
Appendix L
**Assigned Adaptation Strategies and Associated Costs for the Benefit
Cost Analysis**

Appendix L

Sketch-Level Benefit-Cost Analysis

A single-run of a sketch-level BCA was conducted that compares the costs (to implement all the assigned adaptation strategies for the vulnerable assets located within each subarea boundary) to the benefits and evaluates whether the investment is economically advisable economically feasible. In general, a BCA is not the sole basis of the decision-making process but plays a supporting role to assist in investments decisions and are useful when deciding between a few viable options to solve a problem. It is not uncommon for public spending to be based on the need to protect the health and safety of the public or to improve the economy without the expectation that there will be an economic payback.

This sketch-level BCA does not include benefits related to health and safety or the economy.

In addition, this sketch-level BCA does not consider construction feasibility (can a facility/road be built), financial feasibility (can the it be funded), or environmental (can impacts be mitigated). The sketch-level BCA was conducted to evaluate a comprehensive package of adaptation strategies within a short timeframe, but this budget-constrained study was not able to develop project-specific BCA and evaluate which projects should be included into capital plans. Ideally, additional studies will conduct several BCA iterations based on the work presented herein.

The first section begins with an overview of the methodology, followed by a quantification of costs and benefits and a comparison of costs and benefits through breakeven analyses and BCA evaluation metrics. Given the BCA findings, the last section provides the conclusions including recommendations for future efforts. **Figure 1** shows the benefit-cost evaluation approach in the context of the entire study's workflow process.

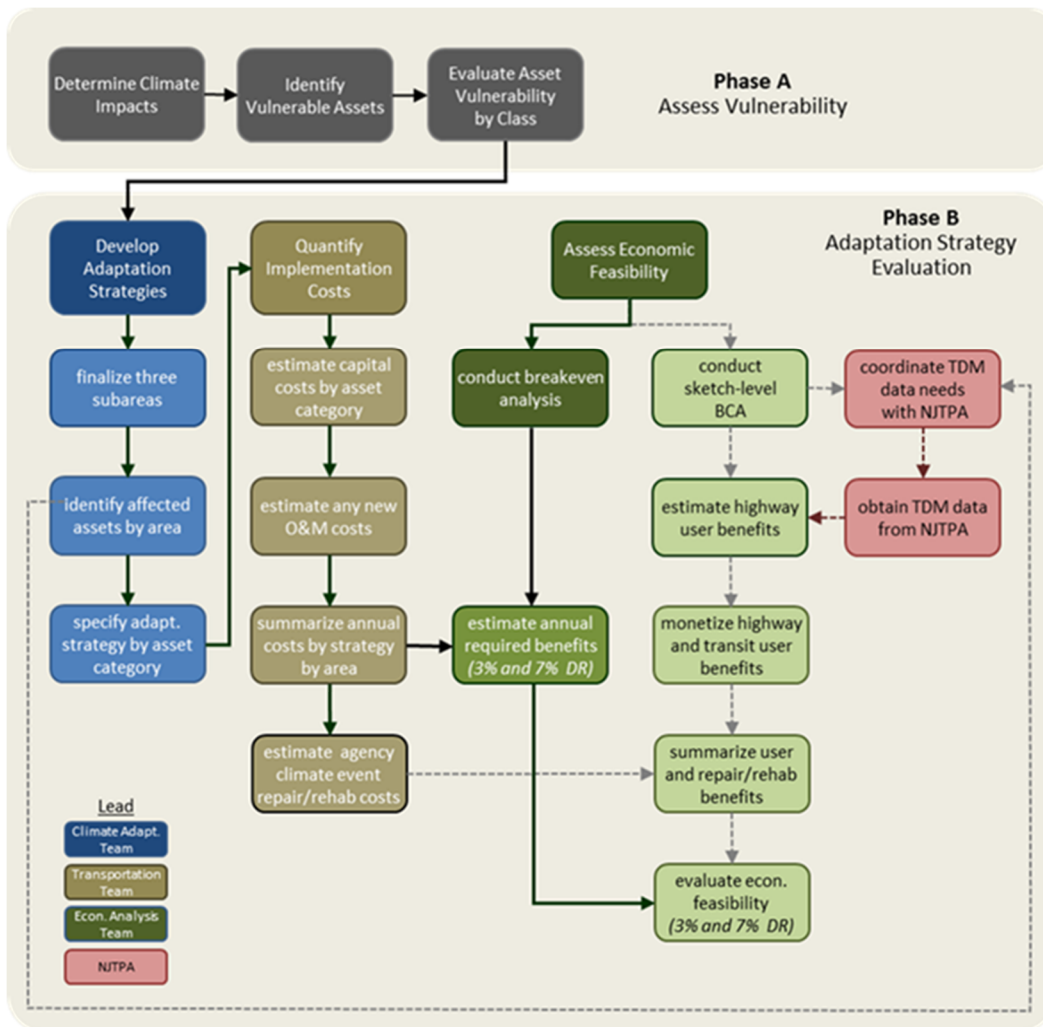


Figure 1. PRB Study Workflow Process and Benefit Cost Evaluation Approach

L.1 Methodology Overview

This BCA approach follows USDOT procedures and guidelines. The guidelines outline how to evaluate improvement scenarios, address implementation costs, and quantify cost-saving benefits. Of these tasks, the quantification of benefits is typically the most challenging. As such, USDOT outlines what can be included in the calculation and how to quantify monetary values (time, vehicle operating cost, accidents, emissions).

This BCA considers the infrastructure lifecycle and evaluates how the proposed adaptation strategies mitigate impacts on transportation assets that would otherwise incur costly damages and/or disrupt travel as a result of a severe weather event. Implementing adaptation strategies is comprised of two implementation costs: initial construction and subsequent operations and maintenance (O&M). Resultant cost-savings are comprised of two types of benefits: agency cost savings or benefits and transport users' benefits such as avoided accidents or reduced travel time. Conceptually, the implementation cost and resultant benefit types are shown in **Figure 2**.

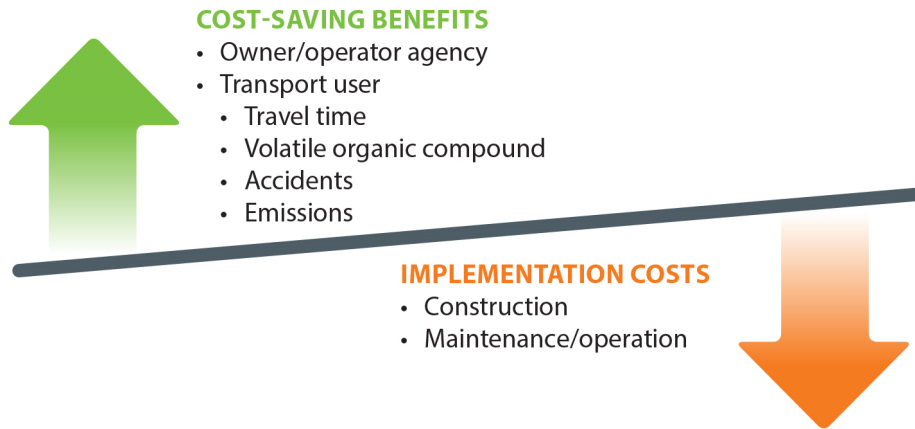


Figure 2. Implementation Costs and Cost-Saving Benefits

This BCA approach compares two scenarios for each of the three subareas:

- *Do-Nothing Scenario* – Reflects conditions in which no adaptation strategies are implemented and an extreme weather event disrupts vulnerable assets. Under this scenario, it is assumed that transportation assets are damaged or destroyed, warranting repair or replacement, and is unavailable for public use.
- *Build Scenario* – Represents implementation of all assigned adaptation strategies within each subarea that would avoid transportation asset damages and travel disruptions.

L.2 Breakeven Analyses

Initial indications were that the build scenario, at a subarea scale, was unlikely to be economically prudent. Therefore, breakeven analyses were employed to gain insights into the BCA approach. The breakeven analyses identify the magnitude of annually recurring benefits required to cover the implementation costs for each of the three subareas (in their entirety) given an assumed discount rate. Such annually recurring benefit requirements were then compared with sketch-level benefits (for both agency and transport user).

L.3 BCA Evaluation Metrics

BCAs compare discounted benefits to discounted costs across a project lifecycle. These temporal discounted benefits and costs are compared in three foundational metrics. All three metrics yield the same conclusion: project is or is not economically prudent with the difference being estimates of magnitude (NPV), relativity (BCR), or sensitivity (IRR). These foundational metrics are defined below:

- *Net Present Value (NPV)* – Discounted benefits less discounted costs; a positive monetary value indicates the investment is economically prudent.

- *Benefit-Cost Ratio (BCR)* – Discounted benefits divided by discounted costs; a ratio greater than 1.0 indicates the project is economically prudent.
- *Internal Rate of Return (IRR)* – Discount rate at which the present value of the benefits is equal to the present value of the costs; an IRR greater than the discount rate (either 3 percent per NJTPA or 7 percent per USDOT) indicates the project is economically prudent.

L.4 Quantify Implementation Costs

The first step in the BCA process is to estimate the order of magnitude costs for the assigned adaptation strategies per subarea. These costs were not developed for specific assets and represent national averages. These costs need to be further refined if used for any other purposes beyond this study.

L.4.1 Cost for Each Asset Type

The cost estimates for each of the five asset types—bridges, roads, culverts, rail, and facilities—are developed based on CDM Smith subject matter experts (SME) interviews and available marketplace research¹. Unit cost estimates (i.e., dollars per square foot or dollars per lane mile) or total costs are developed both for proactively implementing the adaptation strategy for the assets and for repairing or replacing the assets after damage by a climate event. In addition, O&M costs are considered in the BCA, where additional effort and resources would be required beyond current operational budgets of the asset owners and operators. Where cost estimates were available as a range because they depend on project-specific information, an average cost is used. The cost estimates are summarized by asset type and by adaptation strategy in **Appendix K Benefit Cost Analysis Costs for Asset Adaptation Strategies**.

L.4.2 Costs to Subarea Assets

Next, the geospatial database was used to calculate the implementation costs and the O&M cost estimates for the adaptation strategies assigned to each asset. The unit costs were programmed into the geospatial database, and with the information already available in the database (such as bridge deck area, miles of roadway, linear feet of rail track, or acres of land), the asset-specific cost estimates for both initial construction and O&M were developed. For

These costs should only be used at the subarea level and not as detailed cost estimates at a granular asset level due to the planning level nature of the costs and the assumptions necessary for this sketch-level BCA.

¹ Sources of adaptation strategy cost research include “Post Hurricane Sandy Transportation Resilience Study in NY, NJ, and CT,” available at https://www.fhwa.dot.gov/environment/sustainability/resilience/publications/hurricane_sandy/fhwahep17097.pdf; “Fresh Coast Green Solutions,” available at <https://www.mmsd.com/application/files/8514/8779/6598/SustainBookletweb1209.pdf>; “Underground vs. Overhead: Power Line Installation-Cost Comparison and Mitigation,” Electric Light and Power Newsletter, available at https://www.elp.com/articles/powergrid_international/print/volume-18/issue-2/features/underground-vs-overhead-power-line-installation-cost-comparison-.html.

example, if the unit cost to implement a given strategy is estimated at \$1,000 per lane mile and the asset is a 20-lane-mile road segment, then the program would determine the total cost is \$20,000.

These costs along with all assumptions are summarized by asset, adaptation strategy, and subarea in subsequent tables.

