APPENDIX F

Historical & Predictive Crash Data & Analysis

Mercer County Route 634 (Parkway Avenue), Scotch Road (CR 611) to Pennington Road (NJ 31) MP 2.20 – MP 4.40

Safety Concept Development Study

Historical Crash Analysis

December 2017

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Introduction

Michael Baker International, Inc. (Michael Baker) was tasked by the New Jersey Department of Transportation (NJDOT) Office of Bicycle and Pedestrian Programs (OBPP) to perform a Safety Concept Development (CD) Study on Parkway Avenue (CR 634) from Scotch Road (CR 611) to Pennington Road (NJ 31) in Ewing Township and the City of Trenton. As part of the Data Analysis task, a Historical Crash Analysis has been conducted to summarize historical crash data. Findings from this analysis will assist with crash countermeasure selection and identifying areas where safety improvements may be effective. To conduct this analysis, Michael Baker obtained motor vehicle crash data from the NJDOT Bureau of Safety Programs. Data for the most recent available three-year period available (2014-2016) for Mercer County Route 634 Parkway Avenue from (milepost (MP) 2.20) to MP 4.40 was retrieved.

A total of 234 crashes occurred from MP 2.20 to MP 4.40 on Parkway Avenue between 2014 and 2016. Results of the crash analysis are presented in this report with figures and tables showing factors of the crashes including crash locations, crash types, crash occurrence time of day, contributing circumstances and vehicle actions. Crash diagrams were prepared to provide visual representation of each crash location. Crash diagrams of the study corridor depicting the locations of crashes and quantity of each crash type by milepost are included in Appendix A. Police reports (TR-1 Forms) of the crashes were obtained from NJDOT and were reviewed to confirm the direction of travel for each vehicle and obtain other pertinent information. Raw data of the 234 crashes obtained from NJDOT Bureau of Safety Programs, detailing crash type, date, time, contributing circumstances, and vehicle actions is included in Appendix B. Additional details found in the raw data include roadway conditions and environmental circumstances. Appendix C includes crash types broken down into types of contributing circumstances and vehicle actions that took place before crashes.

Crash Types

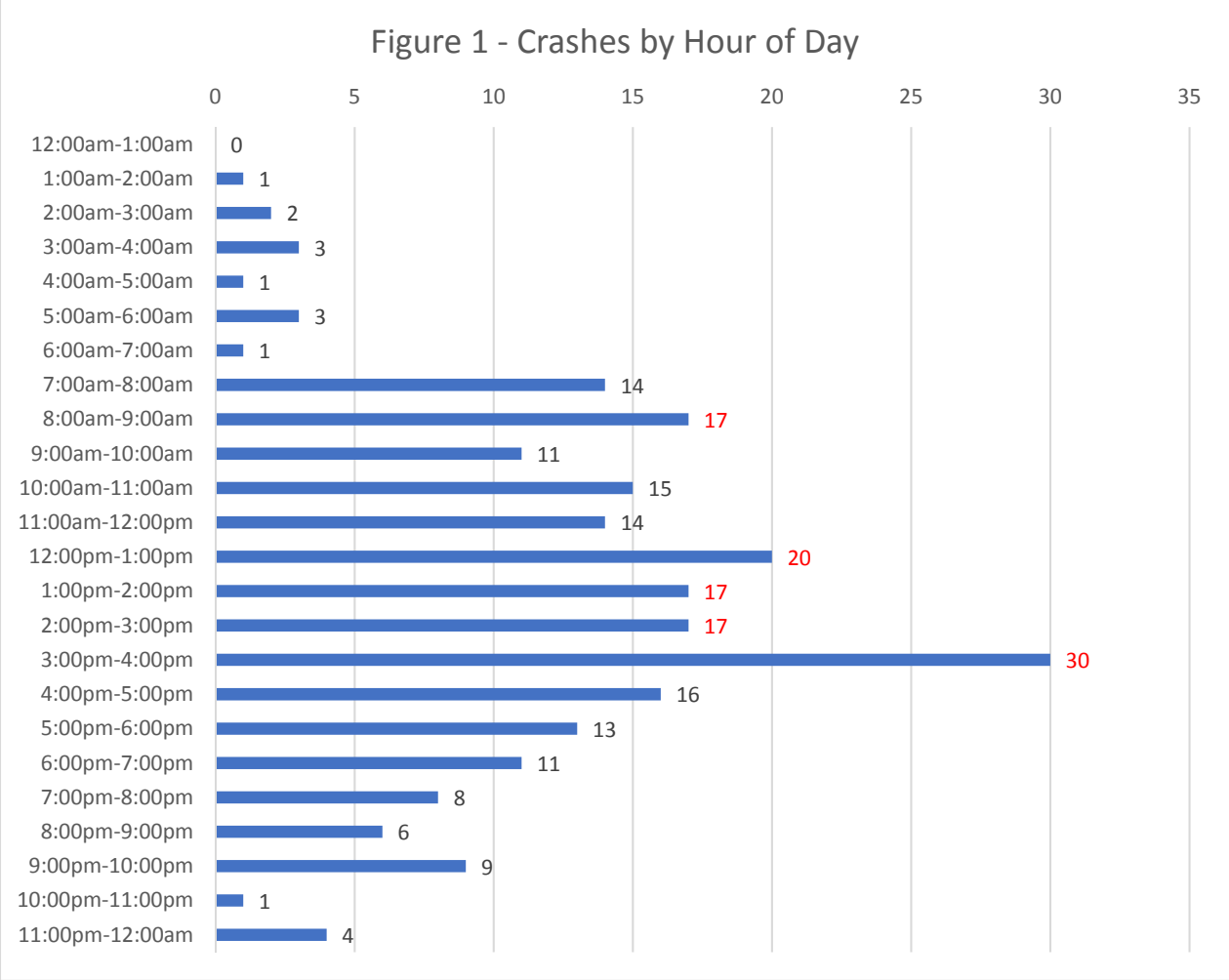
The 234 crashes were classified into 13 types of crashes. Representing the top five crash types were 53 (22.6%) *Right Angle* crashes, 51 (21.8%) *Same Direction-Rear End* crashes, 51 (21.8%) *Same Direction-Sideswipe* crashes, 24 (10.3%) *Fixed Object*, and 23 (10.3%) *Left Turn/U Turn* crashes. The 13 crash types, frequency and percentages are shown in Table 1 with the top five highlighted in red.

Table 1

Crash Type	Number	Percentage
Animal	6	2.6%
Backing	3	1.3%
Encroachment	1	0.4%
Fixed Object	24	10.3%
Left Turn / U Turn	23	9.8%
Opposite Direction/Head On Angular	14	6.0%
Opposite Direction/Sideswipe	2	0.9%
Pedalcyclist	2	0.9%
Pedestrian	3	1.3%
Right Angle	53	22.5%
Same Direction-Rear End	51	21.8%
Same Direction-Sideswipe	51	21.8%
Struck Parked Vehicle	1	0.4%
Total	234	100.0%

Crashes by Hour of Day

Figure 1 shows the crashes by hour of the day with the top five highlighted in red. 30 (12.8%) crashes occurred between 3:00 PM and 4:00 PM, 20 (8.5%) crashes occurred from 12:00 PM to 1:00 PM, 17 (7.3%) crashes occurred from 8:00 AM to 9:00 AM, 17 (7.3%) crashes occurred from 1:00 PM to 2:00 PM, and 17 (7.3%) crashes occurred from 2:00 PM to 3:00 PM. Each of these hourly intervals occurred during the AM and Mid Day/PM peak periods when traffic volumes were highest. A summary of traffic data is included in the Parkway Avenue Safety CD Study Project Fact Sheet. Nearby trip generators include employment centers, Ewing High School and Parkway Elementary School which may contribute to a significant increase in traffic volumes during these hour.



Crash Hotspots

The four locations with the highest crash quantities were the signalized intersections of Parkway Avenue and Lower Ferry Road, Olden Avenue, Parkside Avenue, and Pennington Road. These four locations represented 40% of the total crashes along the study corridor.

Parkway Avenue and Lower Ferry Road

The hotspot location with the highest crash quantity within the study corridor was the intersection of Parkway Avenue and Lower Ferry Road and its eastbound and westbound approaches (MP 2.65-2.69). 53 (22.6%) crashes of the 234 total crashes occurred at this hotspot. Of the 53 crashes, 14 (26.4%) crashes were *Right Angle*, 12 (22.6%) crashes were *Same Direction-Rear End*, 10 (18.8%) crashes were *Left Turn/U Turn*, 10 (8.8%) crashes were *Same Direction-Sideswipe,* four (7.5%) crashes were *Fixed Object*, one was *Pedestrian*, one was *Opposite Direction-Head On*, and one was *Backing*. The crash types at Parkway Avenue and Lower Ferry Road are shown in Figure 2.

Figure 2 - Crash Types Occurred at Parkway Avenue and Lower Ferry Road

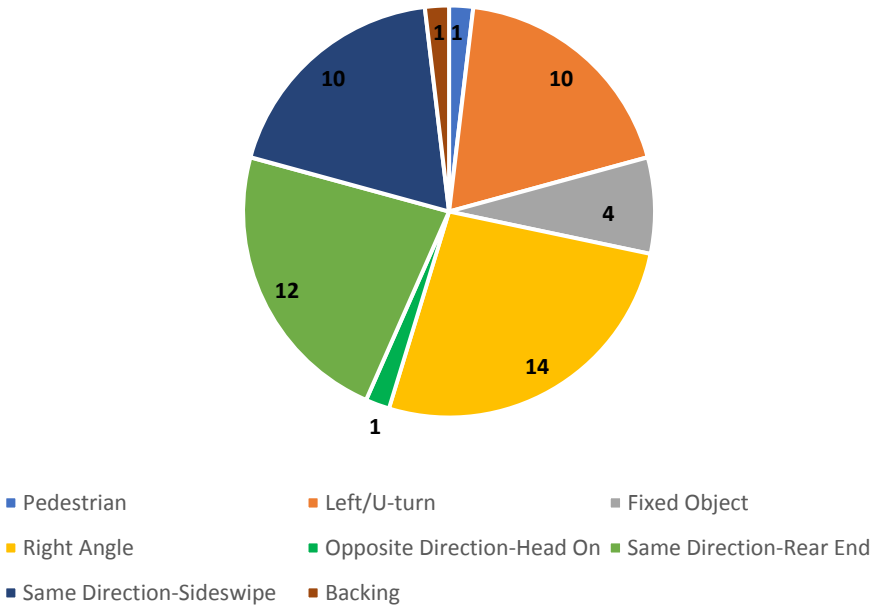


Table 2 shows crash types that occurred more than once at the intersection of Parkway Avenue and Lower Ferry Road with contributing circumstances and the number of vehicles involved. The most common contributing circumstance of *Right Angle* and *Left Turn/U Turn* crashes was *Failure to Yield Right-Of-Way to Vehicle or Pedestrian*. The lack of protected left turn phasing at this intersection. may attribute to these two crash types. The most common contributing circumstance for *Same Direction-Read End* crashes was Unsafe Speed.

Table 2

Crash Type	Contributing Circumstances	Number of Vehicles
Right Angle (14 Crashes)	Driver Inattention	1
	Failure to Yield Right-Of-Way to Vehicle or Pedestrian	10
	Improper Turn	3
	None	13
	Road Surface Condition	1
Same Direction-Rear End (12 Crashes)	Disobeyed Traffic Control Device	1
	Driver Inattention	2
	Following Too Closely	4
	Improper Lane Change	1
	None	12
	Unsafe Speed	4
Left Turn/U Turn (10 Crashes)	Disobeyed Traffic Control Device	1
	Failure to Yield Right-Of-Way to Vehicle or Pedestrian	7
	Improper Turn	1
	None	10
	Unknown	1
Same Direction-Side Swipe (10 Crashes)	Disobeyed Traffic Control Device	1
	Improper Lane Change	5
	Improper Passing	1
	Improper Turn	2
	None	10
	Road Surface Condition	1
Fixed Object (4 Crashes)	None	5
	Other Driver Action	1
	Road Surface Condition	1
	Unsafe Speed	1

Parkway Avenue and Olden Avenue

At the intersection of Parkway Avenue and Olden Avenue and its approaches (MP 3.25-3.26), 14 (6%) crashes of the 234 total study corridor crashes occurred. Of the 14 crashes, six (42.8%) crashes were *Same Direction-Sideswipe*, four (28.6%) crashes were *Right Angle*, and the remaining four crashes were comprised of *Fixed Object, Same Direction-Rear End, Opposite Direction-Head On, and Pedalcyclist,* as shown in Figure 3.

