

# PREDICTIVE SAFETY ANALYSIS FINAL REPORT

October 2022



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### Acknowledgements

Management Team: Jesse Cohn McGowan, David Anspacher, and Jason Sartori

Study Team: Eli Glazier, Stephen Aldrich, Wade Holland (County Executive’s Office), John Hoobler (MCDOT), and Andrew Bossi (MCDOT)

Coordinating Agencies and Jurisdictions: MCDOT, Montgomery County Department of Permitting Services, Maryland State Highway Administration, City of Rockville, City of Gaithersburg, and City of Takoma Park

Consultant Support: University of North Carolina Highway Safety Research Center and Safe Streets Research & Consulting, LLC.

## EXECUTIVE SUMMARY

Between 2015 and 2019, there were over 59,000 crashes in Montgomery County, resulting in over 1,200 severe injuries and nearly 150 fatalities. There is an element of randomness to where these individual crashes occur, but there is much less randomness to the types of streets and intersections where these crashes occur. As part of Montgomery County's Vision Zero goal to eliminate traffic deaths and severe injuries by 2030, Montgomery Planning is using a new strategy to improve road safety for drivers, bicyclists and pedestrians called the Predictive Safety Analysis. This proactive data-driven approach works to prevent severe and fatal crashes before they happen.

The Predictive Safety Analysis estimates the expected number of crashes at a given roadway segment or intersection through Safety Performance Functions (SPFs). Safety Performance Functions (SPFs) are equations (or models) that predict the number of crashes on roadway segments and at intersections based on exposure, roadway characteristics, and other variables. This analysis then allows the county to prioritize where and how to most effectively invest in safety improvements through capital projects, development approvals, and master planning.

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### KEY FINDINGS

Through this analysis, a few key findings emerged:

- **Prioritization needs to look beyond crash history.** In the past, Montgomery County has sometimes taken a reactionary approach to transportation safety, implementing site-specific improvements in the aftermath of a fatal crash. The results of this analysis show that prioritizing safety treatments based solely on locations with a history of severe injury and fatal crashes could result in unmitigated crash risk. From 2015 to 2019, only 55% of fatalities and 46% of severe injuries occurred in top 200 locations identified in the Predictive Safety Analysis.
- **As a suburban county, much of Montgomery County's crash risk is in the suburbs.** The county's suburban areas and the high-speed, high-volume suburban Boulevards that run through them have the highest concentration of crash risk in the county for most crash types. To reach Vision Zero, safety improvements must address these locations.
- **Yet Downtowns and Town Centers have the highest average crash risk.** On a per-intersection or per-roadway segment basis, crash risk is highest in the county's urban areas, particularly for pedestrian and bicycle crash types. Systemic improvements on Downtown Boulevards and Town Center Boulevards – and more broadly in Downtown and Town Center areas – would yield the greatest benefits per location improved.
- **Safety improvements in Equity Emphasis Areas (EEAs) should be prioritized.** Across all metrics, crash risk is disproportionately concentrated in EEAs. More than half of the top 200 locations for pedestrian crash types are located within EEAs (even though only 16% of county intersections are in EEAs), and the average crash risk in EEAs far exceeds that for non-EEAs for five of the six crash types. Focusing investments in EEAs can mitigate this disparity and balance crash risk in the county.

Based on these findings, this report does not provide a prescriptive recommendation of capital improvements to address the areas and street types with high crash risk; it does not recommend which safety treatments should be implemented at which locations. Instead, the project provides a countermeasure evaluation tool for planners, engineers, and decisionmakers to assess different investment scenarios based on their goals and priorities. The tool can be used to determine which countermeasures to implement and how many locations to improve, and it evaluates the effectiveness of different countermeasures in several ways: potential crash reduction, potential crash reduction per location, cost per crash reduced, and percent of locations in Equity Emphasis Areas.

Each countermeasure is associated with a ranked list of locations for systemic implementation.

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## APPLICATIONS

**The Predictive Safety Analysis is the first step towards implementing a proactive approach to safety. It is now incumbent upon planners, engineers, and decisionmakers to apply the findings of this analysis.** There are several uses of the results of the Predictive Safety Analysis:

- **Apply Data-Driven Planning:** The Predictive Safety Analysis provides the data, analysis, and tools to shift the county’s approach and implement improvements where they are needed and more equitably. This data can combat the “squeaky wheel” by distributing resources equitably and to where they are most needed. In addition, the data can support funding requests, both as part of the local or state budgeting process as well as through grant applications.
- **Identify Locations with High Crash Risk:** The results can be used to identify location types that are likely to experience a high number of crashes. This data can be used to inform Capital Improvement Program (CIP) project prioritization, prioritization of off-site mitigation for new development, a focus for transportation improvements within master planning areas, and Mandatory Referral comments.
- **Prioritize Safety Improvements:** The tools allow implementing agencies to prioritize where to implement systemic safety treatments as well as to assess which safety treatments may be the most effective at reducing crashes. This information can make the case for additional funding for CIP level-of-effort programs, inform master plan recommendations, and support updates to the Growth and Infrastructure Policy.
- **Determine Locations with Similar Conditions:** The databases developed include hundreds of variables related to the transportation, land use, and demographic context in which the crash occurred. In the wake of future severe or fatal crashes, these data can help identify other locations similar to the crash location and inform a more systemic response to the incident.

The Planning Department, Montgomery County Department of Transportation, and the County Council can use this information in a variety of ways to inform future recommendations, priority projects, and funding allocations. Taking a more proactive, data-driven approach to transportation safety impacts all facets of the transportation planning process.

## 1. OVERVIEW

Between 2015 and 2019, there were over 59,000 crashes in Montgomery County, resulting in over 1,200 severe injuries and nearly 150 fatalities. There is an element of randomness to where these individual crashes occur, but there is much less randomness to the types of streets and intersections where these crashes occur. When a fatality or severe injury occurs at a particular location, decisionmakers and the public tend to galvanize around addressing the causes of that specific crash to ensure it will never happen again. Yet in largely taking a reactive approach that focuses on where crashes have occurred in the past, we are overlooking where crashes may happen in the future.

As part of Montgomery County's Vision Zero goal to eliminate traffic deaths and severe injuries by 2030, Montgomery Planning is using a new strategy to improve road safety for drivers, bicyclists and pedestrians called the Predictive Safety Analysis. This is a proactive data-driven approach that identifies future problem areas and works to prevent severe and fatal crashes before they happen.

The Predictive Safety Analysis estimates the expected number of crashes at a given roadway segment or intersection through Safety Performance Functions (SPFs). Safety Performance Functions (SPFs) are equations (or models) that predict the number of crashes on roadway segments and at intersections based on exposure, roadway characteristics, and other variables. This analysis then allows the county to prioritize where and how to most effectively invest in safety improvements through capital projects, development approvals, and master planning. This approach is more proactive than crash hotspot approaches and recognizes the uncertainty about where crashes and injuries will occur next.

The Predictive Safety Analysis uses the context and characteristics of locations that have a history of crashes to understand what may have contributed to these events. To inform this analysis, Montgomery Planning developed a formula that estimates the number of bicycle, pedestrian, and vehicle crashes for common crash types at intersections and roadway segments throughout the county. This formula looks at several variables, including land use context (urban, suburban, and rural), roadway characteristics (speed limits, traffic signals, and presence of sidewalks or bikeways, etc.), and the level of travel activity (the number of pedestrians, bicyclists, and motorists using a roadway or intersection). The Predictive Safety Analysis was completed with consultant support from the University of North Carolina Highway Safety Research Center and Safe Streets Research & Consulting, LLC and is generally based on the approach outlined in the National Highway Cooperative Research Program (NCHRP) Report 893: Systemic Pedestrian Safety Analysis.

Montgomery County is one of the first jurisdictions of its size and land use mix to undertake a predictive analysis with this level of rigor and detail. This marks a shift from a transportation safety approach that focuses on locations where high rates of severe injuries or fatalities have occurred to one that proactively identifies and treats locations with similar high-risk characteristics.

This report documents the process used to conduct the Predictive Safety Analysis. Each section summarizes a distinct step in the analysis, listed below:

- Compile Data
- Develop Volume Estimates
- Identify Key Crash Types
- Develop Safety Performance Functions
- Summarizing Crash Risk
- Pair Crash Types with Countermeasures

The report closes with a section (8. Applications) focused on how the results of the analysis can be used in future planning and engineering efforts throughout Montgomery County.

## 2. COMPILE DATA

The first step of the analysis was to create two databases: an intersection database and a roadway segment database. Crash data and context data – including transportation, land use, and demographic data – are assigned to each intersection and roadway segment.

Intersections and roadway segments represent the two “units of analysis” for the Predictive Safety Analysis. This means that the analysis evaluates crash trends associated with roadway segments and intersections, rather than some other unit or geography.

The databases include the entire county, with a few exceptions. The databases exclude interstates and their associated ramps, private streets, streets constructed during the study period (2015-2019), and streets along county borders (e.g., Eastern Avenue). Streets within municipalities are included.

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### CRASH DATA

The Predictive Safety Analysis includes crash data from 2015 to 2019, downloaded from the Montgomery County Vision Zero website. Montgomery Planning made a few edits to the crash data:

- **Revised Mode of Transportation:** The database identifies the modes of transportation (pedestrian, bicyclist, motorist) that were involved in the crash, but in some instances these data needed to be revised. The most common reason for revisions of these data was when the mode of transportation was stated as “unknown,” but further investigation revealed the mode was pedestrian or bicyclist.
- **Revised Crash Location:** The geospatial crash data locates crashes at the X-Y coordinates provided in the crash database. However, this often represents where the crash report was filed by a police officer, rather than the location of the crash itself. Montgomery Planning created an automated approach to relocate crashes based on the description provided in the



crash database, specifically whether the crash was at an intersection or intersection-related, the name of the street and cross-street, and the distance and direction from the intersection defined through the street and cross-street.

Each crash is assigned to a roadway segment or an intersection, based on its location. During this process, some crashes were removed from the crash database. This generally occurred when a crash was located along an intersection or roadway segment removed or not included in the databases, such as crashes on interstates. Of the removed crashes, the vast majority are motor vehicle crashes; very few crashes including bicyclists and pedestrians were removed.

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## CONTEXT DATA

### TRANSPORTATION DATA

Transportation data describe the roadway network, accounting for street characteristics related to motor vehicles as well as transit service and bicycle and pedestrian infrastructure. Examples of included transportation data include:

- Speed limit
- Number of lanes
- Roadway slope
- Presence and type of crosswalk
- Presence and type of bicycle facility
- Roadway classification
- Presence of signals and stop signs
- Lighting
- Transit service

While the included transportation data are expansive, they are not comprehensive. Some characteristics of the transportation network were not included for one of two reasons:

- 1) **Countywide data are not available.** Without available data throughout the entire county, an attribute of the transportation environment cannot be analyzed. For example, there is not a countywide dataset for signalized intersections with protected left turn phases. Creating these datasets were beyond the scope of the analysis.
- 2) **The transportation characteristic occurs very infrequently.** The county has started to implement a wide range of bicycle and pedestrian treatments, such as pedestrian hybrid beacons, floating transit islands, and leading pedestrian intervals. While national research associates these treatments with safety improvements, there are too few instances of these treatments in the county to draw statistically valid conclusions. The analysis included over 16,000 intersections and 30,000 roadway segments in the county. Including variables only relevant to a few dozen locations were not expected to impact the results of the study.

Montgomery Planning worked with the cities of Rockville and Gaithersburg to acquire transportation data for roadways within the municipalities.

## Incorporating Recent Projects

The analysis period runs from 2015-2019. During that time, many capital improvements were completed throughout the county, changing the transportation attributes of individual intersections and roadway segments. These transportation projects added a time element to the context database, including a “before” and “after” condition for some intersections and roadway segments where conditions changed during the study period. This allows for crashes to be associated with the intersection or roadway characteristics that existed at the time of the crash.

Montgomery Planning worked with the Montgomery County Department of Transportation (MCDOT) and Maryland Department of Transportation State Highway Administration (MDOT SHA) to inventory county and state-funded transportation projects. In addition, Montgomery Planning worked with Montgomery County Department of Permitting Services (DPS) to document changes to the transportation network completed as part of private development construction during the study period. The incorporated changes primarily focused on speed limit reductions and construction of sidewalks, crosswalks, and bicycle facilities.

## LAND USE DATA

In addition to transportation data, land use variables are included in the databases. These variables generally capture the density of different land use types within different distances from the intersection or roadway segment (generally within one tenth, quarter, and half mile buffers).

Examples of included data are listed below:

- Parks
- Hospitals
- Gas stations
- Parking lots
- Schools
- Government facilities
- Shopping centers
- Alcohol-serving locations
- Population density
- Employment density

## DEMOGRAPHIC DATA

Lastly, context data include demographic information related to income, race and ethnicity, and an aggregate Equity Emphasis Areas variable. Equity Emphasis Areas, developed by the Metropolitan Washington Council of Governments (MWCOC), are a composite measure for Census tracts in the region with high concentrations of lower-income households and people of color.

Appendix A includes an inventory of all collected variables.



### 3. DEVELOP VOLUME ESTIMATES

While the first step of the Predictive Safety Analysis compiled crash data and context variables, one key set of variables was missing: exposure. Exposure represents the number of daily pedestrians, bicyclists, or motorists using a given intersection or roadway segment. These variables are important, as crash trends are often related to exposure; more walking, bicycling and driving often mean more crashes involving these modes. In addition, more driving is often associated with more bicycle or pedestrian crashes.

As these variables are not available countywide, a major task in the Predictive Safety Analysis was to create these variables by developing volume estimation models to capture the number of daily pedestrians, bicyclists, and motorists on each intersection and roadway segment countywide.

This task uses the existing pedestrian, bicyclist, and motor vehicle counts throughout the county to estimate the daily number of pedestrians, bicyclists, and motor vehicles at intersections and roadway segments where counts are not available. Between counts compiled by Montgomery Planning, MCDOT, and SHA, there are about 600 short-duration (between 2 hours and 7 days) counts on a range of different roadway types in different contexts throughout the county, including both intersection counts and counts on roadway segments. In 2020, Montgomery Planning contracted with Toole Design Group to evaluate if additional counts were needed to develop volume estimation models. Their assessment states: “While Montgomery County’s count dataset is not perfectly representative, and [sic] it is sufficiently large and varied that exposure models could be successfully estimated. Expanding the available count dataset to fill gaps in location types such as unsignalized intersections on local roads in low density areas outside of Bicycle/Pedestrian Priority Areas will help to improve modeling efforts, but the lack of this data should not preclude Montgomery Planning from proceeding with their crash analysis, particularly in light of current disruptions to normal travel patterns.” As a result of this evaluation, no additional counts were conducted. The full memo is included in Appendix B.

For the purposes of this analysis, all the counts are evaluated as roadway segment counts, meaning that the intersection turning movement data are translated to roadway segments counts.<sup>1</sup> This is simple for motor vehicle and bicycle counts, where the intersection data show where the motor vehicle starts and ends its movement. For example, a northbound right starts on the northbound roadway segment and ends on the roadway segment east of the intersection (the westbound segment), and vehicles or bicyclists making this movement would be counted on both roadway segments. In contrast, pedestrian counts are usually documented based on how many pedestrians use a given crossing. For the Predictive Safety Analysis, it is assumed that all pedestrians travel

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<sup>1</sup> The results of the volume estimation models for roadway segments are later translated back to intersections by summing the volumes on each approach and then dividing by two, as each vehicle, pedestrian, or bicyclist traverses two roadway segments when passing through the intersection (entering the intersection on one roadway segment and departing the intersection on another roadway segment).

straight through the intersection. For example, a pedestrian walking eastbound on the south crosswalk would have walked on the westbound and eastbound intersection approaches. This is an imperfect assumption, but it is a reasonable course of action given the available data.

Developing the volume estimates included two primary steps: annualizing existing counts and developing volume estimation models.

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### ANNUALIZING EXISTING COUNTS

Existing short-duration counts were originally conducted at a variety of different times – they represent different times of day, days of the week, months of the year, and different years (spanning 2015-2019). In order to use these data to estimate exposure at other locations, all of the counts must be translated to a consistent measure. For this analysis, that measure is average annual daily volume. This does not represent a specific day, but instead represents the average daily usage across the entire time period.

To annualize the counts, unique factors were developed to account for how travel differs based on the time of day, day of the week, etc. as well as for the roadway type (rural or urban, primarily used for commute or other travel). These factors were created based on locations with continuous count data, such as continuous bicycle and pedestrian counters along trails, as well as based on month and day-of-the-week factors provided by SHA. This approach is generally based on the Federal Highway Administration’s Traffic Monitoring Guide<sup>2</sup> and American Association of State Highway and Transportation Officials’ Guidelines for Traffic Data Programs.<sup>3</sup>

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### DEVELOPING VOLUME ESTIMATION MODELS

Once the counts were annualized, they were used to develop volume estimation models. Essentially the 600 existing counts were used to estimate the daily volumes at locations without counts.<sup>4</sup> Each model was essentially a combination of context data that best estimated existing counts. Two models were developed for bicyclists, with distinct variables used to estimate bicycle volumes on roadway segments with and without separated bikeways (separated bike lanes or sidepaths).

Of the list of over 200 context variables, each was first evaluated using a Conditional Random Forest model, which determined if the individual context variables have a statistical relationship to the annualized count data. For each model, this generally limited the context variables to about 20% of the original variables. Those remaining variables were then used to create a model that best fits the count data. The models were then used to calculate an average annual daily volume for pedestrians,

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<sup>2</sup> Federal Highway Administration. (2016). Traffic Monitoring Guide. Washington, D.C.: FHWA, U.S. Department of Transportation). <https://www.fhwa.dot.gov/policyinformation/tmguide/>

<sup>3</sup> AASHTO. (1992). Guidelines for Traffic Data Programs. Washington, D.C.: Joint Task Force on Traffic Monitoring Standards of the AASHTO Highway Subcommittee on Traffic Engineering.

<sup>4</sup> This is referred to as a “direct demand model”, as described in NCHRP 770: Estimating Bicycling and Walking for Planning and Project Development – A Guidebook.

bicyclists, and motorists for each roadway segment in the county. The volume estimation models are included in Appendix C.

#### 4. IDENTIFY KEY CRASH TYPES

The Predictive Safety Analysis includes an analysis of specific crash types; it does not analyze all crashes countywide. Six crash types were selected to cover a large number of crashes, severe injuries, and fatalities but also be specific enough to point to specific safety treatments. The six crash types are described below:

- **Pedestrian crashes after dark at intersections** could also be considered “evening” or “nighttime” crashes. Given that sunset time varies throughout the course of the year, this crash type is defined based on the crash data’s description of lighting conditions when the crash occurred.<sup>5</sup>
- **Pedestrian crashes on roadway segments with vehicles going straight** capture pedestrians crossing midblock and pedestrians walking along a roadway segment that are hit by a motor vehicle going straight.
- **Bicycle crashes at intersections** include all bicycle crashes at intersections.
- **Left-turn crashes at intersections (all modes)** represent crashes with left-turning vehicles that involve motorists as well as bicyclists and pedestrians.
- **Motor vehicle straight/angle crashes at intersections** are crashes that involve two (or more) vehicles traveling straight. Some examples of where these crashes can occur include when a motorist does not stop at a red light or does not yield to crossing vehicles at a stop-controlled intersection.
- **Single vehicle crashes along roadway segments** are crashes that only involved one vehicle (and do not involve a pedestrian or bicyclist). These can be run-off-the-road crashes, collisions with debris in the road, or collisions with animals.

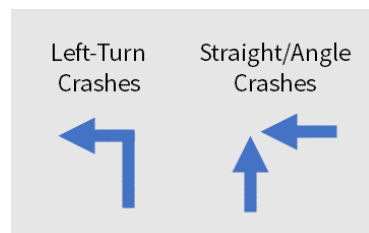


Table 1 summarizes the selected crash types. Crash types involving motor vehicles include a higher number of crashes and people killed or severely injured (KSI), yet these crash types are less severe, with lower percentages of crashes resulting in a severe injury or fatality.