L.4.3 Cost Estimates

Construction costs for implementing the adaptation strategies range between \$228 and \$401 million per subarea (**Table 1**). These costs are dominated by roadway infrastructure, which comprise between 80 percent (Subarea B) and 98 percent (Subarea A) of the total. The majority of the roadway costs are from two adaptation strategies which were applied to the length of the roads within the subareas:

- SW08 - Increase capacity of stormwater infrastructure and drainage system makes up over half of the roadway costs
- FD8 - Use new asphalt/concrete mixtures able to withstand flood conditions makes up approximately a third of the roadway costs

Table 1. Subarea Construction Implementation Costs by Asset Classification

Asset Classification	Subarea A	Subarea B	Subarea C
Bridges	\$2.2	\$3.4	\$5.9
Culverts	\$4.6	\$5.6	\$4.6
Facilities (Buildings, stations)	\$0.0	\$0.0	\$0.0
Rail track	\$0.0	\$36.3	\$8.7
Roads	<u>\$394.2</u>	<u>\$182.4</u>	<u>\$236.9</u>
Total Construction Costs	\$401.0	\$227.7	\$256.1
*in millions of 2018 U.S. dollars			

To conduct this BCA, the following reasonable assumptions on timeframe are utilized: construction is assumed to begin in year 2020 and span five years through 2024 with a uniform annual cost distribution; O&M costs ranging between \$1.6 and \$2.9 million are assumed to be expended during the initial five years; and from 2025 forward the O&M costs are assumed to range between \$2.5 million to \$3.0 million annually.

Table 2. Subarea Implementation Costs by Type and Year

Cost Type by Year	Subarea A	Subarea B	Subarea C
Construction			
2020	\$80.2	\$45.5	\$51.2
2021	\$80.2	\$45.5	\$51.2
2022	\$80.2	\$45.5	\$51.2
2023	\$80.2	\$45.5	\$51.2
2024	\$80.2	\$45.5	\$51.2
Total	\$401.0	\$227.7	\$256.1
O&M			
2020	\$1.6	\$2.3	\$2.4
2021	\$1.8	\$2.4	\$2.5
2022	\$2.0	\$2.5	\$2.7
2023	\$2.2	\$2.6	\$2.8
2024	\$2.4	\$2.7	\$2.9
2025-Ongoing	\$2.5	\$2.7	\$3.0

*in millions of 2018 U.S. dollars

L.5 Quantify Cost-Saving Benefits

The two cost-saving benefit types—agency benefits and transport user benefits—are quantified for this sketch-level BCA.

L.5.1 Agency Benefits

Agency benefits are the cost savings an agency would realize for avoided asset repair or replacement costs due to a climate event at any year in the asset’s lifecycle. Similar to the implementation costs, subject matter experts (SME) interviews and available marketplace research² were used to develop the estimated costs to repair and/or replace assets that an agency can expect to avoid under the build scenario (represents implementation of all assigned adaptation strategies that would avoid transportation asset damages and travel disruptions). The expected value³ of such cost savings in 2018 dollars amount to \$283.6, \$334.7, and \$504.8 million for Subareas A, B, and C, respectively. These agency cost-saving benefits are summarized in **Table 3**

² Sources of adaptation strategy cost research include “Post Hurricane Sandy Transportation Resilience Study in NY, NJ, and CT,” available at https://www.fhwa.dot.gov/environment/sustainability/resilience/publications/hurricane_sandy/fhwahep17097.pdf; “Fresh Coast Green Solutions,” available at <https://www.mmsd.com/application/files/8514/8779/6598/SustainBookletweb1209.pdf>; “Underground vs. Overhead: Power Line Installation-Cost Comparison and Mitigation,” Electric Light and Power Newsletter, available at https://www.elp.com/articles/powergrid_international/print/volume-18/issue-2/features/underground-vs-overhead-power-line-installation-cost-comparison.html.

³ “Expected value” is a mathematical term and is calculated as the sum of all possible values, each multiplied by the respective probability of occurrence.

and reflect a similar order of magnitude to the implementation costs (**Table 2**).⁴ Applying the 1 percent annual (100-year) probability of the climate event occurrence to the total estimated agency benefits yields an annual expected-value benefit for the project lifecycle of \$5.0, \$2.8, and \$3.3 million for Subareas A, B, and C, respectively.⁵

Table 3. Subarea Agency Cost-Saving Benefits by Asset Type

Asset Type	Subarea A	Subarea B	Subarea C
Cost-Saving Benefits			
Bridges	\$9.2	\$14.3	\$23.8
Culverts	\$4.6	\$5.6	\$4.6
Facilities	\$0.0	\$0.0	\$0.0
Rail Track	\$0.0	\$38.5	\$9.3
Roads	\$491.1	\$225.2	\$297.1
Total Repair/Replacement Costs	\$504.8	\$283.6	\$334.7
Annual Event			
Probability	1%	1%	1%
Annual Cost-Saving Benefits	\$5.0	\$2.8	\$3.3
*in millions of 2018 U.S. dollars			

L.5.2 Transport User Benefits

Transport user benefits reflect avoided transportation costs to passenger cars, trucks, and transit riders from a network shutdown and rerouting and are measured via monetized travel demand model (TDM) data from the NJTPA North Jersey Regional Transportation Model-Enhanced (NJRTM-E). The avoided costs include lost travel time and increased vehicle-operating, accident, and emissions costs. These avoided costs or benefits are based on network changes in travel patterns and represented by vehicle hours traveled (VHT) and vehicle miles traveled (VMT) developed through the TDM for each subarea. Vehicle hours traveled (VHT) is calculated from data on speed and miles traveled to measure the quality of service provided by highways. One vehicle traveling the distance of one mile equals one VMT; this measure is used to estimate congestion, fuel consumption, and other transportation-related factors.

Travel demand modeling is a complex process with various dimensions, including geographic and transportation network resolution, model years, modes, and trip purposes. The NJTPA modeled two scenarios for each subarea: do-nothing (climate-event-damage) and build (adaptation strategies and no network shutdown). The NJTPA provided data as VMT and VHT per day and by vehicle type (cars, trucks, transit) for the years that bound this study -2017 for current conditions and 2045 for the last year of the planning timeframe (referred to herein as the “anchor” years).

⁴ Repair and replacement costs range between 121 percent (Subarea A) to 161 percent (Subarea C) of implementation construction.

⁵ “Expected value” is a mathematical term. It is calculated as the sum of all possible values, each multiplied by the respective probability of occurrence; herein, it is the total repair and/or replacement costs multiplied by 1 percent annually.

The TDM data were evaluated and applied to unit and monetization metrics to estimate daily travel user benefits. Changes in networkwide VMT and VHT for the two scenarios indicate how travel patterns change with an improvement, represented by implementation of adaptation strategies subarea-wide. **Table 4** provides a summary of the VMT and VHT for cars and trucks (and roadway total); transit was excluded for simplicity due to its minimal relative benefits.

Table 4. Daily TDM Metrics and Related Travel User Benefits by Anchor Year and Vehicle Type

Subarea Metrics	2017			2045		
	Cars	Trucks	Total	Cars	Trucks	Total
VMT						
<i>Daily Volume</i>						
<i>Do-Nothing – Subarea A</i>	78,395,788	5,745,102	84,140,890	88,497,733	5,944,710	94,442,443
<i>Do-Nothing – Subarea B</i>	80,200,401	5,933,270	86,133,671	90,172,661	6,449,190	96,621,851
<i>Do-Nothing – Subarea C</i>	79,690,098	5,964,012	85,654,111	89,874,446	6,526,608	96,401,053
<i>Build – All Subareas</i>	<i>80,880,305</i>	<i>5,998,986</i>	<i>86,879,291</i>	<i>91,114,256</i>	<i>6,567,271</i>	<i>97,681,527</i>
<i>Daily Δ(Do-Nothing less Build)</i>						
Subarea A	-2,484,517	-253,884	-2,738,402	-2,616,523	-622,561	-3,239,084
Subarea B	-679,904	-65,716	-745,621	-941,595	-118,081	-1,059,676
Subarea C	-1,190,207	-34,974	-1,225,181	-1,239,811	-40,663	-1,280,474
<i>Daily Benefits</i>						
Subarea A	(\$1,573,625)	(\$332,828)	(\$1,906,453)	(\$1,657,234)	(\$816,143)	(\$2,473,377)
Subarea B	(\$430,633)	(\$86,150)	(\$516,783)	(\$596,380)	(\$154,798)	(\$751,178)
Subarea C	(\$753,844)	(\$45,849)	(\$799,693)	(\$785,262)	(\$53,308)	(\$838,570)
VHT						
<i>Daily Volume</i>						
<i>Do-Nothing – Subarea A</i>	3,093,025	157,849	3,250,874	3,751,001	172,468	3,923,469
<i>Do-Nothing – Subarea B</i>	3,146,720	157,785	3,304,505	3,733,868	177,280	3,911,148
<i>Do-Nothing – Subarea C</i>	3,166,878	159,323	3,326,201	3,794,041	180,998	3,975,039
<i>Build – All Subareas</i>	<i>3,077,077</i>	<i>155,306</i>	<i>3,232,383</i>	<i>3,676,774</i>	<i>175,808</i>	<i>3,852,582</i>
<i>Daily Δ(Do-Nothing less Build)</i>						
Subarea A	15,948	2,543	18,490	74,227	-3,340	70,887
Subarea B	69,643	2,479	72,122	57,094	1,472	58,566
Subarea C	89,801	4,017	93,818	117,266	5,190	122,456
<i>Daily Benefits</i>						
Subarea A	\$335,525	\$74,370	\$409,896	\$1,561,649	(\$97,686)	\$1,463,963
Subarea B	\$1,465,207	\$72,508	\$1,537,715	\$1,201,199	\$43,048	\$1,244,248
Subarea C	\$1,889,314	\$117,499	\$2,006,813	\$2,467,155	\$151,800	\$2,618,955
Total Daily Benefits						
Subarea A	(\$1,238,100)	(\$258,458)	(\$1,496,558)	(\$95,585)	(\$913,828)	(\$1,009,414)
Subarea B	\$1,034,574	(\$13,642)	\$1,020,932	\$604,819	(\$111,750)	\$493,069
Subarea C	\$1,135,470	\$71,650	\$1,207,120	\$1,681,893	\$98,492	\$1,780,385

* Benefits and disbenefits are bolded and shaded if specifically discussed in the subsequent summary.

Δ: change = do-nothing scenario minus the build scenario

Red = disbenefits (minus dollars)

In **Table 4**, VHT changes are applied a weighted-average value of \$21.04 and \$29.25 per VHT for cars and trucks, respectively. Similarly, per-VMT costs of \$0.63 and \$1.31 for cars and trucks, respectively, were applied to VMT changes. Such VMT costs include vehicle-operating, accident, and emission costs, based on various assumptions (**Table 5**).