Figure 3 - Crash Types Occurred at Parkway Avenue and Olden Avenue

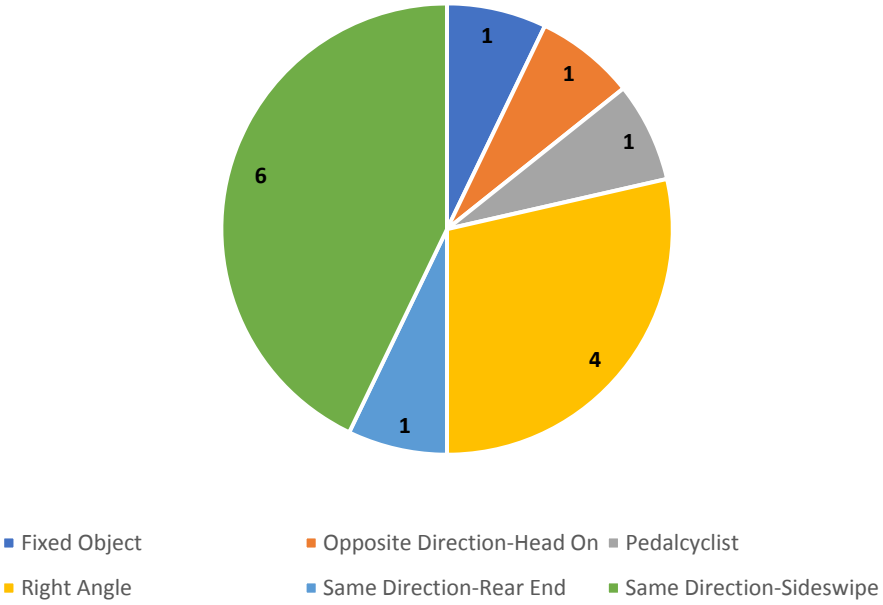


Table 3 shows crash types that occurred more than once at the intersection of Parkway Avenue and Olden Avenue with contributing circumstances and the number of vehicles involved. The most common contributing circumstance of *Same Direction-Side Swipe* crashes was *Improper Lane Change*. In addition to this contributing circumstance, *Improper Passing* and *Improper Turn* were also reported.

Table 3

Crash Type	Contributing Circumstances	Number of Vehicles
Same Direction-Side Swipe (6 Crashes)	Failure to Yield Right-Of-Way to Vehicle or Pedestrian	1
	Improper Lane Change	3
	Improper Passing	1
	Improper Turn	1
	None	6
Right Angle (4 Crashes)	Disobeyed Traffic Control Device	2
	Improper Turn	1
	None	4
	Road Surface Condition	1

Parkway Avenue and Parkside Avenue

At the intersection of Parkway Avenue and Parkside Avenue (MP 4.11), 14 (6%) crashes of the 234 total study corridor crashes occurred. Of the 14 crashes, six (42.8%) crashes were *Right Angle*, two (14.2%) crashes were *Same Direction-Rear End*, and two (14.2%) crashes were *Same Direction-Side Swipe* and there were one *Left Turn/U Turn* crash, one *Pedestrian* crash, one *Opposite Direction-Head On* crash, and one *Fixed Object* crash. Figure 4 shows the crash types at Parkway Avenue and Parkside Avenue.

Figure 4 - Crash Types Occurred at Parkway Avenue and Parkside Avenue

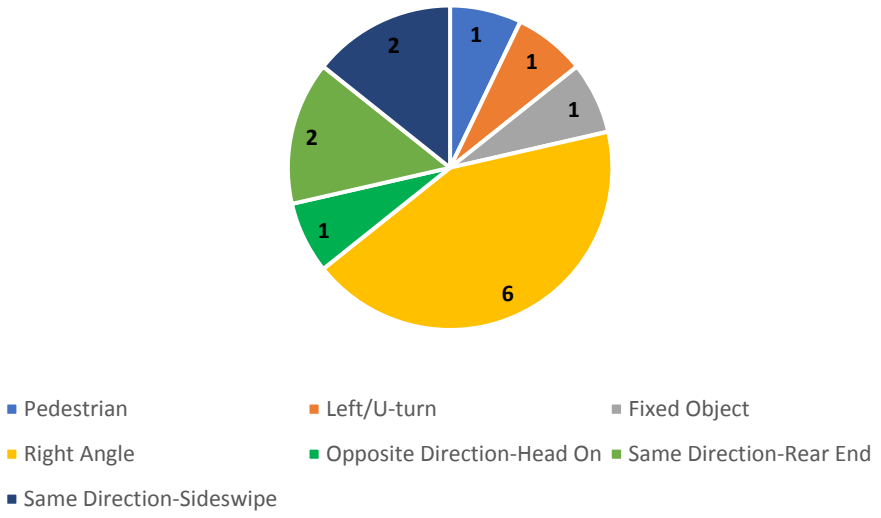


Table 4 shows crash types that occurred more than once at the intersection of Parkway Avenue and Parkside Avenue with contributing circumstances and the number of vehicles involved. Crashes occurring with contributing circumstances of *Disobeyed Traffic Control Device* or *Control Device Defective or Missing* may indicate poor visibility of either the intersection or traffic control device(s).

Table 4

Crash Type	Contributing Circumstances	Number of Vehicles
Right Angle (6 Crashes)	Disobeyed Traffic Control Device	3
	Control Device Defective or Missing	2
	Driver Inattention	3
	None	4
Same Direction-Rear End (2 Crashes)	Driver Inattention	2
	None	2
Same Direction-Side Swipe (2 Crashes)	Improper Lane Change	1
	Improper Passing	1
	None	1
	Unknown	1

Parkway Avenue and Pennington Road (NJ 31)

At the intersection of Parkway Avenue and Pennington Road (NJ 31), 13 (5.5%) crashes out of the total 234 crashes within the study corridor occurred. Of the 13 crashes, five (38.4%) crashes were *Same Direction-Rear End*, three (23%) crashes were *Fixed Object*, and two (15.3%) crashes were *Same Direction-Side Swipe*, and there were one *Right Angle* crash, one *Opposite Direction-Head On* crash, and one *Animal* crash. Figure 5 shows the crashes by type at the intersection of Parkway Avenue and Pennington Road.

Figure 5 - Crash Types Occurred at Parkway Avenue and Pennington Road

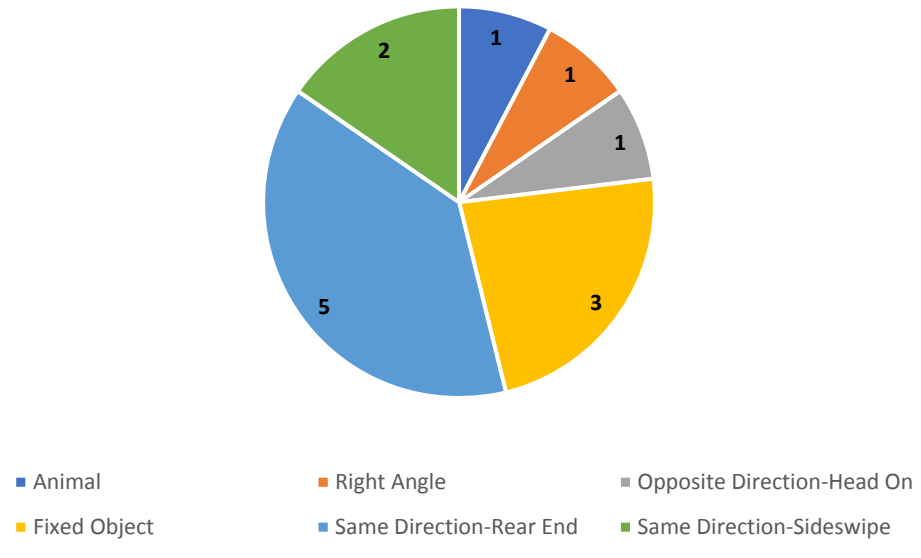


Table 5 shows crash types that occurred more than once at the intersection of Parkway Avenue and Pennington Road with contributing circumstances and the number of vehicles involved.

Table 5

Crash Type	Contributing Circumstances	Number of Vehicles
Same Direction-Rear End (5 Crashes)	Driver Inattention	1
	Following Too Closely	2
	None	6
	Unknown	1
Fixed Object (3 Crashes)	None	4
	Other Driver Action	1
	Unsafe Speed	1
Same Direction-Side Swipe (2 Crashes)	Improper Lane Change	1
	Improper Passing	1
	None	2

Crash Severity

Crash severity was analyzed for this report to determine the number of crashes which involved injuries or fatalities. Of the 234 crashes, 70 (29.9%) crashes involved one or more injuries. No crashes resulted in a fatality. In terms of the severity of injury, 67 crashes involved at least one minor injury and 10 crashes involved at least one moderate injury (NOTE: Some crashes involved both a minor injury and a moderate injury). In these 70 crashes, 93 people suffered minor injuries and 10 suffered moderate injuries. 15 (21.4%) of the 70 crashes occurred at Lower Ferry Road and its approaches (MP 2.65-2.69) and seven (10%) of the 70 crashes occurred at Parkside Avenue.

Conclusion

This crash analysis indicates that while crashes along the Parkway Avenue study corridor were concentrated at the six signalized intersections, lower concentrations of crashes also consistently occurred along roadway segments between signalized intersections throughout the study corridor. Crashes occurring at the signalized intersections accounted for 48.3% of total crashes. As both segment and intersection-related crashes are approximately equally represented, it is important to identify and select appropriate safety improvements that will address crashes both at signalized intersections and along segments between.

The findings of the Crash Analysis will be used in the development and evaluation of alternatives throughout the Parkway Avenue study corridor. Roadway features or deficiencies that may contribute to the observed crash patterns, such as substandard roadway design elements, will be addressed when possible. Additionally, FHWA proven safety countermeasures and other safety improvements can be incorporated into design alternatives based on observed crash types and the contributing circumstances that led to those crash types.

Mercer County Route 634 (Parkway Avenue), Scotch Road (CR 611) to Pennington Road (NJ 31) MP 2.20 – MP 4.40

Safety Concept Development Study

Predictive Safety Analysis Memorandum

Prepared for:
Office of Bicycle and Pedestrian Programs
Bureau of Commuter Mobility and Strategies
Division of Statewide Planning

August 2018

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Introduction

Michael Baker International, Inc. (Michael Baker) was tasked by the New Jersey Department of Transportation (NJDOT) Office of Bicycle and Pedestrian Programs (OBPP) to perform a Safety Concept Development (CD) Study on Parkway Avenue (CR 634) from Scotch Road (CR 611) to Pennington Road (NJ 31) in Ewing Township and the City of Trenton. The purpose of this project is to recommend, advance, and implement safety improvements along Parkway Avenue in Ewing Township. This Safety Concept CD Study will review and assess existing roadway conditions, identify opportunities and deficiencies, develop and evaluate improvement alternatives, and select a Preliminary Preferred Alternative to advance to design and construction.

This study was initiated through the Federal Highway Administration's (FHWA) Highway Safety Improvement Program (HSIP) as a result of a data-driven Pilot Program developed by the New Jersey Department of Transportation that identified Parkway Avenue as one of the top-2 candidate locations for road diet implementation. The goal of the HSIP is to reduce traffic fatalities and serious injuries along public roadways using substantive safety approaches and data-driven strategies, and the goal of this study is to maximize safety for all roadway users throughout the corridor.

AASHTO Highway Safety Manual (HSM) Predictive Analysis is a recognized method for assessing facilities and countermeasures. The HSM Predictive Analysis will be used in this study to quantify the benefit of potential improvement alternatives. This memorandum explains the process through which the HSM Predictive Analysis was completed, including analysis of the Preliminary Preferred Alternative.

Project Background and Existing Conditions

Project Location

The study encompasses Parkway Avenue (CR 634) from Scotch Road (CR 611) to Pennington Road (NJ 31) (MP 2.20 to MP 4.40) in Ewing Township and the City of Trenton, Mercer County. Parkway Avenue is an Urban Minor Arterial that provides access to Routes I-95, NJ 29, NJ 129, and NJ 31. This section of Parkway Avenue is adjacent to New Jersey Department of Transportation (NJDOT) headquarters, Ewing High School, Parkway Elementary School, multiple religious institutions, restaurants, and dense residential land use.

Parkway Avenue has sidewalks along both sides of the roadway throughout the project area, which are narrow and in poor to fair conditions. The crosswalks are also in poor to fair condition throughout, while bicycle lanes and painted shoulders are non-existent. The corridor facilitates multiple bus lines and associated bus stops, for which there are very few bus shelters or measures related to pedestrian safety.

Roadway Characteristics

The existing study corridor consists of 6 signalized intersections, and for the purpose of this analysis, the corridor was divided into 5 sections between those intersections, which vary in configuration (see *Table 1*). In 2017, the segments from Lower Ferry Road to Olden Avenue were converted to the road diet configuration currently in-place.

Segment (Milepost)	Posted Speed (MPH)	Configuration
Scotch to Lower Ferry (2.20-2.67)	40	Four 12' lanes, undivided

Lower Ferry to Farrell (2.67-2.97)	40	Three 12' lanes, one two-way-left-turn lane
Farrell to Olden (2.97-3.25)	40	Three 12' lanes, one two-way-left-turn lane
Olden to Parkside (3.25-4.11)	40	Four 11' lanes, undivided
Parkside to Pennington (4.11-4.40)	35	Two 15' lanes, undivided

Table 1: Corridor Configurations and Speeds

Parkway Avenue is relatively straight and has few sight distance concerns based on geometry. The roadway also has a very consistent grade, especially at the signalized intersections. The section with the most curvature, from Ranchwood Drive (MP 3.5) to Maple Avenue (4.26) between Olden Avenue and Parkside Avenue, is also the densest in intersections.

The NJDOT Straight Line Diagrams for Parkway Avenue (CR 634) within the study area are provided in *Appendix A.*

Crash History

A Historical Crash Analysis was conducted to summarize historical crash data. Michael Baker obtained motor vehicle crash data from the NJDOT Bureau of Safety Programs. A total of 234 crashes occurred along the study corridor during a three-year period from 2014 to 2016:

- 70 crashes involved injuries, resulting in 103 injured people.
- The Top 3 crash types represented 66.1% of all crashes, the Top 5 represented 86.2%:
  - 22.5% of crashes were Right Angle.
  - 21.8% of crashes were Same Direction-Rear End
  - 21.8% of crashes were Same Direction-Side Swipe.
  - 10.3% of crashes were Fixed Object
  - 9.8% of crashes were Left-turn/U-turn
- Five crashes were pedestrian or bicycle crashes.
- 22.6% of crashes occurred at Parkway Avenue and Lower Ferry Road

The Historical Crash Analysis identified concentrations of crashes at the signalized intersections and consistent, less concentrated, groups of crashes along the segments between the signalized intersections.