<sup>5</sup> This crash type includes pedestrian crashes at intersections where lighting is defined as “dark lights on,” “dark no lights” or “dark – unknown lighting.”

Table 1. Predictive Safety Analysis Crash Types (2015 - 2019)

Crash Type	# Crashes	# KSI	% KSI	% in EEAs
Pedestrian crashes after dark at intersections	496	86	17%	49%
Pedestrian crashes on roadway segments with vehicles going straight	418	103	25%	40%
Bicycle crashes at intersections	456	44	10%	25%
Left-turn crashes at intersections (all modes)	4,647	167	4%	34%
Motor vehicle straight/angle crashes at intersections	6,680	178	3%	31%
Single vehicle crashes along roadway segments	3,989	199	5%	16%

Equity was also a consideration in selecting crash types. Equity Emphasis Areas (EEAs) are a regional planning concept adopted by the Metropolitan Washington Council of Governments (MWCOC) to inform future growth and investment decisions. EEAs are Census tracts with high concentrations of low-income individuals and/or racial and ethnic minorities. EEAs comprise less than 20% of intersections and roadway segments, yet 32% of crashes and 29% of KSI occurred in Equity Emphasis Areas between 2015 and 2019. Three of the selected crash types exceed this average, with a higher percent of crashes occurring in Equity Emphasis Areas.

It should be noted that EEAs represent locations, not people. These are areas in Montgomery County with a high concentration of residents with specific demographics. Data are not available about the race or income of individuals involved in crashes.

There is overlap in the crashes included in some of the crash types. For example, a pedestrian intersection crash after dark may also be a crash involving a motor vehicle turning left. Accounting for this overlap, overall these crash types capture 31% of crashes and 49% of crashes resulting in a severe injury or fatality (KSI), but much higher shares of pedestrian and bicycle crashes and KSI (Table 2).

Table 2. Crash Types Summary (2015 - 2019)

Crash Type	% Crashes	% KSI
Pedestrian Crashes	63%	73%
Bicycle Crashes	74%	65%
Motor Vehicle Crashes	29%	41%
Overall Crashes	31%	49%

Appendix D provides a diagram of crash types by mode, including both those crash types selected for analysis as well as other crash types associated with each mode.

#### RELATIONSHIP TO VISION ZERO

The crash types address crashes of all severities, rather than focusing on severe injuries and fatalities. This approach was taken to provide a large sample size of locations with crashes to inform the analysis. While Vision Zero focuses on eliminating severe injuries and fatalities, the approach taken in the Predictive Safety Analysis is consistent with Vision Zero for the following reasons:

- **Selected crash types have high injury rates.** Only 2% of crashes in Montgomery County result in a severe injury or fatality. All six of the selected crash types have higher injury rates

than the countywide average, and this is particularly pronounced for bicycle and pedestrian crash types (Table 1).

- **The severity of bicycle and pedestrian crashes is somewhat random.** Given the vulnerability of bicyclists and pedestrians, very minor changes in how a crash occurred – or who the crash victim was – can result in a dramatic difference in crash severity. As a result, using all severities is a reasonable approach for the bicycle and pedestrian crash types (three of the six crash types).
- **The county’s High Injury Network provides similar coverage.** The draft High Injury Network using crash data from 2015 to 2019 accounts for 41% of severe injuries and fatalities, while the six crash types used in the Predictive Safety Analysis cover 49% of severe injuries and fatalities. Primary metrics for tracking implementation of Vision Zero in Montgomery County include the number of severe injuries and fatalities along the High Injury Network, as well as the percentage of High Injury Network streets with new traffic safety improvements.

## 5. DEVELOP SAFETY PERFORMANCE FUNCTIONS

This step used the context and characteristics of locations that have a history of crashes to understand what may have contributed to these events. This was accomplished through the development of Safety Performance Functions (SPFs), which are equations (or models) that predict the number of crashes on roadway segments and at intersections based on exposure, roadway characteristics, and other variables.

### DEVELOPING SPFs

To develop SPFs for each of the six crash types, a list of over 200 context variables was first evaluated using a Conditional Random Forest model, which determines if the individual context variables have a statistical relationship to the crash data. For each model, this generally limited the context variables to about 20% of the original variables. Those remaining variables were then used to create a model that best fits the crash data for each crash type, and generally fit into five categories: exposure, roadway/infrastructure, land use, transit, and demographics.<sup>6</sup>

One crash type was modified during the Safety Performance Functions (SPFs) development process because the data for these crash types did not lead to an intuitive model that effectively explained the crash trends. **Motor vehicle straight/angle crashes at intersections** was revised to only include crashes at four-legged intersections (excluding three-legged and five-legged intersections).

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<sup>6</sup> This approach was informed by NCHRP 893: Systemic Pedestrian Safety Analysis.

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## CRASH ANALYSIS METRICS

The Predictive Safety Analysis was developed based on observed crashes, but the outputs of the SPFs led to additional measures to understand how many crashes occurred or could occur at a given location. Overall, this project uses three different metrics to develop and review the crash analysis:

- **Observed Crashes** are the historical crashes that occurred at an intersection or along a roadway segment. These data can be used to identify high-crash locations. Observed crashes are the basis of most crash analysis, but they are biased by the random nature of crashes. Even though one intersection has no crashes, and another has one or two, the underlying crash risk at both may be the same. This can be overcome to some extent by studying longer time periods, but longer periods increase the potential for changes to roadways, population or other characteristics. Over reliance on observed crash data is a particular problem for bicycle crashes, which are relatively rare compared to other crash types.
- **Predicted Crashes** are the outcome of the SPFs and account for the location-specific characteristics quantified in the SFP equation. They are useful for identifying sites which may not currently have many observed crashes but have the potential to be high-crash sites based on the characteristics of the location. Predicted crashes are also used in estimating potential future crash reductions from countermeasures. Especially for SPFs with poor model fit, analysis or rankings based on predicted crashes alone may be misleading. Estimates can only be made at locations where all predictor variables are available.
- **Empirical-Bayes (EB) Crashes** weighs both observed and predicted crashes based on 1) how well the SPF predicts crashes and 2) the number of predicted crashes at the specific location. EB crashes can be considered the most reliable estimate of the underlying crash frequency at a given location based on all available information. Because the EB crashes combines observed and predicted crashes, it cannot be used to create estimates for the future. Throughout this report, the EB value is generally referred to as “crash risk.”

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## RESULTS

For each of the crash types, the SPFs are largely a function of exposure. Vehicle, pedestrian, or bicycle volumes are often positively correlated with the predicted number of crashes. In addition, transportation, land use, and demographic variables associated with more people, activity, and travel, are also often positively associated with crashes. For example, traffic signals are typically installed at intersections with high traffic volumes, and traffic signals are positively correlated with predicted crashes for some crash types. Similarly, population density and the number of bus routes through a community indicate a large number of residents and travelers, and these variables are generally both associated with more predicted crashes. **While these correlations exist, this is not to say that the county should avoid installing traffic signals, eliminate transit service, or discourage dense development.** These equations are intended to point us to where improvements



are most needed. Strategies to improve safety are identified in a subsequent section (7. Pair Crash Types with Countermeasures) and are based on national research on crash reduction.

For some crash types, demographic variables related to race, income, and age are statistically related to the number of predicted crashes. These findings do not indicate that people of a certain age walk less safely than other age groups, or that drivers from a certain racial background are safer drivers than drivers of another background. The significance of these variables is likely associated with a transportation or built environment factor not captured in the analysis. While the SPFs help explain the factors associated with crashes, they are not a perfect predictor of crash risk.

In the following sections, each crash type is summarized through a table, listing each of the statistically significant variables and their direction of correlation with predicted crashes. A plus sign indicates a positive correlation, demonstrating that as that variable is present or increases, so does the number of predicted crashes (e.g., more vehicle travel is associated with more predicted crashes). A minus sign indicates a negative correlation, indicating that as the variable is present or increases, the number of predicted crashes decreases (e.g., roadway segments that are dead ends are associated with fewer crashes than through streets).

Some variables are noted with two plus signs or two minus signs. These variables are some of the strongest indicators of the predicted crashes; changing one of these variables has a large impact on the number of predicted crashes. Each of these key variables are summarized following the table of variables.

Appendix E includes the SPF equations for each crash type.

### PEDESTRIAN CRASHES AFTER DARK AT INTERSECTIONS

Table 3. Variables Associated with Pedestrian Crashes after Dark at Intersections

Statistically Significant Variables		Relationship to Crashes
Exposure	Pedestrian traffic	++
	Motor vehicle traffic	++
Transportation	Number of intersection legs	++
	Maximum number of through lanes	++
	Speed limit	+
	Number of marked crosswalks	++
	Presence of a traffic signal	++
	Transportation points of interest (e.g., transit, bikeshare)	+
	Bus routes	+
	Metro stations	+
Demographics	Population density	+
	Household income	-

Key variables:

- **Pedestrian traffic:** increasing daily pedestrian volumes from 10 to 100 pedestrians increases predicted crashes by 190%. Increasing daily pedestrian volumes from 100 to 1,000 pedestrians further increases predicted crashes by 110%.
- **Motor vehicle traffic:** increasing motor vehicle volumes from low (0-5,000 daily vehicles) to medium (5,001-10,000 daily vehicles) increases predicted crashes by 350%. Increasing from medium to high (greater than 10,000 daily vehicles) increases predicted crashes by only 5%.
- **Number of intersection legs:** increasing the number of legs at the intersection from three to four legs or from four to five legs is associated with an approximately 60% increase in crashes.
- **Maximum number of through lanes:** increasing from two to four lanes or from four to six lanes is associated with increasing predicted crashes by about 40%.
- **Number of marked crosswalks:** increasing from zero to two or from two to four marked crosswalks is associated with an increase in predicted crashes of approximately 50%.
- **Presence of a traffic signal:** intersections with traffic signals have nearly triple the number of predicted crashes as unsignalized intersections.

#### PEDESTRIAN CRASHES ON ROADWAY SEGMENTS WITH VEHICLES GOING STRAIGHT

Table 4. Variables Associated with Pedestrian Crashes on Roadway Segments with Vehicles Going Straight

Statistically Significant Variables		Relationship to Crashes
Exposure	Pedestrian traffic	+
	Motor vehicle traffic	++
Transportation	Block length	++
	Dead end	--
	Street class (state road, major road)	++
	Parking lots	+
	Number of marked crosswalks	+
	Bus routes	+
Land Use	Alcohol establishments	+
	Recreational points of interest	-
	Business points of interest	-
Demographics	Household Income	--

Key variables:

- **Motor vehicle traffic:** increasing motor vehicle volumes from low (0-5,000 daily vehicles) to medium (5,001-10,000 daily vehicles) or from medium to high (greater than 10,000 daily vehicles) increases predicted crashes by 100%.

- **Block length:** increasing block length from 0.1 miles to 0.5 miles increases predicted crashes by 36%, and increasing block length from 0.5 miles to 1.0 miles increases predicted crashes by 47%.
- **Dead end:** the number of predicted crashes is 75% lower on dead end streets than streets that are not a dead end.
- **Street classification:** the number of predicted crashes is 140% higher on state roads and arterials than local, residential streets.
- **Household income:** Increasing the portion of households making greater than \$100,000 within a quarter mile of the intersection from the median (64%) to 80% results in a 40% reduction in crashes.

## BICYCLE CRASHES AT INTERSECTIONS

Table 5. Variables Associated with Bicycle Crashes at Intersections

Statistically Significant Variables		Relationship to Crashes
Exposure	Bicycle traffic	++
	Motor vehicle traffic	++
Transportation	Number of legs	++
	Number of legs with a median	++
	Number of marked crosswalks	++
	Presence of a stop sign	+
	Presence of a traffic signal	++
	Proximity to a sidepath	+
	Proximity to a bike lane	-
	Bus Stops	+
Land Use	Proximity to parks	+
Demographics	Concentration of Latino residents	+

### Key variables:

- **Bicycle traffic:** increasing daily bicycle volumes from 10 to 100 bicyclists increases predicted crashes by approximately 90%. Increasing daily bicycle volumes from 100 to 500 bicyclists increases predicted crashes by 58%.
- **Motor vehicle traffic:** increasing motor vehicle traffic between different volume categories has varying impacts depending on the categories. The greatest impact on predicted crashes is between streets with < 2,000 daily vehicles and 4,000 and 9,999 daily vehicles (an increase in predicted crashes of 680%).

AADT Category 1	AADT Category 2	Change in Predicted Crashes
< 2,000	4,000 to 9,999	680% more crashes
4,000 to 9,999	10,000 to 19,999	40% more crashes
10,000 to 19,999	>= 20,000	10% more crashes

Note: AADT 2,000-3,999 was not statistically significant.

- **Number of intersection legs:** increasing the number of legs at the intersection from three to four legs or from four to five legs is associated with an approximately 45% increase in crashes.
- **Number of legs with a median:** intersections with a median on two legs have 60% more crashes than intersections with a median on zero or one leg. Intersections with a median on three legs have 36% more predicted crashes than intersections with a median on two legs.
- **Number of marked crosswalks:** increasing from zero to two or from two to four marked crosswalks is associated with an increase in predicted crashes of approximately 40%.
- **Presence of a traffic signal:** intersections with traffic signals have nearly triple the number of predicted crashes as unsignalized intersections.

#### LEFT-TURN CRASHES AT INTERSECTIONS (ALL MODES)

Table 6. Variables Associated with Left-Turn Crashes at Intersections (All Modes)

Statistically Significant Variables		Relationship to Crashes
Exposure	Motor vehicle traffic	++
	Pedestrian traffic	-
Transportation	Number of legs	++
	Number of lanes	++/- (non-linear)
	Speed limit	+
	Street classification	++
	Presence of a traffic signal	++
	Number of high-visibility crosswalks	+
	Presence of a bikeway	+
	Parking lots	+
	Bus stops	+
Land Use	Rural context (relative to suburban and urban)	++
Demographics	Household income	--

Key variables:

- **Motor vehicle volumes:** increasing motor vehicle traffic between different volume categories has varying impacts depending on the categories. The greatest impact on predicted crashes is between streets with 2,000-3,999 daily vehicles and 4,000 and 9,999 daily vehicles (an increase in predicted crashes of 320%).

AADT Category 1	AADT Category 2	Change in Predicted Crashes
< 2,000	2,000 to 3,999	100% more crashes
2,000 to 3,999	4,000 to 9,999	320% more crashes
4,000 to 9,999	10,000 to 19,999	70% more crashes
10,000 to 19,999	>= 20,000	25% more crashes

- **Number of intersection legs:** increasing the number of legs at the intersection from three to four legs or from four to five legs is associated with an approximately 70% increase in crashes.
- **Number of lanes:** intersections where all legs have three or four lanes have 150% more predicted crashes where all legs have two lanes. Intersections where any leg has more than four lanes has 30% fewer crashes than intersections where all legs have three or four lanes.
- **Street classification:** intersections including at least one state road have twice as many predicted crashes as intersections only including county roads.
- **Presence of a traffic signal:** intersections with traffic signals have the number four times as many predicted crashes as unsignalized intersections.
- **Land use:** predicted crashes in urban and suburban areas are 50% and 35% lower, respectively, than in country areas.

## MOTOR VEHICLE STRAIGHT/ANGLE CRASHES AT FOUR-LEGGED INTERSECTIONS

Table 7. Variables Associated with Straight/Angle Crashes at Four-Legged Intersections

Statistically Significant Variables		Relationship to Crashes
Exposure	Motor vehicle traffic	++
Transportation	State roads	++
	Speed limit	++
	Number of marked crosswalks	++
	Bus routes	+
	Metro stations	+
Land Use	Located within a municipality	-
	Recreational points of interest	-
Demographics	Located within an Equity Emphasis Area	++
	Household income	-

Key variables:

- **Motor vehicle traffic:** increasing motor vehicle volumes from 5,000 daily vehicles to 10,000 daily vehicles or from 10,000 to 20,000 increases predicted crashes by 46%.
- **State roads:** crash risk is 225% higher on state roads relative to county roads.
- **Speed limit:** increasing the speed limit by 5 miles per hour increases crash risk by 15%, and increasing the speed limit by 10 miles per hour increases crash risk by 32%.
- **Number of marked crosswalks:** increasing from zero to two or from two to four marked crosswalks is associated with an increase in predicted crashes of approximately 45%.
- **Located within an Equity Emphasis Area:** intersections within an Equity Emphasis Area (EEA) have 31% more predicted crashes than intersections not within an EEA.

## SINGLE VEHICLE CRASHES ALONG ROADWAY SEGMENTS

Table 8. Variables Associated with Single Vehicle Crashes along Roadway Segments

Statistically Significant Variables		Relationship to Crashes
Exposure	Motor vehicle traffic	++
	Pedestrian traffic	--
Transportation	Roadway segment length	+
	Street classification	+
	Presence of a traffic signal at adjacent intersection	++
	Maximum street slope	+
	Dead end	-
	Street light density	+
	Driveway density	-
	Bus stops	+
Land Use	Population density	-
	Proximity to parks	+
	Business points of interest	-
Demographics	Concentration of African American residents	+
	Household income	-
	Concentration of youth (< 18 years)	-
	Concentration of seniors (> 65 years)	-



Key variables:

- **Motor vehicle traffic:** increasing daily vehicles from 1,500 to 3,000 daily vehicles increases predicted crashes by 200%, while increasing from 3,000 to 12,000 daily vehicles increases predicted crashes by 40% and increasing from 12,000 to 24,000 daily vehicles results in a 1% reduction in predicted crashes.
- **Pedestrian traffic:** increasing pedestrian traffic from 10 to 100 daily pedestrians and from 100 to 1,000 daily pedestrians decreases predicted crashes by 21%.
- **Presence of a traffic signal at adjacent intersection:** when one traffic signal is located adjacent to the roadway segment, predicted crashes increase by 30% relative to no traffic signal. When there is a traffic signal at both ends of a roadway segment (two signals), predicted crashes increase by 30% relative to one traffic signal.

## 6. SUMMARIZING CRASH RISK

In this section, crash risk is evaluated in three ways to better understand the implications for land use planning, street classification and equity using the Empirical Bayes crash assessment:

- **Total Crash Risk** looks at how crash risk is distributed by summing the crash risk for each crash type. This assessment determines which areas have the greatest overall crash risk. In the tables summarizing total crash risk, each cell represents the number of annual crashes for that crash type and location type.
- **Hot Spot Analysis** looks at the locations with the highest crash risk, generally the top 200 intersections or roadway segments for a given crash type.<sup>7</sup> This analysis determines the specific locations with the greatest safety challenges and can inform stand-alone capital projects. Given the extent of the crash risk at these locations, improving safety may require high-cost treatments. In the tables summarizing the hot spot analysis, each cell represents the number of locations within the top 200 that fall within the noted crash type and location type.
- **Average Crash Risk** applies a broader lens to understanding crash risk by dividing the number of crashes by the number of locations for each crash type. This analysis determines type of locations with the greatest safety challenges and can inform systemic improvements. In the tables summarizing average crash risk, each cell represents the average crashes per location for each crash type and location type.<sup>8</sup>

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<sup>7</sup> Two hundred intersections represent 1.2% of all intersections and 200 roadway segments represents 0.6% of all roadway segments.

<sup>8</sup> While the average crash risk is the total crash risk divided by the number of locations within a given context, the values in the table summarizing crash risk (Tables 11, 14, and 17) do not always equal the noted total crash risk (Tables 9, 12, and 15) divided by the noted number of locations. In a small number of locations, missing data meant that a predicted crash value could be calculated, and these locations were excluded from the average calculation.

No one approach to understanding crash risk provides a complete picture of transportation safety – each of the three measures are needed to comprehensively understand crash risk in Montgomery County.

Appendix F includes the top 50 locations for each crash type, and Appendix G includes additional tables showing the total crash risk, hot spot analysis, and average crash risk for additional context characteristics, including land use, number of lanes, and signalization.