Table 5. Benefit Assumptions, Ratios, and Costs (Current 2018 U.S. Dollars)

Assumptions	Applied Factor	Source	Notes
Inflation Assumptions			
2017\$ to 2018\$	1.0227	BEA Implicit Price Deflators for GDP	T1.1.9
Travel Time Assumptions			
<i>Vehicle Occupancy (persons/vehicle)</i>			
Passenger Cars	1.39	FHWABCAGuidance 2018	
Commercial Vehicles	1.00	FHWABCAGuidance 2018	
Fixed Guideway	45.00	GIS processing of NJTPAPHT/VHT	rounded
Local Bus (5)	15.00	GIS processing of NJTPAPHT/VHT	rounded
Express Bus to PABT (6)	15.00	GIS processing of NJTPAPHT/VHT	rounded
Express Bus PNR (7)	4.00	GIS processing of NJTPAPHT/VHT	rounded
<i>Time Values (2018\$/person-hour)</i>			
Passenger Cars/Transit Riders	\$15.14	FHWABCAGuidance 2018	inflated to 2018\$
Commercial Vehicle Operator	\$29.25	FHWABCAGuidance 2018	inflated to 2018\$
Fixed Guideway Operator	\$50.01	FHWABCAGuidance 2018	inflated to 2018\$
Local Bus (5) Operator	\$30.68	FHWABCAGuidance 2018	inflated to 2018\$
Express Bus to PABT (6) Operator	\$30.68	FHWABCAGuidance 2018	inflated to 2018\$
Express Bus PNR (7) Operator	\$30.68	FHWABCAGuidance 2018	inflated to 2018\$
Vehicle Operating Cost Assumptions			
<i>Operating Costs (2018\$/VMT)</i>			
Passenger Cars	\$0.40	FHWABCAGuidance 2018	inflated to 2018\$
Commercial Vehicles	\$0.92	FHWABCAGuidance 2018	inflated to 2018\$
<i>Fixed Guideway</i>	<i>\$2.00</i>	<i>Placeholder</i>	
<i>Local Bus (5)</i>	<i>\$0.92</i>	<i>Placeholder</i>	
<i>Express Bus to PABT (6)</i>	<i>\$0.92</i>	<i>Placeholder</i>	
<i>Express Bus PNR (7)</i>	<i>\$0.92</i>	<i>Placeholder</i>	
Accidents Assumptions			
<i>Accident Rates (accident/100m-VMT)</i>			
Fatalities	0.76	NJDOT	2017
Injuries	79.67	NJDOT	2017
PDO	268.21	NJDOT	2017
<i>Accident Costs (2018\$/accident)</i>			
Fatalities	\$9,817,890	FHWABCAGuidance 2018	inflated to 2018\$
Injuries	\$177,949	FHWABCAGuidance 2018	inflated to 2018\$
PDO	\$4,425	FHWABCAGuidance 2018	inflated to 2018\$
<i>Accident Costs (2018\$/VMT)</i>			
Accident Costs/VMT	\$0.23		
Emissions Cost Assumptions			
<i>Emissions Costs (2018\$/short ton)</i>			
VOC	\$1,948	FHWABCAGuidance 2018	inflated to 2018\$
NOX	\$7,678	FHWABCAGuidance 2018	inflated to 2018\$
PM	\$351,237	FHWABCAGuidance 2018	inflated to 2018\$
<i>Emissions Costs (2018\$/VMT)</i>			
Passenger Cars	\$0.01	FHWABCAGuidance 2018, FTA, and EPA	inflated to 2018\$
Commercial Vehicles	\$0.16	FHWABCAGuidance 2018, FTA, and EPA	inflated to 2018\$
Fixed Guideway	\$0.36	FHWABCAGuidance 2018, FTA, and EPA	inflated to 2018\$
Local Bus (5)	\$0.02	FHWABCAGuidance 2018, FTA, and EPA	inflated to 2018\$
Express Bus to PABT (6)	\$0.02	FHWABCAGuidance 2018, FTA, and EPA	inflated to 2018\$
Express Bus PNR (7)	\$0.02	FHWABCAGuidance 2018, FTA, and EPA	inflated to 2018\$

Note: Federal Highway Administration (FHWA) benefit cost analysis (BCA) Guidance (Table [T] 1.1.9) does not provide standard vehicle-operating costs for transit. As such, a placeholder was incorporated, akin to the vehicle-operating costs of commercial vehicles. However, the temporary placeholder does not have bearing on the results or conclusions herein, as transit calculations were not directly included in the sketch-level, rounded-out \$1M/day estimate of users' benefits (per Table 7). Knowing that transit would/should only constitute a relatively small percentage of the total, incorporating would currently add unnecessary complication to the analysis process.

Acronyms:

BEA: Bureau of Economic Analysis
 EPA: Environmental Protection Agency
 FHWA: Federal Highway Administration
 FTA: Federal Transit Administration
 GDP: gross domestic product
 GIS: geographic information system
 NJDOT: NJ Department of Transportation

NOX: nitrogen oxides
 PABT: Port Authority Bus Terminal
 PDO: property damage only
 PHT: person-hours traveled
 PM: particulate matter
 PNR: Park and Ride
 VHT: vehicle hours traveled
 VMT: vehicle miles traveled
 VOC: volatile organic compound

Table 4 presents the daily TDM metrics and related travel user benefits by anchor year (2017 and 2045) and vehicle type. The following summarizes the transport user benefits using the TDM results:

- *VMT* – The NJTPA TDM results exhibit longer distances are driven in the build scenarios, where the network is operating normally due to implementation of adaptation strategies, relative to the do-nothing scenarios, where the network is compromised. This is logical, as highway travel is typically preferred by users if a network is fully functional, which results in longer distances traveled and higher speeds. The daily change (Δ) in VMT results in more vehicle-operating costs, accidents, and emissions and thus monetized disbenefits (shown as VMT daily benefits in **Table 4**).
- *VHT* – The NJTPA TDM results generally exhibit shorter time in vehicle hours traveled in the build scenarios than the do-nothing scenarios. Similarly, if a network is fully functional (build), highway travel is faster and time reduction is a primary objective of users. The daily change (Δ) in VHT results in less travel-time costs and monetized benefits (shown as VHT daily benefits in **Table 4**).

Combining the VMT- and VHT-related monetized results yields positive total daily benefits for two of the three subareas. In year 2045, Subareas B and C exhibit between \$0.5 and \$1.8 million per day in total daily benefits. Conversely, Subarea A exhibits VMT disbenefits (–\$2.5 million) that are greater than the VHT benefits (\$1.5 million), resulting in a net disbenefit (–1.0 million).⁶ Atypical findings were also observed as Subarea B’s total daily benefits decline from \$1.0 million (year 2017) to \$0.5 million (year 2045). It is important to note that TDMs are complex, and these simplified, aggregated results nonetheless include detailed components that could be revised easily and could be subject to wholesale change. An assumption was needed to continue the sketch-level BCA calculation given that the TDM numbers were atypical. Based on the NJTPA TDM data and in lieu of using the quantified daily benefits as presented in **Table 4**, the order of magnitude benefits was assumed to be \$1 million per day from avoiding a climate event-related network shutdown via implementation of the build scenario in comparison to the do-nothing scenario.

L.6 Breakeven Analyses

Breakeven analyses were performed to identify the magnitude of annually recurring benefits required to cover the implementation costs for each of the three subareas (in their entirety). Such annually recurring benefit requirements were compared with sketch-level benefits (for both agency and transport user) to further evaluate economic advisability of implementing adaptation strategies subarea-wide.

⁶ This is a counterintuitive economic result but may be accurate within the TDM. It is likely rerouting traffic from the damaged assets at a relatively large distance that is not monetized within the TDM as is required for the economics.

L.6.1 Breakeven – Annual Required Benefits

The timing of when benefits and costs start to accrue and be realized, and the analysis time frame or lifecycle, are critical assumptions for a breakeven analysis. Project lifecycle (in years) reflects the useful time frame in which benefits occur. Transport infrastructure lifecycles typically span 20 to 50 years depending on factors such as asset type, depreciation schedule, and wear-and-tear variances, some of which can be affected by the implementing agency through maintenance practices. For this study, an array of breakeven analyses across a range of lifecycle years was conducted given the uncertainty of the actual benefit lifecycle of the varied mix of adaptation strategies and assets.

Annual required benefits for the three subareas, given the implementation costs (from **Table 2**), discount rates, and lifecycle years assumptions, are tabulated in **Table 6** and graphed in **Figure 3**.

The results range from the most relaxed combination (50-year lifecycle at a 3 percent discount rate⁷) that requires \$12.7 million in annually recurring benefits for Subarea B to the most austere combination (20-year lifecycle at a 7 percent discount rate⁸) that requires \$47.1 million in annually recurring benefits for Subarea A.

Table 6. Annual Breakeven Benefit Requirements

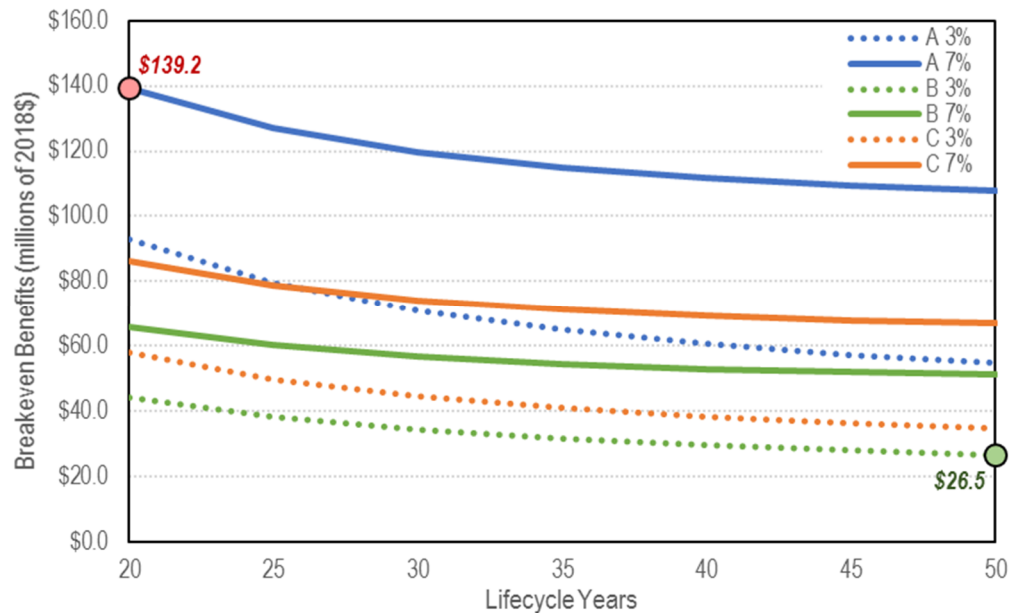
Subarea	Discount Rate	Lifecycle Years						
		20	25	30	35	40	45	50
A	3%	\$31.9	\$27.6	\$24.8	\$22.8	\$21.4	\$20.3	\$19.5
	7%	\$47.1	\$43.1	\$40.6	\$39.0	\$38.0	\$37.3	\$36.8
B	3%	\$19.9	\$17.4	\$15.7	\$14.6	\$13.8	\$13.1	\$12.7
	7%	\$28.8	\$26.4	\$25.0	\$24.1	\$23.4	\$23.0	\$22.7
C	3%	\$22.2	\$19.4	\$17.6	\$16.3	\$15.4	\$14.7	\$14.1
	7%	\$32.3	\$29.6	\$28.0	\$26.9	\$26.3	\$25.8	\$25.5

*in millions of 2018 U.S. dollars
Red = highest annual breakeven benefit-cost requirement
Green = lowest annual breakeven benefit-cost requirement

⁷ A 3-percent discount rate is used by NJTPA.

⁸ A 7-percent discount rate is used by USDOT.

