capital expenditures, concrete structures built to withstand flooding and to support development atop. These structures are expected to last 75 years at a minimum, well beyond the last year of the analysis. Dividing the cost by 75, and multiplying by the number of years of remaining value yields a residual value of \$32.0 million in 2051, with a present value of \$3.4 million.

Project Benefits

Health Benefits of Additional Miles Walked

Additional trips using all modes will be created by the new “origins and destinations” that will be built on top of the Project platforms. These include an assumed 200 new dwelling units (condos and/or apartments), and office development to house an additional 500 new employees.

The new greenspaces and the new Music venue are expected to bring in 300,000 new visits to the Banks annually. These developments together are expected to increase use of Smale Riverfront Park by 100,000 visits annually. This represents growth of 10% over today’s estimated one million annual visitors.

Given the walkability of the Banks, and the availability of transit, it is likely that many of the new residents, employees, and visitors brought to the Banks by the Project will walk additional miles, both recreational and purposeful (destination-driven).

A Victoria Transport Policy Institute (VTPI)¹ study valued the health benefits of walking at \$0.50 per mile. The estimate of the annual number of new person-miles walked comes from these sources:

- Commuting patterns of new residents (walking to work and walk-to-streetcar)
- Commuting patterns of new employees (walking to work and walk-from-streetcar)

¹ Evaluating Active Transport Benefits and Costs; Guide to Valuing Walking and Cycling Improvements and Encouragement Programs 11 April 2018, p45. <http://www.vtpi.org/nmt-tdm.pdf>

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- Additional walking from the new visitors to the music venue (walking along the waterfront before or after a performance, walking to restaurants in the Banks or in the CBD, etc.)
- Additional recreational walking from new employees and residents

The commuting patterns of new residents and employees are based on recent Census journey-to-work data, as shown in Table 4.

Table 4: Census Commuting Data for Downtown and Citywide

Mode of Travel to Work	Downtown	Citywide
Walk to work	41.56%	5.29%
Bike to work	0.40%	0.32%
Transit	11.89%	9.67%
Work at home	1.91%	3.60%

Source: City of Cincinnati (<https://www.cincinnati-oh.gov/planning/reports-data/census-demographics/>)

Of the anticipated 200 new residents to the Banks, it was assumed that they would follow the existing “Downtown” journey-to-work patterns, namely 41.56% (83 individuals) would walk to work, and 11.89% (24 individuals) would take the nearby streetcar.

Of the anticipated 500 new employees, it was assumed that they would follow the “Citywide” journey-to-work-patterns, namely 5.29% (26 individuals) would walk to work, and 9.67% (48) would take transit, walking to/from the Cincinnati Bell Connector Station 1. To be conservative, half of the 26 individuals predicted to walk to work were assumed to live at the Banks, in the developments that would be built on top of the Project. So only 13 walk-to-work commuters were assumed.

The walk from Lot 25 to the Cincinnati Bell Connector Station 1 is 0.3 miles, and the average walk from the Banks to typical work locations is estimated at 0.33 miles. Assuming 250 workdays per year, the resulting mileage is **15,600** annual miles walked for new walk-to-work commuters, and **10,800** annual miles walked by individuals walking to the Cincinnati Bell Connector Station 1 from new residential development at the Project site, or walking from the Cincinnati Bell Connector Station 1 to new office development at the Project site.

For the 300,000 new visitors to the Project site, it was assumed that the average walk is 0.3 miles, and that 20% of visitors will walk recreationally before or after visiting the music venue. This adds up to **18,000** new miles walked annually. All of these miles are attributable to the Project due to the fact that the music venue will not be built here without the Project. Another reason is the Banks development’s focus on greenspace and walkability, encouraging individuals to walk more, and to take advantage of Smale Riverfront Park and other greenspaces adjacent to the Project.

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Lastly, and again because of the Banks development's focus on walkability and greenspace, it was assumed that the new residents and employees would be much more likely to walk recreationally (e.g., after work for new residents, or at lunchtime for employees). These walks were assumed to average 0.62 miles (the length of the Banks from east to west). The length was multiplied by 70% of the 100,000 new visitors to Smale Riverfront Park (as the other 30% is assumed to be biking recreationally). This adds up to **43,400** person-miles annually.

Taking all these miles (15,600+10,800+18,000+43,400) and multiplying them by the \$0.50 per mile benefit, leads to a \$43,900 annual benefit. This benefit was assumed to phase in slowly, with partial benefits in the first two years after construction.

Note that past Banks developments have filled in (being near-fully occupied) in one year to three years; this BCA used an average assumption of two years.

The present value over the entire analysis period adds up to \$465,500.