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#### CRASH RISK BY AREA TYPE

The Complete Streets Design Guide (CSDG) identifies five land use contexts within unincorporated Montgomery County:

- **Downtowns** are envisioned as Montgomery County’s highest intensity areas including central business districts and urban centers. They are envisioned to have dense, transit-oriented development and a walkable street grid (existing or planned).
- **Town Centers** are similar to Downtowns but generally feature less intense development and cover a smaller geographic area. While the Town Center area type includes a mixture of uses, it is commonly envisioned as high-to-moderate intensity residential development, including multifamily buildings and townhouses, and retail (existing or planned).
- **Suburban** areas are envisioned as low-to-moderate intensity residential development.
- **Industrial** areas are unique areas where employment and industrial uses are the primary activities. These areas often have higher densities of development but maintain lower to moderate levels of bicycle and pedestrian activity. Given how few industrial areas there are in Montgomery County, these are grouped with suburban areas for the analysis.
- **Country** areas comprise the least dense portions of the county, with land uses of low intensity residential and agriculture.

Montgomery Planning does not have planning authority over seven jurisdictions in Montgomery County, including Rockville, Gaithersburg, Laytonsville, Brookville, Poolesville, Washington Grove, and Barnesville. For this analysis, these jurisdictions are grouped together and defined as **Other** areas.

Table 9, Table 10, and Table 11 summarize the crash risk by CSDG area type. Given that the majority of the county is suburban in nature, the highest areas for total crash risk occur in the county’s Suburban communities, as shown in Table 9.

Table 9. Total Crash Risk by CSDG Area Type (Annual Crashes)

CSDG Area Type	# Ints.*	Intersection Crash Types				# Segs.	Segment Crash Types	
		Ped Dark	Bike	Left Turn	Angle		Ped Seg	Single Veh
Downtown	359	31	11	85	92	760	12	41
Town Center	808	20	11	131	144	1,719	17	83
Suburban**	12,165	36	48	337	472	22,591	38	428
Country	1,027	0	2	22	20	1,898	3	155
Other***	2,297	17	14	154	119	4,067	12	77

Highlighted cells have the highest value for any column.

\* As the angle crash type only includes four-legged intersections, the number of intersections for this crash type would only include a fraction of the intersections noted here. Countywide, 23% of intersections have four legs.

\*\* Suburban includes Industrial areas.

\*\*\* Other includes municipalities with independent planning authority.

The findings indicate that the top 200 intersections and segments with the greatest crash risk also tend to be in Suburban areas, with two exceptions. As shown in Table 10, 84 of the top 200 intersections for pedestrian crashes after dark occurred in Downtowns. And 75 of the top 200 segments for pedestrian crashes along segments occurred in Town Centers.

Table 10. Hot Spot Analysis by CSDG Area Type (# of Top 200 Intersections and Segments)

CSDG Area Type	# Ints.*	Intersection Crash Types				# Segs.	Segment Crash Types	
		Ped Dark	Bike	Left Turn	Angle		Ped Seg	Single Veh
Downtown	359	84	45	22	26	760	51	3
Town Center	808	45	36	42	42	1,719	75	20
Suburban**	12,165	42	89	87	99	22,591	36	94
Country	1,027	0	0	1	4	1,898	1	68
Other***	2,297	29	30	48	29	4,067	37	15

Highlighted cells have the highest value for any column.

\* As the angle crash type only includes four-legged intersections, the number of intersections for this crash type would only include a fraction of the intersections noted here. Countywide, 23% of intersections have four legs.

\*\* Suburban includes Industrial areas.

\*\*\* Other includes municipalities with independent planning authority.

Average crash risk is highest in downtowns for five crash types (pedestrian crashes after dark, bicycle crashes at intersections, left-turn crashes, pedestrian crashes along segments, and four-legged intersection angle crashes), and Country areas have the highest average crash risk for single-vehicle crashes. Given the vast number of residential intersections and segments in Suburban areas, it is not surprising that Suburban areas have the lowest average crash risk.

Table 11. Average Crash Risk by CSDG Area Type (Annual Crashes per Location)

CSDG Area Type	# Ints.*	Intersection Crash Types				# Segs.	Segment Crash Types	
		Ped Dark	Bike	Left Turn	Angle		Ped Seg	Single Veh
Downtown	359	0.09	0.03	0.24	0.76	760	0.02	0.06
Town Center	808	0.03	0.01	0.18	0.74	1,719	0.01	0.05
Suburban**	12,165	0.00	0.00	0.03	0.17	22,519	0.00	0.02
Country	1,027	0.00	0.00	0.02	0.16	1,898	0.00	0.08
Other***	2,297	0.01	0.01	0.07	0.23	4,067	0.00	0.02

Highlighted cells have the highest value for any column.

\* As the angle crash type only includes four-legged intersections, the number of intersections for this crash type would only include a fraction of the intersections noted here. Countywide, 23% of intersections have four legs.

\*\* Suburban includes Industrial areas.

\*\*\* Other includes municipalities with independent planning authority.

### CRASH RISK BY STREET TYPE

In addition to defining area types, the CSDG defines street types for different roadway classes throughout the county. They are listed below, in order of intensity (higher speeds, lanes, and vehicle volumes towards the top):

- **Major Highways** are limited/controlled access roads that are primarily designed for vehicle safety and mobility. Transit and heavy vehicles are common and pedestrian and bicycle activity is often low (and in some cases, not permitted).
- **Boulevards** are critical roadways that typically connect employment and entertainment centers, civic, commercial, and institutional land uses and may also provide cross-county and regional connections. Some buildings are positioned close to the street, while others are set back. These streets are currently dominated by motor vehicle traffic.
- **Downtown Boulevards** are Montgomery County’s highest intensity streets – with a bustling mix of vehicle traffic, dense development, walking, bicycling, and transit. Downtown Boulevards are located in central business districts and urban centers.
- **Town Center Boulevards** are located in smaller activity centers. Whereas Downtown Boulevards are compact places with continuous building frontages along the street, Town Center Boulevards are more likely to have some buildings close and others set back from the street behind lawns or planted areas.
- **Downtown Streets** are also found in bustling, mixed-use and commercial areas; however, the building heights tend to be lower than on Downtown Boulevards. Downtown Streets are often the side streets in busy commercial areas that connect to Downtown Boulevards.
- **Town Center Streets** are located in areas that have or are planned to have small- and medium-sized businesses, restaurants, civic buildings, or residences. These streets have significant pedestrian and bicycle activity and typically offer on-street parallel parking.

- **Neighborhood Connectors** are residential through streets. While the land uses are predominately medium- or low-intensity residential development, some businesses may be present.
- **Country Connectors** provide important connections through low-density rural areas of Montgomery County. They are surrounded by very low-scale development set back from the road, or undeveloped/agricultural areas.
- **Country Roads** occur in low-density areas of the county. Compared to Country Connectors, Country Roads feature more development activity (most often large lot single-family residential), more frequent driveways, and lower vehicle speeds.
- **Industrial Streets** serve industrial corridors and are built to accommodate commercial trucks in addition to passenger vehicles, bicyclists, and pedestrians. While there may be fewer pedestrians and bicyclists in these locations, these streets may also serve as destinations for maker space, retail, or other public-serving uses that may attract foot or bicycle traffic.
- **Neighborhood Streets** serve predominantly residential areas with low volumes of motor vehicle traffic. Pedestrian and bicycle activity are common along these streets.
- **Rustic Roads and Exceptionally Rustic Roads** are historic and scenic roads that reflect the agricultural character and rural origins of the county. If a road is designated as a Rustic Road or Exceptional Rustic Road, certain physical features of the road must be retained, and special right-of-way maintenance procedures may apply to keep speeds low and retain road safety.

Table 12, Table 13, and Table 14 summarize crash risk by CSDG street type. Where intersections include more than one street type (e.g., the intersection of a Downtown Boulevard and a Downtown Street), the intersection is designated based on the higher-intensity street type. Streets in municipalities with independent planning authority are excluded from this analysis.

While most locations are Neighborhood Streets (63% of intersections and 79% of segments), the four intersection crash types have the greatest amount of crash risk along Boulevards. This is not surprising given the low-speed and low-volume nature of Neighborhood Streets. Neighborhood Streets do have the highest total crash risk for analyzed segment crash types.

Table 12. Total Crash Risk by CSDG Street Type (Annual Crashes)

CSDG Street Type	# Ints.*	Intersection Crash Types				# Segs.	Segment Crash Types	
		Ped Dark	Bike	Left Turn	Angle		Ped Seg	Single Veh
Major Highway	18	1	1	11	13	16	0	19
Boulevard	1,191	29	33	334	359	1,217	16	194
Downtown Blvd	134	20	6	57	58	161	7	14
Town Center Blvd	225	13	6	70	89	288	10	31
Downtown Street	210	13	4	26	26	336	5	11
Town Center Street	138	1	1	11	12	191	2	9
Neighborhood Conn	2,825	8	14	64	132	2,997	10	112
Country Conn	280	0	1	14	13	226	1	57
Country Road	90	0	0	1	1	60	0	4
Industrial Street	50	0	0	5	1	59	0	3
Neighborhood Street	9,132	9	6	21	55	21,168	20	227
Rustic Road**	183	0	0	2	4	317	1	36

Highlighted cells have the highest value for any column.

\* As the angle crash type only includes four-legged intersections, the number of intersections for this crash type would only include a fraction of the intersections noted here. Countywide, 23% of intersections have four legs.

\*\* Includes Exceptionally Rustic Roads

For intersection crashes, the trends from total crash risk hold for the hot spot analysis; all four intersection crash types have the highest number of top 200 locations along Boulevards. For segment crash types, the most pedestrian segment hot spots are along Town Center Boulevards, while single vehicle crashes have the most hot spots along Neighborhood Streets.

Table 13. Hot Spot Analysis by CSDG Street Type (# of Top 200 Intersections and Segments)

CSDG Street Type	# Ints.*	Intersection Crash Types				# Segs.	Segment Crash Types	
		Ped Dark	Bike	Left Turn	Angle		Ped Seg	Single Veh
Major Highway	18	1	0	2	5	16	2	10
Boulevard	1,191	50	109	109	104	1,217	39	59
Downtown Blvd	134	48	29	18	16	161	30	0
Town Center Blvd	225	35	21	22	25	288	58	6
Downtown Street	210	40	8	3	5	336	19	0
Town Center Street	138	0	0	2	3	191	5	1
Neighborhood Conn	2,825	2	7	5	17	2,997	6	10
Country Conn	280	0	0	2	2	226	0	30
Country Road	90	0	0	0	0	60	0	0
Industrial Street	50	0	0	2	0	59	0	0
Neighborhood Street	9,132	1	6	1	1	21,168	5	59
Rustic Road**	183	0	0	2	0	317	0	10

Highlighted cells have the highest value for any column.

\* As the angle crash type only includes four-legged intersections, the number of intersections for this crash type would only include a fraction of the intersections noted here. Countywide, 23% of intersections have four legs.

\*\* Includes Exceptionally Rustic Roads

Note: Location totals are less than 200 because intersections and segments within municipalities within independent planning authority do not have designated street types per the CSDG.



The results for average crash risk differ from the other analyses, with the highest crash risk for pedestrian crashes in the dark and bicycle crashes at intersections along Downtown Boulevards, left-turn crashes at intersections along Major Highways and motor vehicle straight / angle crashes in Town Center Boulevards. Pedestrian crashes along segments also have their highest average crash risk along Downtown Boulevards. In contrast, single-vehicle crashes have their highest crash risk along Major Highways. While Major Highways is much higher than the other values, there are very few segments designated as this street type. Other high values for this crash type include Boulevards, Country Connectors, and Rustic Roads.

Table 14. Average Crash Risk by CSDG Street Type (Annual Crashes per Location)

CSDG Street Type	# Ints.*	Intersection Crash Types				# Segs.	Segment Crash Types	
		Ped Dark	Bike	Left Turn	Angle		Ped Seg	Single Veh
Major Highway	18	0.05	0.03	0.60	1.08	16	0.02	1.17
Boulevard	1,191	0.02	0.03	0.28	0.81	1,217	0.01	0.16
Downtown Blvd	134	0.16	0.05	0.43	1.09	161	0.04	0.09
Town Center Blvd	225	0.06	0.03	0.31	1.33	288	0.04	0.11
Downtown Street	210	0.06	0.02	0.12	0.33	336	0.01	0.03
Town Center Street	138	0.01	0.01	0.08	0.32	191	0.01	0.05
Neighborhood Conn	2,825	0.00	0.00	0.02	0.15	2,997	0.00	0.03
Country Conn	280	0.00	0.00	0.05	0.22	226	0.00	0.25
Country Road	90	0.00	0.00	0.01	0.12	60	0.00	0.06
Industrial Street	50	0.01	0.01	0.10	0.28	59	0.01	0.04
Neighborhood Street	9,132	0.00	0.00	0.00	0.03	21,168	0.00	0.01
Rustic Road**	183	0.00	0.00	0.01	0.26	317	0.00	0.12

Highlighted cells have the highest value for each column.

\* As the angle crash type only includes four-legged intersections, the number of intersections for this crash type would only include a fraction of the intersections noted here. Countywide, 23% of intersections have four legs.

\*\* Includes Exceptionally Rustic Roads

#### CRASH RISK BY EQUITY EMPHASIS AREAS

Table 15, Table 16 and Table 17 summarize crash risk based on whether or not a segment is located within an EEA, Census tracts with high concentrations of low-income individuals and/or racial and ethnic minorities. Given that EEAs comprise just 18% of intersections and 16% of segments, it is not surprising that total crash risk is higher in non-EEA areas in Montgomery County.

Table 15. Total Crash Risk in EEAs vs. Non-EEAs (Annual Crashes)

Equity Area Type	# Ints.*	Intersection Crash Types				# Segs.	Segment Crash Types	
		Ped Dark	Bike	Left Turn	Angle		Ped Seg	Single Veh
EEA	3,049	48	24	251	278	5,040	32	124
Non-EEA	13,607	56	61	477	569	26,002	51	661

Highlighted cells have the highest value for any column.

\* As the angle crash type only includes four-legged intersections, the number of intersections for this crash type would only include a fraction of the intersections noted here. Countywide, 23% of intersections have four legs.

In looking at the top 200 crash locations, EEAs are overrepresented relative to the number of intersections and segments in EEAs. This is most extreme for the pedestrian crash types, where more than half of the top 200 locations are within EEAs. Addressing this disparity requires focusing pedestrian improvements in the low-income communities and Communities of Color within Montgomery County.

Table 16. Hot Spot Analysis in EEAs vs. Non-EEAs (# of Top 200 Intersections and Segments)

Equity Area Type	# Ints.*	Intersection Crash Types				# Segs.	Segment Crash Types	
		Ped Dark	Bike	Left Turn	Angle		Ped Seg	Single Veh
EEA	3,049	108	66	80	78	5,040	134	26
Non-EEA	13,607	92	134	120	122	26,002	66	174

Highlighted cells have the highest value for any column.

\* As the angle crash type only includes four-legged intersections, the number of intersections for this crash type would only include a fraction of the intersections noted here. Countywide, 23% of intersections have four legs.

The disparity between EEAs and non-EEAs is most apparent in the evaluation of average crash risk, where EEAs have higher values for all but one crash type. At intersections in EEAs, the average crash risk is higher than non-EEAs by 272% for pedestrian crashes after dark, 72% for bicycle crashes at intersections, 130% for left-turn crashes, 92% higher for angle crashes at four-legged intersections, and 226% higher for pedestrian crashes along segments. The outlier is single vehicle crashes, yet this is unsurprising given these crashes are less prevalent in urban areas, while EEAs tend to be focused in the dense parts of the county.

Table 17. Average Crash Risk in EEAs vs. Non-EEAs (Annual Crashes per Location)

Equity Area Type	# Ints.*	Intersection Crash Types				# Segs.	Segment Crash Types	
		Ped Dark	Bike	Left Turn	Angle		Ped Seg	Single Veh
EEA	3,049	0.02	0.01	0.08	0.37	5,040	.007	.025
Non-EEA	13,607	0.00	0.00	0.04	0.19	26,002	.002	.026

Highlighted cells have the highest value for any column.

\* As the angle crash type only includes four-legged intersections, the number of intersections for this crash type would only include a fraction of the intersections noted here. Countywide, 23% of intersections have four legs.

#### RELATIONSHIP TO OBSERVED SEVERE AND FATAL CRASHES

The crash risk summaries on the previous pages provide a new lens with which to look at where safety issues are concentrated and where safety improvements may be most beneficial. This approach can also be used to review historic severe injuries and fatalities. Between 2015 and 2019, there were 1,267 crashes that resulted in a severe injury and 152 crashes that resulted in a fatality. The context trends associated with these serious crashes are similar to those presented in the tables above:

- While most severe injuries and fatalities occur in Suburban areas, the average rates for these types of crashes are highest in urban areas (Town Centers for fatalities and Downtowns for severe injuries).

- Boulevards have the highest history of severe injuries and fatalities, but the average crash rate along Boulevards is lower than that of Downtown Boulevards and Major Highways.
- Equity Emphasis Areas have fewer severe and fatal crashes overall, but the average rate of these crash types is substantially higher in EEAs than in other parts of the county (fatalities are 160% higher while severe injuries are 90% higher).

A hot spot analysis is not conducted as part of this review, as there are few locations with more than one severe injury or fatality. Appendix H presents the severe and fatal crash analysis in more detail.

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## KEY FINDINGS

The results summarized on the previous pages provide the total crash risk, hot spot analysis, and average crash risk for the county's area types, street types, and EEAs. This analysis reveals a few high-level findings that can inform where safety improvements are needed and should be prioritized in the future:

- **Prioritization needs to look beyond crash history.** In the past, Montgomery County has sometimes taken a reactionary approach to transportation safety, implementing site-specific improvements in the aftermath of a severe or fatal crash. The results of this analysis show that prioritizing safety treatments based solely on locations with a history of severe injury and fatal crashes could result in unmitigated crash risk, due to the randomness of severe and fatal crashes. In fact, between 2015 and 2019 in Montgomery County, only 55% of fatalities and 46% of severe injuries occurred in top 200 intersections and roadway segments.
- **As a suburban county, much of Montgomery County's crash risk is in the suburbs.** The county's suburban areas and the high-speed, high-volume suburban Boulevards (like Georgia Avenue or Middlebrook Road) that run through them have the highest concentration of crash risk in the county for most crash types. To reach Vision Zero, safety improvements must address these locations.
- **Yet Downtowns and Town Centers have the highest average crash risk.** On a per-intersection or per-roadway segment basis, crash risk is highest in the county's urban areas, particularly for pedestrian and bicycle crash types. Systemic improvements on Downtown Boulevards and Town Center Boulevards – and more broadly in Downtown and Town Center areas – would yield the greatest benefits.
- **Safety improvements in Equity Emphasis Areas should be prioritized.** Across all metrics, crash risk is disproportionately concentrated in EEAs. More than half of the top 200 locations for pedestrian crash types are located within EEAs, and the average crash risk in EEAs far exceeds that for non-EEAs for five of the six crash types. Focusing investments in EEAs can mitigate this disparity and balance crash risk in the county.

## 7. PAIR CRASH TYPES WITH COUNTERMEASURES

Once the predicted crashes for each crash type is identified for all intersections and segments in the county, countermeasures, or strategies to reduce crashes, can be applied to each location. This analysis uses crash modification factors (CMFs) to estimate reductions in the number of predicted crashes. CMFs essentially provide a percentage of crashes that would still occur if the countermeasure was implemented, and they are based on research evaluated by the Federal Highway Administration and are inventoried in the CMF Clearinghouse.<sup>9</sup> For example, a specific stop-controlled intersection could be expected to experience 10 crashes per year. One countermeasure for improving safety at this stop-controlled intersections could be installing a traffic signal, which has a CMF of 0.56. The expected total crashes after installing the signal would be  $10 \times 0.56 = 5.6$  crashes per year.

The Predictive Safety Analysis generally looks at the impact of implementing one countermeasure at a location. However, in reality, multiple safety treatments may be appropriate at a given intersection or segment. If more than one treatment is applied, the expected crash reduction is greater than just one treatment alone, however, the expected crash reduction is less than the sum of each CMF. The analysis here presents the benefits of individual countermeasures, but it does not estimate the combined effect should multiple safety treatments be used at the same location.