Crash Hotspots were also analyzed. The four locations with the highest crash quantities were the signalized intersections of Parkway Avenue and Lower Ferry Road, Olden Avenue, Parkside Avenue, and Pennington Road, representing 40% of the total crashes within the corridor from 2014-2016. Only 48.3% of the total crashes occurred at the signalized intersections, which highlighted a need for safety improvements that address crashes throughout the corridor addressing both intersection-related and segment crashes. Crash diagrams for 2014-2016 can be found in *Appendix B*.

Historical crashes were also utilized in comparing alternative configurations, countermeasures, and the resultant expected crash frequencies from the Predictive Analyses of the Highway Safety Manual. Crashes were extracted from Safety Voyager from 2012-2016 and assigned to signalized intersections and segments between those intersections, as they would be analyzed in the Predictive Analysis. Private property crashes were eliminated from the analysis.

Average Annual Crash History (2012-2016)		Scotch	Lower Ferry	Farrell	Olden	Parkside	Pennington
Multiple vehicle crashes	Fatal and Injury Only	4.60	5.40	3.40	3.80	3.20	0.20
	Property Damage Only	7.00	14.00	4.60	10.80	6.20	3.20
Single-vehicle crashes	Fatal and Injury Only	0.00	1.80	0.00	0.60	1.20	0.20
	Property Damage Only	1.40	1.40	0.80	1.20	0.40	0.40

Table 2: Average Annual Crashes at signalized intersections

Average Annual Crash History (2012-2016)		Scotch to Ferry	Ferry to Farrell	Farrell to Olden	Olden to Parkside	Parkside to Pennington
Multiple vehicle driveway crashes	Fatal and Injury Only	0.33	0.00	0.67	0.33	0.00
	Property Damage Only	4.00	1.00	2.00	1.33	0.00
Multiple vehicle nondriveway crashes	Fatal and Injury Only	1.67	1.40	0.13	2.07	0.20
	Property Damage Only	1.80	3.00	0.60	3.47	0.40
Single-vehicle crashes	Fatal and Injury Only	0.40	0.00	0.20	1.00	0.00
	Property Damage Only	0.20	0.60	0.60	1.80	0.40

Table 3: Average Annual Crashes between signalized intersections

As noted in the historical crash analysis, the Lower Ferry Road intersection also showed the highest average annual crashes in 2012-2016 data across each category utilized in the predictive analysis.

Traffic Data

Traffic data, such as Average Annual Daily Traffic (AADT) volumes, are used in the Highway Safety Analysis to help group sites with similar peer sites, addressing the likelihood that higher volume roadways have a higher crash frequency when all other variables are held constant. Major Road AADT was calculated by averaging 7-day Automated Traffic Recorders (ATR) counts both east and west of the Olden Avenue intersection. Seasonal adjustment factors from the NJDOT website were used. AADT for minor roadways were estimated using a rule-of-thumb that the peak hour volumes from turning movement counts represent 10% of the AADT for minor (intersecting) roadways.

Table 4 summarizes the traffic volume data used in the HSM analysis of the segments and intersections within project.

Element	Location Information		Major AADT	Minor AADT
	Route	Location	Total	Total
Segment 1	CR 634	2.20-2.67 (Scotch to Lower Ferry)	16779	-
Segment 2	CR 634	2.67-2.97 (Lower Ferry to Farrell)	16779	-
Segment 3	CR 634	2.97-3.25 (Farrell to Olden)	16779	-
Segment 4	CR 634	3.25-4.11 (Olden to Parkside)	9373	-
Segment 5	CR 634	4.11-4.40 (Parkside to Pennington)	9373	-
Intersection 1	Scotch & Silva Street (CR 611)	2.2	16779	8191
Intersection 2	Lower Ferry Road (CR 643)	2.67	16779	8378
Intersection 3	Farrell Avenue	2.97	16779	3149
Intersection 4	North Olden Avenue &Lexington Avenue (CR 622)	3.25	13206	6396
Intersection 5	Parkside Avenue (CR 636)	4.11	9373	12469
Intersection 6	Pennington Road (NJ 31)	4.4	9373	7347

Table 4: Traffic volume data used for HSM Analysis

Pedestrian turning movement counts were also collected and used in the analysis. Similar assumptions were made that the total pedestrian counts represented 55% of actual volume. Seasonal adjustment factors were used to account for the time of year the pedestrian counts were taken due to weather or climate being a major factor in an individual's decision to walk.

Methodology

HSM Predictive Method Overview

The HSM Predictive Analysis allows planners and engineers to compare facilities and countermeasures in a quantitative way. This analysis is used to identify site elements, segments and intersections, within a study area that have the most potential for safety improvement based on the element's crash frequency compared to peer sites with similar characteristics and traffic conditions.

The Predictive Method generates a predicted crash rate based on the Safety Performance Function, as determined by those site characteristics and conditions related to safety and potential for crashes. Types and severities of crashes are predicted using variables such as AADT, Roadway/Intersection class, historical crash data, geometric design, and roadway cross sectional elements. Regression-to-the-mean bias is accounted for by applying historical crash data to the predicted crash rate using the Empirical-Bayes methodology. Including the historical crash data in the analysis allows an expected crash rate to be generated, a weighted rate between the historical crash rate and the rate predicted by the Safety Performance Function.

Proposed improvements that have a known effect on crash rate are included in the analysis through Crash Modification Factors (CMFs). CMFs are factors multiplied by the expected crash rate or the Safety Performance Function (depending on the availability of historical crash data) at specific sites to compute and estimate the expected crash rate following the implementation of those improvements.

The facility must be evaluated by individual sites, either homogeneous segments or intersections, when using the predictive method. These individual pieces or elements can be found in Table 4. This allows evaluators to determine which elements of a project have the most potential for safety improvement and what the expected crash frequency of each of the proposed alternatives will be.

Analysis Method and Approach

Parkway Avenue (CR634) was analyzed using the methodology designed for urban and suburban arterials. The segments were divided at each of the signalized intersections, where the highest concentrations of crashes occurred. The individual elements were analyzed individually for proposed alternatives at specific locations, as well as together for corridor-wide improvements.

For multi-year analysis 2020 was used as the construction year, and 2040 was used as the design year to. *Appendix C* shows the calculated 20-year expected crash rates. 20-year analysis also allows evaluators to see the benefit of treatments or alternatives over the useful life of most infrastructure improvements. The assumption was made that traffic growth would increase 0.36% annually for the multi-year analysis.

HSM Input Data

Each project site must first be classified as either a Two-Lane Rural Road, Multi-Lane Rural Road, or Urban and Suburban Arterial. The data for HSM analysis was collected in previous tasks, specifically knowing the corridor would be analyzed as an urban/suburban arterial site-type. The input data necessary for calculating the predicted average crash frequency for this site-type are shown in *Table 5*.

Segments	Intersections
• Roadway Type/Configuration (e.g. 2-lane undivided) • Length of Segment • AADT of Segment • Presence and Type of On-Street Parking • Proportion of Curb Length with On-Street Parking • Presence and Width of Median • Presence of Lighting • Presence of Automatic Speed Enforcement • Number and Type of Major/Minor Driveways • Speed Category • Roadside Fixed Object Density • Offset to Roadside Fixed Objects • Calibration Factor	• Intersection Type (3/4 Leg, Stop/Signal Controlled) • AADT of Major Roadway • AADT of Minor Roadway • Presence of Intersection Lighting • Approaches with Left-Turn Lanes • Approaches with Right-Turn Lanes • Left-Turn Phasing Type • Approaches with Right-Turn on Red Prohibited • Presence of Red Light Cameras • Sum of all Pedestrian Crossing Volumes • Number of Bus Stops within 1,000 feet • Presence of Schools within 1,000 feet • Number of Alcohol Sales Establishments within 1,000 feet • Calibration Factor

Table 5: Urban and Suburban Arterial Input Data for HSM Analysis

Summary of Alternatives

Five (5) alternatives were analyzed for the entirety of the corridor, specifically focusing on the segments. These alternatives focused on reconfiguration and making use of road diet countermeasures, while proposing alternate ways to utilize the remaining pavement width. Concepts for these alternatives can be found in *Appendix D*. Assumptions were made for analysis purposes that there would be no on-street parking and that lighting would remain present throughout the corridor.

Alternative 1 –Striping prior to Fall 2017 (4-Lane Undivided)

Alternative 1 calls for a restriping of Parkway Avenue (CR 634) between Scotch Road and Olden Avenue to return the roadway to the 4-lane undivided configuration between that existed prior to 2017. This alternative does not include bicycle accommodations and analysis predicts an increase in expected crash frequency.

Alternative 2 – No-Build (Existing, Modified Road Diet)

Alternative 2 is the no-build option, keeping the roadway in its current configuration with a partial road diet between Scotch Road and Olden Avenue. The partial road diet in this section (implemented in 2017) has two 12-ft eastbound thru lanes, one 12-ft westbound thru lane, and a two-way-left-turn-lane (TWLTL). This alternative also does not include bicycle accommodations.

Alternative 3 – Basic Road Diet

Alternative 3 is the conversion of the current 4-lane sections to a road diet with an 11-ft thru lane in each direction and a 12-ft TWLTL. This conversion would also provide shoulders of varying widths, based on the remaining pavement width, to accommodate bicycles.

Alternative 4 – Enhanced Road Diet

Alternative 4 is the conversion of the current 4-lane sections to a road diet with an 11-ft thru lane in each direction and a 12-ft TWLTL. Bicycle lanes (5 feet wide) are to be provided on either side with a 2-ft buffer. The section between Parkside Avenue and Pennington Road will have the same configuration and striped shoulder as Alternative 3.

Alternative 5 – Reduced Roadway Width & Shared Use Paths

Alternative 5 is the conversion of the current 4-lane sections to a road diet with an 11-ft thru lane in each direction and a 12-ft TWLTL. Shared use paths (8-10 feet wide) are to be provided either side of the roadway outside the existing pavement width, utilizing a painted shoulder in the remaining available pavement width. The section between Parkside Avenue and Pennington Road will have the same configuration and striped shoulder as Alternatives 3 and 4.

Intersection Alternatives

A range of alternatives were evaluated for each signalized intersection. Intersection alternatives include changing lane configurations, adding or removing turn lanes, and utilizing treatments such as roundabouts and backplates. Proposed left turn lanes were assumed to have protected/permissive phasing for analysis purposes, as well as the assumption that right-on-red will be prohibited where channelized right turn slips are to be eliminated.

Alternatives Analysis

Crash Modification Factors for Alternative Improvements

Alternatives 3, 4, and 5 have the same base lane configuration, and thus the same resulting SPF and Predictive Method results. The difference in these alternatives specifically stems from Part D CMFs, CMFs that aren't included in the Part C Predictive Method. These are applied directly to the expected crash frequencies.

The following tables show the CMFs for the alternatives evaluated at respective intersections and segments, as well as the applicable crash types and severities. These values are retrieved and interpolated from the CMF Clearinghouse, provided by the Federal Highway Administration.

Alternative	Countermeasure	CMF	Crash Type	Crash Severity
3. Basic Road Diet (3 lanes Striped Shoulder)	Change Right Shoulder Width	0.988	All	All
4. Enhanced Road Diet (3 lanes with bike lanes)	Install Bike Lanes	0.944	All	All
5. Narrow Roadway + Shared Use Paths	Install Cycle Tracks	0.41	Bicycle	A,B,C
	Install Bike Lanes	0.944	All	PDO

Table 6: Part D CMFs utilized for Segments

Part D CMFs for intersections include countermeasures that cannot be included in Part C, such roundabouts, pedestrian improvements, and backplates. The following table shows the CMFs used for these types of changes. Adding or removing turn lanes is associated with Part C and are not included in this portion of the calculations.