Health Benefits of Additional Miles Traveled by Bicycle

The estimation of additional bicycle miles is based on the assumptions described in the previous section regarding new residents, employees, and visitors. Additional inputs included the Census journey-to-work data, and the VTPI study cited above, which also provides a value of the social (health) benefits of bicycling, of \$0.20 per person-mile.

The estimate of the annual number of new bicycle-miles comes from these sources:

- Commuting patterns of new residents biking to work
- Commuting patterns of new employees biking to work
- Additional biking from the new visitors to the music venue (biking to the venue)
- Additional recreational walking from new employees and residents

The commuting patterns of new residents and employees are based on recent Census journey-to-work data, as shown in Table 4 above. Of the anticipated 200 new residents to the Banks, it was assumed that they would follow the existing "Downtown" journey-to-work patterns, namely 0.4% (one individual) would walk to work.

Hamilton County staff indicated that the 0.32% city-wide bike-to-work percentage was too low, as it was based on Census surveys prior to the implementation of recent bike policies. The staff indicated that 1.29% (6 individuals) was a more appropriate figure. The average length of a bicycle commute was estimated to be 3.3 miles each way, based on a Census estimate² that the average bicycle commute was 18 minutes (assuming 11 mph to arrive at 3.3 miles).

The total of seven bike-to-work commuters, with a 6.6-mile round trip commute, yields **11,550** bike-miles annually.

² <https://www.census.gov/prod/2014pubs/acs-25.pdf>, Figure 12

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It is assumed that no residents would take a bicycle to the streetcar, as Cincinnati Bell Connector Station 1 is only 0.33 miles from the Project site.

For the 300,000 new visitors to the Project site, it was assumed that 0.32% of visitors will bicycle to get there, and that the average bike trip would be 3.3 miles. These figures were based on the original Census journey-to-work data, and the assumed bike commute length described above, as more appropriate data was not available. It should be noted that a larger number of individuals would likely bike to the new music venue, but these individuals might have also biked to a different music venue location under the No Build. The additional bicycle miles result from the fact that the Project location is surrounded by a bicycle-friendly environment, including a major bicycle path (through Smale Riverfront Park with links across the Ohio River). The result is **3,188** annual bicycle miles.

Lastly, approximately 30% of the assumed new 100,000 annual park visitors (brought by the Project) were assumed to be cycling. The average length of these bicycle trips was assumed to be 6 miles (based on an assumed half-hour ride at 12 mph). Annual new bike miles are therefore **180,000**.

Taking all these miles (11,550+3,188+180,000) and multiplying them by the \$0.20 per mile benefit, leads to an annual benefit of approximately \$38,950. This benefit was assumed to phase in slowly, with partial benefits in the first two years after construction.

The present value over the entire analysis period adds up to \$406,500.

Reduced Flood Damage

The flooding of the Ohio River, as described in the Application Narrative, has historically hampered development in the area that is now the Banks. The Project site is currently surface parking, and the company that currently manages the parking on the Project site, as well as other parking facilities in the Banks, estimated that the cost of this flooding averages \$5,760 per year, based on the following calculation:

- Recent (February 2018) flood clean-up costs for the entire 18.62-acre Central Riverfront Garage were \$114,092. The Project site is 4.7 acres, yielding a likely cost of \$28,799 for that portion of the clean-up. Floods in this area are estimated to occur every five years, providing an average annual cost of \$5,760.

Over the course of the analysis, this adds up to a present value of approximately \$67,500.

Enhanced Property Value

Two aspects of enhanced property values were quantified:

- The property values created on the Project Site, enabled by the Project
- Enhanced property values experienced by surrounding properties

These are described separately below.

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Project Site

By creating a platform on the Project site that will raise the development above the floodplain while providing parking, the Project literally creates new property for development. The value of the development was estimated by local officials, and the likely cost of construction of that development was provided by potential developers. Exact figures are not possible, as the design (including basics such as height, number of housing units, square footage of office/commercial space) have not been finalized.

Table 5: Value Growth on Project Site

Lot Number	23	25	27	28
A. Current Value (as surface parking)	\$3,613,050	\$3,619,350	\$2,308,950	\$2,308,950
B. Proposed Use after Project	Greenspace	Mult-Story Mixed-Use	Music venue	Greenspace
C. Cost of Development	\$5,000,000	\$45,000,000	\$15,000,000	\$3,000,000
D. Value of Development	\$12,000,000	\$110,000,000	\$30,000,000	\$6,000,000
Net Value Increase (=D-A-C)	\$3,386,950	\$61,380,650	\$12,691,050	\$691,050
Project Site Total				\$78,149,700

*Note that current property values are based on the cost-per-acre of surface parking lots north of Third Street.