Figure 3. Annual Breakeven Benefit Requirements by Subarea (A, B, and C) and Discount Rate (3 percent and 7 percent)



L.6.2 Breakeven – Agency Cost-Saving Benefits

Agency benefits reflect avoided post extreme weather event repair and/or replacement costs. This quantifies the required annually recurring breakeven that can be covered by the agency cost savings. In effect, this comparison is the agency’s direct return on investment (ROI), as opposed to a BCR, which more broadly includes the non-agency benefits (i.e., transport users).⁹ Annualized expected-value agency cost-saving benefits (**Table 4**) are compared to the required annually recurring breakeven benefits (**Table 6**) to depict the proportion of required benefits offset by proactively implementing adaptation strategies. As shown in **Table 7**, agency benefits cover between 0.10 and 0.26 (10 percent and 26 percent) of implementation costs depending on the lifecycle and discount rate assumptions. These ratios reflect an agency’s direct ROI.¹⁰

Table 7. Agency Benefits Share of Annual Breakeven Requirements

⁹ An ROI reflects the direct agency returns to itself but does not consider wider societal effects.

¹⁰ Often confused with a societal-oriented economic BCA, public sector ROI compare agency project cashflow changes. In this case, the upfront/initial implementation costs are offset by later-year avoided repair cost-savings. Like a BCR, ROI ratios over 1.0 are favored versus those under 1.0, which are considered unfavorable.

Subarea	Discount Rate	Lifecycle Years						
		20	25	30	35	40	45	50
A	3%	0.16	0.18	0.20	0.22	0.24	0.25	0.26
	7%	0.11	0.12	0.12	0.13	0.13	0.14	0.14
B	3%	0.14	0.16	0.18	0.19	0.21	0.22	0.22
	7%	0.10	0.11	0.11	0.12	0.12	0.12	0.12
C	3%	0.15	0.17	0.19	0.20	0.22	0.23	0.24
	7%	0.10	0.11	0.12	0.12	0.13	0.13	0.13

L.6.3 Breakeven – Transport User Benefits

As previously discussed, a simplified order of magnitude benefit of \$1 million per day from avoiding a climate event-related network shutdown is assumed. This sketch-level daily benefit is compared to the required transport user benefits that is calculated using Tables 11 and 12. For example, the most relaxed option, Subarea B, 50-year lifecycle, 3 percent discount rate, has a required benefit of \$12.7 million, of which 0.22 (22 percent) or \$2.8 million is agency benefits and the remaining \$ 9.9 million is transport use benefits. To realize annually recurring expected-value transport user benefits of at least \$9.9 million under the most relaxed combination requires an annually recurring network shutdown of at least 9.9 days, assuming \$1 million per day. To realize annually recurring expected-value transport user benefits of at least \$42 million under the most austere combination requires an annually recurring network shutdown of at least 42 days, assuming \$1 million per day.

Accounting for the 1 percent probability of annual occurrence due to a 100-year climate event increases by a hundredfold the additional travel user benefits required or the number of closure days saved following a climate event. As shown in **Table 8**, a severe climate event would need to shut down an entire subarea-wide transportation network for between 982 and 4,209 days (2.7 to 11.5 years) to have an annual expected-value travel user benefit sufficient to plug the benefits requirement gap.

Table 8. Breakeven – Network Closure Days for Required Transport User Benefits

Sub area	Discount Rate	Lifecycle Years						
		20	25	30	35	40	45	50
A	3%	2,681	2,254	1,975	1,779	1,637	1,528	1,445
	7%	4,209	3,803	3,556	3,398	3,293	3,222	3,172
B	3%	1,704	1,455	1,291	1,177	1,094	1,030	982
	7%	2,596	2,360	2,215	2,123	2,061	2,020	1,991
C	3%	1,890	1,610	1,427	1,299	1,205	1,134	1,079
	7%	2,891	2,626	2,464	2,360	2,291	2,244	2,212

Red = highest network closure days for required transport user benefits

Green = lowest network closure days for required transport user benefits

L.7 Sketch-Level BCA Evaluation Metrics and Summary

The range of breakeven metrics presented in **Sections L.6.1 through L.6.3** reflect the assumptions by subarea, discount rate, and lifecycle with a resultant most relaxed (Subarea B, 50-year lifecycle, 3 percent discount rate) and most austere (Subarea A, 20-year lifecycle, 7 percent discount rate)

combination. The assumptions to calculate the NPV, BCRs, and internal rates of return for these two combinations are presented in **Tables 9 and 10**.

Table 9. BCA and Breakeven – Subarea A, 20-year Lifecycle, 7 Percent Discount Rate

Years			Implementation Costs			Cost-Saving Benefits			Total	Breakeven		Benefits as % of Breakeven Rqd.		
Impl.	Lifecycle	CY	Construction	O&M	Subtotal	Agency	Users	Subtotal		Rqd. Benefits	Total	Agency	Users	Subtotal
1		2020	(\$80.2)	(\$1.6)	(\$81.8)			\$0.0	(\$81.8)		(\$81.8)			
2		2021	(\$80.2)	(\$1.8)	(\$82.0)			\$0.0	(\$82.0)		(\$82.0)			
3		2022	(\$80.2)	(\$2.0)	(\$82.2)			\$0.0	(\$82.2)		(\$82.2)			
4		2023	(\$80.2)	(\$2.2)	(\$82.4)			\$0.0	(\$82.4)		(\$82.4)			
5		2024	(\$80.2)	(\$2.4)	(\$82.5)			\$0.0	(\$82.5)		(\$82.5)			
	1	2025		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	2	2026		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	3	2027		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	4	2028		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	5	2029		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	6	2030		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	7	2031		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	8	2032		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	9	2033		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	10	2034		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	11	2035		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	12	2036		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	13	2037		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	14	2038		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	15	2039		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	16	2040		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	17	2041		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	18	2042		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	19	2043		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%
	20	2044		(\$2.5)	(\$2.5)	\$5.0	\$3.7	\$8.7	\$6.2	\$47.1	\$44.6	10.7%	7.7%	18.5%

*in millions of 2018\$

Table 10. BCA and Breakeven – Subarea B, 50-year Lifecycle, 3 Percent Discount Rate

Subarea:	B
Lifecycle:	50
Discount:	3.0%

NPV:	(\$136.9)
BCR:	0.51
IRR:	-0.9%

NPV:	\$0.0
BCR:	1.00
IRR:	3.0%

Years			Implementation Costs			Cost-Saving Benefits			Total	Breakeven		Benefits as % of Breakeven Rqd.		
Impl.	Lifecycle	CY	Construction	O&M	Subtotal	Agency	Users	Subtotal		Rqd. Benefits	Total	Agency	Users	Subtotal
1		2020				\$2.8	\$3.7	\$0.0	(\$47.8)	\$2.8	(\$47.8)	0.0%	0.0%	0.0%
2		2021	(\$45.5)	(\$2.4)	(\$47.9)	\$2.8	\$3.7	\$0.0	(\$47.9)	\$2.8	(\$47.9)	0.0%	0.0%	0.0%
3		2022	(\$45.5)	(\$2.5)	(\$48.0)	\$2.8	\$3.7	\$0.0	(\$48.0)	\$2.8	(\$48.0)	0.0%	0.0%	0.0%
4		2023	(\$45.5)	(\$2.6)	(\$48.1)	\$2.8	\$3.7	\$0.0	(\$48.1)	\$2.8	(\$48.1)	0.0%	0.0%	0.0%
5		2024	(\$45.5)	(\$2.7)	(\$48.2)	\$2.8	\$3.7	\$0.0	(\$48.2)	\$2.8	(\$48.2)	0.0%	0.0%	0.0%
	1	2025	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	2	2026	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	3	2027	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	4	2028	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	5	2029	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	6	2030	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	7	2031	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	8	2032	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	9	2033	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	10	2034	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	11	2035	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	12	2036	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	13	2037	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	14	2038	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	15	2039	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	16	2040	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	17	2041	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	18	2042	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	19	2043	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	20	2044	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	21	2045	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	22	2046	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	23	2047	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	24	2048	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	25	2049	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	26	2050	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	27	2051	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	28	2052	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	29	2053	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	30	2054	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	31	2055	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	32	2056	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	33	2057	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	34	2058	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	35	2059	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	36	2060	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	37	2061	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	38	2062	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	39	2063	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	40	2064	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	41	2065	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	42	2066	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	43	2067	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	44	2068	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	45	2069	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	46	2070	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	47	2071	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	48	2072	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	49	2073	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%
	50	2074	\$0.0	(\$2.7)	(\$2.7)	\$2.8	\$3.7	\$6.5	\$3.7	\$12.7	\$9.9	22.4%	28.9%	51.3%

*In millions of 2018\$

The most austere and worst-case assumptions (Subarea A, 20-year lifecycle at a 7 percent discount rate) results in an NPV of -\$290.3 million (net societal loss), a BCR of 0.18, and an IRR of -8.3%. The most relaxed and best-case assumptions (Subarea B, 50-year lifecycle at a 3 percent discount rate), result in an NPV of -\$137 million (net societal loss), a BCR of 0.51, and an IRR of -0.9%.

Table 11. Sketch-Level BCA Evaluation Metrics and Summary

	Subarea	
	A	B
Assumptions		
Annual Event Probability	1%	1%
Facility Shutdown-Days	365	365
Lifecycle	20	50
Discount Rate	7%	3%
Daily Travel User Benefit *	\$1	\$1
Implementation Costs		
Total Construction*	\$401.0	\$227.7
Annual O&M (year 2025+)*	\$2.5	\$2.7
Annual Benefits (2025+)		
Agency*	\$5.0	\$2.8
Users* ¹¹	\$3.7	\$3.7
Total*	\$8.7	\$6.5
BCA Metrics		
NPV*	-\$290.3	-\$136.8
BCR	0.18	0.51
IRR	-8.3%	-0.9%
Breakeven		
Required Annual Benefits (Table 6)*	\$47.1	\$12.7
Agency Benefit Share of Breakeven (Table 7)	0.11	0.22
Network Closure Days for User Benefits (Table 8)	4,209	982
*in millions of 2018 U.S. dollars		

L.8 BCA Conclusions and Recommendations

This sketch-level BCA (see **Table 11**) indicates that it is not economically prudent to implement the comprehensive package of adaptation strategies across the array of assets for the three subareas. However, this BCA had a limited scope, and should not be the determinant factor regarding a project's development. Some additional benefits, and examples, beyond the purview of this study that may be considered in future include:

- health and safety benefits - protecting the public from harm of a climate event, providing access to emergency services after an event
- property value benefits – proximity to green spaces, flood mitigation on private properties
- environmental benefits - cleaner surface water as a result of green infrastructure, less noise due to a berm or flood wall
- quality of life - access to amenities, reduced traffic delays due to infrastructure repairs

¹¹ Assume network shutdown of 365 days, \$1 million per day TDM-related, and 1 percent probability.

- regional economy benefits - improving movement of freight, creating construction and long-term employment to maintain new infrastructure

Below are recommendations to consider for future BCA iterations:

- *Implementation Costs* – Magnitude and timing are critical; refining the costs assumptions (e.g., using asset-specific costs for the region) and/or disaggregating assets and strategies (i.e., analyzing a small set of the assets within a subarea and/or a small set of strategies for assets) may yield wide-ranging individual results.
- *Sketch-Level versus Simulation* – This BCA applies expected-value calculations for each assumed benefits year, as an annual average, given the uncertainty of when exactly a 100-year event could occur (e.g., 1 percent per year chance). Because timing is a critical assumption, a more refined analysis would simulate various climate event scenarios (Monte Carlo¹²) and would compile a distribution of probable results rather than a point estimate. As an example, a destructive event occurring within a few years following implementation might be economically prudent, whereas no event or one 50 years in the future would not be economically prudent.
- *TDM Refinement* – TDM data are complex and modeling could be revisited such that results are more aligned with implementation details with detailed check mechanisms that ensure results are representative and appropriate for the assumed scenario. Transit could be incorporated with more refined assumptions although inclusion would not appreciably alter conclusions, as transit typically comprises a relatively small component of the overall network.