Scotch Road Intersection				
Alternative	**Countermeasure**	**CMF**	**Crash Type**	**Crash Severity**
A. Convert signalized intersection to single lane roundabout	Modern Roundabout	0.76	All	PDO
	Modern Roundabout	0.34	All	A,B,C
B. Convert signalized intersection to 2-lane roundabout	Multi-lane Roundabout	1.062	All	PDO
	Multi-lane Roundabout	0.367	All	K,A,B,C
C. Reduced Signalized Intersection	Backplates	0.85	All	All
Lower Ferry Road Intersection				
Alternative	**Countermeasure**	**CMF**	**Crash Type**	**Crash Severity**
A. Convert signalized intersection to 2-lane roundabout	Multi-lane Roundabout	1.062	All	PDO
	Multi-lane Roundabout	0.367	All	K,A,B,C
B. Signalized Striping Modification	Backplates	0.85	All	All
C. Signalized Striping Modification	Backplates	0.85	All	All
Farrell Avenue Intersection				
Alternative	**Countermeasure**	**CMF**	**Crash Type**	**Crash Severity**
A. Reduced Signalized Intersection	Backplates	0.85	All	All
Saratoga Avenue Intersection				
Alternative	**Countermeasure**	**CMF**	**Crash Type**	**Crash Severity**
A. Install HAWK	Install HAWK	0.82	All	All
	Install HAWK	0.432	Pedestrian	All
B. Install RRFB	Install RRFB	0.93	Rear End	All
	Install RRFB	0.526	Pedestrian	All
Olden Avenue Intersection				
Alternative	**Countermeasure**	**CMF**	**Crash Type**	**Crash Severity**
A. Convert signalized intersection to 2-lane roundabout	Multi-lane Roundabout	1.062	All	PDO
	Multi-lane Roundabout	0.367	All	K,A,B,C
B. Reduced Signalized Intersection	Backplates	0.85	All	All
Parkside Avenue Intersection				
Alternative	**Countermeasure**	**CMF**	**Crash Type**	**Crash Severity**
A. Reduced Signalized Intersection	Backplates	0.85	All	All
Pennington Road Intersection				
Alternative	**Countermeasure**	**CMF**	**Crash Type**	**Crash Severity**
A. Peanut Roundabout	Modern Roundabout	0.76	All	PDO
	Modern Roundabout	0.34	All	A,B,C
B. Traditional Roundabout	Modern Roundabout	0.76	All	PDO
	Modern Roundabout	0.34	All	A,B,C
C. Reduced Signalized Intersection	Backplates	0.85	All	All

Table 7: Part D CMFs utilized for Intersections

Benefit Summary

Table 8 – Expected Annual Benefits of Intersection Alternatives

Scotch Road	No-Build	Existing Conditions	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	71.6	133.4	204.9
Expected Crashes (Alternative)	71.6	133.4	204.9
Expected 20-Year Reduction	0.0	0.0	0.0
Expected % Reduction	0.0%	0.0%	0.0%
Expected Annual Benefit	$0	$0	$0

Scotch Road	A	Roundabout Version 1	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	71.6	133.4	204.9
Expected Crashes (Alternative)	24.3	101.4	125.7
Expected 20-Year Reduction	47.2	32.0	79.2
Expected % Reduction	66.0%	24.0%	38.7%
Expected Annual Benefit	$562,116	$17,048	$579,164

Scotch Road	B	Roundabout Version 2	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	71.6	133.4	204.9
Expected Crashes (Alternative)	26.3	141.7	167.9
Expected 20-Year Reduction	45.3	-8.3	37.0
Expected % Reduction	63.3%	-6.2%	18.1%
Expected Annual Benefit	$539,120	($4,404)	$534,716

Scotch Road	C	Reduced Signalized Intersection	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	71.6	133.4	204.9
Expected Crashes (Alternative)	61.0	113.8	174.7
Expected 20-Year Reduction	10.6	19.6	30.2
Expected % Reduction	14.8%	14.7%	14.7%
Expected Annual Benefit	$126,028	$10,442	$136,470

Lower Ferry Road	No-Build	Existing Conditions	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	124.5	235.4	359.9
Expected Crashes (Alternative)	124.5	235.4	359.9
Expected 20-Year Reduction	0.0	0.0	0.0
Expected % Reduction	0.0%	0.0%	0.0%
Expected Annual Benefit	$0	$0	$0

Lower Ferry Road	A	Roundabout	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	124.5	235.4	359.9
Expected Crashes (Alternative)	45.7	250.0	295.7
Expected 20-Year Reduction	78.8	-14.6	64.2
Expected % Reduction	63.3%	-6.2%	17.8%
Expected Annual Benefit	$938,143	($7,772)	$930,371

Lower Ferry Road	B	Signalized Version 1	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	124.5	235.4	359.9
Expected Crashes (Alternative)	104.0	194.9	298.9
Expected 20-Year Reduction	20.5	40.5	61.0
Expected % Reduction	16.5%	17.2%	17.0%
Expected Annual Benefit	$244,280	$21,575	$265,855

Lower Ferry Road	C	Signalized Version 2	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	124.5	235.4	359.9
Expected Crashes (Alternative)	103.3	193.0	296.3
Expected 20-Year Reduction	21.2	42.4	63.6
Expected % Reduction	17.0%	18.0%	17.7%
Expected Annual Benefit	$252,250	$22,585	$274,835

Farrell Avenue	No-Build	Existing Conditions	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	55.9	96.9	152.8
Expected Crashes (Alternative)	55.9	96.9	152.8
Expected 20-Year Reduction	0.0	0.0	0.0
Expected % Reduction	0.0%	0.0%	0.0%
Expected Annual Benefit	$0	$0	$0

Farrell Avenue	A	Reduced Signalized Intersection	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	55.9	96.9	152.8
Expected Crashes (Alternative)	47.5	82.4	129.9
Expected 20-Year Reduction	8.4	14.5	22.9
Expected % Reduction	15.0%	15.0%	15.0%
Expected Annual Benefit	$99,819	$7,735	$107,554

Olden Avenue	No-Build	Existing Conditions	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	92.7	147.9	240.6
Expected Crashes (Alternative)	92.7	147.9	240.6
Expected 20-Year Reduction	0.0	0.0	0.0
Expected % Reduction	0.0%	0.0%	0.0%
Expected Annual Benefit	$0	$0	$0

Olden Avenue	A	Roundabout	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	92.7	147.9	240.6
Expected Crashes (Alternative)	34.0	157.1	191.1
Expected 20-Year Reduction	58.7	-9.2	49.5
Expected % Reduction	63.3%	-6.2%	20.6%
Expected Annual Benefit	$698,531	($4,883)	$693,648

Olden Avenue	B	Reduced Signalized Intersection	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	92.7	147.9	240.6
Expected Crashes (Alternative)	78.9	126.3	205.3
Expected 20-Year Reduction	13.8	21.6	35.3
Expected % Reduction	14.9%	14.6%	14.7%
Expected Annual Benefit	$163,951	$11,478	$175,429

Parkside Avenue	No-Build	Existing Conditions	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	72.1	102.4	174.5
Expected Crashes (Alternative)	72.1	102.4	174.5
Expected 20-Year Reduction	0.0	0.0	0.0
Expected % Reduction	0.0%	0.0%	0.0%
Expected Annual Benefit	$0	$0	$0

Parkside Avenue	A	Reduced Signalized Intersection	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	72.1	102.4	174.5
Expected Crashes (Alternative)	60.7	77.5	138.2
Expected 20-Year Reduction	11.4	24.9	36.3
Expected % Reduction	15.8%	24.3%	20.8%
Expected Annual Benefit	$136,107	$13,256	$149,363

Pennington Road	No-Build	Existing Conditions	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	27.1	47.0	74.1
Expected Crashes (Alternative)	27.1	47.0	74.1
Expected 20-Year Reduction	0.0	0.0	0.0
Expected % Reduction	0.0%	0.0%	0.0%
Expected Annual Benefit	$0	$0	$0

Pennington Road	A	Peanut Roundabout	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	27.1	47.0	74.1
Expected Crashes (Alternative)	9.2	35.7	44.9
Expected 20-Year Reduction	17.9	11.3	29.2
Expected % Reduction	66.0%	24.0%	39.4%
Expected Annual Benefit	$213,109	$6,004	$219,113

Pennington Road	B	Traditional Roundabout	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	27.1	47.0	74.1
Expected Crashes (Alternative)	9.2	35.7	44.9
Expected 20-Year Reduction	17.9	11.3	29.2
Expected % Reduction	66.0%	24.0%	39.4%
Expected Annual Benefit	$213,109	$6,004	$219,113

Pennington Road	C	Reduced Signalized Intersection	
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	27.1	47.0	74.1
Expected Crashes (Alternative)	21.9	34.0	56.0
Expected 20-Year Reduction	5.2	13.0	18.1
Expected % Reduction	19.1%	27.8%	24.5%
Expected Annual Benefit	$61,671	$6,906	$68,577

Table 9 – Expected Annual Benefits of Corridor-wide Alternatives

Corridor Alternative 1 - Old Striping (4 lanes undivided)			
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	196.5	405.3	601.8
Expected 20-Year Reduction	-9.3	5.6	-3.8
Expected % Reduction	-5.0%	1.4%	-0.6%
Expected Annual Benefit	($111,294)	$2,956	($108,339)

Corridor Alternative 2 - No-Build (Modified Road Diet)			
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	187.2	410.9	598.0
Expected 20-Year Reduction	0.0	0.0	0.0
Expected % Reduction	0.0%	0.0%	0.0%
Expected Annual Benefit	$0	$0	$0

Corridor Alternative 3 - Basic Road Diet (3 lanes, shoulder)			
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	158.0	423.9	581.9
Expected 20-Year Reduction	29.1	-13.1	16.1
Expected % Reduction	15.6%	-3.2%	2.7%
Expected Annual Benefit	$346,939	($6,966)	$339,973

Corridor Alternative 4 - Enhanced Road Diet (3 lanes, bike lane)			
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	150.9	405.0	555.9
Expected 20-Year Reduction	36.2	5.9	42.1
Expected % Reduction	19.3%	1.4%	7.0%
Expected Annual Benefit	$431,007	$3,125	$434,132

Corridor Alternative 5 - Reduce Cross Section + Shared Use Paths			
Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	158.0	405.0	562.9
Expected 20-Year Reduction	29.2	5.9	35.1
Expected % Reduction	15.6%	1.4%	5.9%
Expected Annual Benefit	$347,445	$3,125	$350,570

Benefit-Cost Analysis

Benefit-Cost ratios for each alternative can Table 10 below:

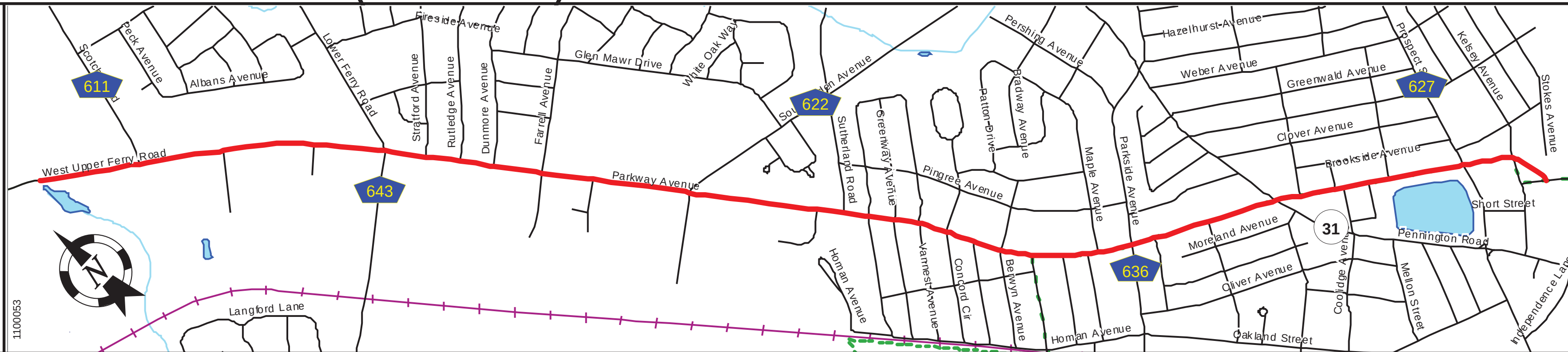
Appendix A

MERCER COUNTY 634 (West to East)

Mile Posts: 2.000 - 4.930

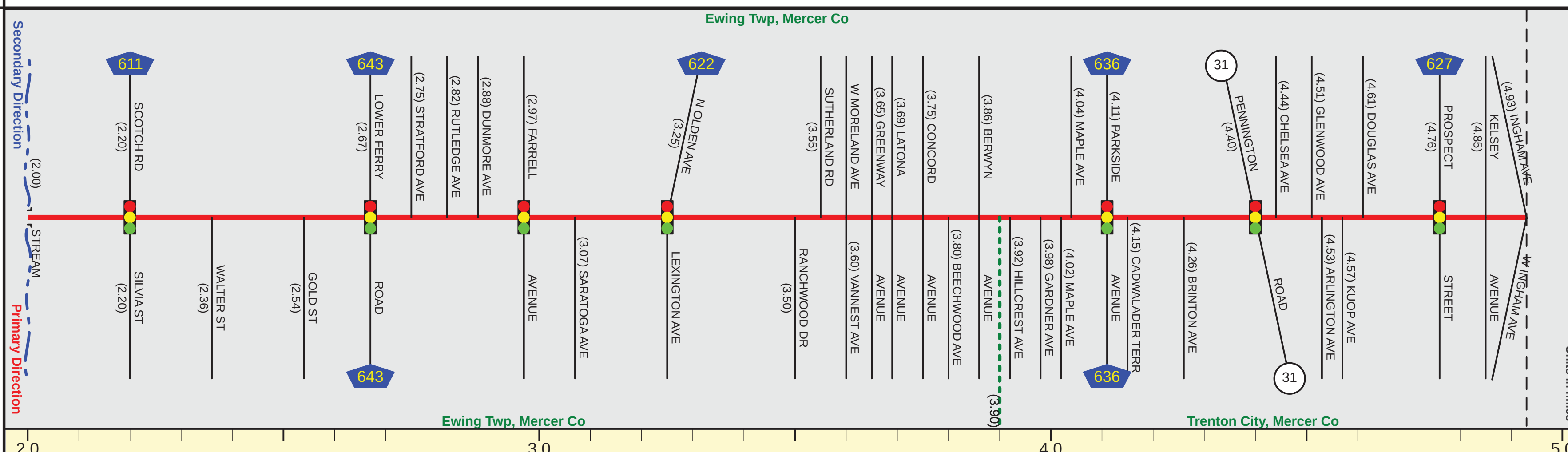
Secondary Direction

Primary Direction



Pavement	
Shoulder	
Number of Lanes	
Speed Limit	
Street Name	

Interstate Route 287
US Route 22
NJ Route 33
County Road 689
Interchange Number 2
Grade Separated Interchange
Traffic Signal
Traffic Monitoring Sites WIM AVC VOL
Road Underpass
Road Overpass