The value of the parking lots was assumed to be equal to their cost, just to be conservative.

Adjacent Parcels

The Banks development vision brings dense transit-supportive development to the heart of the City along the Ohio River, supporting a more transportation-efficient future for the City. The Project will enable the further development of the Banks, providing additional residential, office, and commercial space, as well as a new entertainment venue. This will continue the process of carrying out the long-term vision for this vibrant area, supporting the existing Banks developments, as well as Banks developments that are in progress and planned for the next few years. This support makes surrounding properties more desirable, which will be realized as increased property values for the surrounding area.

The increased property values are in part due to the new foot-traffic which will be brought by the developments on the Project site. As noted in the sections on walking and cycling activity, the Project will bring a substantial number of daily visitors to the Banks (including new residents, new employees, new park users, and new music venue attendees), bringing additional customers year after year for the existing and planned commercial developments in the Banks and adjacent areas. This increased attractiveness will increase commercial rents. The Project-induced increase in activity and advantages (greenspace, access to entertainment opportunities) will also make it more attractive to residents, increasing the demand for residences in the Banks area. Other land use types will also benefit. For example, office locations next to greenspace

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and new developments will be more desirable than those with views of surface parking lots.

For these reasons, the Project's benefits to adjacent properties, reflected in property values, are estimated as noted below:

Properties Impacted	Increase Expected	Increase in Value
Properties on Third Street (overlooking the Banks)	• 6% for properties near the Project • 4% for properties more than 0.25-miles from the Project site (easy walking distance) • Vacant lots just north of Project assumed to develop to average value-per-acre of other nearby developed properties	\$11,766,086
Developed Banks Properties	• 6% for properties near the Project • 4% for properties more than 0.25 miles away	\$20,800,000
Banks (not yet developed)	• 6% for properties near the Project • 4% for properties more than 0.25 miles away	\$14,100,000

Details are provided in the BCA spreadsheet provided with the BUILD grant application.

To calculate the \$95.4 million present value of the property value growth (including Project site properties as well as adjacent properties), it was assumed that the total value would not occur all at once, but would be spread out over three years after construction is completed.

The \$95.4 million assumptions may be conservative, as there may be secondary effects, including development opportunities and property value growth for properties further away from the Project site, including further north in downtown, and all areas within walking distance of the Cincinnati Bell Connector.

Reduced Pavement Damage

The new electric charging stations that are part of the Project will make the Banks even more attractive as a park-and-ride site for commuters, residents, and tourists. This will reduce VMT in downtown Cincinnati. With the growing number of electric vehicles, it is believed that it will take many years for the full benefit of the 150 (potentially more) electric charging spots to be fully utilized. The analysis conservatively assumed that 10 daily users would be attracted to the site in 2021, growing to 130 in 2050. The annualization factor used was 365, since the lots can be used more than once per day, and because of the high level of weekend interest in destinations along the Cincinnati

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Bell Connector route, on top of the high level of use of the existing parking for commuters.

Some of the users of these lots would use it as park-and-walk. For these users, no reduction in VMT was assumed. For new users of these lots who would be using the Cincinnati Bell Connector, it was assumed that the VMT reduction per trip is half a mile (one mile round trip).

These assumptions result in VMT reduction of 1,354 in 2021, growing to 17,602 in 2050.

This VMT was used to calculate a reduction in pavement damage of \$0.001743 per mile based on the 2000 FHWA study. The present value calculations year-by-year are shown in Table 6.

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Table 6: Reduced Pavement Damage from Avoided VMT

Year	Years After Construction	VMT Reduction	Pavement Damage Avoided	Discounted at 7%
2018				\$0.00
2019				\$0.00
2020				\$0.00
2021	1	1,354	\$2.36	\$1.93
2022	2	1,896	\$3.30	\$2.52
2023	3	2,437	\$4.25	\$3.03
2024	4	2,979	\$5.19	\$3.46
2025	5	3,520	\$6.14	\$3.82
2026	6	4,062	\$7.08	\$4.12
2027	7	4,604	\$8.03	\$4.37
2028	8	5,145	\$8.97	\$4.56
2029	9	5,687	\$9.91	\$4.71
2030	10	6,228	\$10.86	\$4.82
2031	11	6,770	\$11.80	\$4.90
2032	12	7,312	\$12.75	\$4.94
2033	13	7,853	\$13.69	\$4.96
2034	14	8,395	\$14.64	\$4.96
2035	15	8,936	\$15.58	\$4.93
2036	16	9,478	\$16.52	\$4.89
2037	17	10,020	\$17.47	\$4.83
2038	18	10,561	\$18.41	\$4.76
2039	19	11,103	\$19.36	\$4.68
2040	20	11,644	\$20.30	\$4.58
2041	21	12,186	\$21.25	\$4.48
2042	22	12,728	\$22.19	\$4.37
2043	23	13,269	\$23.13	\$4.26
2044	24	13,811	\$24.08	\$4.15
2045	25	14,352	\$25.02	\$4.03
2046	26	14,894	\$25.97	\$3.91
2047	27	15,436	\$26.91	\$3.78
2048	28	15,977	\$27.86	\$3.66
2049	29	16,519	\$28.80	\$3.54
2050	30	17,602	\$30.69	\$3.52
TOTALS			\$483	\$125