Alternatively, agencies may select to conduct the BCA of specific assets and strategies, beginning with a heuristics-based intuition of which assets or strategies seems logical. For example, planting a tree line along an embankment is relatively inexpensive, is implemented quickly, and generates a relatively long benefits lifecycle (50+ years). Such benefits may appreciate over time as the trees grow and provide positive externality benefits such as environmental and aesthetics. Other assets and strategies, such as bridge reinforcement, can be costly and may never realize any direct benefits.

¹² Monte-Carlo – Computational algorithms that use repeated random sampling to obtain numerical results. It addresses the randomness of when a climate event might occur to assess the associated benefits of implementing adaptation strategies. Monte Carlo simulation performs risk analysis by building models of possible results by substituting a range of values—a probability distribution—for any factor that has inherent uncertainty. It then calculates results over and over, each time using a different set of random values from the probability functions. Depending upon the number of uncertainties and the specified ranges, a Monte Carlo simulation could involve thousands of recalculations before it is complete. Ultimately, Monte Carlo simulation produces distributions of possible outcome values.

Assigned Adaptation Strategies and Associated Costs for the BCA													
Asset ID ¹	Asset Name	Subarea	Construction Strategy								O&M Strategy		Notes
			TE5_Proactive	TE5_Reactive	TE6_Proactive	TE6_Reactive	FD1_Proactive	FD1_Reactive	FD2_Proactive	FD2_Reactive	FD4_Proactive	FD4_Reactive	
1430150	NJ ROUTE 159 WB OVER US 46 EB	A	\$ 14,040.00	\$ 25,272.00	\$ 2,000.00	\$ 2,000.00	\$ 14,040.00	\$ 105,300.00	\$ 11,232.00	\$ 53,352.00	\$ 100,000.00	\$ 123,552.00	
1430151	N.J RT.159 OVER BRANCH OF PASSAIC RIV	A	\$ 14,265.00	\$ 25,677.00	\$ 2,000.00	\$ 2,000.00	\$ 14,265.00	\$ 106,987.50	\$ 11,412.00	\$ 54,207.00	\$ 100,000.00	\$ 125,532.00	
1430152	RT 159 EB OVER THE PASSAIC RIVER	A	\$ 35,145.00	\$ 63,261.00	\$ 2,000.00	\$ 2,000.00	\$ 35,145.00	\$ 263,587.50	\$ 28,116.00	\$ 133,551.00	\$ 100,000.00	\$ 309,276.00	
1430153	NJ ROUTE 159 WB OVER PASSAIC RIVER	A	\$ 45,405.00	\$ 81,729.00	\$ 2,000.00	\$ 2,000.00	\$ 45,405.00	\$ 340,537.50	\$ 36,324.00	\$ 172,539.00	\$ 100,000.00	\$ 399,564.00	
1415157	I-80 EB OVER PASSAIC RIVER.	A	\$ 75,870.00	\$ 136,566.00	\$ 2,000.00	\$ 2,000.00	\$ 75,870.00	\$ 569,025.00	\$ 60,696.00	\$ 288,306.00	\$ 100,000.00	\$ 667,656.00	
1415158	I-80 WB OVER PASSAIC RIVER	A	\$ 78,435.00	\$ 141,183.00	\$ 2,000.00	\$ 2,000.00	\$ 78,435.00	\$ 588,262.50	\$ 62,748.00	\$ 298,053.00	\$ 100,000.00	\$ 690,228.00	
1400433	OLD BLOOMFIELD AV. OVER PASSAIC RIVER	A	\$ 16,875.00	\$ 30,375.00	\$ 2,000.00	\$ 2,000.00	\$ 16,875.00	\$ 126,562.50	\$ 13,500.00	\$ 64,125.00	\$ 100,000.00	\$ 148,500.00	
1410158	ROUTE US 46 OVER BRANCH OF PASSAIC RIVER	A	\$ 46,080.00	\$ 82,944.00	\$ 2,000.00	\$ 2,000.00	\$ 46,080.00	\$ 345,600.00	\$ 36,864.00	\$ 175,104.00	\$ 100,000.00	\$ 405,504.00	
1410159	ROUTE US 46 OVER PASSAIC RIVER	A	\$ 112,815.00	\$ 203,067.00	\$ 2,000.00	\$ 2,000.00	\$ 112,815.00	\$ 846,112.50	\$ 90,252.00	\$ 428,697.00	\$ 100,000.00	\$ 992,772.00	
1410157	ROUTE US 46 OVER ROCKAWAY RIVER	A	\$ 69,390.00	\$ 124,902.00	\$ 2,000.00	\$ 2,000.00	\$ 69,390.00	\$ 520,425.00	\$ 55,512.00	\$ 263,682.00	\$ 100,000.00	\$ 610,632.00	
1400431	BLOOMFIELD AVE/TRIB TO ROCKAWAY RIVER	A	\$ 7,515.00	\$ 13,527.00	\$ 2,000.00	\$ 2,000.00	\$ 7,515.00	\$ 56,362.50	\$ 6,012.00	\$ 28,557.00	\$ 100,000.00	\$ 66,132.00	
1414175	I-80 EB & OFF RAMP / I-280, US 46 EB & I-80 RAMP C	A	\$ 125,820.00	\$ 226,476.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1400432	BLOOMFIELD AVE/ROCKAWAY RIVER	A	\$ 11,970.00	\$ 21,546.00	\$ 2,000.00	\$ 2,000.00	\$ 11,970.00	\$ 89,775.00	\$ 9,576.00	\$ 45,486.00	\$ 100,000.00	\$ 105,336.00	
1410156	ROUTE US 46 OVER BRANCH OF TROY BROOK	A	\$ 12,150.00	\$ 21,870.00	\$ 2,000.00	\$ 2,000.00	\$ 12,150.00	\$ 91,125.00	\$ 9,720.00	\$ 46,170.00	\$ 100,000.00	\$ 106,920.00	
1415151	I-80 WB & RAMP A OVER EDWARDS ROAD	A	\$ 30,060.00	\$ 54,108.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1415152	ROUTE I-80 EASTBOUND OVER ROCKAWAY RIVER	A	\$ 54,090.00	\$ 97,362.00	\$ 2,000.00	\$ 2,000.00	\$ 54,090.00	\$ 405,675.00	\$ 43,272.00	\$ 205,542.00	\$ 100,000.00	\$ 475,992.00	
1415153	ROUTE I-80 WB OVER ROCKAWAY RIVER	A	\$ 54,090.00	\$ 97,362.00	\$ 2,000.00	\$ 2,000.00	\$ 54,090.00	\$ 405,675.00	\$ 43,272.00	\$ 205,542.00	\$ 100,000.00	\$ 475,992.00	
1414182	ROUTE I-80 AND RAMPS E&N OVER TROY BROOK	A	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	Not a bridge. Possible Culvert. Culvert 167729753
1414181	ROUTE I-80 RAMPS A & M OVER SMITH ROAD	A	\$ 26,820.00	\$ 48,276.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1400261	CR 621(CHANGE BRIDGE RD) / HATFIELD CREEK	A	\$ 6,120.00	\$ 11,016.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1420153	I-287 NB OVER LITTLETON ROAD (CR 630)	A	\$ 18,090.00	\$ 32,562.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1414183	RT I-80 RAMP M (LITTLETON RD E/CR 630)/ TROY BOOK	A	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	Not a Bridge / Possible Culvert Duplication
1414165	ROUTE US 202 SB(LITTLETON RD)/ ROUTE I-80 RAMP F	A	\$ 13,185.00	\$ 23,733.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1420155	LITTLETON ROAD OVER TROY BROOK	A	\$ 1,620.00	\$ 2,916.00	\$ 2,000.00	\$ 2,000.00	\$ 1,620.00	\$ 12,150.00	\$ 1,296.00	\$ 6,156.00	\$ 100,000.00	\$ 14,256.00	
1420157	I-287 NB / RT.US 46	A	\$ 58,094.15	\$ 104,569.46	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1420158	I287 SB / US46	A	\$ 54,317.75	\$ 97,771.94	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Subarea A total for Bridges			\$ 982,261.89	\$ 1,768,071.40	\$ 48,000.00	\$ 48,000.00	\$ 649,755.00	\$ 4,873,162.50	\$ 519,804.00	\$ 2,469,069.00	\$ 1,600,000.00	\$ 5,717,844.00	