### COUNTERMEASURES OVERVIEW

Roadway improvements are often categorized in two ways, as systemic or spot safety improvements. Systemic countermeasure implementation is a common Vision Zero approach that identifies many locations throughout the county for rapid application. These treatments are generally considered well-suited for widespread implementation because of their safety effectiveness, cost effectiveness, and because they may be implemented with limited study and design. In contrast, spot safety treatments use traditional site-based analysis at a specific location.

[The systemic approach to safety] provides a more comprehensive method for safety planning and implementation that supplements and complements traditional site analysis. The approach also helps agencies broaden their traffic safety efforts and consider risk as well as crash history when identifying where to make low-cost safety improvements.<sup>10</sup>

The countermeasure analysis in the Predictive Safety Analysis includes 15 systemic countermeasures, summarized on the following pages. These countermeasures improve safety through several mechanisms, including speed management, pedestrian crossings, intersection control, signal timing, and other means.

<sup>9</sup> <https://www.cmfclearinghouse.org/>

<sup>10</sup> FHWA. Systemic Safety Project Selection Tool.  
<https://safety.fhwa.dot.gov/systemic/fhwasa13019/chap1.cfm#chap111>

The systemic improvements analyzed for this project are not comprehensive, and potentially applicable countermeasures are excluded from this analysis for two reasons:

- **Data Availability:** In order to analyze the potential crash reduction associated with a countermeasure, data must be available about where that countermeasure currently exists in the county, as well as data about where that countermeasure would be appropriate for implementation. For example, while eliminating channelized (or “free”) right turn movements could improve safety, our database does not include an inventory of intersections that currently have a channelized right-turn.
- **Existing Research:** There are many countermeasures that may offer safety benefits but have not yet been evaluated and inventoried in the CMF Clearinghouse, or because the previous research was not deemed conclusive or reliable. These countermeasures are excluded from this analysis, as crash reduction cannot be estimated without a CMF value. One example is “No Right Turn on Red” restrictions at signalized intersections; because there is no CMF for this safety treatment, its benefit cannot be evaluated.

Additional countermeasures and additional information about the countermeasures summarized below are included in the county’s [Vision Zero Community Toolkit](#).

## SPEED MANAGEMENT

### **Automated Enforcement – Speed Cameras** automatically issue fines for speeding

CMFs: along urban arterials, 0.46 for all crashes (54% reduction) and 0.37 for single-vehicle crashes (63% reduction)<sup>11</sup>



**Speed Humps** are paved ramps measuring 3- to 4- inches high that extend the full width of the street

CMF: 0.55 for all crashes (45% reduction)<sup>13</sup>



**Lower Speed Limit by 5 MPH** decreases the posted speed limit and can decrease crashes and crash severity.

CMF: 0.44 for all crashes in rural areas (56% reduction)<sup>12</sup>



<sup>11</sup> Shin, K., Washington, S., van Schalkwyk, I., "Evaluation of the Scottsdale Loop 101 automated speed enforcement demonstration program." *Accident Analysis and Prevention*, Vol. 41, No. 3, Oxford, N.Y., Pergamon Press, (2009) pp. 393-403.

<sup>12</sup> Gayah, V.V., E.T. Donnell, Z. Yu, and L.Li. "Safety and operational impacts of setting speed limits below engineering recommendations". *Accident Analysis and Prevention*, Vol. 121, (2018) pp. 43-52.

<sup>13</sup> Elvik, R. and Vaa, T., "Handbook of Road Safety Measures." Oxford, United Kingdom, Elsevier, (2004)



## PEDESTRIAN CROSSINGS

**High-Visibility Crosswalks** use parallel markings that motorists see more easily compared with traditional crosswalk markings located perpendicular to the motor vehicle path of travel.

CMF: 0.63 for pedestrian crashes in urban areas (37% reduction)<sup>14</sup>

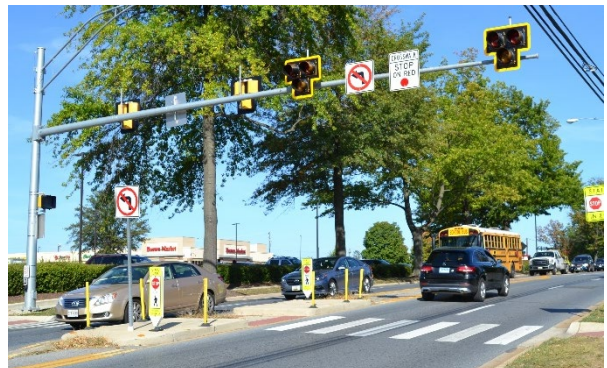


**Raised Pedestrian Crosswalks** are crossings elevated at least three inches above the roadway, up to the sidewalk level.

CMFs: 0.64 for all severe injury crashes on 2-lane roads (36% reduction) and 0.55 for mid-block, severe-injury pedestrian crashes on 2-lane roads (45% reduction)<sup>15</sup>

**Pedestrian Hybrid Beacons** are signals at major street crossing locations that remain dark until pedestrian activates via a pushbutton. Also called High Intensity Activated Crosswalks, or HAWKS.

CMFs: 0.883 for all crashes (11.7% reduction) and 0.54 for mid-block pedestrian crashes (46% reduction)<sup>16</sup>



<sup>14</sup> Feldman, M., J. Manzi, and M. Mitman. "An Empirical Bayesian Evaluation of the Safety Effects of High-Visibility School Crosswalks in San Francisco." TRB 89th Annual Meeting Compendium of Papers CD-ROM. Washington, D.C. 2010.

<sup>15</sup> Elvik, R. and Vaa, T., "Handbook of Road Safety Measures." Oxford, United Kingdom, Elsevier, (2004)

<sup>16</sup> Fitzpatrick, K., M.J. Cynecki, M.P. Pratt, E.S. Park, and M.E. Beckley. "Evaluation of Pedestrian Hybrid Beacons on Arizona Highways." Report No. FHWA-AZ-19-756. Arizona Department of Transportation. Phoenix, Arizona. (September 2019).

## INTERSECTION CONTROL

**All-Way Stop Control** includes a stop sign on all intersection approaches. All vehicles are required to stop and yield to pedestrians, bicyclists, or other vehicles before continuing through the intersection.

CMFs: 0.319 for all crashes (68.1% reduction),<sup>17</sup> 0.57 for pedestrian crashes in urban areas (43% reduction), and 0.25 for angle crashes in urban areas (75% reduction)<sup>18</sup>

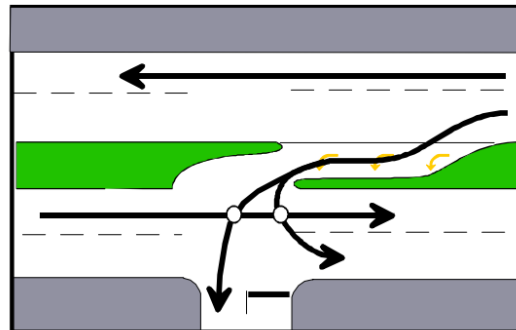


**Traffic Signals** are used to assign vehicular and pedestrian right-of-way, promoting the orderly movement of traffic through the intersection while preventing excessive delay.

CMFs: 0.614 and 0.716 for all crashes at 4-leg and 3-leg intersections, respectively (38.6% and 28.4% reductions)<sup>19</sup> and 0.46 and 0.45 for angle crashes at 4-leg and 3-leg intersections, respectively (54% and 55% reductions)<sup>20</sup>

**“Left-In-Only” Median** permits vehicles turning off the major street to make a left onto the minor street, while vehicles on the minor street can only make a right turn onto the major street.

CMFs: 0.95 for all crashes (5% reduction) and 0.55 for left-turn crashes (45% reduction)<sup>21</sup>



<sup>17</sup> Simpson, C.L. and Hummer, J.E., "Evaluation of the Conversion from Two-Way Stop Sign Control to All-Way Stop Sign Control at 53 Locations in North Carolina." *Journal of Transportation Safety and Security*, Vol 2, No. 3, (2010) pp. 239-260.

<sup>18</sup> Lovell, J. and Hauer, E., "The Safety Effect of Conversion to All-Way Stop Control." *Transportation Research Record* 1068, Washington, D.C., Transportation Research Board, National Research Council, (1986) pp. 103-107.

<sup>19</sup> Srinivasan, R., B. Lan, and D. Carter. "Safety Evaluation of Signal Installation With and Without Left Turn Lanes on Two Lane Roads in Rural and Suburban Areas." Report No. FHWA/NC/2013-11. North Carolina Department of Transportation. Raleigh, North Carolina. (October 2014).

<sup>20</sup> Abdel-Aty, M.A., C. Lee, J. Park, J.Wang, M. Abuzwidah, and S. Al-Arifi. "Validation and Application of Highway Safety Manual (Part D) in Florida." Florida Department of Transportation. Tallahassee, Florida. (May 2014).

<sup>21</sup> H. Zhou, J. Zhao, P. Hsu and J. Huang, "Safety Effects of Median Treatments Using Longitudinal Channelizers: Empirical Bayesian Before After Study", *Journal of Transportation Engineering*, Vol.139, No.12, American Society of Civil Engineers, (2013) pp. 1149-1155



## SIGNAL TIMING

**Increase All-Red Clearance Interval** increases the period in which no vehicles are permitted to travel through the intersection, reducing the likelihood of crashes associated with red-light running.

CMF: 0.798 (20.2% reduction) for all crashes in urban areas<sup>22</sup>

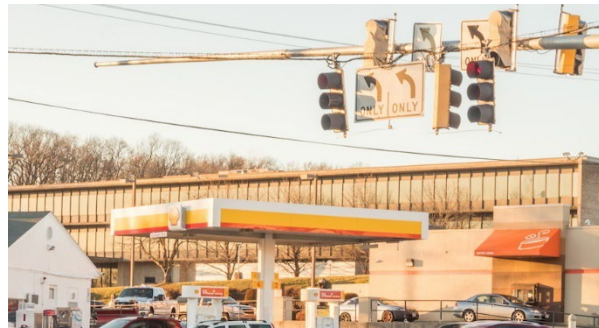


**Protected/Permissive Left Turn** provides green-signals to restrict motorist turning left, allowing pedestrians and bicyclists to use crossings without interactions from turning vehicles and reducing left-turn conflicts between vehicles.

CMF: 0.862 for left-turn crashes at four-legged intersections (13.8% reduction)<sup>14</sup>

**Fully Protected Left Turn** provides a separate phase for left-turning traffic and allows left turns only to be made on a green left arrow signal.

CMF: 0.58 for urban and suburban crashes (42% reduction)<sup>23</sup>



**Leading Pedestrian Intervals** are adjustments to traffic signals to give pedestrians a three-to-seven-second head start before motorists enter the intersection.

CMFs: 0.83 for all crashes (17% reduction) and 0.81 for pedestrian crashes (19% reduction)<sup>24</sup>

<sup>22</sup> Srinivasan, R., et al. "NCHRP Report 705: Evaluation of Safety Strategies at Signalized Intersections.", Washington, D.C., Transportation Research Board, National Research Council, (2011)

<sup>23</sup> Davis, G.A. and Aul, N., "Safety Effects of Left-Turn Phasing Schemes at High-Speed Intersections", Minnesota Department of Transportation, Report No. MN/RC-2007-03, (2007)

<sup>24</sup> Goughnour, E., et al. "Safety Evaluation of Protected Left-Turn Phasing and Leading Pedestrian Intervals on Pedestrian Safety." Report No. FHWA-HRT-18-044. Federal Highway Administration. (October 2018)

## OTHER COUNTERMEASURES

**Centerline Rumble Strips** alert drivers through vibration and sound that their vehicle has drifted from the travel lane towards the oncoming travel lane.

CMFs: 0.86 for all crashes in rural areas (14% reduction)<sup>25</sup> and 0.808 for single-vehicle crashes in rural areas (19.2% reduction)<sup>26</sup>



**Lighting** improves visibility for all road users. Pedestrian-scale lighting illuminates sidewalks and crossings and light fixtures are shorter than roadway-scale light fixtures.

CMFs: 0.881 for all nighttime crashes (11.9% reduction) at intersections with 2-4 lanes per leg<sup>27</sup>

<sup>25</sup> Persaud, B. N., Retting, R. A., and Lyon, C., "Crash Reduction Following Installation of Centerline Rumble Strips on Rural Two-Lane Roads." Arlington, Va., Insurance Institute for Highway Safety, (2003)

<sup>26</sup> Rys, M., D. Karkle, and E. Russell. "Study of KDOT Policy on Lane and Shoulder Minimum Width for Application of Centerline Rumble Strips." Report No. K-TRAN:KSU-10-7. Kansas Department of Transportation. Topeka, Kansas. (August 2012).

<sup>27</sup> Donnell, E.T., R.J. Porter, and V.N. Shankar. "A Framework for Estimating the Safety Effects of Roadway Lighting at Intersections." Safety Science, Vol. 48(10), pp. 1436-1444, 2010.

## COUNTERMEASURE ANALYSIS APPROACH

For each of the analyzed crash types, one or more countermeasures are identified as strategies to reduce that specific type of crash. For example, lighting is identified as a countermeasure for reducing pedestrian crashes after dark at intersections. Beyond pairing countermeasures with crash types, some countermeasures are evaluated through several different contexts in order to understand where the countermeasure would be most effective. The summary of scenarios by crash type and countermeasure are summarized in Table 18. Additional context considerations for each scenario are included in Appendix I.

Table 18. Countermeasure and Contexts by Crash Type

Crash Type	Countermeasure	Context (if applicable)
Pedestrian crashes after dark at intersections	High-Visibility Crosswalk	Signalized Intersections with some High-Visibility Crosswalks
		Signalized Intersections with Only Standard Crosswalks
		Unsignalized Intersections with Only Standard Crosswalks
		Signalized Intersections with No Crosswalks
	Lighting	Signalized Intersections
		Unsignalized Intersections
Pedestrian crashes along segments with vehicles going straight	High-Visibility Crosswalk	
	Raised Crossing	
	Pedestrian Hybrid Beacon	
	Speed Humps	
Bicycle crashes at intersections	Leading Pedestrian Interval	Downtown Boulevards
		Town Center Boulevards, Boulevards, and Major Highways
Left-turn crashes at intersections (all modes)	Traffic Signal	
	Protected/Permitted Signal Phase	
	Fully Protected Left Turn	
Motor vehicle straight/angle crashes at four-legged intersections	Increase All-Red Clearance Interval	Boulevards, Downtown Boulevards, Town Center Boulevards, Major Highways
		All Other Street Types
	Mini-Roundabout	
	All-Way Stop Control	
	Traffic Signal	
Restrict to Left-In Access		
Single vehicle crashes along segments	Centerline Rumble Strip	
	Reduce Speeds by 5 MPH	
	Automated Speed Enforcement	

The crash reduction is then calculated for all intersections and roadway segments for each countermeasure and its associated contexts. The crash reduction is the sum of two parts: crash

reduction for the identified crash type (one of the six crash types noted above) and crash reduction for other crashes at that location.

- Crash Reduction for the Identified Crash Type:** The analysis is focused on six crash types, and the selected countermeasures are focused on specifically reducing those types of crashes. The first piece of assessing crash reduction assesses the countermeasure’s impact on the identified crash types. In some cases, this means applying a specific CMF for that crash type, though it may also entail applying a more general CMF (e.g., a CMF for all crashes or for all crashes of a certain mode) to the predicted number of crashes.
- Crash Reduction for Other Crashes at that Location:** While some number of crashes at each location is associated with the six crash types, there are other types of crashes that happen at these locations as well, and those crashes could also be reduced through the implementation of safety countermeasures. This analysis subtracts the observed crashes of the identified crash type from the total observed crashes at a given location to understand the “other” crashes at that location. CMFs are then applied to the other crashes. There is no predicted crash metric for other crashes, so the observed metric must be used for this calculation.

#### APPLYING COUNTERMEASURES BASED ON LOCATION RANK

Safety improvements should be prioritized in the places where they are most needed. As a result, the countermeasure analysis applies the countermeasures to the top ranked locations for each countermeasure. Table 19 and Figure 1 summarize how crash risk is distributed across different locations, demonstrating the benefit of focusing on top-ranked locations for improvements.

For three crash types, almost half of the county’s crash risk is concentrated in the top 200 locations, and 80 to 90% of crash risk is concentrated in the top 1,000 locations, suggesting that targeted improvements at these locations could have a substantial impact at reducing crash risk<sup>28</sup>. For the other crash types, risk is more diffused, with a higher percent of crashes outside of the top 1,000 locations. Appendix J includes a list of the top 50 ranked locations for each countermeasure.

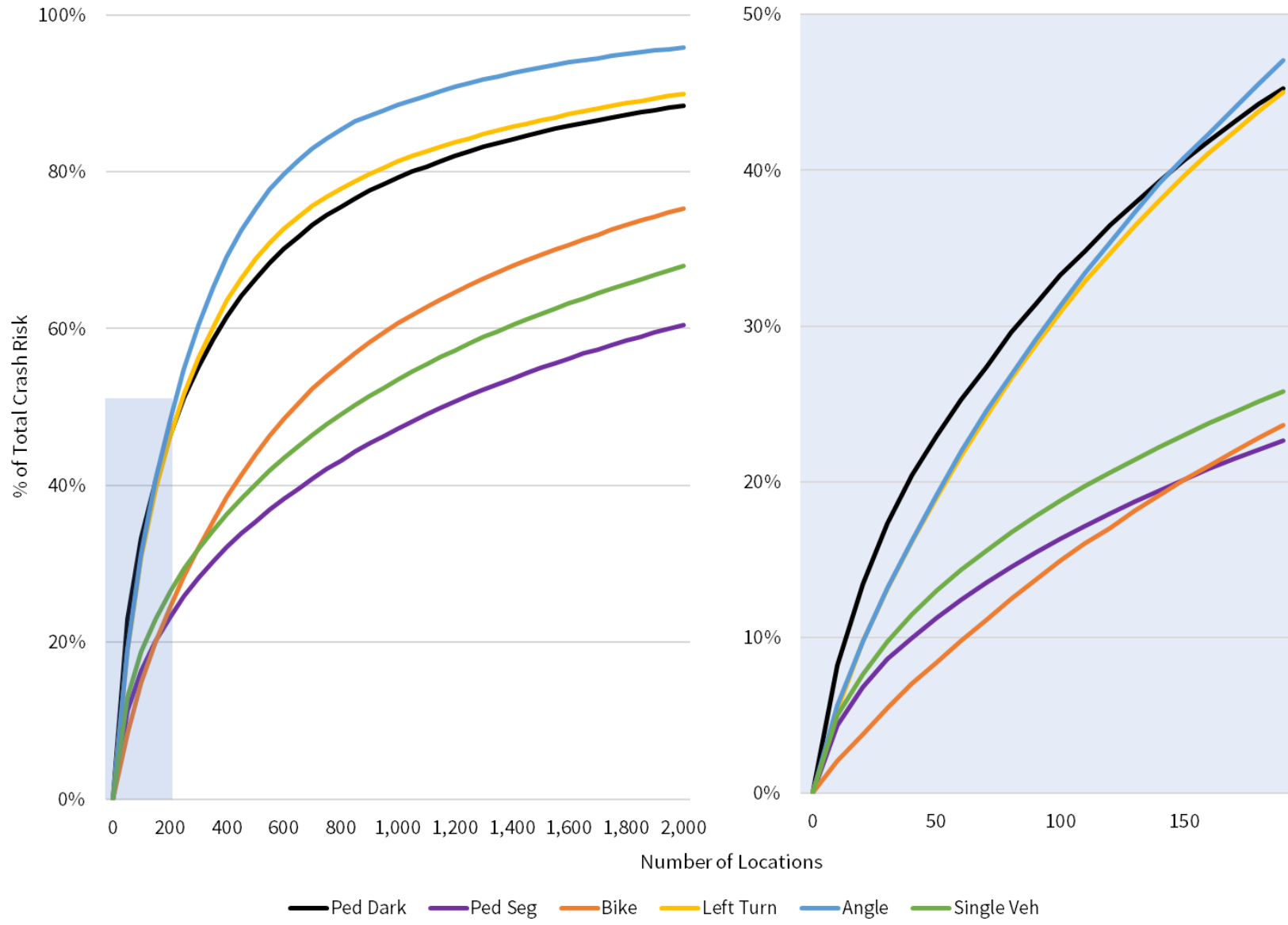
Table 19. Portion of Total Annual Crash Risk included in Top 200 Locations

Crash Type	Total Crash Risk	% Crash Risk in Top 200	% Crash Risk in Top 1,000
Pedestrian crashes after dark at intersections	106	47%	80%
Pedestrian crashes on roadway segments with vehicles going straight	83	23%	47%
Bicycle crashes at intersections	86	25%	61%
Left-turn crashes at intersections (all modes)	734	46%	81%
Motor vehicle straight/angle crashes at four-legged intersections	875	48%	88%
Single vehicle crashes along roadway segments	787	27%	54%

<sup>28</sup> The top 200 locations comprise just 1.2% of intersections and 0.6% of roadway segments, and the top 1,000 locations comprise 6.0% of intersections and 3.2% of roadway segments.