Street Name	West Upper Ferry Road (2.00–2.36); Parkway Avenue (2.36–4.93)
Jurisdiction	County
Functional Class	Urban Minor Arterial
Federal Aid - NHS Sy	STP
Control Section	
Speed Limit	40 (to 4.11); 35 (4.11–4.76); 30 (4.76–4.93)
Number of Lanes	4 (to 4.11); 2 (4.11–4.93)
Med. Type	None
Med. Width	0
Pavement	60 (to 4.11); 30 (4.11–4.40); 48 (4.40–4.76); 36 (4.76–4.93)
Shoulder	0
Traffic Volume	19,161 (2012); 5,667 (2012)
Traffic Sta. ID	5-6-135; 5-5-514
Structure No.	
Enlarged Views	

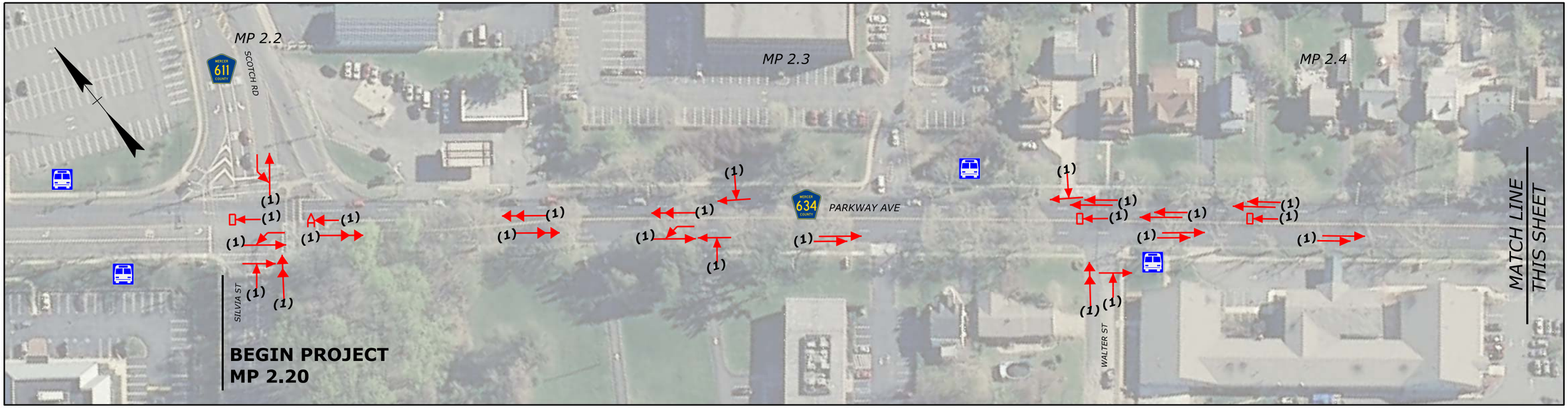
End Mercer County 634 MP=5.31

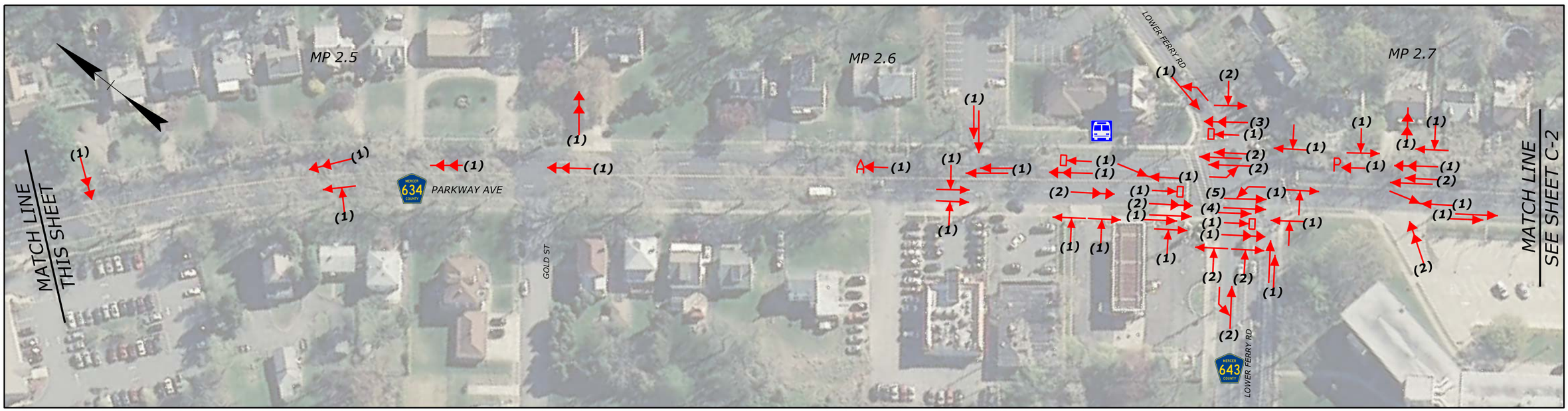
Page Created: June, 2015

SRI = 11000634__

Date last inventoried: May 2011

Appendix B





LEGEND

- SAME DIRECTION-REAR END
- SAME DIRECTION-SIDE SWIPE
- LEFT TURN/U-TURN
- OPPOSITE DIRECTION - SIDE SWIPE
- OPPOSITE DIRECTION - HEAD ON/ANGULAR
- E ENCROACHMENT
- B PEDALCYCLIST
- FIXED OBJECT
- BACKING
- RIGHT ANGLE
- A ANIMAL
- NON-FIXED OBJECT
- P PEDESTRIAN
- P STRUCK PARKED VEHICLE
- O OTHER

0 100 200 Feet

(X) NUMBER OF CRASHES

BUS STOP

Source: NJDOT BTD&S

C-1 / C-4

Crash Locations (2014-2016)

Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 2.20 To MP 2.72

November 2017

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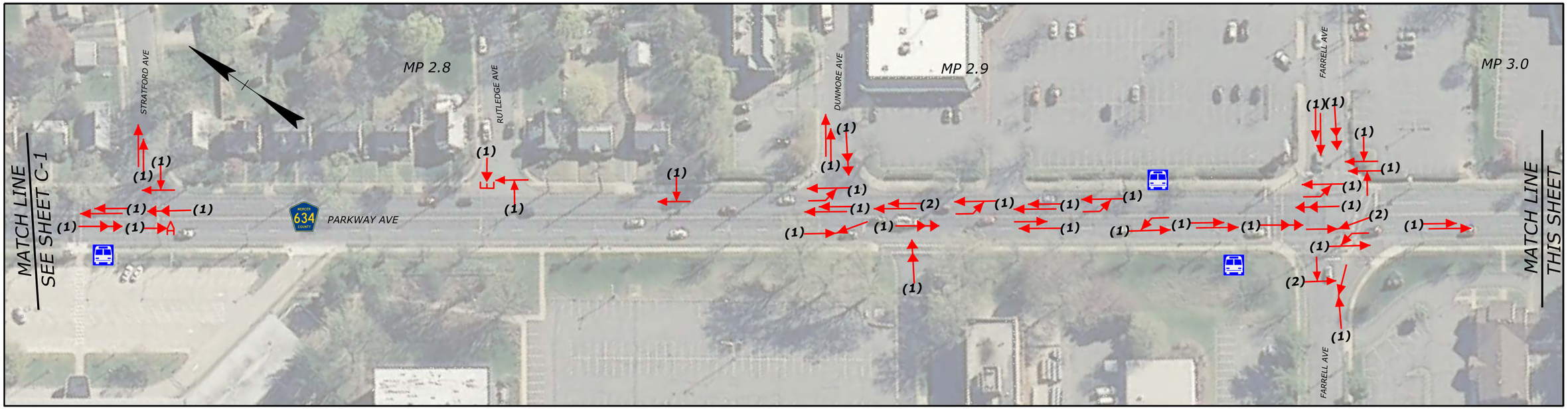

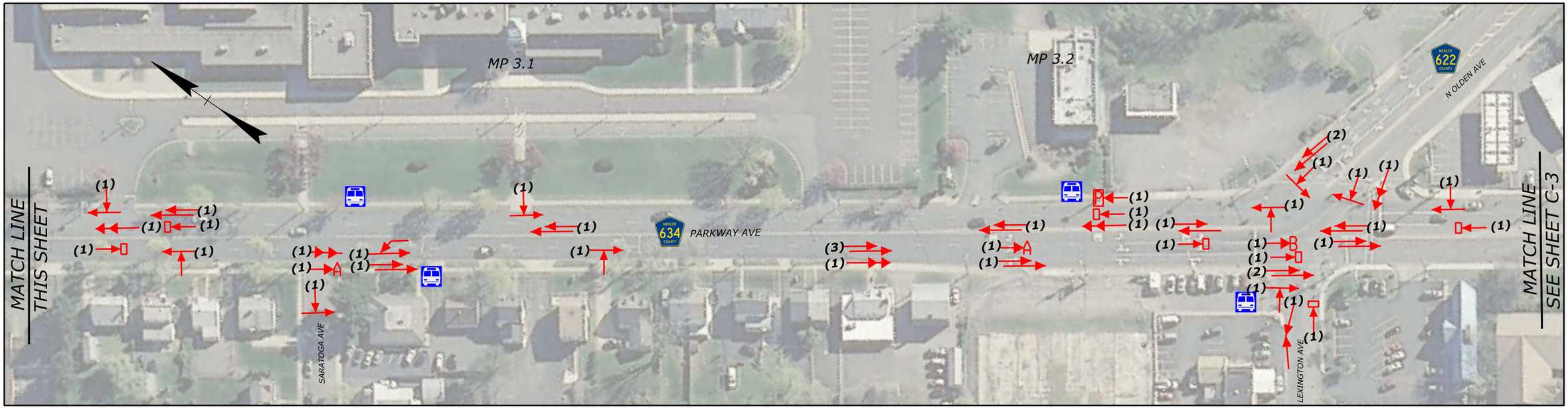

LEGEND

- SAME DIRECTION-REAR END
- SAME DIRECTION-SIDE SWIPE
- LEFT TURN/U-TURN
- OPPOSITE DIRECTION - SIDE SWIPE
- OPPOSITE DIRECTION - HEAD ON/ANGULAR
- ENCROACHMENT
- PEDALCYCLIST
- FIXED OBJECT
- BACKING
- RIGHT ANGLE
- ANIMAL
- NON-FIXED OBJECT
- PEDESTRIAN
- STRUCK PARKED VEHICLE
- OTHER

0 100 200 Feet

(X) NUMBER OF CRASHES

BUS STOP

Source: NJDOT BTD&S

C-2 / C-4

Crash Locations (2014-2016)

Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 2.72 To MP 3.29

November 2017

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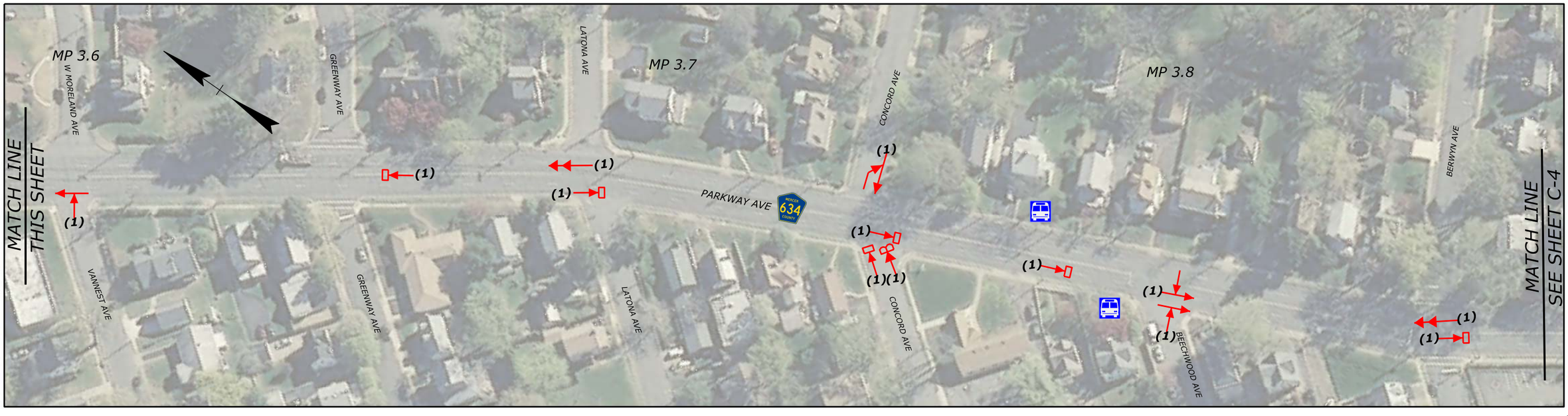

LEGEND

- SAME DIRECTION-REAR END
- SAME DIRECTION-SIDE SWIPE
- LEFT TURN/U-TURN
- OPPOSITE DIRECTION - SIDE SWIPE
- OPPOSITE DIRECTION - HEAD ON/ANGULAR
- ENCROACHMENT
- PEDALCYCLIST
- FIXED OBJECT
- BACKING
- RIGHT ANGLE
- ANIMAL
- NON-FIXED OBJECT
- PEDESTRIAN
- STRUCK PARKED VEHICLE
- OTHER

0 100 200 Feet

(X) NUMBER OF CRASHES

BUS STOP

Source: NJDOT BTD&S

C-3
C-4

Crash Locations (2014-2016)

Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 3.29 To MP 3.88

November 2017

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MP 3.9

MP 4.0

MP 4.1

MATCH LINE
SEE SHEET C-3

MATCH LINE
THIS SHEET

MERCER 634 COUNTY

PARKWAY AVE

HILLCREST AVE

GARDNER AVE

MAPLE AVE

MAPLE AVE

MERCER 636 COUNTY

CADWALADER TERRACE

BROWNS ALLEY

PARKSIDE AVE

MP 4.2

MP 4.3

MP 4.4

PENNINGTON ROAD

BERWYN AVE

MATCH LINE
THIS SHEET

PARKWAY AVE

MERCER 634 COUNTY

BRINTON AVE

END PROJECT
MP 4.40

LEGEND

- SAME DIRECTION-REAR END
- SAME DIRECTION-SIDE SWIPE
- LEFT TURN/U-TURN
- OPPOSITE DIRECTION - SIDE SWIPE
- OPPOSITE DIRECTION - HEAD ON/ANGULAR
- E ENCROACHMENT
- B PEDALCYCLIST
- FIXED OBJECT
- BACKING
- RIGHT ANGLE
- A ANIMAL
- NON-FIXED OBJECT
- P PEDESTRIAN
- P STRUCK PARKED VEHICLE
- O OTHER

0 100 200 Feet

(X) NUMBER OF CRASHES

BUS STOP

Source: NJDOT BTD&S

C-4
C-4

Crash Locations (2014-2016)

Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 3.88 To MP 4.40

November 2017

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Appendix C

Parkway Avenue (CR 634) Safety Concept Development Study

Predictive Crash Analysis Results Summary and Benefit-Cost Analysis

Corridor-Wide Alternatives - Segments Only

		Predictive Crash Analysis Results														Economic Analysis Results					
		Expected Crashes/Year (2020-2040)			Expected Total Crashes (2020-2040)			Avg Yearly Crash Reduction (2020-2040)			Total Crash Reduction (2020-2040)			% Reduction (2020-2040)			Avg Annual Benefit			Construction Costs		
Alternative	Description	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	Total	Annualized	Benefit - Cost Ratio
1	Old Striping (4 lanes undivided)	9.8	20.3	30.1	196.5	405.3	601.8	-0.5	0.3	-0.2	-9.3	5.6	-3.8	-5.0%	1.4%	-0.6%	($111,294)	$2,956	($108,339)	$771,700	$51,870	-2.09
2	No-Build (Modified Road Diet)	9.4	20.5	29.9	187.2	410.9	598.0	-	-	-	-	-	-	0.0%	0.0%	0.0%	-	-	-		$0	0.00
3	Basic Road Diet (3 lanes, shoulder)	7.9	21.2	29.1	158.0	423.9	581.9	1.5	-0.7	0.8	29.1	-13.1	16.1	15.6%	-3.2%	2.7%	$346,939	($6,966)	$339,973	$1,608,700	$108,130	3.14
4	Enhanced Road Diet (3 lanes, bike lane)	7.5	20.2	27.8	150.9	405.0	555.9	1.8	0.3	2.1	36.2	5.9	42.1	19.3%	1.4%	7.0%	$431,007	$3,125	$434,132	$1,673,500	$112,485	3.86
5	Reduce Cross Section + Shared Use Paths	7.9	20.2	28.1	158.0	405.0	562.9	1.5	0.3	1.8	29.2	5.9	35.1	15.6%	1.4%	5.9%	$347,445	$3,125	$350,570	$3,232,600	$217,281	1.61

Spot-Location Alternatives

Scotch Road

		Predictive Crash Analysis Results														Economic Analysis Results					
		Expected Crashes/Year (2020-2040)			Expected Total Crashes (2020-2040)			Avg Yearly Crash Reduction (2020-2040)			Total Crash Reduction (2020-2040)			% Reduction (2020-2040)			Avg Annual Benefit			Construction Costs		
Alternative	Description	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	Total	Annualized	Benefit - Cost Ratio
No-Build	Existing Conditions	3.6	6.7	10.2	71.6	133.4	204.9	-	-	-	-	-	-	0.0%	0.0%	0.0%	-	-	-		$0	0
A	Roundabout Version 1	1.2	5.1	6.3	24.3	101.4	125.7	2.4	1.6	4.0	47.2	32.0	79.2	66.0%	24.0%	38.7%	$562,116	$17,048	$579,164	$1,143,400	$76,854	7.54
B	Roundabout Version 2	1.3	7.1	8.4	26.3	141.7	167.9	2.3	-0.4	1.9	45.3	-8.3	37.0	63.3%	-6.2%	18.1%	$539,120	($4,404)	$534,716	$1,303,500	$87,616	6.10
C	Reduced Signalized Intersection	3.0	5.7	8.7	61.0	113.8	174.7	0.5	1.0	1.5	10.6	19.6	30.2	14.8%	14.7%	14.7%	$126,028	$10,442	$136,470	$412,100	$27,700	4.93

Lower Ferry Road

		Predictive Crash Analysis Results														Economic Analysis Results					
		Expected Crashes/Year (2020-2040)			Expected Total Crashes (2020-2040)			Avg Yearly Crash Reduction (2020-2040)			Total Crash Reduction (2020-2040)			% Reduction (2020-2040)			Avg Annual Benefit			Construction Costs		
Alternative	Description	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	Total	Annualized	Benefit - Cost Ratio
No-Build	Existing Conditions	6.2	11.8	18.0	124.5	235.4	359.9	-	-	-	-	-	-	0.0%	0.0%	0.0%	-	-	-		$0	0
A	Roundabout	2.3	12.5	14.8	45.7	250.0	295.7	3.9	-0.7	3.2	78.8	-14.6	64.2	63.3%	-6.2%	17.8%	$938,143	($7,772)	$930,371	$1,081,400	$72,687	12.80
B	Signalized Version 1	5.2	9.7	14.9	104.0	194.9	298.9	1.0	2.0	3.1	20.5	40.5	61.0	16.5%	17.2%	17.0%	$244,280	$21,575	$265,855	$513,600	$34,522	7.70
C	Signalized Version 2	5.2	9.6	14.8	103.3	193.0	296.3	1.1	2.1	3.2	21.2	42.4	63.6	17.0%	18.0%	17.7%	$252,250	$22,585	$274,835	$556,700	$37,419	7.34

Farrell Avenue

		Predictive Crash Analysis Results														Economic Analysis Results					
		Expected Crashes/Year (2020-2040)			Expected Total Crashes (2020-2040)			Avg Yearly Crash Reduction (2020-2040)			Total Crash Reduction (2020-2040)			% Reduction (2020-2040)			Avg Annual Benefit			Construction Costs		
Alternative	Description	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	Total	Annualized	Benefit - Cost Ratio
No-Build	Existing Conditions	2.8	4.8	7.6	55.9	96.9	152.8	-	-	-	-	-	-	0.0%	0.0%	0.0%	-	-	-		$0	0
A	Roundabout	1.0	5.1	6.2	20.5	102.9	123.4	1.8	-0.3	1.5	35.4	-6.0	29.4	63.3%	-6.2%	19.2%	$421,354	($3,206)	$418,148	$812,600	$54,619	7.66
B	Reduced Signalized Intersection	2.4	4.1	6.5	47.5	82.4	129.9	0.4	0.7	1.1	8.4	14.5	22.9	15.0%	15.0%	15.0%	$99,819	$7,735	$107,554	$556,700	$37,419	2.87

Olden Avenue

		Predictive Crash Analysis Results														Economic Analysis Results					
		Expected Crashes/Year (2020-2040)			Expected Total Crashes (2020-2040)			Avg Yearly Crash Reduction (2020-2040)			Total Crash Reduction (2020-2040)			% Reduction (2020-2040)			Avg Annual Benefit			Construction Costs		
Alternative	Description	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	Total	Annualized	Benefit - Cost Ratio
No-Build	Existing Conditions	4.6	7.4	12.0	92.7	147.9	240.6	-	-	-	-	-	-	0.0%	0.0%	0.0%	-	-	-		$0	0
A	Roundabout	1.7	7.9	9.6	34.0	157.1	191.1	2.9	-0.5	2.5	58.7	-9.2	49.5	63.3%	-6.2%	20.6%	$698,531	($4,883)	$693,648	$1,412,600	$94,949	7.31
B	Reduced Signalized Intersection	3.9	6.3	10.3	78.9	126.3	205.3	0.7	1.1	1.8	13.8	21.6	35.3	14.9%	14.6%	14.7%	$163,951	$11,478	$175,429	$537,600	$36,135	4.85

Parkside Avenue

		Predictive Crash Analysis Results														Economic Analysis Results					
		Expected Crashes/Year (2020-2040)			Expected Total Crashes (2020-2040)			Avg Yearly Crash Reduction (2020-2040)			Total Crash Reduction (2020-2040)			% Reduction (2020-2040)			Avg Annual Benefit			Construction Costs		
Alternative	Description	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	Total	Annualized	Benefit - Cost Ratio
No-Build	Existing Conditions	3.6	5.1	8.7	72.1	102.4	174.5	-	-	-	-	-	-	0.0%	0.0%	0.0%	-	-	-		$0	0
A	Reduced Signalized Intersection	3.0	3.9	6.9	60.7	77.5	138.2	0.6	1.2	1.8	11.4	24.9	36.3	15.8%	24.3%	20.8%	$136,107	$13,256	$149,363	$446,000	$29,978	4.98

Pennington Road

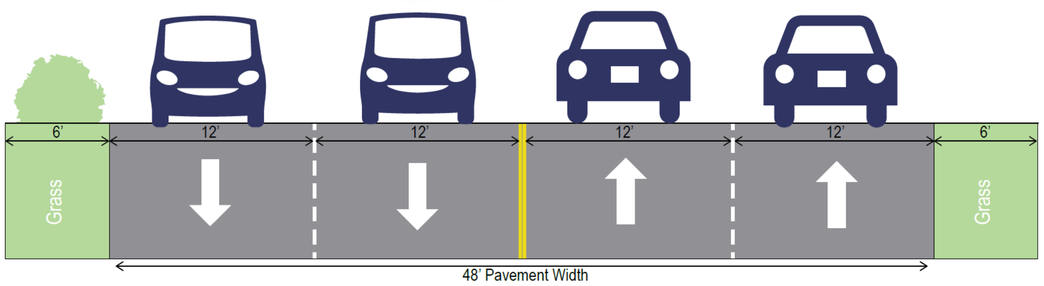
		Predictive Crash Analysis Results														Economic Analysis Results					
		Expected Crashes/Year (2020-2040)			Expected Total Crashes (2020-2040)			Avg Yearly Crash Reduction (2020-2040)			Total Crash Reduction (2020-2040)			% Reduction (2020-2040)			Avg Annual Benefit			Construction Costs		
Alternative	Description	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	Total	Annualized	Benefit - Cost Ratio
No-Build	Existing Conditions	1.4	2.3	3.7	27.1	47.0	74.1	-	-	-	-	-	-	0%	0%	0%	-	-	-		$0	0
A	Peanut Roundabout	0.5	1.8	2.2	9.2	35.7	44.9	0.9	0.6	1.5	17.9	11.3	29.2	66.0%	24.0%	39.4%	$213,109	$6,004	$219,113	$1,122,600	$75,456	2.90
B	Traditional Roundabout	0.5	1.8	2.2	9.2	35.7	44.9	0.9	0.6	1.5	17.9	11.3	29.2	66.0%	24.0%	39.4%	$213,109	$6,004	$219,113	$1,559,500	$104,823	2.09
C	Reduced Signalized Intersection	1.1	1.7	2.8	21.9	34.0	56.0	0.3	0.6	0.9	5.2	13.0	18.1	19.1%	27.6%	24.5%	$61,671	$6,906	$68,577	$405,800	$27,276	2.51

Saratoga Avenue - Predicted

		Predictive Crash Analysis Results														Economic Analysis Results					
		Expected Crashes/Year (2020-2040)			Expected Total Crashes (2020-2040)			Avg Yearly Crash Reduction (2020-2040)			Total Crash Reduction (2020-2040)			% Reduction (2020-2040)			Avg Annual Benefit			Construction Costs		
Alternative	Description	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	FI	PDO	Total	Total	Annualized	Benefit - Cost Ratio
No-Build	Existing Conditions	0.6	0.9	1.5	11.7	17.7	29.4	-	-	-	-	-	-	0.0%	0.0%	0.0%	-	-	-		$0	0
A	HAWK	0.5	0.7	1.2	9.5	14.4	24.0	0.1	0.2	0.3	2.2	3.3	5.4	18.7%	18.4%	18.5%	$25,982	$1,731	$27,713	$88,000	$5,915	4.69
B	RRFB	0.5	0.8	1.4	10.8	16.4	27.2	0.0	0.1	0.1	0.9	1.3	2.2	7.6%	7.2%	7.4%	$10,548	$683	$11,231	$20,000	$1,344	8.35

Appendix D

Alternative 1 - 4-Lanes Undivided



Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	196.5	405.3	601.8
Expected 20-Year Reduction	-9.3	5.6	-3.8
Expected % Reduction	-5.0%	1.4%	-0.6%
Expected Annual Benefit	($103,474)	$2,743	($100,730)

Source: NJDOT BTD&S

Concept Alternatives

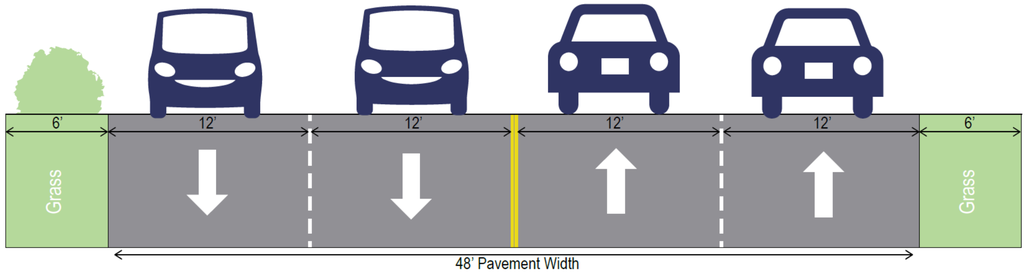
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 2.20 To MP 2.72