Assigned Adaptation Strategies and Associated Costs for the BCA													
Asset ID ¹	Asset Name	Subarea	Construction Strategy								O&M Strategy		Notes
			TE5_Proactive	TE5_Reactive	TE6_Proactive	TE6_Reactive	FD1_Proactive	FD1_Reactive	FD2_Proactive	FD2_Reactive	FD4_Proactive	FD4_Reactive	
0722157	US 46 EB / PASSAIC RVR	B	\$ 62,415.00	\$ 112,347.00	\$ 2,000.00	\$ 2,000.00	\$ 62,415.00	\$ 468,112.50	\$ 49,932.00	\$ 237,177.00	\$ 100,000.00	\$ 549,252.00	
0722158	US 46 WB /PASSAIC RVR	B	\$ 53,910.00	\$ 97,038.00	\$ 2,000.00	\$ 2,000.00	\$ 53,910.00	\$ 404,325.00	\$ 43,128.00	\$ 204,858.00	\$ 100,000.00	\$ 474,408.00	
0700096	PASSAIC AVENUE (CR 613) OVER DEEPAVAAL BROOK	B	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	Possible Duplicate Bridge. Bridge ID 0700005
0726155	I-80 EB / PASSAIC RV & FRFLD RD	B	\$ 91,305.00	\$ 164,349.00	\$ 2,000.00	\$ 2,000.00	\$ 91,305.00	\$ 684,787.50	\$ 73,044.00	\$ 346,959.00	\$ 100,000.00	\$ 803,484.00	
0726156	I-80 WB / PASSAIC RV & FRFLD RD (CR 679)	B	\$ 91,530.00	\$ 164,754.00	\$ 2,000.00	\$ 2,000.00	\$ 91,530.00	\$ 686,475.00	\$ 73,224.00	\$ 347,814.00	\$ 100,000.00	\$ 805,464.00	
0701565	LITTLE FALLS RD CR 615/ DEEPAVAAL BRK	B	\$ 7,065.00	\$ 12,717.00	\$ 2,000.00	\$ 2,000.00	\$ 7,065.00	\$ 52,987.50	\$ 5,652.00	\$ 26,847.00	\$ 100,000.00	\$ 62,172.00	
1606174	NJ TRANSIT BOONTON LINE OVER US46	B	\$ 6,793.52	\$ 12,228.33	\$ 2,000.00	\$ 2,000.00	\$ 6,793.52	\$ 50,951.36	\$ 5,434.81	\$ 25,815.36	\$ 100,000.00	\$ 59,782.93	
1606175	US 46 WB & RAMP G OVER RT. I-80 RAMPS D&E	B	\$ 27,765.00	\$ 49,977.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1606176	RT 46EB & RAMPS D&E/RT-23NB & RAMP G	B	\$ 33,255.00	\$ 59,859.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1606177	RT US 46WB & RAMP I/NJ RT 23 NB & RAMP J&M	B	\$ 35,055.00	\$ 63,099.00	\$ 2,000.00	\$ 2,000.00	\$ 35,055.00	\$ 262,912.50	\$ 28,044.00	\$ 133,209.00	\$ 100,000.00	\$ 308,484.00	
1606178	US 46 EB/BRANCH OF PASSA	B	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	Not a bridge Possible Culvert. Culvert 167730374
1606179	US 46 RAMP M OVER UNNAMED STREAM	B	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	Not a bridge. Possible duplicate record 1606177
1606180	US. RTE. 46W OVER UNNAMED STREAM	B	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	Not a bridge. Possible duplicate record 1606177
1609150	I-80 / SINGAC BROOK	B	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	Possible Duplicate Bridge
1609152	NJT (BOONTON LINE) / SINGAC BROOK	B	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	Not a bridge / Not a Culvert
1600514	FAIRFIELD RD (CR 679)/SINGAC BROOK	B	\$ 21,555.00	\$ 38,799.00	\$ 2,000.00	\$ 2,000.00	\$ 21,555.00	\$ 161,662.50	\$ 17,244.00	\$ 81,909.00	\$ 100,000.00	\$ 189,684.00	
1604150	ROUTE NJ 23/PASSAIC RIVER	B	\$ 73,433.61	\$ 132,180.50	\$ 2,000.00	\$ 2,000.00	\$ 73,433.61	\$ 550,752.08	\$ 58,746.89	\$ 279,047.72	\$ 100,000.00	\$ 646,215.77	
1604151	NJ RT 23 / BRANCH OF PASSAI	B	\$ 4,500.00	\$ 8,100.00	\$ 2,000.00	\$ 2,000.00	\$ 4,500.00	\$ 33,750.00	\$ 3,600.00	\$ 17,100.00	\$ 100,000.00	\$ 39,600.00	
1604158	N.J.ROUTE 23 SB OVER U.S.ROUTE 46	B	\$ 22,815.00	\$ 41,067.00	\$ 2,000.00	\$ 2,000.00	\$ 22,815.00	\$ 171,112.50	\$ 18,252.00	\$ 86,697.00	\$ 100,000.00	\$ 200,772.00	
1604159	BOONTON LINE OVER ROUTE 23NB	B	\$ 4,498.38	\$ 8,097.08	\$ 2,000.00	\$ 2,000.00	\$ 4,498.38	\$ 33,737.85	\$ 3,598.70	\$ 17,093.84	\$ 100,000.00	\$ 39,585.74	
1604160	BOONTON LINE OVER ROUTE 23SB	B	\$ 4,365.00	\$ 7,857.00	\$ 2,000.00	\$ 2,000.00	\$ 4,365.00	\$ 32,737.50	\$ 3,492.00	\$ 16,587.00	\$ 100,000.00	\$ 38,412.00	
1604161	NJ RTE 23NB AND RAMP""I"" /I-80 RAMP""C""	B	\$ 23,265.00	\$ 41,877.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1604162	RT 23 NB & RAMP I / I-80	B	\$ 50,760.00	\$ 91,368.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1604163	NJ 23 SB & RAMP B / I-80 RAMP E	B	\$ 35,685.00	\$ 64,233.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1604164	NJ RT 23 SB / I-80 & RAMP I	B	\$ 181,575.00	\$ 326,835.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1604166	RT NJ 23 SB AND RAMPS B&C/SINGAC BRK	B	\$ 16,065.00	\$ 28,917.00	\$ 2,000.00	\$ 2,000.00	\$ 16,065.00	\$ 120,487.50	\$ 12,852.00	\$ 61,047.00	\$ 100,000.00	\$ 141,372.00	
0700005	CR 613 (Passaic Ave) ovr Deepavaal Brook	B	\$ 18,270.00	\$ 32,886.00	\$ 2,000.00	\$ 2,000.00	\$ 18,270.00	\$ 137,025.00	\$ 14,616.00	\$ 69,426.00	\$ 100,000.00	\$ 160,776.00	
070M060	TWO BRIDGES RD (CR613) OVER PASSAIC RVR	B	\$ 35,280.00	\$ 63,504.00	\$ 2,000.00	\$ 2,000.00	\$ 35,280.00	\$ 264,600.00	\$ 28,224.00	\$ 134,064.00	\$ 100,000.00	\$ 310,464.00	
1606181	ROUTE US 46 WB OVER STREAM	B	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	Not a bridge. Possible Culvert. Culvert 167731031
1604175	WILLOW BROOK BLVD OVER US ROUTE 46	B	\$ 62,460.00	\$ 112,428.00	\$ 2,000.00	\$ 2,000.00	\$ 62,460.00	\$ 468,450.00	\$ 49,968.00	\$ 237,348.00	\$ 100,000.00	\$ 549,648.00	

Assigned Adaptation Strategies and Associated Costs for the BCA													Notes
Asset ID ¹	Asset Name	Subarea	Construction Strategy								O&M Strategy		
			TE5_Proactive	TE5_Reactive	TE6_Proactive	TE6_Reactive	FD1_Proactive	FD1_Reactive	FD2_Proactive	FD2_Reactive	FD4_Proactive	FD4_Reactive	
1663153	BOONTON LINE OVER PASSAIC RIVER	B	\$ 20,835.00	\$ 37,503.00	\$ 2,000.00	\$ 2,000.00	\$ 20,835.00	\$ 156,262.50	\$ 16,668.00	\$ 79,173.00	\$ 100,000.00	\$ 183,348.00	
1604172	PEDESTRIAN BRIDGE OVER ROUTE 23	B	\$ 83,115.00	\$ 149,607.00	\$ 2,000.00	\$ 2,000.00	\$ 83,115.00	\$ 623,362.50	\$ 66,492.00	\$ 315,837.00	\$ 100,000.00	\$ 731,412.00	Updated with approximate Bridge Deck Area. Bridge Deck Area Approximated from aerial imagery. Original Bridge Deck Area was -2 square feet.
1618150	US 202& NJ 23 / US 202, RAMPS M&N & NORFOLK SO. RR	B	\$ 221,445.00	\$ 398,601.00	\$ 2,000.00	\$ 2,000.00	\$ 221,445.00	\$ 1,660,837.50	\$ 177,156.00	\$ 841,491.00	\$ 100,000.00	\$ 1,948,716.00	
1663163	BOONTON LINE OVER POMPTON RIVER	B	\$ 39,240.00	\$ 70,632.00	\$ 2,000.00	\$ 2,000.00	\$ 39,240.00	\$ 294,300.00	\$ 31,392.00	\$ 149,112.00	\$ 100,000.00	\$ 345,312.00	
1618152	RAMP""A""OVER US 202 AND NJ RT.23	B	\$ 51,525.00	\$ 92,745.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1462150	COMLY RD-CR511 / MONTCLAIR LINE & PARK AV	B	\$ 50,355.00	\$ 90,639.00	\$ 2,000.00	\$ 2,000.00	\$ 50,355.00	\$ 377,662.50	\$ 40,284.00	\$ 191,349.00	\$ 100,000.00	\$ 443,124.00	
1400243	CR 511A (COMLY RD) / BEAVER DAM BRK	B	\$ 12,600.00	\$ 22,680.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1400244	PARK AVE OVER BEAVER DAM BROOK	B	\$ 5,490.00	\$ 9,882.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Subarea B total for Bridges			\$ 1,448,225.51	\$ 2,606,805.91	\$ 62,000.00	\$ 62,000.00	\$ 1,026,305.51	\$ 7,697,291.29	\$ 821,044.40	\$ 3,899,960.92	\$ 2,200,000.00	\$ 9,031,488.44	
0203151	COUNTY RT 30 (PARK AVENUE)/ROUTE NJ 3	C	\$ 30,060.00	\$ 54,108.00	\$ 2,000.00	\$ 2,000.00	\$ 30,060.00	\$ 225,450.00	\$ 24,048.00	\$ 114,228.00	\$ 100,000.00	\$ 264,528.00	
0225150	I-80 & RAMP A OVER ACCESS ROAD	C	\$ 27,270.00	\$ 49,086.00	\$ 2,000.00	\$ 2,000.00	\$ 27,270.00	\$ 204,525.00	\$ 21,816.00	\$ 103,626.00	\$ 100,000.00	\$ 239,976.00	
0220150	ROUTE US 46 OVER RIVER DRIVE (CR 507)	C	\$ 26,595.00	\$ 47,871.00	\$ 2,000.00	\$ 2,000.00	\$ 26,595.00	\$ 199,462.50	\$ 21,276.00	\$ 101,061.00	\$ 100,000.00	\$ 234,036.00	
0265157	MAIN LINE PASSAIC RIVER BRIDGE	C	\$ 46,575.00	\$ 83,835.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1607168	RT. US 46/PASSAIC RIVER	C	\$ 218,745.00	\$ 393,741.00	\$ 2,000.00	\$ 2,000.00	\$ 218,745.00	\$ 1,640,587.50	\$ 174,996.00	\$ 831,231.00	\$ 100,000.00	\$ 1,924,956.00	
1607170	US ROUTE 46 EB & RAMP B OVER NJ RT 21	C	\$ 117,675.00	\$ 211,815.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1610150	RT 20 OVER I-80 RAMP K	C	\$ 23,625.00	\$ 42,525.00	\$ 2,000.00	\$ 2,000.00	\$ 23,625.00	\$ 177,187.50	\$ 18,900.00	\$ 89,775.00	\$ 100,000.00	\$ 207,900.00	
1610151	I-80 RAMP B / RT NJ 20 & RAMP A	C	\$ 27,765.00	\$ 49,977.00	\$ 2,000.00	\$ 2,000.00	\$ 27,765.00	\$ 208,237.50	\$ 22,212.00	\$ 105,507.00	\$ 100,000.00	\$ 244,332.00	
1610152	ROUTE I-80 / NJ RT.20,PASSAIC RIV&SLG. RD.	C	\$ 433,980.00	\$ 781,164.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
0717157	NJ RT 21 / WATER MAINS	C	\$ 35,100.00	\$ 63,180.00	\$ 2,000.00	\$ 2,000.00	\$ 35,100.00	\$ 263,250.00	\$ 28,080.00	\$ 133,380.00	\$ 100,000.00	\$ 308,880.00	
0717158	RT NJ 21 / THIRD RVR	C	\$ 60,930.00	\$ 109,674.00	\$ 2,000.00	\$ 2,000.00	\$ 60,930.00	\$ 456,975.00	\$ 48,744.00	\$ 231,534.00	\$ 100,000.00	\$ 536,184.00	
1601164	RT3 OVER PASSAIC RIV & RT21	C	\$ 266,220.00	\$ 479,196.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1602152	US RT.46 WB.& NJ RT.20/CROOKS AVENUE	C	\$ 90,540.00	\$ 162,972.00	\$ 2,000.00	\$ 2,000.00	\$ 90,540.00	\$ 679,050.00	\$ 72,432.00	\$ 344,052.00	\$ 100,000.00	\$ 796,752.00	
1602153	NJ RT 20 & RAMP B / US 46 WB	C	\$ 39,375.00	\$ 70,875.00	\$ 2,000.00	\$ 2,000.00	\$ 39,375.00	\$ 295,312.50	\$ 31,500.00	\$ 149,625.00	\$ 100,000.00	\$ 346,500.00	
1603151	KINGSLAND AVE EXIT/RAMP 1 (RT 21)	C	\$ 6,898.05	\$ 12,416.49	\$ 2,000.00	\$ 2,000.00	\$ 6,898.05	\$ 51,735.38	\$ 5,518.44	\$ 26,212.59	\$ 100,000.00	\$ 60,702.84	
1603153	MAIN LINE/ROUT NJ.21	C	\$ 16,875.00	\$ 30,375.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1603154	RAMP 5 OVER NJ 21 AND RAMPS 3 & 7	C	\$ 202,725.00	\$ 364,905.00	\$ 2,000.00	\$ 2,000.00	\$ 202,725.00	\$ 1,520,437.50	\$ 162,180.00	\$ 770,355.00	\$ 100,000.00	\$ 1,783,980.00	
1603157	RAMP 3 (NJ 3 TO NJ 21 NB)	C	\$ 106,290.00	\$ 191,322.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	