Figure 1. Cumulative Crash Risk by Location Rank and Crash Type



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## COUNTERMEASURE EVALUATION TOOL

This report does not provide a prescriptive recommendation of capital improvements; it does not recommend which countermeasures should be implemented at which locations. Instead, the project provides a countermeasure evaluation tool for planners, engineers, and decisionmakers to assess different investment scenarios based on their goals and priorities.

The tool evaluates the effectiveness of different countermeasure scenarios in several ways.

- **Potential Crash Reduction:** the number of crashes that could be mitigated with implementation of the countermeasure. This measure summarizes the total or aggregate benefit of implementing the countermeasure, and it rises with the more locations that are improved.
- **Potential Crash Reduction per Location:** the potential crash reduction divided by the number of locations. This measure provides the per-location benefit of the countermeasure, and it generally decreases with the more locations that are improved (because the highest-risk locations are improved first).
- **Cost per Crash Reduced:** the total estimated cost divided by the potential crash reduction. This measure provides insight into the cost effectiveness of the countermeasure, and it generally rises with the more locations that are improved (again, because the highest-risk locations are improved first). Appendix K includes countermeasure costs.
- **% of Locations in Equity Emphasis Areas:** what portion of locations are within an EEA. This assesses the equity benefit of a countermeasure, and it generally decreases with the more locations that are improved (as many of the highest-risk locations in the county are within EEAs, and these locations are improved first).

Generally, the CMFs are applied to the number of annual predicted or observed crashes, yet the benefits of safety improvements extend beyond one year. The tool allows the user to input their desired timeline for analysis, which could coincide with the budget cycle (6 years) or the lifecycle of a given type of infrastructure (e.g., stop signs last 10+ years). Extending the analysis time period increases the potential crash reduction and potential crash reduction per location while decreasing the cost per crash reduced.

Two examples below show how the tools can be used to determine which countermeasures to implement and how many locations to improve.

### EXAMPLE 1: DETERMINING WHICH COUNTERMEASURES TO IMPLEMENT

The first example allows the user to determine the best way to spend \$350,000 to decrease straight/angle crashes at four-legged intersections. Assuming a 10-year analysis period, Table 20

shows the one-year and long-term benefit of increasing all red clearance time on selected street types, implementing all-way stop control, and installing traffic signals.

As countermeasures vary in their costs, how many locations can be addressed with \$350,000 differs across the countermeasures. Updating signal timing is far less costly than a new traffic signal, so many more locations could be updated with this treatment (116 locations vs. 1 location). Given the number of locations addressed, the potential crash reduction for increasing all red clearance far exceeds the other treatments, yet the per-location crash reduction is lower than that of installing a traffic signal.

Table 20. Example Scenarios for Reducing Straight/Angle Crashes with \$350,000

Scenarios		Increase All Red Clearance*	All-Way Stop	Traffic Signal
Number of Locations		116	70	1
Total Estimated Cost		\$348,000	\$350,000	\$350,000
One-Year Impact	Potential Crash Reduction	256	31	5
	Potential Crash Reduction per Location	2.2	0.4	4.7
	Cost per Crash Reduced	\$1,400	\$11,300	\$73,800
Long-Term Impact (10 Years)	Potential Crash Reduction	2,557	311	47
	Potential Crash Reduction per Location	22.0	4.4	47.4
	Cost per Crashes Reduced	\$140	\$1,130	\$7,380
% of Locations in Equity Emphasis Areas		47%	21%	0%

\* on Boulevards, Downtown Boulevards, Town Center Boulevards, Major Highways

#### EXAMPLE 2: ASSESSING HOW MANY LOCATIONS TO IMPROVE

The second example allows the user to determine how many signalized intersections should be recommended for improving lighting to reduce pedestrian crashes after dark. While the cost increases with the addition of new locations, the total potential crash reduction increases as well. The crash reduction per location declines slightly with additional locations, and the cost per crash reduced increases.

Table 21. Examples Scenarios for Improving Lighting at Signalized Intersections

Scenarios		20 Locations	40 Locations	60 Locations
Total Estimated Cost		\$100,000	\$200,000	\$300,000
One-Year Impact	Potential Crash Reduction	5	9	11
	Potential Crash Reduction per Location	0.2	0.2	0.2
	Cost per Crash Reduced	\$20,900	\$23,100	\$27,400
Long-Term Impact (10 Years)	Potential Crash Reduction	48	87	109
	Potential Crash Reduction per Location	2.4	2.2	1.8
	Cost per Crashes Reduced	\$2,090	\$2,310	\$2,740
% of Locations in Equity Emphasis Areas		55%	48%	38%

## CANDIDATE LOCATIONS

Each of the countermeasures are associated with a ranked list of candidate locations for systemic implementation. However, given the countywide nature of this analysis, individual site reviews are needed to confirm that the identified locations are context-appropriate for the selected countermeasures. Appendix J includes the top 50 locations for each countermeasure and its associated contexts.

## 8. APPLICATIONS

The Predictive Safety Analysis is the first step towards implementing a proactive approach to safety. While additional study could further the benefits of this work (see Appendix L), the Predictive Safety Analysis provides Montgomery County with a solid foundation for proactive safety planning. Based on the findings and tools developed as part of this project, the Planning Department, Montgomery County Department of Transportation, and the County Council can use this information in a variety of ways to inform future recommendations, priority projects, and funding allocations.

There are several uses of the results of the Predictive Safety Analysis:

- **Apply Data-Driven Planning:** Historically, much of transportation planning has been reactive, through improving locations with a recent severe or fatal crash or making investments in response to vocal community members. The Predictive Safety Analysis provides the data, analysis, and tools to shift the county’s approach and implement improvements where they are needed and more equitably. This data can combat the “squeaky wheel” by distributing resources equitably and to where they are most needed. In addition, the data can support funding requests, both as part of the local or state budgeting process as well as through grant applications.
- **Identify Locations with High Crash Risk:** The results included in the section 6. Summarizing Crash Risk identify the types of locations with high crash risk. The findings in this section can be used to identify location types that are likely to experience a high number of crashes. This data can be used to inform Capital Improvement Program (CIP) capital project prioritization, prioritization of off-site mitigation for new development, a focus for transportation improvements within master planning areas, and can inform Mandatory Referral comments.
- **Prioritize Safety Improvements:** The tools summarized in the Section 7. Pair Crash Types with Countermeasures) allow implementing agencies to prioritize where to implement systemic safety treatments as well as to assess which safety treatments may be the most effective at reducing crashes. This information can make the case for additional funding for



CIP level-of-effort programs, inform master plan recommendations, and support updates to the Growth and Infrastructure Policy focused on motorist safety.<sup>29</sup>

- **Determine Locations with Similar Conditions:** The databases developed as part of the Predictive Safety Analysis include hundreds of variables related to the transportation, land use, and demographic context in which the crash occurred. In the wake of future severe or fatal crashes, this data can help identify other “like” locations to the severe or fatal crash and inform a more systemic response to the incident (rather than just improving the location here the crash occurred).

These broad uses can be applied to several aspects of transportation planning, engineering, funding, and implementation in Montgomery County, as listed in the examples above. Over the longer term, a systemic approach to crash prediction can also help facilitate redesign of the entire transportation network, by identifying road designs, populations, and land use patterns, that are associated with risk and mitigating that risk through new policies and systematic designs. Taking a more proactive, data-driven approach to transportation safety will impact all facets of transportation planning process.

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<sup>29</sup> The 2020 Growth and Infrastructure Policy already addresses pedestrian and bicycle safety through its adequacy tests. The Predictive Safety Analysis provides a quantitative approach to evaluating motorist safety not currently addressed in the Growth & Infrastructure Policy.

## GLOSSARY

**Correlation:** A statistical measure that expresses the extent to which two variables are linearly related.

**Countermeasure:** Strategies effective at reducing roadway crashes, severe injuries, and fatalities.

**Crash Modification Factor (CMF):** A percentage of crashes that would still occur if the countermeasure was implemented, based on research evaluated by the Federal Highway Administration.

**Crash Risk:** The number of expected crashes at a location, accounting for both a safety performance function and crash history. Also referred to as Empirical-Bayes (EB) crashes.

**Empirical-Bayes (EB) Crashes:** Crash estimate that weighs both observed and predicted crashes based on 1) how well the SPF predicts crashes and 2) the number of predicted crashes at the specific location. Also referred to as crash risk.

**Equity Emphasis Areas (EEAs):** Census tracts in the DC region categorized by high concentrations of lower-income households and people of color. The EEAs were developed by the Metropolitan Washington Council of Governments.

**High Injury Network:** Identifies roadways with the highest rates of severe and fatal crashes.

**Observed Crashes:** The historical crashes that occurred at an intersection or on a roadway segment.

**Predicted Crashes:** The number of expected crashes at a location, this is the outcome of the safety performance function.

**Safety Performance Function (SPF):** A regression model used to predict the expected number of crashes based on several factors.

**Severe Injury:** An injury that results in one or more of the following:

- Severe laceration resulting in exposure of underlying tissues/muscle/organs or resulting in significant loss of blood
- Broken or distorted extremity (arm or leg)
- Crush injuries
- Suspected skull, chest or abdominal injury other than bruises or minor lacerations
- Significant burns (second and third degree burns over 10% or more of the body)
- Unconsciousness when taken from the crash scene
- Paralysis

**Systemic Safety:** A common Vision Zero approach that identifies many locations throughout the county for rapid application of countermeasures because of their safety effectiveness, cost effectiveness, and because they may be implemented with limited study and design

**Vision Zero:** A proven approach to preventing roadway-related deaths and severe injuries. It represents a fundamental change in how we plan and design our roads, shifting from a focus on maximizing motor vehicle efficiency to ensuring that our roads are safe.

## APPENDICES

Appendix A. Intersection and Segment Variables

Appendix B. Count Data Collection Plan

Appendix C. Volume Estimation Models

Appendix D. Crash Types

Appendix E. SPF Equations

Appendix F. Top 50 Locations by Crash Type

Appendix G. High-Risk Locations by Context Characteristics

Appendix H. Severe and Fatal Crashes Context Analysis

Appendix I. Where Countermeasures are Applied

Appendix J. Candidate Locations for Systemic Countermeasure Implementation

Appendix K. Countermeasure Costs

Appendix L. Areas for Future Study

## APPENDIX A. INTERSECTION AND SEGMENT VARIABLES

### INTERSECTION VARIABLES

Category	Description
ID	Intersection ID
Transportation	
Enforcement	Presence of red-light camera at int. (0=no, 1=yes)
Bike/Ped	Highest category of bikeway w/in 100 feet of the int.
Bike/Ped	Highest category of bikeway w/in 500 feet of the int.
Bike/Ped	int. has a trail crossing w/in 100 ft (0=no, 1=yes)
Bike/Ped	Total bikeway length w/in 100 feet of the int.
Bike/Ped	Total bikeway length w/in 500 feet of the int.
Bike/Ped	Total number of crosswalks with median island near the int.
Bike/Ped	Total number of high visibility crosswalks near the int.
Bike/Ped	Total number of marked crosswalks near the int.
Bike/Ped	Total sidewalk length w/in 100 feet of the int.
Bike/Ped	Total sidewalk length w/in 500 feet of the int.
Bikeshare	Density of Bikeshare Stations per sq. mile w/in 1/10 mile of the int.
Bikeshare	Density of Bikeshare Stations per sq. mile w/in 1/2 mile of the int.
Bikeshare	Density of Bikeshare Stations per sq. mile w/in 1/4 mile of the int.
Parking	Density of Parking Garages and Lots per sq. mile w/in 1/10 mile of the int.
Parking	Density of Parking Garages and Lots per sq. mile w/in 1/2 mile of the int.
Parking	Density of Parking Garages and Lots per sq. mile w/in 1/4 mile of the int.
Parking	Percent of area w/in 100 ft of int. comprised of parking lots
Parking	Percent of area w/in 500 ft of int. comprised of parking lots
Segment-Based	Highest road class among all legs at the int.
Segment-Based	Maximum number of through lanes on any leg at the int.
Segment-Based	Minimum number of through lanes on any leg at the int.
Segment-Based	Number of legs with no lane data at the int.
Segment-Based	Total number of legs among all segments at the int.
Segment-Based	Total through lanes on all legs at the int.
Traffic Control	int. has stop signs
Traffic Control	Number of stop signs at the int.
Traffic Control	Signalized traffic control at int. (0=no, 1=yes)
Transit	Density of MARC Train Stations per sq. mile w/in 1/10 mile of the int.
Transit	Density of MARC Train Stations per sq. mile w/in 1/2 mile of the int.
Transit	Density of MARC Train Stations per sq. mile w/in 1/4 mile of the int.
Transit	Density of Metro Stations per sq. mile w/in 1/10 mile of the int.
Transit	Density of Metro Stations per sq. mile w/in 1/2 mile of the int.
Transit	Density of Metro Stations per sq. mile w/in 1/4 mile of the int.

Category	Description
Transportation	
Transit	Density of Park and Ride Lots per sq. mile w/in 1/10 mile of the int.
Transit	Density of Park and Ride Lots per sq. mile w/in 1/2 mile of the int.
Transit	Density of Park and Ride Lots per sq. mile w/in 1/4 mile of the int.
Transit	Number of bus stops w/in 1/10 mile of int.
Transit	Number of bus stops w/in 1/2 mile of int.
Transit	Number of bus stops w/in 1/4 mile of int.
Transit	Number of commuter rail stops w/in 1/10 mile of int.
Transit	Number of commuter rail stops w/in 1/2 mile of int.
Transit	Number of commuter rail stops w/in 1/4 mile of int.
Transit	Number of metro stations w/in 1/10 mile of int.
Transit	Number of metro stations w/in 1/2 mile of int.
Transit	Number of metro stations w/in 1/4 mile of int.
Transit	Number of routes at all stops w/in 1/10 mile of int.
Transit	Number of routes at all stops w/in 1/2 mile of int.
Transit	Number of routes at all stops w/in 1/4 mile of int.
Land Use	
Aircraft Facilities	Density of Aircraft Facilities per sq. mile w/in 1/10 mile of the int.
Aircraft Facilities	Density of Aircraft Facilities per sq. mile w/in 1/2 mile of the int.
Aircraft Facilities	Density of Aircraft Facilities per sq. mile w/in 1/4 mile of the int.
Alcohol	Density of Liquor Stores per sq. mile w/in 1/10 mile of the int.
Alcohol	Density of Liquor Stores per sq. mile w/in 1/2 mile of the int.
Alcohol	Density of Liquor Stores per sq. mile w/in 1/4 mile of the int.
Alcohol	Density of off-premise alcoholic beverage locs per sq. mile w/in 1/10 mile of the int.
Alcohol	Density of off-premise alcoholic beverage locs per sq. mile w/in 1/2 mile of the int.
Alcohol	Density of off-premise alcoholic beverage locs per sq. mile w/in 1/4 mile of the int.
Alcohol	Density of on/off-premise alcoholic beverage locs per sq. mile w/in 1/10 mile of the int.
Alcohol	Density of on/off-premise alcoholic beverage locs per sq. mile w/in 1/2 mile of the int.
Alcohol	Density of on/off-premise alcoholic beverage locs per sq. mile w/in 1/4 mile of the int.
Alcohol	Density of on-premise alcoholic beverage locs per sq. mile w/in 1/10 mile of the int.
Alcohol	Density of on-premise alcoholic beverage locs per sq. mile w/in 1/2 mile of the int.
Alcohol	Density of on-premise alcoholic beverage locs per sq. mile w/in 1/4 mile of the int.
Alcohol	Density of unknown alcoholic beverage locs per sq. mile w/in 1/10 mile of the int.
Alcohol	Density of unknown alcoholic beverage locs per sq. mile w/in 1/2 mile of the int.
Alcohol	Density of unknown alcoholic beverage locs per sq. mile w/in 1/4 mile of the int.
Apartments	Density of Apartments per sq. mile w/in 1/10 mile of the int.
Apartments	Density of Apartments per sq. mile w/in 1/2 mile of the int.
Apartments	Density of Apartments per sq. mile w/in 1/4 mile of the int.
Area Type	Activity center in which the int. falls
Area Type	Complete Streets area type in which the int. falls

Category	Description
Land Use	
Area Type	Municipality in which the int. falls
Area Type	Policy area category (G, O, R, Y) in which the int. falls
Area Type	Policy area in which the int. falls
Business Parks	Density of Business Parks per sq. mile w/in 1/10 mile of the int.
Business Parks	Density of Business Parks per sq. mile w/in 1/2 mile of the int.
Business Parks	Density of Business Parks per sq. mile w/in 1/4 mile of the int.
Cemeteries	Density of Cemeteries per sq. mile w/in 1/10 mile of the int.
Cemeteries	Density of Cemeteries per sq. mile w/in 1/2 mile of the int.
Cemeteries	Density of Cemeteries per sq. mile w/in 1/4 mile of the int.
Cultural Facilities	Density of Cultural Facilities per sq. mile w/in 1/10 mile of the int.
Cultural Facilities	Density of Cultural Facilities per sq. mile w/in 1/2 mile of the int.
Cultural Facilities	Density of Cultural Facilities per sq. mile w/in 1/4 mile of the int.
Fire Stations	Density of Federal Fire Stations per sq. mile w/in 1/10 mile of the int.
Fire Stations	Density of Federal Fire Stations per sq. mile w/in 1/2 mile of the int.
Fire Stations	Density of Federal Fire Stations per sq. mile w/in 1/4 mile of the int.
Fire Stations	Density of Fire Stations per sq. mile w/in 1/10 mile of the int.
Fire Stations	Density of Fire Stations per sq. mile w/in 1/2 mile of the int.
Fire Stations	Density of Fire Stations per sq. mile w/in 1/4 mile of the int.
Gas Stations	Density of Gas Stations per sq. mile w/in 1/10 mile of the int.
Gas Stations	Density of Gas Stations per sq. mile w/in 1/2 mile of the int.
Gas Stations	Density of Gas Stations per sq. mile w/in 1/4 mile of the int.
Gov't Facilities	Density of Federal Facilities per sq. mile w/in 1/10 mile of the int.
Gov't Facilities	Density of Federal Facilities per sq. mile w/in 1/2 mile of the int.
Gov't Facilities	Density of Federal Facilities per sq. mile w/in 1/4 mile of the int.
Gov't Facilities	Density of MC Government per sq. mile w/in 1/10 mile of the int.
Gov't Facilities	Density of MC Government per sq. mile w/in 1/2 mile of the int.
Gov't Facilities	Density of MC Government per sq. mile w/in 1/4 mile of the int.
Gov't Facilities	Density of Regional Services Centers per sq. mile w/in 1/10 mile of the int.
Gov't Facilities	Density of Regional Services Centers per sq. mile w/in 1/2 mile of the int.
Gov't Facilities	Density of Regional Services Centers per sq. mile w/in 1/4 mile of the int.
Gov't Facilities	Density of State and Muni per sq. mile w/in 1/10 mile of the int.
Gov't Facilities	Density of State and Muni per sq. mile w/in 1/2 mile of the int.
Gov't Facilities	Density of State and Muni per sq. mile w/in 1/4 mile of the int.
HHS Facilities	Density of HHS Facilities per sq. mile w/in 1/10 mile of the int.
HHS Facilities	Density of HHS Facilities per sq. mile w/in 1/2 mile of the int.
HHS Facilities	Density of HHS Facilities per sq. mile w/in 1/4 mile of the int.
Hospitals	Density of Hospitals per sq. mile w/in 1/10 mile of the int.
Hospitals	Density of Hospitals per sq. mile w/in 1/2 mile of the int.
Hospitals	Density of Hospitals per sq. mile w/in 1/4 mile of the int.