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Reduced Emissions

The VMT reduction explained in the Pavement Reduction section above, and shown in Table 6, was also used to calculate reduced emissions.

EMFAC emissions factors for autos at 25 mph were used to reflect the speed of downtown traffic (see Table 7).

The value of emissions factors used are as follows:

- CO – no value assumed
- CO₂ – Values from the 2016 USDOT BCA Guidance were used (inflated to 2017 dollars)
- NO_x – \$7,508 per short ton
- SO_x – \$44,373 per short ton
- PM – \$343,442 per short ton
- VOC – \$1,905 per short ton

The resulting emissions saved vary by year and are shown in the BCA spreadsheet. Total present value over the term of the analysis are \$55,295.

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Table 7: Emissions Factors for Autos Traveling at 25 MPH

Emissions Factors (g/VMT) from 2017 EMFAC					
CO2	NOx	SOx	PM 10	VOC	CO
1.400079	1.115536	0.00281	1.99243	1.798404	1.470368
1.399781	1.123997	0.002743	1.994986	1.819169	1.482335
1.399993	1.129859	0.002674	1.994455	1.827622	1.489597
1.400085	1.132051	0.002606	1.992859	1.831606	1.494615
1.40009	1.13471	0.002537	1.993921	1.836786	1.499504
1.400059	1.137713	0.002468	1.996305	1.842299	1.503475
1.400772	1.16234	0.002397	1.999016	1.901899	1.52545
1.400464	1.162599	0.002328	1.999963	1.90092	1.523856
1.400507	1.163079	0.002266	1.996803	1.901158	1.523273
1.400757	1.16291	0.002209	1.990818	1.899456	1.522498
1.401025	1.162478	0.002159	1.983465	1.896953	1.52176
1.401261	1.161517	0.002114	1.981698	1.892922	1.520431
1.40146	1.160302	0.002074	1.982248	1.887203	1.518794
1.401832	1.178292	0.002039	1.98396	1.929053	1.531155
1.401977	1.179086	0.002008	1.985521	1.928405	1.530773
1.402109	1.179745	0.001981	1.986901	1.927824	1.530482
1.402223	1.18042	0.001958	1.98788	1.927578	1.530074
1.402322	1.181061	0.001937	1.988586	1.927193	1.529524
1.402418	1.181555	0.00192	1.990039	1.926267	1.528992
1.402494	1.182119	0.001905	1.991373	1.92596	1.528645
1.402557	1.182572	0.001892	1.992616	1.925531	1.528411
1.402602	1.182986	0.001882	1.99378	1.925569	1.528434
1.402627	1.183045	0.001874	1.994673	1.925064	1.528375
1.402643	1.183087	0.001867	1.995989	1.924334	1.528225
1.402642	1.183102	0.001861	1.997098	1.923597	1.528019
1.402629	1.183092	0.001857	1.998015	1.922909	1.527782
1.402606	1.183067	0.001853	1.998749	1.922277	1.527512
1.402573	1.183015	0.00185	1.999325	1.92163	1.527187
1.402536	1.182882	0.001848	1.999779	1.920847	1.526842
1.402494	1.182677	0.001847	2.000094	1.919963	1.526452
1.402445	1.182419	0.001845	2.000262	1.919028	1.526026
1.402397	1.182236	0.001844	2.00056	1.918239	1.525781
1.402347	1.182009	0.001843	2.000793	1.917357	1.525517

Source: WSP, EMFAC 2014

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Non-Quantified Benefits

There are a number of other Project benefits that could not be reasonably quantified for the benefit-cost analysis. Among these are:

- Long-term benefits to the regional economy by better linking residents to jobs, while providing businesses (particularly those located at the Banks Intermodal Transit Facility) with access to a broader workforce and customer base.
- Long-term benefits of creating a more walkable, mixed use community in the heart of Cincinnati to attract the region's expected population and job growth to the centrally-located, transit/bike/pedestrian-friendly Banks.
- The emissions benefits of the electrical charging stations were not assessed due to lack of data regarding indirect emissions of electric-fueled vehicles