Assigned Adaptation Strategies and Associated Costs for the BCA													Notes	
Asset ID ¹	Asset Name	Subarea	Construction Strategy								O&M Strategy			
			TE5_Proactive	TE5_Reactive	TE6_Proactive	TE6_Reactive	FD1_Proactive	FD1_Reactive	FD2_Proactive	FD2_Reactive	FD4_Proactive	FD4_Reactive		
1603158	RVR RD / RT NJ 21-SB	C	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	Didnt meet criteria for FD1, FD2, FD4
1603159	ENTIN ROAD OVER NJ ROUTE 21	C	\$ 34,408.71	\$ 61,935.68	\$ 2,000.00	\$ 2,000.00	\$ 34,408.71	\$ 258,065.33	\$ 27,526.97	\$ 130,753.10	\$ 100,000.00	\$ 302,796.65		
1603164	NJ RT 21 RAMP A / DRAIN	C	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	Not a Bridge. Possible Culvert. Duplicate of 1603165. Culvert 167735697
1603165	NJ RT 21 RAMP / DRAIN	C	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	Not a Bridge. Possible Culvert. Duplicate of 1603164. Culvert 167735697
1603166	VAN HOUTEN AVENUE AND RIVER DRIVE NB OVER NJ RT 21	C	\$ 43,245.00	\$ 77,841.00	\$ 2,000.00	\$ 2,000.00	\$ 43,245.00	\$ 324,337.50	\$ 34,596.00	\$ 164,331.00	\$ 100,000.00	\$ 380,556.00		
1603167	NJ RT 21 & RAMP F/RIVER DR (CR624)	C	\$ 74,430.00	\$ 133,974.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1603168	PAULISON AVE (CR618)/NJ RTE 21&RAMP H	C	\$ 56,025.00	\$ 100,845.00	\$ 2,000.00	\$ 2,000.00	\$ 56,025.00	\$ 420,187.50	\$ 44,820.00	\$ 212,895.00	\$ 100,000.00	\$ 493,020.00		
1603169	GREGORY AVE OVER NJ ROUTE 21 & RAMP K	C	\$ 57,375.00	\$ 103,275.00	\$ 2,000.00	\$ 2,000.00	\$ 57,375.00	\$ 430,312.50	\$ 45,900.00	\$ 218,025.00	\$ 100,000.00	\$ 504,900.00		
1603170	RIVER DRIVE OVER NJ RT 21 & RAMPS J&K	C	\$ 45,270.00	\$ 81,486.00	\$ 2,000.00	\$ 2,000.00	\$ 45,270.00	\$ 339,525.00	\$ 36,216.00	\$ 172,026.00	\$ 100,000.00	\$ 398,376.00		
1603171	STATE ST EXTENSION OVER NJ RTE 21	C	\$ 25,299.14	\$ 45,538.44	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
361582T	GSP / PASSAIC RIVER, US 46, RIVER RD	C	\$ 401,445.00	\$ 722,601.00	\$ 2,000.00	\$ 2,000.00	\$ 401,445.00	\$ 3,010,837.50	\$ 321,156.00	\$ 1,525,491.00	\$ 100,000.00	\$ 3,532,716.00		
1603185	ROUTE NJ-21 OVER ACKERMAN AVE.	C	\$ 33,190.07	\$ 59,742.12	\$ 2,000.00	\$ 2,000.00	\$ 33,190.07	\$ 248,925.49	\$ 26,552.05	\$ 126,122.25	\$ 100,000.00	\$ 292,072.57		
020011C	MARKET STREET (CR 56 I) OVER PASSAIC RIVER.	C	\$ 71,325.00	\$ 128,385.00	\$ 2,000.00	\$ 2,000.00	\$ 71,325.00	\$ 534,937.50	\$ 57,060.00	\$ 271,035.00	\$ 100,000.00	\$ 627,660.00		
361581A	RAMP B:NB EXIT TO US 46/US RTE 46	C	\$ 45,900.00	\$ 82,620.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1600002	GREGORY AVENUE OVER PASSAIC RIVER	C	\$ 29,520.00	\$ 53,136.00	\$ 2,000.00	\$ 2,000.00	\$ 29,520.00	\$ 221,400.00	\$ 23,616.00	\$ 112,176.00	\$ 100,000.00	\$ 259,776.00		
1600003	MARKET STREET OVER PASSAIC RIVER	C	\$ 50,940.00	\$ 91,692.00	\$ 2,000.00	\$ 2,000.00	\$ 50,940.00	\$ 382,050.00	\$ 40,752.00	\$ 193,572.00	\$ 100,000.00	\$ 448,272.00		
1600080	River Road (CR 624) over Third River	C	\$ 25,200.00	\$ 45,360.00	\$ 2,000.00	\$ 2,000.00	\$ 25,200.00	\$ 189,000.00	\$ 20,160.00	\$ 95,760.00	\$ 100,000.00	\$ 221,760.00		
1600081	KINGSLAND RD (NJ 7)OVER THIRD RIVER.	C	\$ 7,335.00	\$ 13,203.00	\$ 2,000.00	\$ 2,000.00	\$ 7,335.00	\$ 55,012.50	\$ 5,868.00	\$ 27,873.00	\$ 100,000.00	\$ 64,548.00		
1601161	NJ RT 3 OVER RIVER RD (CO. RT 624)	C	\$ 27,900.00	\$ 50,220.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
1601156	NJ 3 / MAIN AVE (CO 601)	C	\$ 34,470.00	\$ 62,046.00	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
Subarea C total for Bridges			\$ 2,840,520.96	\$ 5,112,937.73	\$ 70,000.00	\$ 70,000.00	\$ 1,644,906.83	\$ 12,336,801.19	\$ 1,315,925.46	\$ 6,250,645.94	\$ 2,400,000.00	\$ 14,475,180.06		

Footnote: 1. Geodatabase asset identification (ID) number.

Assigned Adaptation Strategies and Associated Costs for the BCA: Culverts
 North Jersey Transportation Planning Authority

Updated: April 2019

Assigned Adaptation Strategies and Associated Costs for the BCA						
Construction Strategy						
Asset ID ¹	Asset Name	Subarea	SW10_Proactive	SW10_Reactive	SW12_Proactive	SW12_Reactive
167729753	Troy Brook	A	\$ 550,000.00	\$ 550,000.00	\$ 1,296,000.00	\$ 1,296,000.00
167730011	NI*	A	\$ 550,000.00	\$ 550,000.00	\$ 648,000.00	\$ 648,000.00
167731313	Troy Brook	A	\$ 550,000.00	\$ 550,000.00	\$ 972,000.00	\$ 972,000.00
Subarea A total for Culverts			\$ 1,650,000.00	\$ 1,650,000.00	\$ 2,916,000.00	\$ 2,916,000.00
167722400	/ Packanack Brook	B	\$ 550,000.00	\$ 550,000.00	\$ 648,000.00	\$ 648,000.00
167730374	NI*	B	\$ 550,000.00	\$ 550,000.00	\$ 540,000.00	\$ 540,000.00
167730690	NI*	B	\$ 550,000.00	\$ 550,000.00	\$ 972,000.00	\$ 972,000.00
167731031	NI*	B	\$ 550,000.00	\$ 550,000.00	\$ 432,000.00	\$ 432,000.00
167731624	NI*	B	\$ 550,000.00	\$ 550,000.00	\$ 216,000.00	\$ 216,000.00
Subarea B total for Culverts			\$ 2,750,000.00	\$ 2,750,000.00	\$ 2,808,000.00	\$ 2,808,000.00
167735697	NI*	C	\$ 550,000.00	\$ 550,000.00	\$ 648,000.00	\$ 648,000.00
167737197	Weasel Brook	C	\$ 550,000.00	\$ 550,000.00	\$ 432,000.00	\$ 432,000.00
167737605	NI*	C	\$ -	\$ -	\$ -	\$ -
167739352	Weasel Brook	C	\$ 550,000.00	\$ 550,000.00	\$ 432,000.00	\$ 432,000.00
167739655	Third River	C	\$ 550,000.00	\$ 550,000.00	\$ 864,000.00	\$ 864,000.00
167739987	NI*	C	\$ -	\$ -	\$ -	\$ -
Subarea C total for Culverts			\$ 2,200,000.00	\$ 2,200,000.00	\$ 2,376,000.00	\$ 2,376,000.00

Footnote: 1. Geodatabase asset identification (ID) number.

* No information (NI) indicates information was not available in the PRB study geodatabase.

Assigned Adaptation Strategies and Associated Costs for the BCA: Facilities
North Jersey Transportation Planning Authority

Updated: April 2019

			Assigned Adaptation Strategies and Associated Costs for the BCA							
Asset ID ¹	Asset Name	Subarea	TE6_ Proactive	TE6_ Reactive	FP5_ Proactive	FP5_ Reactive	FP8_ Proactive	FP8_ Reactive	FP15_ Proactive	FP15_ Reactive
1055	Mountain View-Wayne Rail Station	B	\$ 2,000.00	\$ 2,000.00	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
1056	Lincoln Park Rail Station	B	\$ 2,000.00	\$ 2,000.00	\$ 3,600.00	\$ 3,600.00	\$ 20,000.00	\$ 20,000.00	\$ 15,000.00	\$ 15,000.00
Subarea B total for Facilities			\$ 4,000.00	\$ 4,000.00	\$ 3,600.00	\$ 3,600.00	\$ 20,000.00	\$ 20,000.00	\$ 15,000.00	\$ 15,000.00

Footnote: 1. Geodatabase asset identification (ID) number.

Strategies can be applied at both the construction and operation and maintenance (O&M) stage.