Category	Description
Land Use	
Libraries	Density of Libraries per sq. mile w/in 1/10 mile of the int.
Libraries	Density of Libraries per sq. mile w/in 1/2 mile of the int.
Libraries	Density of Libraries per sq. mile w/in 1/4 mile of the int.
Lodging	Density of Lodging per sq. mile w/in 1/10 mile of the int.
Lodging	Density of Lodging per sq. mile w/in 1/2 mile of the int.
Lodging	Density of Lodging per sq. mile w/in 1/4 mile of the int.
Places	Density of Places per sq. mile w/in 1/10 mile of the int.
Places	Density of Places per sq. mile w/in 1/2 mile of the int.
Places	Density of Places per sq. mile w/in 1/4 mile of the int.
Police	Density of Police Facilities per sq. mile w/in 1/10 mile of the int.
Police	Density of Police Facilities per sq. mile w/in 1/2 mile of the int.
Police	Density of Police Facilities per sq. mile w/in 1/4 mile of the int.
Police	Density of Police Stations per sq. mile w/in 1/10 mile of the int.
Police	Density of Police Stations per sq. mile w/in 1/2 mile of the int.
Police	Density of Police Stations per sq. mile w/in 1/4 mile of the int.
Polling	Density of Polling Places per sq. mile w/in 1/10 mile of the int.
Polling	Density of Polling Places per sq. mile w/in 1/2 mile of the int.
Polling	Density of Polling Places per sq. mile w/in 1/4 mile of the int.
Post Office	Density of Post Offices per sq. mile w/in 1/10 mile of the int.
Post Office	Density of Post Offices per sq. mile w/in 1/2 mile of the int.
Post Office	Density of Post Offices per sq. mile w/in 1/4 mile of the int.
Recreation	Density of Golf Courses per sq. mile w/in 1/10 mile of the int.
Recreation	Density of Golf Courses per sq. mile w/in 1/2 mile of the int.
Recreation	Density of Golf Courses per sq. mile w/in 1/4 mile of the int.
Recreation	Density of Park Facilities per sq. mile w/in 1/10 mile of the int.
Recreation	Density of Park Facilities per sq. mile w/in 1/2 mile of the int.
Recreation	Density of Park Facilities per sq. mile w/in 1/4 mile of the int.
Recreation	Density of Recreation Centers per sq. mile w/in 1/10 mile of the int.
Recreation	Density of Recreation Centers per sq. mile w/in 1/2 mile of the int.
Recreation	Density of Recreation Centers per sq. mile w/in 1/4 mile of the int.
Recreation	Density of Swimming Pools per sq. mile w/in 1/10 mile of the int.
Recreation	Density of Swimming Pools per sq. mile w/in 1/2 mile of the int.
Recreation	Density of Swimming Pools per sq. mile w/in 1/4 mile of the int.
Recreation	Density of YMCAs per sq. mile w/in 1/10 mile of the int.
Recreation	Density of YMCAs per sq. mile w/in 1/2 mile of the int.
Recreation	Density of YMCAs per sq. mile w/in 1/4 mile of the int.
Recreation	Percent of area w/in 100 ft of int. comprised of park land
Recreation	Percent of area w/in 500 ft of int. comprised of park land
Religious	Density of Places of Worship per sq. mile w/in 1/10 mile of the int.



Category	Description
Land Use	
Religious	Density of Places of Worship per sq. mile w/in 1/2 mile of the int.
Religious	Density of Places of Worship per sq. mile w/in 1/4 mile of the int.
Schools	Density of Colleges or Universities per sq. mile w/in 1/10 mile of the int.
Schools	Density of Colleges or Universities per sq. mile w/in 1/2 mile of the int.
Schools	Density of Colleges or Universities per sq. mile w/in 1/4 mile of the int.
Schools	Density of Elementary Schools per sq. mile w/in 1/10 mile of the int.
Schools	Density of Elementary Schools per sq. mile w/in 1/2 mile of the int.
Schools	Density of Elementary Schools per sq. mile w/in 1/4 mile of the int.
Schools	Density of High Schools per sq. mile w/in 1/10 mile of the int.
Schools	Density of High Schools per sq. mile w/in 1/2 mile of the int.
Schools	Density of High Schools per sq. mile w/in 1/4 mile of the int.
Schools	Density of K-12 schools per sq. mile w/in 1/10 mile of the int.
Schools	Density of K-12 schools per sq. mile w/in 1/2 mile of the int.
Schools	Density of K-12 schools per sq. mile w/in 1/4 mile of the int.
Schools	Density of Middle Schools per sq. mile w/in 1/10 mile of the int.
Schools	Density of Middle Schools per sq. mile w/in 1/2 mile of the int.
Schools	Density of Middle Schools per sq. mile w/in 1/4 mile of the int.
Schools	Density of Private Schools per sq. mile w/in 1/10 mile of the int.
Schools	Density of Private Schools per sq. mile w/in 1/2 mile of the int.
Schools	Density of Private Schools per sq. mile w/in 1/4 mile of the int.
Schools	Density of Special Schools per sq. mile w/in 1/10 mile of the int.
Schools	Density of Special Schools per sq. mile w/in 1/2 mile of the int.
Schools	Density of Special Schools per sq. mile w/in 1/4 mile of the int.
Schools	Distance, in feet, from the int. to the nearest university or college
Senior Centers	Density of Senior Centers per sq. mile w/in 1/10 mile of the int.
Senior Centers	Density of Senior Centers per sq. mile w/in 1/2 mile of the int.
Senior Centers	Density of Senior Centers per sq. mile w/in 1/4 mile of the int.
Shopping Centers	Density of Shopping Centers per sq. mile w/in 1/10 mile of the int.
Shopping Centers	Density of Shopping Centers per sq. mile w/in 1/2 mile of the int.
Shopping Centers	Density of Shopping Centers per sq. mile w/in 1/4 mile of the int.
Demographics	
Age	Older Adult Concentration Relative to Regional Average
Age	Older Adult Population
Age	Percent of the population 65 years of age and up w/in 1/10 mile of the int.
Age	Percent of the population 65 years of age and up w/in 1/2 mile of the int.
Age	Percent of the population 65 years of age and up w/in 1/4 mile of the int.
Age	Percent of the population under 18 years of age w/in 1/10 mile of the int.
Age	Percent of the population under 18 years of age w/in 1/2 mile of the int.
Age	Percent of the population under 18 years of age w/in 1/4 mile of the int.

Category	Description
Demographics	
Disabilities	Percent Persons with Disabilities
Disabilities	Persons with Disabilities
Disabilities	Persons with Disabilities Concentration Relative to the Regional Average
Employment	Employment density (people per sq. mile) w/in 1/10 mile of the int.
Employment	Employment density (people per sq. mile) w/in 1/2 mile of the int.
Employment	Employment density (people per sq. mile) w/in 1/4 mile of the int.
EEAs	Located w/in an Equity Emphasis Area
Income	Low Income Concentration Relative to Regional Average
Income	Low Income Population
Income	Median household income w/in 1/10 mile of the int.
Income	Median household income w/in 1/2 mile of the int.
Income	Median household income w/in 1/4 mile of the int.
Income	Percent of households with income of \$100,000 or more w/in 1/10 mile of the int.
Income	Percent of households with income of \$100,000 or more w/in 1/2 mile of the int.
Income	Percent of households with income of \$100,000 or more w/in 1/4 mile of the int.
Income	Percent of households with income of \$150,000 or more w/in 1/10 mile of the int.
Income	Percent of households with income of \$150,000 or more w/in 1/2 mile of the int.
Income	Percent of households with income of \$150,000 or more w/in 1/4 mile of the int.
Income	Percent of households with income of \$200,000 or more w/in 1/10 mile of the int.
Income	Percent of households with income of \$200,000 or more w/in 1/2 mile of the int.
Income	Percent of households with income of \$200,000 or more w/in 1/4 mile of the int.
Income	Percent of the pop with income less than 1.5x the poverty level w/in 1/10 mile of the int.
Income	Percent of the pop with income less than 1.5x the poverty level w/in 1/2 mile of the int.
Income	Percent of the pop with income less than 1.5x the poverty level w/in 1/4 mile of the int.
Language	Limited English Proficiency Concentration Relative to Regional Average
Language	Limited-English Proficiency Population
Language	Percent Limited English Proficiency
Population	Population density (people per sq. mile) w/in 1/10 mile of the int.
Population	Population density (people per sq. mile) w/in 1/2 mile of the int.
Population	Population density (people per sq. mile) w/in 1/4 mile of the int.
Race/Ethnicity	African American Concentration Relative to Regional Average
Race/Ethnicity	African American Population
Race/Ethnicity	Asian Concentration Relative to Regional Average
Race/Ethnicity	Asian Population
Race/Ethnicity	Latino Concentration Relative to Regional Average
Race/Ethnicity	Latino Population
Race/Ethnicity	Percent African American
Race/Ethnicity	Percent Asian
Race/Ethnicity	Percent Latino

## SEGMENT VARIABLES

Category	Description
ID	Segment ID
Transportation	
Bike/Ped	Bike facility length (ft) associated with the left side of the seg.
Bike/Ped	Bike facility length (ft) associated with the right side of the seg.
Bike/Ped	Bike facility length (ft) associated with the road centerline
Bike/Ped	Highest category of bikeway along the seg.
Bike/Ped	Percent of seg. length represented by all bike facilities
Bike/Ped	Percent of seg. length represented by all sidewalks
Bike/Ped	Percent of seg. length represented by centerline bike facilities
Bike/Ped	Percent of seg. length represented by left-side bike facilities
Bike/Ped	Percent of seg. length represented by left-side sidewalks
Bike/Ped	Percent of seg. length represented by right-side bike facilities
Bike/Ped	Percent of seg. length represented by right-side sidewalks
Bike/Ped	seg. has a trail crossing (0=no, 1=yes)
Bike/Ped	Sidewalk length (ft) associated with the left side of the seg.
Bike/Ped	Sidewalk length (ft) associated with the right side of the seg.
Bike/Ped	Total bike facility length (ft) associated with the seg.
Bike/Ped	Total number of crosswalks with median island along the seg.
Bike/Ped	Total number of high visibility crosswalks along the seg.
Bike/Ped	Total number of marked crosswalks along the seg.
Bike/Ped	Total sidewalk length (ft) associated with the seg.
Bikeshare	Density of Bikeshare Stations per sq. mile w/in 1/10 mile of the seg.
Bikeshare	Density of Bikeshare Stations per sq. mile w/in 1/2 mile of the seg.
Bikeshare	Density of Bikeshare Stations per sq. mile w/in 1/4 mile of the seg.
Direction	Whether a seg. is one-way or two-way
Driveways	Percent of area w/in 75 ft of seg. comprised of driveways
Elevation	Maximum slope along the seg., based on 500-foot intervals
Elevation	Mean slope along the seg., based on 500-foot intervals
Elevation	Minimum slope along the seg., based on 500-foot intervals
Lanes	Number of lanes
Parking	Density of Parking Garages and Lots per sq. mile w/in 1/10 mile of the seg.
Parking	Density of Parking Garages and Lots per sq. mile w/in 1/2 mile of the seg.
Parking	Density of Parking Garages and Lots per sq. mile w/in 1/4 mile of the seg.
Parking	Percent of area w/in 100 ft of seg. comprised of parking lots
Parking	Percent of area w/in 500 ft of seg. comprised of parking lots
Segment	Length of seg., in feet
Speed	Posted speed limit
Street Class	The roadway classification per the Centerlines file
Transit	Density of MARC Train Stations per sq. mile w/in 1/10 mile of the seg.

Category	Description
Transportation	
Transit	Density of MARC Train Stations per sq. mile w/in 1/2 mile of the seg.
Transit	Density of MARC Train Stations per sq. mile w/in 1/4 mile of the seg.
Transit	Density of Metro Stations per sq. mile w/in 1/10 mile of the seg.
Transit	Density of Metro Stations per sq. mile w/in 1/2 mile of the seg.
Transit	Density of Metro Stations per sq. mile w/in 1/4 mile of the seg.
Transit	Density of Park and Ride Lots per sq. mile w/in 1/10 mile of the seg.
Transit	Density of Park and Ride Lots per sq. mile w/in 1/2 mile of the seg.
Transit	Density of Park and Ride Lots per sq. mile w/in 1/4 mile of the seg.
Transit	Number of bus stops along the seg.
Transit	Number of commuter rail stops along the seg.
Transit	Number of metro stations along the seg.
Transit	Number of routes at all stops along the seg.
Land Use	
Aircraft	Density of Aircraft Facilities per sq. mile w/in 1/10 mile of the seg.
Aircraft	Density of Aircraft Facilities per sq. mile w/in 1/2 mile of the seg.
Aircraft	Density of Aircraft Facilities per sq. mile w/in 1/4 mile of the seg.
Alcohol	Density of Liquor Stores per sq. mile w/in 1/10 mile of the seg.
Alcohol	Density of Liquor Stores per sq. mile w/in 1/2 mile of the seg.
Alcohol	Density of Liquor Stores per sq. mile w/in 1/4 mile of the seg.
Alcohol	Density of off-premise alcoholic beverage locs per sq. mile w/in 1/10 mile of the seg.
Alcohol	Density of off-premise alcoholic beverage locs per sq. mile w/in 1/2 mile of the seg.
Alcohol	Density of off-premise alcoholic beverage locs per sq. mile w/in 1/4 mile of the seg.
Alcohol	Density of on/off-premise alcoholic beverage locs per sq. mile w/in 1/10 mile of the seg.
Alcohol	Density of on/off-premise alcoholic beverage locs per sq. mile w/in 1/2 mile of the seg.
Alcohol	Density of on/off-premise alcoholic beverage locs per sq. mile w/in 1/4 mile of the seg.
Alcohol	Density of on-premise alcoholic beverage locs per sq. mile w/in 1/10 mile of the seg.
Alcohol	Density of on-premise alcoholic beverage locs per sq. mile w/in 1/2 mile of the seg.
Alcohol	Density of on-premise alcoholic beverage locs per sq. mile w/in 1/4 mile of the seg.
Alcohol	Density of unknown alcoholic beverage locs per sq. mile w/in 1/10 mile of the seg.
Alcohol	Density of unknown alcoholic beverage locs per sq. mile w/in 1/2 mile of the seg.
Alcohol	Density of unknown alcoholic beverage locs per sq. mile w/in 1/4 mile of the seg.
Apartments	Density of Apartments per sq. mile w/in 1/10 mile of the seg.
Apartments	Density of Apartments per sq. mile w/in 1/2 mile of the seg.
Apartments	Density of Apartments per sq. mile w/in 1/4 mile of the seg.
Area Type	Activity center in which all or the majority of the seg. falls
Area Type	Complete Streets area type in which all or the majority of the seg. falls
Area Type	Municipality in which all or the majority of the seg. falls
Area Type	Policy area category (G, O, R, Y) in which all or the majority of the seg. falls
Area Type	Policy area in which all or the majority of the seg. falls

Category	Description
Land Use	
Business Parks	Density of Business Parks per sq. mile w/in 1/10 mile of the seg.
Business Parks	Density of Business Parks per sq. mile w/in 1/2 mile of the seg.
Business Parks	Density of Business Parks per sq. mile w/in 1/4 mile of the seg.
Cemeteries	Density of Cemeteries per sq. mile w/in 1/10 mile of the seg.
Cemeteries	Density of Cemeteries per sq. mile w/in 1/2 mile of the seg.
Cemeteries	Density of Cemeteries per sq. mile w/in 1/4 mile of the seg.
Cultural Facilities	Density of Cultural Facilities per sq. mile w/in 1/10 mile of the seg.
Cultural Facilities	Density of Cultural Facilities per sq. mile w/in 1/2 mile of the seg.
Cultural Facilities	Density of Cultural Facilities per sq. mile w/in 1/4 mile of the seg.
Federal Facilities	Density of Federal Facilities per sq. mile w/in 1/10 mile of the seg.
Federal Facilities	Density of Federal Facilities per sq. mile w/in 1/2 mile of the seg.
Federal Facilities	Density of Federal Facilities per sq. mile w/in 1/4 mile of the seg.
Fire Stations	Density of Federal Fire Stations per sq. mile w/in 1/10 mile of the seg.
Fire Stations	Density of Federal Fire Stations per sq. mile w/in 1/2 mile of the seg.
Fire Stations	Density of Federal Fire Stations per sq. mile w/in 1/4 mile of the seg.
Fire Stations	Density of Fire Stations per sq. mile w/in 1/10 mile of the seg.
Fire Stations	Density of Fire Stations per sq. mile w/in 1/2 mile of the seg.
Fire Stations	Density of Fire Stations per sq. mile w/in 1/4 mile of the seg.
Gas Stations	Density of Gas Stations per sq. mile w/in 1/10 mile of the seg.
Gas Stations	Density of Gas Stations per sq. mile w/in 1/2 mile of the seg.
Gas Stations	Density of Gas Stations per sq. mile w/in 1/4 mile of the seg.
Gov't Facilities	Density of MC Government per sq. mile w/in 1/10 mile of the seg.
Gov't Facilities	Density of MC Government per sq. mile w/in 1/2 mile of the seg.
Gov't Facilities	Density of MC Government per sq. mile w/in 1/4 mile of the seg.
Gov't Facilities	Density of Regional Services Centers per sq. mile w/in 1/10 mile of the seg.
Gov't Facilities	Density of Regional Services Centers per sq. mile w/in 1/2 mile of the seg.
Gov't Facilities	Density of Regional Services Centers per sq. mile w/in 1/4 mile of the seg.
Gov't Facilities	Density of State and Muni per sq. mile w/in 1/10 mile of the seg.
Gov't Facilities	Density of State and Muni per sq. mile w/in 1/2 mile of the seg.
Gov't Facilities	Density of State and Muni per sq. mile w/in 1/4 mile of the seg.
HHS Facilities	Density of HHS Facilities per sq. mile w/in 1/10 mile of the seg.
HHS Facilities	Density of HHS Facilities per sq. mile w/in 1/2 mile of the seg.
HHS Facilities	Density of HHS Facilities per sq. mile w/in 1/4 mile of the seg.
Hospitals	Density of Hospitals per sq. mile w/in 1/10 mile of the seg.
Hospitals	Density of Hospitals per sq. mile w/in 1/2 mile of the seg.
Hospitals	Density of Hospitals per sq. mile w/in 1/4 mile of the seg.
Libraries	Density of Libraries per sq. mile w/in 1/10 mile of the seg.
Libraries	Density of Libraries per sq. mile w/in 1/2 mile of the seg.
Libraries	Density of Libraries per sq. mile w/in 1/4 mile of the seg.