August 2017

Michael Baker INTERNATIONAL

Alternative 1 - 4-Lanes Undivided



Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	196.5	405.3	601.8
Expected 20-Year Reduction	-9.3	5.6	-3.8
Expected % Reduction	-5.0%	1.4%	-0.6%
Expected Annual Benefit	($103,474)	$2,743	($100,730)

Concept Alternatives

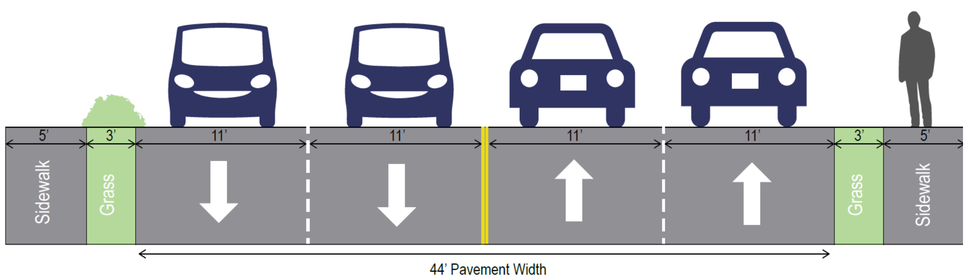
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 2.72 To MP 3.28

August 2017

Michael Baker INTERNATIONAL

Alternative 1 - 4-Lanes Undivided



Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	196.5	405.3	601.8
Expected 20-Year Reduction	-9.3	5.6	-3.8
Expected % Reduction	**-5.0%**	**1.4%**	**-0.6%**
Expected Annual Benefit	**($103,474)**	**$2,743**	**($100,730)**

Source: NJDOT BTD&S

C-3 / C-4

Concept Alternatives

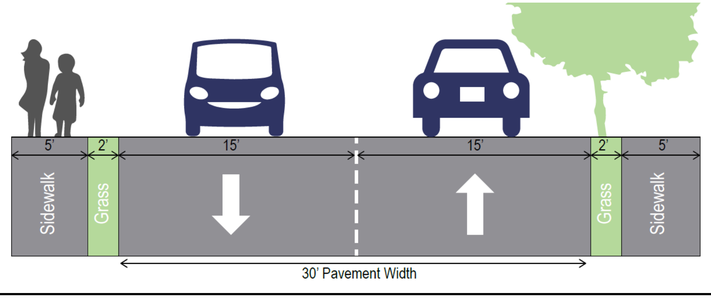
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 3.28 To MP 3.82

August 2017

Michael Baker INTERNATIONAL

Alternative 1 - 4-Lanes Undivided



Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	196.5	405.3	601.8
Expected 20-Year Reduction	-9.3	5.6	-3.8
Expected % Reduction	-5.0%	1.4%	-0.6%
Expected Annual Benefit	($103,474)	$2,743	($100,730)

Source: NJDOT BTB&S

C-4
C-4

Concept Alternatives

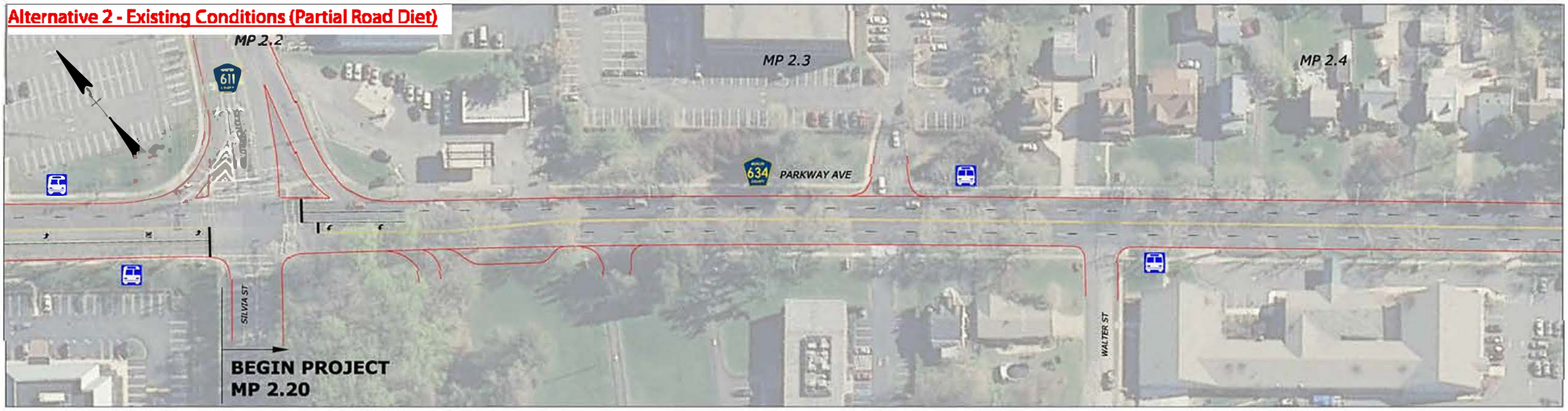
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

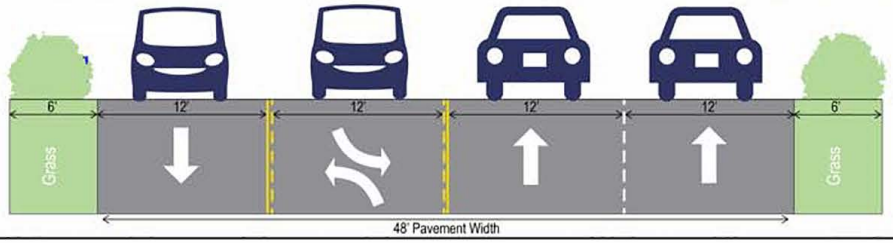
Location	MP 3.82 To MP 4.11

August 2017

Michael Baker INTERNATIONAL

Alternative 2 - Existing Conditions (Partial Road Diet)





Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	187.2	410.9	598.0
Expected 20-Year Reduction	0.0	0.0	0.0
Expected % Reduction	0.0%	0.0%	0.0%
Expected Annual Benefit	$0	$0	$0

C-1 / C-4

Concept Alternatives

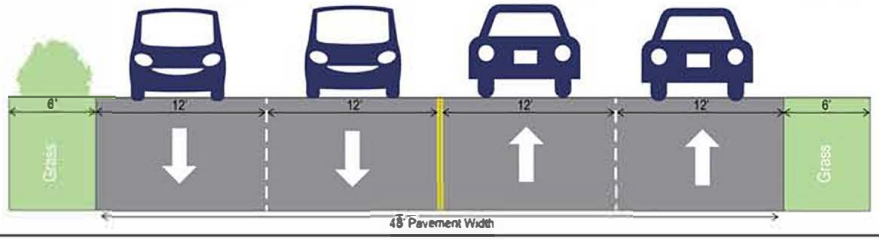
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 2.20 To MP 2.72

August 2017

Michael Baker INTERNATIONAL

Alternative 2 - Existing Conditions (Partial Road Diet)



Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	187.2	410.9	598.0
Expected 20-Year Reduction	0.0	0.0	0.0
Expected % Reduction	0.0%	0.0%	0.0%
Expected Annual Benefit	$0	$0	$0

Concept Alternatives

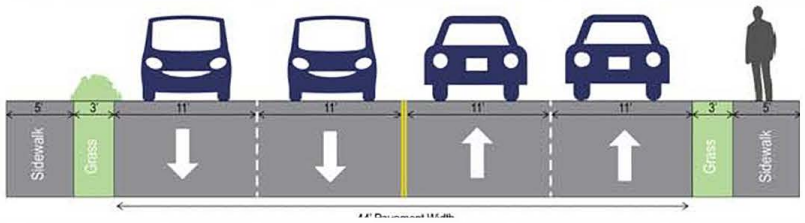
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 2.72 To MP 3.28

August 2017

Michael Baker INTERNATIONAL

Alternative 2 - Existing Conditions (Partial Road Diet)



Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	187.2	410.9	598.0
Expected 20-Year Reduction	0.0	0.0	0.0
Expected % Reduction	0.0%	0.0%	0.0%
Expected Annual Benefit	$0	$0	$0

C-3
C-4

Concept Alternatives

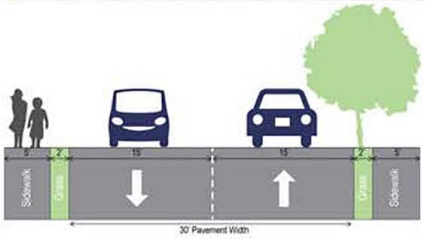
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 3.28 To MP 3.82

August 2017

Michael Baker INTERNATIONAL

Alternative 2 - Existing Conditions (Partial Road Diet)



Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	187.2	410.9	598.0
Expected 20-Year Reduction	0.0	0.0	0.0
Expected % Reduction	0.0%	0.0%	0.0%
Expected Annual Benefit	$0	$0	$0

C-4 / C-4

Concept Alternatives

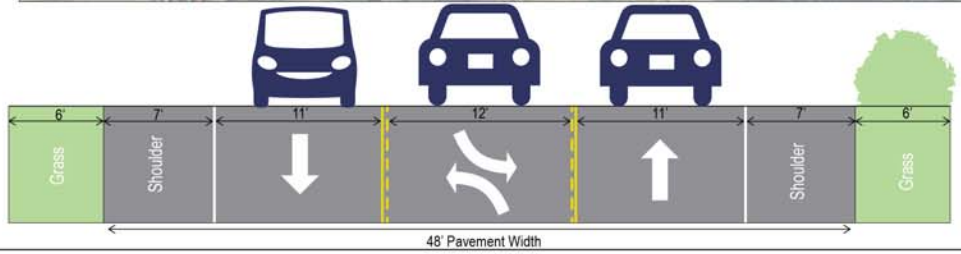
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 3.82 To MP 4.11

August 2017

Michael Baker INTERNATIONAL

Alternative 3 - Basic Road Diet



Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	158.0	423.9	581.9
Expected 20-Year Reduction	29.1	-13.1	16.1
Expected % Reduction	**15.6%**	**-3.2%**	**2.7%**
Expected Annual Benefit	**$322,559**	**($6,466)**	**$316,093**

C-1
C-4

Concept Alternatives

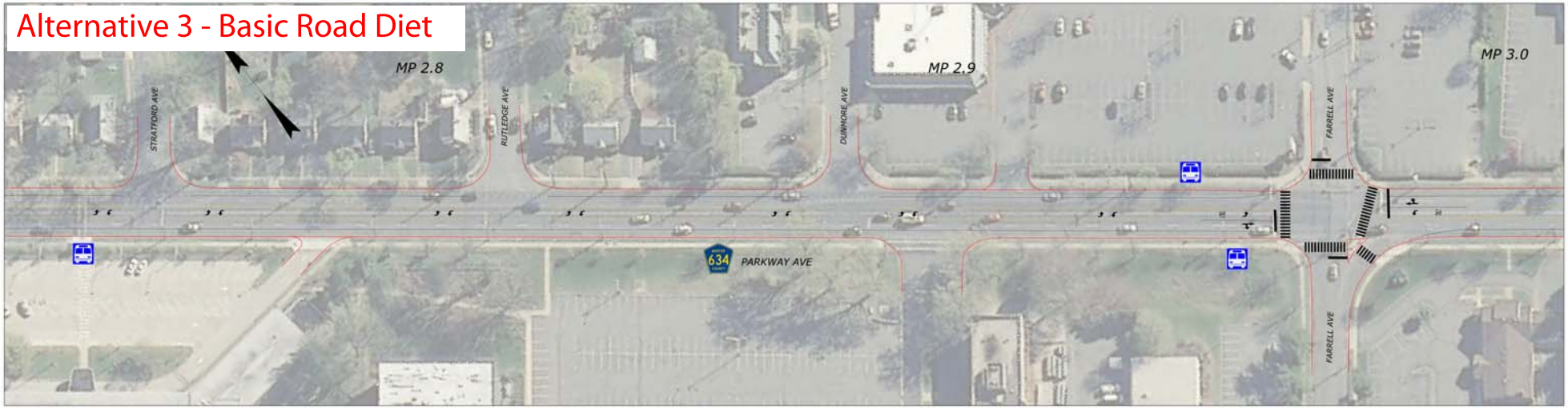
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

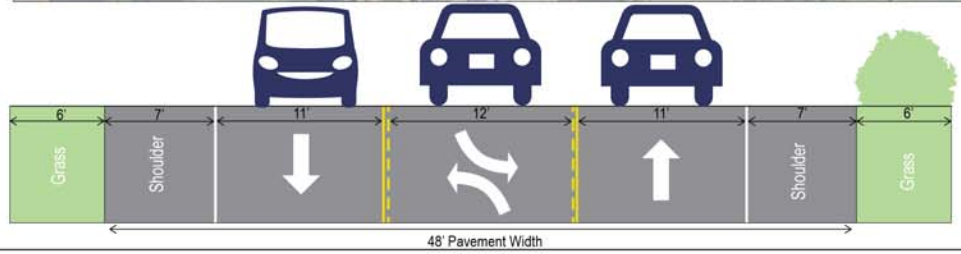
Location	MP 2.20 To MP 2.72

April 2018

Michael Baker INTERNATIONAL

Alternative 3 - Basic Road Diet





Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	158.0	423.9	581.9
Expected 20-Year Reduction	29.1	-13.1	16.1
Expected % Reduction	15.6%	-3.2%	2.7%
Expected Annual Benefit	$322,559	($6,466)	$316,093