Assigned Adaptation Strategies and Associated Costs for the BCA																					
Asset ID ¹	Asset Name	Subarea	Construction Strategy	O&M Strategy	Construction Strategy															Notes	
			TE1_ Reactive	TE2_ Proactive	TE2_ Reactive	TE6_ Proactive	TE6_ Reactive	HR6_ Proactive	HR6_ Reactive	SF3_ Proactive	SF3_ Reactive	SW8_ Proactive	SW8_ Reactive	SW11_ Proactive	SW11_ Reactive	FP10_ Proactive	FP10_ Reactive	FP15_ Proactive	FP15_ Reactive		
110716401270	Conrail RR	B	\$ 1,045,047.50	\$ 5,000.00	\$ 5,000.00	\$ 158.34	\$ 79,170.27	\$ 250,811.40	\$ 250,811.40	\$ 267,199.64	\$ 267,199.64	\$ 2,045,777.72	\$ 2,045,777.72	\$ 2,045,777.72	\$ 2,045,777.72	\$ 125,405.70	\$ 418,019.00	\$ 1,187.55	\$ 79,170.27	No flood inundation depth in dataset, so no flood adaptation costs applied.	
110716401288	Conrail RR	B	\$ 891,362.50	\$ 5,000.00	\$ 5,000.00	\$ 135.05	\$ 67,527.46	\$ 213,927.00	\$ 213,927.00	\$ 227,905.18	\$ 227,905.18	\$ 2,708,606.51	\$ 2,708,606.51	\$ 2,708,606.51	\$ 2,708,606.51	\$ 106,963.50	\$ 356,545.00	\$ 1,012.91	\$ 67,527.46		
110716407439	New Jersey Transit RR	B	\$ 1,269,602.50	\$ 5,000.00	\$ 5,000.00	\$ 192.36	\$ 96,182.01	\$ 304,704.60	\$ 304,704.60	\$ 324,614.28	\$ 324,614.28	\$ 3,857,627.16	\$ 3,857,627.16	\$ 3,857,627.16	\$ 3,857,627.16	\$ 152,352.30	\$ 507,841.00	\$ 1,442.73	\$ 96,182.01		
110716409758	NI*	B	\$ 112,187.50	\$ 5,000.00	\$ 5,000.00	\$ 17.00	\$ 8,499.05	\$ 26,925.00	\$ 26,925.00	\$ 28,684.30	\$ 28,684.30	\$ 340,876.41	\$ 340,876.41	\$ 340,876.41	\$ 340,876.41	\$ 13,462.50	\$ 44,875.00	\$ 127.49	\$ 8,499.05		
110716409760	NI*	B	\$ 301,077.50	\$ 5,000.00	\$ 5,000.00	\$ 45.62	\$ 22,808.90	\$ 72,258.60	\$ 72,258.60	\$ 76,980.04	\$ 76,980.04	\$ 914,809.75	\$ 914,809.75	\$ 914,809.75	\$ 914,809.75	\$ 36,129.30	\$ 120,431.00	\$ 342.13	\$ 22,808.90		
110716409764	NI*	B	\$ 128,292.50	\$ 5,000.00	\$ 5,000.00	\$ 19.44	\$ 9,719.13	\$ 30,790.20	\$ 30,790.20	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	
110745129822	Erie-Lackawanna RR	B	\$ 1,376,377.50	\$ 5,000.00	\$ 5,000.00	\$ 208.54	\$ 104,271.02	\$ 330,330.60	\$ 330,330.60	\$ 351,914.70	\$ 351,914.70	\$ 4,182,057.94	\$ 4,182,057.94	\$ 4,182,057.94	\$ 4,182,057.94	\$ 165,165.30	\$ 550,551.00	\$ 1,564.07	\$ 104,271.02		
Subarea B total for Rail			\$ 5,123,947.50	\$ 35,000.00	\$ 35,000.00	\$ 776.36	\$ 388,177.84	\$ 1,229,747.40	\$ 1,229,747.40	\$ 1,277,298.15	\$ 1,277,298.15	\$ 14,049,755.48	\$ 14,049,755.48	\$ 14,049,755.48	\$ 14,049,755.48	\$ 599,478.60	\$ 1,998,262.00	\$ 5,676.88	\$ 378,458.71		
110710481158	Conrail RR	C	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	No Adaptation Strategy applied. Track no longer exists or is abandoned.	
110710495056	Erie-Lackawanna RR	C	\$ 488,765.00	\$ 5,000.00	\$ 5,000.00	\$ 37.03	\$ 37,027.65	\$ 58,651.80	\$ 58,651.80	\$ 62,484.16	\$ 62,484.16	\$ 755,818.66	\$ 755,818.66	\$ 755,818.66	\$ 755,818.66	\$ 29,325.90	\$ 97,753.00	\$ 277.71	\$ 37,027.65	No flood inundation depth in dataset, so no flood adaptation costs applied.	
110710495058	Erie-Lackawanna RR	C	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	No Adaptation Strategy applied. Track no longer exists or is abandoned.	
110710495062	Erie-Lackawanna RR	C	\$ 484,480.00	\$ 5,000.00	\$ 5,000.00	\$ 36.70	\$ 36,703.03	\$ 58,137.60	\$ 58,137.60	\$ 61,936.36	\$ 61,936.36	\$ 749,190.23	\$ 749,190.23	\$ 749,190.23	\$ 749,190.23	\$ 29,068.80	\$ 96,896.00	\$ 275.27	\$ 36,703.03		
110710495197	NY Susquehanna and Western Rlwy	C	\$ 286,085.00	\$ 5,000.00	\$ 5,000.00	\$ 21.67	\$ 21,673.11	\$ 34,330.20	\$ 34,330.20	\$ 36,573.37	\$ 36,573.37	\$ 442,411.06	\$ 442,411.06	\$ 442,411.06	\$ 442,411.06	\$ 17,165.10	\$ 57,217.00	\$ 162.55	\$ 21,673.11		
110710497670	No Information Provided	C	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	No Adaptation Strategy applied. Track no longer exists or is abandoned.	
110716401273	Conrail RR	C	\$ 461,285.00	\$ 5,000.00	\$ 5,000.00	\$ 34.95	\$ 34,945.83	\$ 55,354.20	\$ 55,354.20	\$ 58,971.09	\$ 58,971.09	\$ 713,326.59	\$ 713,326.59	\$ 713,326.59	\$ 713,326.59	\$ 27,677.10	\$ 92,257.00	\$ 262.09	\$ 34,945.83		
110716401274	Conrail RR	C	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	No Adaptation Strategy applied. Track no longer exists or is abandoned.	
110716401280	Conrail RR	C	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	No Adaptation Strategy applied. Track no longer exists or is abandoned.	
110716401281	Conrail RR	C	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	No Adaptation Strategy applied. Track no longer exists or is abandoned.	
110716401282	Conrail RR	C	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	No Adaptation Strategy applied. Track no longer exists or is abandoned.	
110716401286	Conrail RR	C	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	No Adaptation Strategy applied. Track no longer exists or is abandoned.	
110716407461	New York Susquehanna and Western Rlwy	C	\$ 286,085.00	\$ 5,000.00	\$ 5,000.00	\$ 21.67	\$ 21,673.11	\$ 34,330.20	\$ 34,330.20	\$ 36,573.37	\$ 36,573.37	\$ 395,180.12	\$ 395,180.12	\$ 395,180.12	\$ 395,180.12	\$ 17,165.10	\$ 57,217.00	\$ 162.55	\$ 21,673.11		
110716407469	7th Street	C	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	No Adaptation Strategy applied. Track no longer exists or is abandoned.	
Subarea C total for Rail			\$ 2,006,700.00	\$ 25,000.00	\$ 25,000.00	\$ 152.02	\$ 152,022.73	\$ 240,804.00	\$ 240,804.00	\$ 256,538.35	\$ 256,538.35	\$ 3,055,926.66	\$ 3,055,926.66	\$ 3,055,926.66	\$ 3,055,926.66	\$ 120,402.00	\$ 401,340.00	\$ 1,140.17	\$ 152,022.73		

Footnote: 1. Geodatabase asset identification (ID) number.
* No information (NI) indicates information was not available in the PRB study geodatabase.

Assigned Adaptation Strategies and Associated Costs for the BCA																		
Asset Name	Location Info.	TE6_Reactive	HR3_Proactive	HR3_Reactive	HR4_Proactive	HR4_Reactive	SF3_Proactive	SF3_Reactive	SW8_Proactive	SW8_Reactive	FP10_Proactive	FP10_Reactive	FP15_Proactive	FP15_Reactive	FD8_Proactive	FD8_Reactive	HR6_Proactive	HR6_Reactive
Interstate 80	I-80 SECONDARY	\$ 124,251.56	\$ 15,745.16	\$ 15,745.16	\$ 91,946.15	\$ 124,251.56	\$ 33,547.92	\$ 33,547.92	\$ 903,647.69	\$ 903,647.69	\$ 15,745.16	\$ 52,483.86	\$ 149.10	\$ 124,251.56	\$ 1,988,024.92	\$ 1,988,024.92	\$ 31,490.31	\$ 31,490.31
US Hwy 46	US 46 SECONDARY	\$ 182,091.41	\$ 57,686.56	\$ 57,686.56	\$ 134,747.64	\$ 182,091.41	\$ 122,911.70	\$ 122,911.70	\$ 1,589,161.39	\$ 1,589,161.39	\$ 57,686.56	\$ 192,288.53	\$ 546.27	\$ 182,091.41	\$ 6,409,617.59	\$ 6,409,617.59	\$ 115,373.12	\$ 115,373.12
US Hwy 46	US 46	\$ 89,281.60	\$ 28,284.41	\$ 28,284.41	\$ 66,068.39	\$ 89,281.60	\$ 60,265.08	\$ 60,265.08	\$ 779,184.90	\$ 779,184.90	\$ 28,284.41	\$ 94,281.37	\$ 267.84	\$ 89,281.60	\$ 3,142,712.45	\$ 3,142,712.45	\$ 56,568.82	\$ 56,568.82
US Hwy 46	US 46	\$ 62,977.06	\$ 13,300.75	\$ 13,300.75	\$ 46,603.02	\$ 62,977.06	\$ 28,339.68	\$ 28,339.68	\$ 396,946.30	\$ 396,946.30	\$ 13,300.75	\$ 44,335.85	\$ 125.95	\$ 62,977.06	\$ 1,545,037.14	\$ 1,545,037.14	\$ 26,601.51	\$ 26,601.51
US Hwy 46	US 46 SECONDARY	\$ 132,871.24	\$ 28,062.41	\$ 28,062.41	\$ 98,324.72	\$ 132,871.24	\$ 59,792.06	\$ 59,792.06	\$ 837,491.44	\$ 837,491.44	\$ 28,062.41	\$ 93,541.35	\$ 265.74	\$ 132,871.24	\$ 3,259,774.38	\$ 3,259,774.38	\$ 56,124.81	\$ 56,124.81
US Hwy 46	US 46 SECONDARY	\$ 42,986.27	\$ 13,618.05	\$ 13,618.05	\$ 31,809.84	\$ 42,986.27	\$ 29,015.73	\$ 29,015.73	\$ 375,152.87	\$ 375,152.87	\$ 13,618.05	\$ 45,393.50	\$ 128.96	\$ 42,986.27	\$ 1,513,116.57	\$ 1,513,116.57	\$ 27,236.10	\$ 27,236.10
US Hwy 46	US 46 SECONDARY	\$ 27,780.84	\$ 8,800.97	\$ 8,800.97	\$ 20,557.82	\$ 27,780.84	\$ 18,752.07	\$ 18,752.07	\$ 242,450.94	\$ 242,450.94	\$ 8,800.97	\$ 29,336.56	\$ 83.34	\$ 27,780.84	\$ 977,885.47	\$ 977,885.47	\$ 17,601.94	\$ 17,601.94
									\$ 124,722,178.54	\$ 124,722,178.54								
		\$ 18,718,743.03	\$ 4,133,926.59	\$ 4,133,926.59	\$ 13,851,869.84	\$ 18,718,743.03	\$ 8,808,082.22	\$ 8,808,082.22	\$ 124,722,178.54	\$ 124,722,178.54	\$ 4,133,926.59	\$ 13,779,755.30	\$ 39,147.03	\$ 18,718,743.03	\$ 477,299,029.29	\$ 477,299,029.29	\$ 8,267,853.18	\$ 8,267,853.18