Category	Description
Land Use	
Lodging	Density of Lodging per sq. mile w/in 1/10 mile of the seg.
Lodging	Density of Lodging per sq. mile w/in 1/2 mile of the seg.
Lodging	Density of Lodging per sq. mile w/in 1/4 mile of the seg.
Places	Density of Places per sq. mile w/in 1/10 mile of the seg.
Places	Density of Places per sq. mile w/in 1/2 mile of the seg.
Places	Density of Places per sq. mile w/in 1/4 mile of the seg.
Police	Density of Police Facilities per sq. mile w/in 1/10 mile of the seg.
Police	Density of Police Facilities per sq. mile w/in 1/2 mile of the seg.
Police	Density of Police Facilities per sq. mile w/in 1/4 mile of the seg.
Police	Density of Police Stations per sq. mile w/in 1/10 mile of the seg.
Police	Density of Police Stations per sq. mile w/in 1/2 mile of the seg.
Police	Density of Police Stations per sq. mile w/in 1/4 mile of the seg.
Polling	Density of Polling Places per sq. mile w/in 1/10 mile of the seg.
Polling	Density of Polling Places per sq. mile w/in 1/2 mile of the seg.
Polling	Density of Polling Places per sq. mile w/in 1/4 mile of the seg.
Post Offices	Density of Post Offices per sq. mile w/in 1/10 mile of the seg.
Post Offices	Density of Post Offices per sq. mile w/in 1/2 mile of the seg.
Post Offices	Density of Post Offices per sq. mile w/in 1/4 mile of the seg.
Recreation	Density of Golf Courses per sq. mile w/in 1/10 mile of the seg.
Recreation	Density of Golf Courses per sq. mile w/in 1/2 mile of the seg.
Recreation	Density of Golf Courses per sq. mile w/in 1/4 mile of the seg.
Recreation	Density of Park Facilities per sq. mile w/in 1/10 mile of the seg.
Recreation	Density of Park Facilities per sq. mile w/in 1/2 mile of the seg.
Recreation	Density of Park Facilities per sq. mile w/in 1/4 mile of the seg.
Recreation	Density of Recreation Centers per sq. mile w/in 1/10 mile of the seg.
Recreation	Density of Recreation Centers per sq. mile w/in 1/2 mile of the seg.
Recreation	Density of Recreation Centers per sq. mile w/in 1/4 mile of the seg.
Recreation	Density of Swimming Pools per sq. mile w/in 1/10 mile of the seg.
Recreation	Density of Swimming Pools per sq. mile w/in 1/2 mile of the seg.
Recreation	Density of Swimming Pools per sq. mile w/in 1/4 mile of the seg.
Recreation	Density of YMCAs per sq. mile w/in 1/10 mile of the seg.
Recreation	Density of YMCAs per sq. mile w/in 1/2 mile of the seg.
Recreation	Density of YMCAs per sq. mile w/in 1/4 mile of the seg.
Recreation	Percent of area w/in 100 ft of seg. comprised of park land
Recreation	Percent of area w/in 500 ft of seg. comprised of park land
Religious	Density of Places of Worship per sq. mile w/in 1/10 mile of the seg.
Religious	Density of Places of Worship per sq. mile w/in 1/2 mile of the seg.
Religious	Density of Places of Worship per sq. mile w/in 1/4 mile of the seg.
Schools	Density of Colleges or Universities per sq. mile w/in 1/10 mile of the seg.

Category	Description
Land Use	
Schools	Density of Colleges or Universities per sq. mile w/in 1/2 mile of the seg.
Schools	Density of Colleges or Universities per sq. mile w/in 1/4 mile of the seg.
Schools	Density of Elementary Schools per sq. mile w/in 1/10 mile of the seg.
Schools	Density of Elementary Schools per sq. mile w/in 1/2 mile of the seg.
Schools	Density of Elementary Schools per sq. mile w/in 1/4 mile of the seg.
Schools	Density of High Schools per sq. mile w/in 1/10 mile of the seg.
Schools	Density of High Schools per sq. mile w/in 1/2 mile of the seg.
Schools	Density of High Schools per sq. mile w/in 1/4 mile of the seg.
Schools	Density of K-12 schools per sq. mile w/in 1/10 mile of the seg.
Schools	Density of K-12 schools per sq. mile w/in 1/2 mile of the seg.
Schools	Density of K-12 schools per sq. mile w/in 1/4 mile of the seg.
Schools	Density of Middle Schools per sq. mile w/in 1/10 mile of the seg.
Schools	Density of Middle Schools per sq. mile w/in 1/2 mile of the seg.
Schools	Density of Middle Schools per sq. mile w/in 1/4 mile of the seg.
Schools	Density of Private Schools per sq. mile w/in 1/10 mile of the seg.
Schools	Density of Private Schools per sq. mile w/in 1/2 mile of the seg.
Schools	Density of Private Schools per sq. mile w/in 1/4 mile of the seg.
Schools	Density of Special Schools per sq. mile w/in 1/10 mile of the seg.
Schools	Density of Special Schools per sq. mile w/in 1/2 mile of the seg.
Schools	Density of Special Schools per sq. mile w/in 1/4 mile of the seg.
Schools	Density of universities and colleges per sq. mile w/in 1/10 mile of the seg.
Schools	Density of universities and colleges per sq. mile w/in 1/2 mile of the seg.
Schools	Density of universities and colleges per sq. mile w/in 1/4 mile of the seg.
Senior Centers	Density of Senior Centers per sq. mile w/in 1/10 mile of the seg.
Senior Centers	Density of Senior Centers per sq. mile w/in 1/2 mile of the seg.
Senior Centers	Density of Senior Centers per sq. mile w/in 1/4 mile of the seg.
Shopping Centers	Density of Shopping Centers per sq. mile w/in 1/10 mile of the seg.
Shopping Centers	Density of Shopping Centers per sq. mile w/in 1/2 mile of the seg.
Shopping Centers	Density of Shopping Centers per sq. mile w/in 1/4 mile of the seg.
Demographics	
Age	Older Adult Concentration Relative to Regional Average
Age	Older Adult Population
Age	Percent Older Adult
Age	Percent of the population 65 years of age and up w/in 1/10 mile of the seg.
Age	Percent of the population 65 years of age and up w/in 1/2 mile of the seg.
Age	Percent of the population 65 years of age and up w/in 1/4 mile of the seg.
Age	Percent of the population under 18 years of age w/in 1/10 mile of the seg.
Age	Percent of the population under 18 years of age w/in 1/2 mile of the seg.
Age	Percent of the population under 18 years of age w/in 1/4 mile of the seg.

Category	Description
Demographics	
Disabilities	Percent Persons with Disabilities
Disabilities	Persons with Disabilities
Disabilities	Persons with Disabilities Concentration Relative to the Regional Average
EEAs	Located w/in an Equity Emphasis Area
Employment	Employment density (people per sq. mile) w/in 1/10 mile of the seg.
Employment	Employment density (people per sq. mile) w/in 1/2 mile of the seg.
Employment	Employment density (people per sq. mile) w/in 1/4 mile of the seg.
Income	Low Income Concentration Relative to Regional Average
Income	Low Income Population
Income	Median household income w/in 1/10 mile of the seg.
Income	Median household income w/in 1/2 mile of the seg.
Income	Median household income w/in 1/4 mile of the seg.
Income	Percent Low Income
Income	Percent of households with income of \$100,000 or more w/in 1/10 mile of the seg.
Income	Percent of households with income of \$100,000 or more w/in 1/2 mile of the seg.
Income	Percent of households with income of \$100,000 or more w/in 1/4 mile of the seg.
Income	Percent of households with income of \$150,000 or more w/in 1/10 mile of the seg.
Income	Percent of households with income of \$150,000 or more w/in 1/2 mile of the seg.
Income	Percent of households with income of \$150,000 or more w/in 1/4 mile of the seg.
Income	Percent of households with income of \$200,000 or more w/in 1/10 mile of the seg.
Income	Percent of households with income of \$200,000 or more w/in 1/2 mile of the seg.
Income	Percent of households with income of \$200,000 or more w/in 1/4 mile of the seg.
Income	Percent of the pop with income less than 1.5x the poverty level w/in 1/10 mile the seg.
Income	Percent of the pop with income less than 1.5x the poverty level w/in 1/2 mile of the seg.
Income	Percent of the pop with income less than 1.5x the poverty level w/in 1/4 mile of the seg.
Language	Limited English Proficiency Concentration Relative to Regional Average
Language	Limited-English Proficiency Population
Language	Percent Limited English Proficiency
Population	Population density (people per sq. mile) w/in 1/10 mile of the seg.
Population	Population density (people per sq. mile) w/in 1/2 mile of the seg.
Population	Population density (people per sq. mile) w/in 1/4 mile of the seg.
Race/Ethnicity	African American Concentration Relative to Regional Average
Race/Ethnicity	African American Population
Race/Ethnicity	Asian Concentration Relative to Regional Average
Race/Ethnicity	Asian Population
Race/Ethnicity	Latino Concentration Relative to Regional Average
Race/Ethnicity	Latino Population
Race/Ethnicity	Percent African American
Race/Ethnicity	Percent Asian
Race/Ethnicity	Percent Latino



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## APPENDIX B. COUNT DATA COLLECTION PLAN

## APPENDIX C. VOLUME ESTIMATION MODELS

### PEDESTRIAN VOLUME MODEL

Statistically Significant Variables		Relationship to Crashes
Roadway/ Infrastructure	Speed Limit	+
	Presence of a median	+
	Presence of a bikeway	-
	Presence of a sidewalk	+
	Dead end	-
	Driveway density	-
	Roadway slope	-
Land Use	Density (based on Policy Area colors and CSDG)	+
	Located in a municipality	+
	Proximity to multifamily housing	+
	Proximity to schools	-
	Proximity to parks	+
	Proximity to emergency facilities	+
	Proximity to off-site alcohol establishments	+
	Proximity to parking lots	+
Transit	Bus routes	+
Demographics	Within an Equity Emphasis Areas	+
	Population over 65	+
	Population under 18	+

NON-SEPARATED BIKEWAY MODEL

Statistically Significant Variables		Relationship to Crashes
Roadway/ Infrastructure	Traffic signal at adjacent intersection	+
	Dead end	-
	Presence of a trail crossing	+
	Presence of a sidewalk	+
Land Use	Density (based on Policy Area colors and CSDG)	+
	Census tract population	-
	Employment density	+
	Proximity to schools	+
	Proximity to universities and colleges	+
	Proximity to recreational points	+
	Proximity to emergency facilities	+
	Proximity to bikeshare	+
Demographics	Within an Equity Emphasis Area	+
	Median household income	+
	Population under 18	-

SEPARATED BIKEWAY MODEL

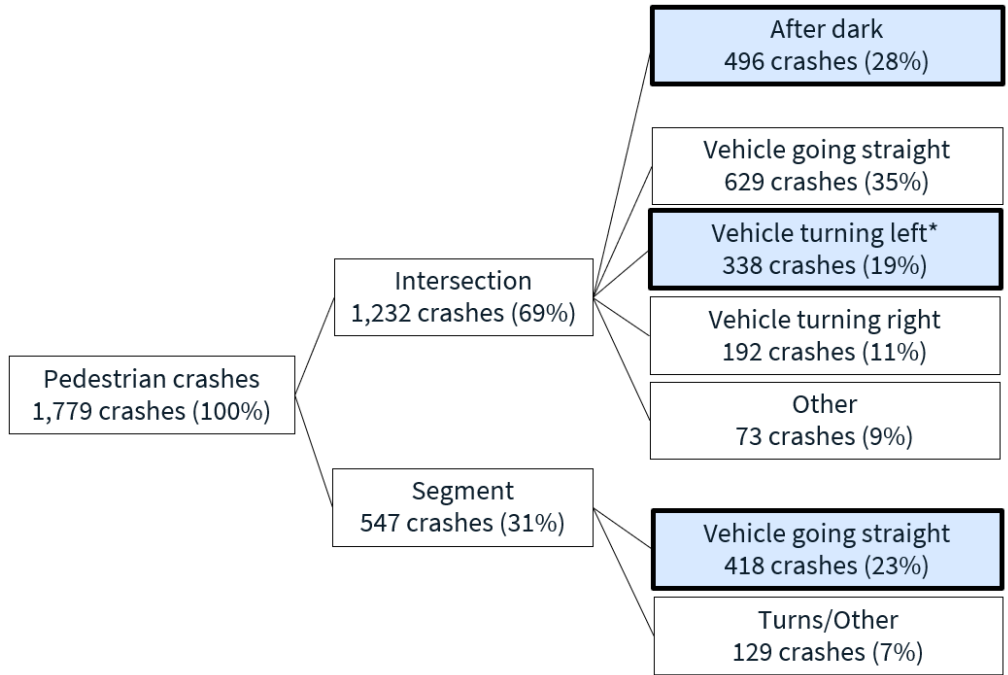
Statistically Significant Variables		Relationship to Crashes
Roadway/ Infrastructure	Traffic signal at adjacent intersection	-
	Dead end	-
	Speed Limit	-
	Presence of a sidewalk	+
Land Use	Density (based on Policy Area colors and CSDG)	+
	Employment density	+
	Proximity to schools	-
	Proximity to alcohol-serving facilities	+
	Proximity to emergency facilities	+
Transit	Proximity to Metro	-
Demographics	Population within an Equity Emphasis Area	+
	Median Household Income	-

## MOTOR VEHICLE VOLUME MODEL

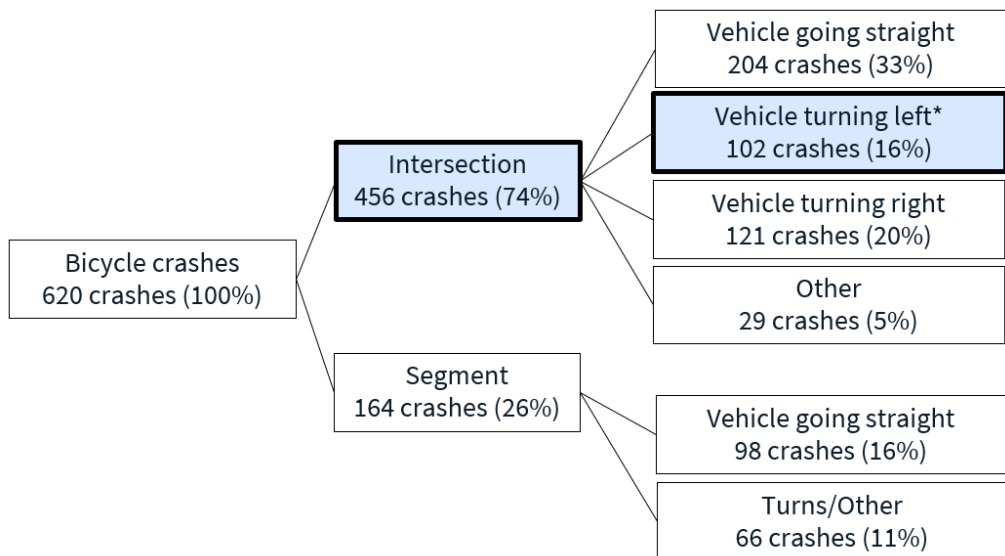
Statistically Significant Variables		Relationship to Crashes
Roadway/ Infrastructure	Speed Limit	+
	Presence of a median	+
	Presence of a bikeway	-
	Presence of a sidewalk	+
	Dead end	-
	Driveway density	-
	Roadway slope	-
Land Use	Density (based on Policy Area colors and CSDG)	+
	Located in a municipality	+
	Proximity to multifamily housing	+
	Proximity to schools	-
	Proximity to parks	+
	Proximity to emergency facilities	+
	Proximity to off-site alcohol establishments	+
	Proximity to parking lots	+
Transit	Bus routes	+
Demographics	Population over 65	+
	Population under 18	+

APPENDIX D. CRASH TYPES

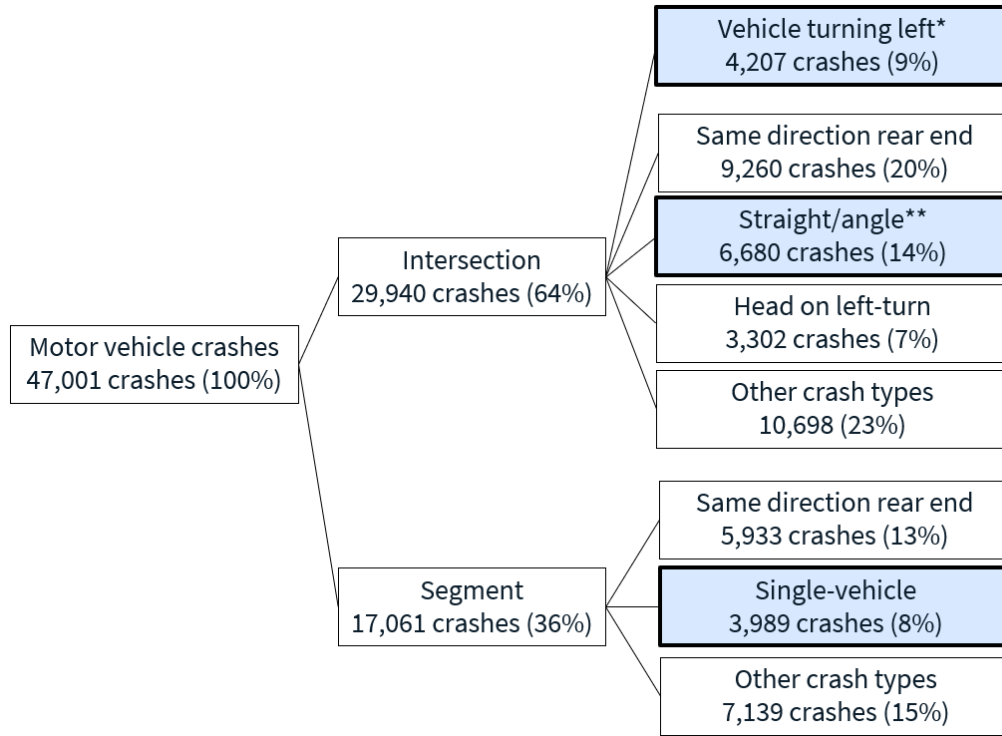
**Pedestrian Crashes**



**Bicycle Crashes**



### Motor Vehicle Crashes



\* Crash type includes motor vehicle, pedestrian, and bicycle crashes with left-turning vehicles.

\*\* Crash type modified during SPF modeling process to only include 4-legged intersections.



## APPENDIX E. SPF EQUATIONS

The SPFs are exponential functions, rather than linear functions. The number of predicted crashes is based on the context variables, but captured in the exponent of “e”, which is a mathematical constant with a value of 2.718. This means that for each equation follows the following general format:

$$\text{Predicted crashes} = 2.718 ^{(\text{sum of context variables multiplied by their coefficients})}$$

The sections below include a table that summarizes the SPF equation for each crash type.