Concept Alternatives

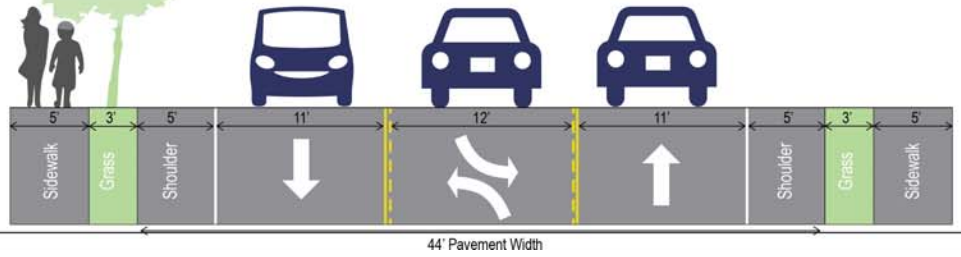
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 2.72 To MP 3.28

April 2018

Michael Baker INTERNATIONAL

Alternative 3 - Basic Road Diet



Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	158.0	423.9	581.9
Expected 20-Year Reduction	29.1	-13.1	16.1
Expected % Reduction	15.6%	-3.2%	2.7%
Expected Annual Benefit	$322,559	($6,466)	$316,093

C-3
C-4

Concept Alternatives

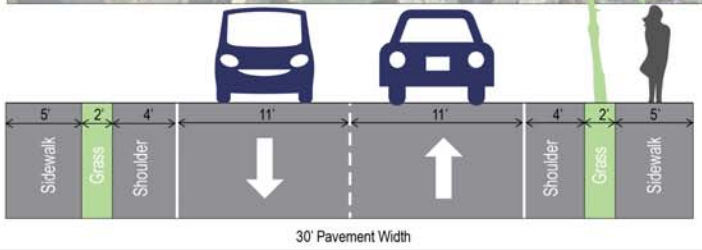
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 3.28 To MP 3.82

April 2018

Michael Baker INTERNATIONAL

Alternative 3 - Basic Road Diet



Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	158.0	423.9	581.9
Expected 20-Year Reduction	29.1	-13.1	16.1
Expected % Reduction	15.6%	-3.2%	2.7%
Expected Annual Benefit	$322,559	($6,466)	$316,093

C-4
C-4

Concept Alternatives

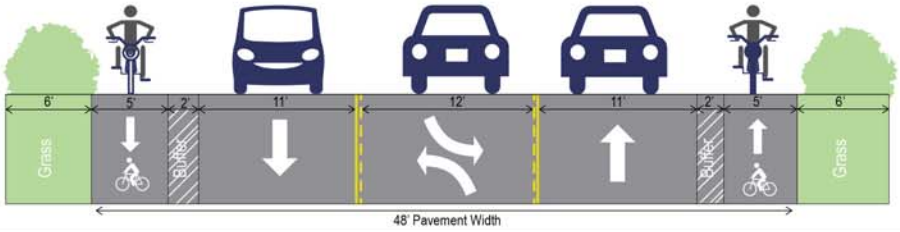
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 3.82 To MP 4.11

April 2018

Michael Baker INTERNATIONAL

Alternative 4 - Enhanced Road Diet (no Roundabouts)



Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	150.9	405.0	555.9
Expected 20-Year Reduction	36.2	5.9	42.1
Expected % Reduction	**19.3%**	**1.4%**	**7.0%**
Expected Annual Benefit	**$400,719**	**$2,901**	**$403,620**

C-1 / C-4

Concept Alternatives

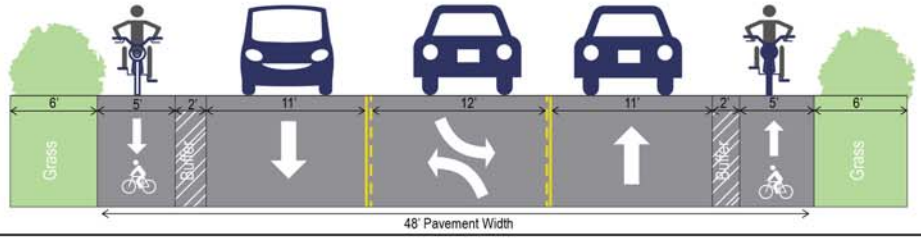
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 2.20 To MP 2.72

June 2018

Michael Baker INTERNATIONAL

Alternative 4 - Enhanced Road Diet (no Roundabouts)



Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	150.9	405.0	555.9
Expected 20-Year Reduction	36.2	5.9	42.1
Expected % Reduction	19.3%	1.4%	7.0%
Expected Annual Benefit	$400,719	$2,901	$403,620

C-2 / C-4

Concept Alternatives

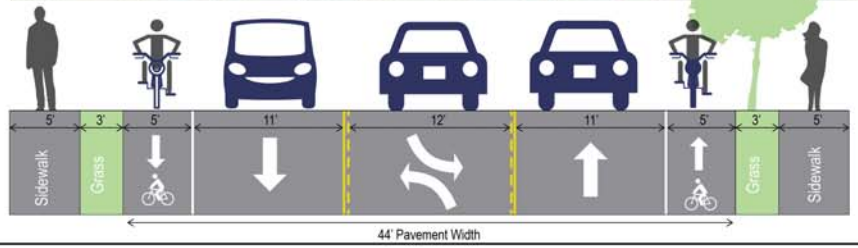
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 2.72 To MP 3.28

June 2018

Michael Baker INTERNATIONAL

Alternative 4 - Enhanced Road Diet (no Roundabouts)



Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	150.9	405.0	555.9
Expected 20-Year Reduction	36.2	5.9	42.1
Expected % Reduction	**19.3%**	**1.4%**	**7.0%**
Expected Annual Benefit	**$400,719**	**$2,901**	**$403,620**

C-3 / C-4

Concept Alternatives

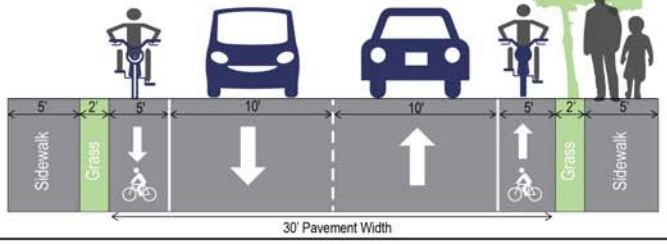
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 3.28 To MP 3.82

June 2018

Michael Baker INTERNATIONAL

Alternative 4 - Enhanced Road Diet (no Roundabouts)



Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	150.9	405.0	555.9
Expected 20-Year Reduction	36.2	5.9	42.1
Expected % Reduction	19.3%	1.4%	7.0%
Expected Annual Benefit	$400,719	$2,901	$403,620

Concept Alternatives

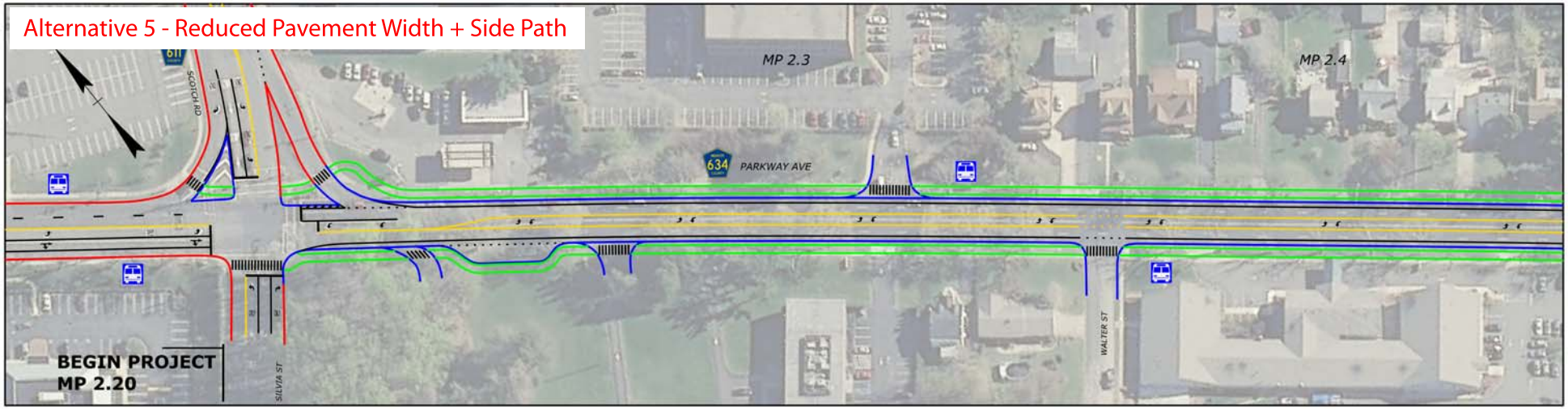
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

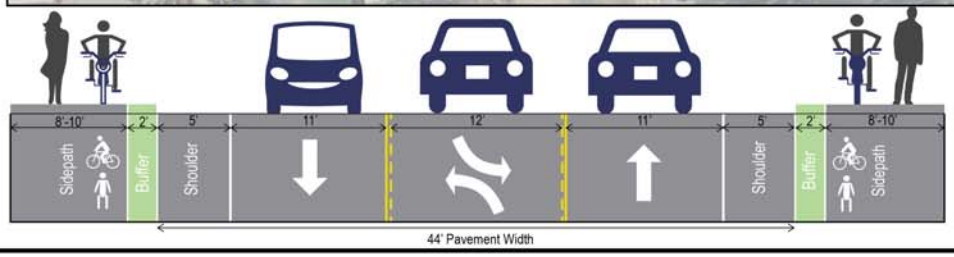
Location	MP 3.82 To MP 4.11

June 2018

Michael Baker INTERNATIONAL

Alternative 5 - Reduced Pavement Width + Side Path





Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	158.0	405.0	562.9
Expected 20-Year Reduction	29.2	5.9	35.1
Expected % Reduction	15.6%	1.4%	5.9%
Expected Annual Benefit	$323,029	$2,901	$325,930

C-1 / C-4

Concept Alternatives

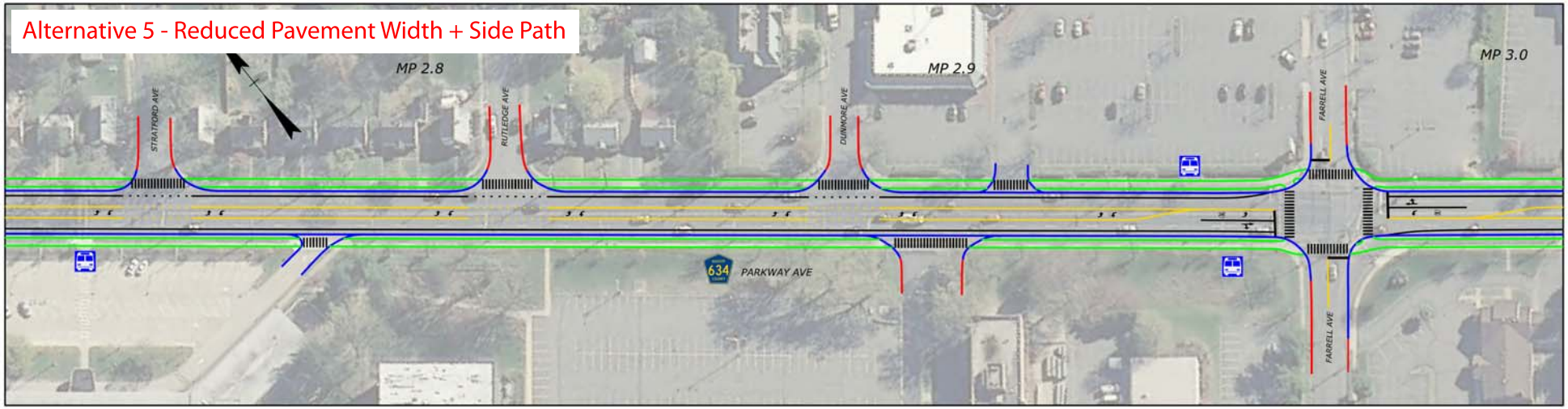
Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

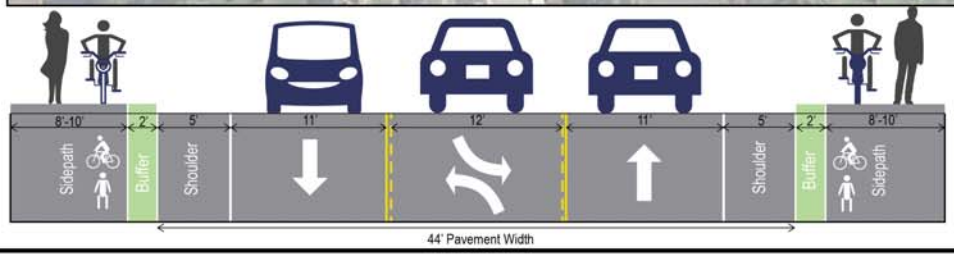
Location	MP 2.20 To MP 2.72

April 2018

Michael Baker INTERNATIONAL

Alternative 5 - Reduced Pavement Width + Side Path





Expected Crashes (20-Year Analysis, 2020-2040)			
	Fatal/Injury	Property Damage	Total
Expected Crashes (No-Build)	187.2	410.9	598.0
Expected Crashes (Alternative)	158.0	405.0	562.9
Expected 20-Year Reduction	29.2	5.9	35.1
Expected % Reduction	**15.6%**	**1.4%**	**5.9%**
Expected Annual Benefit	**$323,029**	**$2,901**	**$325,930**

C-2 / C-4

Concept Alternatives

Parkway Avenue (CR 634)
Ewing Township & City of Trenton, Mercer County

Location	MP 2.72 To MP 3.28

April 2018

Michael Baker INTERNATIONAL