### PEDESTRIAN CRASHES AFTER DARK AT INTERSECTIONS

Statistically Significant Variables		Category	Coefficient
Exposure	Pedestrian traffic	N/A	-0.0003
	Log of Pedestrian traffic	N/A	0.4843
	Motor vehicle traffic	< 5,000 (base)	0
		5,000-9,999	1.5139
		>= 10,000	1.5455
Transportation	Number of intersection legs	N/A	0.4448
	Maximum number of through lanes	N/A	0.1578
	Speed limit	N/A	0.0305
	Number of marked crosswalks	N/A	0.2069
	Presence of a traffic signal	No (base)	0
		Yes	1.0537
	Transportation points of interest (e.g., transit, bikeshare)	N/A	0.0185
	Bus routes (1/10 mile)	N/A	0.0185
	Metro stations (1/4 mile)	N/A	0.2415
Demographics	Population density (1/4 mile)	N/A	0.2329
	Household income (% > \$100k in 1/4 mile)	N/A	-0.0216
Intercept	N/A	N/A	-11.4039

PEDESTRIAN CRASHES ON ROADWAY SEGMENTS WITH VEHICLES GOING STRAIGHT

Statistically Significant Variables		Category	Coefficient
Exposure	Pedestrian traffic	N/A	0.0002
	Motor vehicle traffic	< 5,000 (base)	0
		5,000-9,999	0.6876
		>= 10,000	1.1101
Transportation	Block length	N/A	0.7773
	Dead end	No (base)	0
		Yes	-1.3952
	Street classification	Alley, dead-end, parking-lot access, slip lane (base)	0
		Major Arterial	0.9682
		Minor Arterial	0.9206
		Local	0.0359
	Parking lots (500 feet)	N/A	0.0257
	Number of marked crosswalks	N/A	0.2533
	Bus routes (1/10 mile)	N/A	0.0309
Land Use	Alcohol establishments (1/10 mile)	N/A	0.0108
	Recreational points of interest (1/2 mile)	N/A	-0.0023
	Business points of interest (1/2 mile)	N/A	-0.0065
Demographics	Household Income (% > \$100k in 1/4 mile)	N/A	-0.0312
Intercept	N/A	N/A	-5.2822

## BICYCLE CRASHES AT INTERSECTIONS

Statistically Significant Variables		Category	Coefficient
Exposure	Bicycle traffic (log)	N/A	0.2772
	Motor vehicle traffic	< 2,000 (base)	0
		2,000-3,999	0.4039
		4,000-9,999	2.0541
		10,000-19,999	2.4089
		>= 20,000	2.5530
Transportation	Number of legs	N/A	0.4039
	Number of legs with a median	0 (base)	0
		1	-0.0247
		2	0.4286
		3	0.7380
		4	0.3906
	Number of marked crosswalks	N/A	0.1577
	Presence of a stop sign	No (base)	0
		Yes	0.4725
	Presence of a traffic signal	No (base)	0
		Yes	1.0944
	Proximity to a sidepath	N/A	0.4118
	Proximity to a bike lane (500 feet)	None (base)	0
		Conventional	-0.0388
		Sidepath	0.2752
Bus Stops	No (base)	0	
	Yes	0.4118	
Land Use	Proximity to parks (100 feet)	N/A	0.0163
Demographics	Concentration of Latino residents	N/A	0.1352
Intercept	N/A	N/A	-10.3216

LEFT-TURN CRASHES AT INTERSECTIONS (ALL MODES)

Statistically Significant Variables		Category	Coefficients
Exposure	Motor vehicle traffic	< 2,000 (base)	0
		2,000-3,999	0.6991
		4,000-9,999	2.1431
		10,000-19,999	2.6884
		>= 20,000	2.9262
	Pedestrian traffic	< 60 (base)	0
		60-99	-0.3498
		>= 100	-0.2381
Transportation	Number of legs	N/A	0.5260
	Number of lanes	Max <=2 (base)	0
		Max 3-4, Min <=2	0.3294
		Max > 4, Min <=2	0.5386
		Max 3-4, Min 3-4	0.9055
		Max > 4, Min 3-4	0.5034
		Max > 4, Min > 4	0.5135
	Speed limit	N/A	0.0173
	Street classification	Alley, dead-end, parking-lot access, slip lane (base)	0
		Other Street Types	0.7174
	Presence of a traffic signal	No (base)	0
		Yes	1.6466
	Number of high-visibility crosswalks	N/A	0.1360
	Presence of a bikeway (500 feet)	None (base)	0
		Conventional	0.3905
		Sidepath	0.1805
	Parking lots (500 feet)	N/A	0.0208
	Bus stops	No (base)	0
Yes		0.3944	
Land Use	CSDG Area Type	Country (base)	0
		Downtown	-0.7091
		Town Center	-0.6460
		Suburban	-0.6248
		Other	-0.4462
Demographics	Household income (% > \$150k in 1/2 mile)	N/A	-0.0131
Intercept	N/A	N/A	-8.2099

MOTOR VEHICLE STRAIGHT/ANGLE CRASHES AT FOUR-LEGGED INTERSECTIONS

Statistically Significant Variables		Category	Coefficient
Exposure	Motor vehicle traffic (log)	N/A	0.5446
Transportation	State roads	No (base)	0
		Yes	1.1799
	Speed limit	N/A	0.0277
	Number of marked crosswalks	N/A	0.1942
	Bus routes (1/10 mile)	N/A	0.1080
	Metro stations (1/2 mile)	N/A	0.0709
Land Use	Located within a municipality	No (base)	0
		Yes	-0.2306
	Recreational points of interest (1/4 mile)	N/A	-0.0118
Demographics	Located within an Equity Emphasis Area	No (base)	0
		Yes	0.2736
	Household income (% > \$200k in 1/2 mile)	N/A	-0.0144
Intercept	N/A	N/A	-8.4531

SINGLE VEHICLE CRASHES ALONG ROADWAY SEGMENTS

Statistically Significant Variables		Category	Coefficient
Exposure	Motor vehicle traffic	< 2,000 (base)	0
		2,000-3,999	0.2253
		4,000-9,999	0.9511
		10,000-19,999	0.9530
		>= 20,000	0.7688
	Motor vehicle traffic (log)	N/A	0.2503
	Pedestrian traffic (log)	N/A	-0.1065
Transportation	Roadway segment length (log)	N/A	0.8574
	Street classification	Alley, dead-end, parking-lot access, slip lane (base)	0
		Major Arterial	1.1739
		Minor Arterial	0.8807
		Local	0.0526
	Number of a traffic signals at adjacent intersections	N/A	0.2359
	Maximum street slope	N/A	0.0396
	Dead end	No (base)	0
		Yes	-0.3998
	Street light density	N/A	16.003
	Driveway density (75 feet)	N/A	-0.0435
Bus stops	N/A	63.6722	
Land Use	Population density (1/2 mile)	N/A	-0.0001
	Proximity to parks (500 feet)	N/A	0.0059
	Business points of interest (1/2 mile)	N/A	-0.0061
Demographics	Concentration of African American residents	N/A	0.2631
	Household income (% > \$150k in 1/4 mile)	N/A	-0.0078
	Concentration of youth (< 18 years, 1/2 mile)	N/A	-0.0189
	Concentration of seniors (> 65 years, 1/2 mile)	N/A	-0.0137
Intercept	N/A	N/A	-3.7647

APPENDIX F. TOP 50 LOCATIONS BY CRASH TYPE



PEDESTRIAN CRASHES AFTER DARK AT INTERSECTIONS

Location	Location ID	Jurisdiction	State Road	EEA
2ND AVE & CAMERON ST	X20993	County		X
2ND AVE & FENWICK LN	X20956	County		X
COLESVILLE RD & FENTON ST	X21234	County	X	X
COLESVILLE RD & UNIVERSITY BLVD	X22171	County	X	
COLESVILLE RD & WAYNE AVE & 2ND AVE	X21066	County	X	X
CONNECTICUT AVE & ASPEN HILL RD	X16764	County	X	X
EAST WEST HWY & 16TH ST	X20795	County	X	
EAST WEST HWY & COLESVILLE RD	X20972	County	X	
EAST WEST HWY & WISCONSIN AVE & OLD GEORGETOWN RD	X15532	County	X	
FREDERICK RD & KING FARM BLVD & SHADY GROVE METRO W RD	X09707	Rockville	X	X
FREDERICK RD & REDLAND RD & REDLAND BLVD	X09984	Rockville	X	
GEORGIA AVE & BONIFANT ST	X21253	County	X	X
GEORGIA AVE & CAMERON ST	X21090	County	X	X
GEORGIA AVE & COLESVILLE RD	X21161	County	X	X
GEORGIA AVE & CONNECTICUT AVE	X16983	County	X	
GEORGIA AVE & ELLSWORTH DR	X21224	County	X	X
GEORGIA AVE & GLENALLAN AVE	X19275	County	X	X
GEORGIA AVE & PRICE AVE	X19599	County	X	X
GEORGIA AVE & RANDOLPH RD	X19744	County	X	X
GEORGIA AVE & REEDIE DR	X19641	County	X	X
GEORGIA AVE & SILVER SPRING AVE	X21267	County	X	X
GEORGIA AVE & THAYER AVE	X21258	County	X	X
GEORGIA AVE & UNIVERSITY BLVD	X19555	County	X	X
GEORGIA AVE & WAYNE AVE	X21244	County	X	X
GERMANTOWN RD & CRYSTAL ROCK DR	X02358	County	X	X
GREAT SENECA HWY & CLOPPER RD	X01550	County	X	
LAYHILL RD & GLENALLAN AVE	X19716	County	X	X
MARYLAND AVE & MIDDLE LN	X11246	Rockville		X
MIDCOUNTY HWY & MONTGOMERY VILLAGE AVE	X06778	County	X	X
MIDDLEBROOK RD & CRYSTAL ROCK DR	X02232	County		X
MONROE ST & JEFFERSON ST	X11338	Rockville	X	X
NEW HAMPSHIRE AVE & LOCKWOOD DR	X23608	County	X	
NEW HAMPSHIRE AVE & OAKVIEW DR	X24208	County	X	X
PINEY BRANCH RD & FLOWER AVE	X22767	County	X	X
RANDOLPH RD & VEIRS MILL RD	X16598	County	X	X
ROCKVILLE PIKE & CHAPMAN AVE & HALPINE RD	X13005	Rockville	X	X
ROCKVILLE PIKE & MARINELLI RD	X13981	County	X	
ROCKVILLE PIKE & MIDDLE LN & PARK RD	X11402	Rockville	X	X
ROCKVILLE PIKE & OLD GEORGETOWN RD	X13869	County	X	
ROCKVILLE PIKE & TWINBROOK PKWY & ROLLINS AVE	X13230	Rockville	X	
SOMERVILLE DR & REDLAND RD	X10120	County		
TWINBROOK PKWY & CHAPMAN AVE	X13419	Rockville		
UNIVERSITY BLVD & AMHERST AVE	X19932	County	X	
UNIVERSITY BLVD & PINEY BRANCH RD	X23339	County	X	X
UNIVERSITY BLVD & VEIRS MILL RD	X19201	County	X	X
WAYNE AVE & RAMSEY AVE	X21114	County		X
WISCONSIN AVE & MONTGOMERY LN & MONTGOMERY AVE	X15570	County	X	
WISCONSIN AVE & WOODMONT AVE & LELAND ST	X15718	County	X	
WOODMONT AVE & BATTERY LN	X15264	County		
WOODMONT AVE & HAMPDEN LN	X15337	County		

PEDESTRIAN CRASHES ON ROADWAY SEGMENTS WITH VEHICLES GOING STRAIGHT

Location	Location ID	Jurisdiction	State Road	EEA
CHAPMAN AVE BETWEEN BOU AVE & RANDOLPH RD/MONTROSE PKWY	S27327	County		
COLESVILLE RD BETWEEN FENTON ST & GEORGIA AVE	S30980	County	X	X
COLESVILLE RD BETWEEN RAMSEY AVE & WAYNE AVE/2ND AVE	S28565	County	X	X
COLESVILLE RD BETWEEN SPRING ST & FENTON ST	S30926	County	X	X
COLESVILLE RD BETWEEN WAYNE AVE/2ND AVE & EAST WEST HWY	S31466	County	X	
CRYSTAL ROCK DR BETWEEN CENTURY BLVD & GERMANTOWN RD	S28625	County		X
EAST WEST HWY BETWEEN COLESVILLE RD & BLAIR MILL RD	S00072	County	X	
FENTON ST BETWEEN PARKING LOT CUT THRU & WAYNE AVE	S30286	County		X
FLOWER AVE BETWEEN PINEY BRANCH RD & DOMER AVE	S30377	Takoma Park	X	X
FREDERICK AVE BETWEEN MARYLAND AVE & CHESTNUT ST	S32002	Gaithersburg	X	X
FREDERICK AVE BETWEEN MONTGOMERY VILLAGE AVE & PERRY PKWY	S26404	Gaithersburg	X	X
FREDERICK AVE BETWEEN PERRY PKWY/LAKEFOREST BLVD & ODENDHAL AVE	S26746	Gaithersburg	X	X
FREDERICK AVE BETWEEN WHETSTONE DR & DALAMAR ST	S31011	Gaithersburg	X	X
FREDERICK RD BETWEEN BLUNT RD & GUNNERS BRANCH RD	S27402	County	X	X
FREDERICK RD BETWEEN INDIANOLA DR & GUDE DR/GUDE DR	S27276	Rockville	X	
GEORGIA AVE BETWEEN COLESVILLE RD & ELLSWORTH DR	S28651	County	X	X
GEORGIA AVE BETWEEN JUDSON RD/LAYHILL RD & SHERATON ST	S28790	County	X	X
GEORGIA AVE BETWEEN POSTGATE TER/HEATHFIELD RD & CONNECTICUT AVE	S29685	County	X	X
GEORGIA AVE BETWEEN PRICE AVE & REEDIE DR	S29841	County	X	X
GEORGIA AVE BETWEEN REEDIE DR & PRICHARD RD	S27515	County	X	
GEORGIA AVE BETWEEN SHERATON ST & RANDOLPH RD	S28905	County	X	X
GEORGIA AVE BETWEEN UNIVERSITY BLVD & ENNALLS AVE	S29016	County	X	X
GEORGIA AVE BETWEEN WAYNE AVE & BONIFANT ST	S28652	County	X	X
GERMANTOWN RD BETWEEN MIDCENTER CT & MIDDLEBROOK RD	S28873	County	X	X
GERMANTOWN RD BETWEEN MIDDLEBROOK RD & WISTERIA DR	S27745	County	X	
HUNGERFORD DR BETWEEN WASHINGTON ST/A ST & STATION3 DR	S26698	Rockville	X	X
JEFFERSON ST BETWEEN ROLLINS AVE & CALIFORNIA CIR	S30165	Rockville		
LAYHILL RD BETWEEN GREENERY LN & JUDSON RD/GEORGIA AVE	S27709	County	X	X
LOCKWOOD DR BETWEEN HEATHER HOLLOW CIR & NEW HAMPSHIRE AVE	S22128	County		X
LOCKWOOD DR BETWEEN NEW HAMPSHIRE AVE & OAK LEAF DR	S29964	County		
LOST KNIFE RD BETWEEN CONTOUR RD & ASBURY DR/ODENDHAL AVE	S27397	Gaithersburg		X
LOST KNIFE RD BETWEEN LOST KNIFE CIR & CONTOUR RD	S27395	County		X
ODENDHAL AVE BETWEEN ASBURY DR/LOST KNIFE RD & RUSSELL AVE	S27996	Gaithersburg		X
ODENDHAL AVE BETWEEN RUSSELL AVE & FREDERICK AVE	S29002	Gaithersburg		X
PERRY PKWY BETWEEN FREDERICK AVE/LAKEFOREST BLVD & DIAMOND AVE	S26599	Gaithersburg		X
PINEY BRANCH RD BETWEEN ARLISS ST & GREENWOOD AVE	S30278	County	X	X
PINEY BRANCH RD BETWEEN FLOWER AVE & MANCHESTER RD	S27903	County	X	X
PINEY BRANCH RD BETWEEN GARLAND AVE & ARLISS ST	S28057	County	X	X
PINEY BRANCH RD BETWEEN KODIAK DR & UNIVERSITY BLVD	S28359	County	X	X
REEDIE DR BETWEEN GRANDVIEW AVE & VEIRS MILL RD	S11769	County		X
RUSSELL AVE BETWEEN ODENDHAL AVE & LAKEFOREST BLVD	S26293	Gaithersburg		X
SEMINARY RD BETWEEN GEORGIA AVE & COLUMBIA BLVD	S31408	County		
UNIVERSITY BLVD BETWEEN GRANDVIEW AVE & VEIRS MILL RD	S29839	County	X	X
VEIRS MILL RD BETWEEN ENNALLS AVE & UNIVERSITY BLVD	S29840	County	X	X
VEIRS MILL RD BETWEEN UNIVERSITY BLVD & KENSINGTON BLVD	S29047	County	X	X
VEIRS MILL RD BETWEEN REEDIE DR & ENNALLS AVE	S28789	County	X	X
VEIRS MILL RD BETWEEN WHEATON PLZ ENTRANCE CUT/REEDIE DR & GEORGIA AVE	S28708	County	X	X
WAYNE AVE BETWEEN DIXON AVE/DISCOVERY PL & RAMSEY AVE	S28598	County		X
WAYNE AVE BETWEEN FENTON ST & GEORGIA AVE	S28978	County		X
WAYNE AVE BETWEEN GEORGIA AVE & DIXON AVE/DISCOVERY PL	S28655	County		X

## BICYCLE CRASHES AT INTERSECTIONS

Location	Location ID	Jurisdiction	State Road	EEA
AIRPARK RD & STRATOS LN & ANTARES DR	X11610	County		
AIRPARK RD & WOODFIELD RD	X11026	County	X	
BEACH DR & CEDAR LN	X15851	County		
BEACH DR & KNOWLES AVE	X16303	County	X	
CLARA BARTON PKWY & MAC ARTHUR BLVD	X06334	County		
CLOPPER RD & FIRSTFIELD RD	X05167	Gaithersburg	X	X
COLESVILLE RD & ST ANDREWS WAY & SLIGO CREEK PKWY	X21676	County	X	X
COLESVILLE RD & UNIVERSITY BLVD	X22131	County	X	
COLESVILLE RD & WAYNE AVE & 2ND AVE	X21066	County	X	X
CONNECTICUT AVE & ASPEN HILL RD	X16764	County	X	X
CONNECTICUT AVE & BEACH DR	X16780	County	X	
DARNESTOWN RD & MUDDY BRANCH RD	X05354	County	X	
DARNESTOWN RD & QUINCE ORCHARD RD	X02931	Gaithersburg	X	
EAST WEST HWY & BEACH DR	X18438	County	X	
EAST WEST HWY & COLESVILLE RD	X20972	County	X	
EAST WEST HWY & GRUBB RD	X19520	County	X	X
FREDERICK AVE & WESTLAND DR	X08409	Gaithersburg	X	X
FREDERICK RD & GERMANTOWN RD	X03692	County	X	
FREDERICK RD & MIDDLEBROOK RD	X04073	County	X	
FREDERICK RD & PLUMMER DR	X04294	County	X	X
GEORGIA AVE & BONIFANT ST	X21253	County	X	X
GEORGIA AVE & COLESVILLE RD	X21161	County	X	X
GEORGIA AVE & FOREST GLEN RD	X20383	County	X	
GEORGIA AVE & RANDOLPH RD	X19744	County	X	X
GEORGIA AVE & SPRING ST	X20999	County	X	
GEORGIA AVE & WAYNE AVE	X21244	County	X	X
GREAT SENECA HWY & CLOPPER RD	X01550	County	X	
GREAT SENECA HWY & KEY WEST AVE	X06402	County	X	X
GREAT SENECA HWY & MATENY RD	X01587	County	X	
GREAT SENECA HWY & MUDDY BRANCH RD	X05564	Gaithersburg	X	X
GREAT SENECA HWY & QUINCE ORCHARD RD	X04135	Gaithersburg	X	
GREAT SENECA HWY & RICHTER FARM RD	X01469	County	X	
GUDE DR & SOUTHLAWN LN	X12148	Rockville		
NEW HAMPSHIRE AVE & ADELPHI RD & DILSTON RD	X24164	County	X	X
OBSERVATION DR & RIDGE RD	X02916	County	X	
OLD GEORGETOWN RD & ST ELMO AVE & ARLINGTON RD & WILSON LN	X15097	County	X	
OLNEY SANDY SPRING RD & OLD VIC BLVD	X20025	County	X	
OLNEY SANDY SPRING RD & PRINCE PHILIP DR	X18976	County	X	
RANDOLPH RD & DEWEY RD	X15983	County		X
ROCKVILLE PIKE & JONES BRIDGE RD	X15290	County	X	
SHADY GROVE RD & MUNCASTER MILL RD & AIRPARK RD	X11479	County	X	X
SLIGO CREEK PKWY & FOREST GLEN RD	X20996	County		
SLIGO CREEK PKWY & WAYNE AVE	X22310	County		X
UNIVERSITY BLVD & GRANDVIEW AVE	X19428	County	X	X
UNIVERSITY BLVD & NEWPORT MILL RD & DECATUR AVE	X17608	County	X	
UNIVERSITY BLVD & PINEY BRANCH RD	X23339	County	X	X
WISCONSIN AVE & BRADLEY LN & BRADLEY BLVD	X15866	County	X	
WISCONSIN AVE & WAVERLY ST & ELM ST	X15604	County	X	
WOOTTON PKWY & FALLS RD	X09602	Rockville	X	
WOOTTON PKWY & TOWER OAKS BLVD	X11038	Rockville		

LEFT-TURN CRASHES AT INTERSECTIONS (ALL MODES)

Location	Location ID	Jurisdiction	State Road	EEA
ASBURY DR & LOST KNIFE RD & ODENDHAL AVE	X07089	Gaithersburg		X
BRIGGS CHANEY RD & OLD COLUMBIA PIKE	X24828	County		X
BROADBIRCH DR & CALVERTON BLVD & CHERRY HILL RD	X24753	County		
BUREAU DR & DIAMOND AVE	X05543	Gaithersburg	X	
CHESTNUT ST & DIAMOND AVE & MUDDY BRANCH RD	X06515	Gaithersburg	X	X
CLOPPER RD & FIRSTFIELD RD	X05167	Gaithersburg	X	X
CLOPPER RD & QUINCE ORCHARD RD & DIAMOND AVE	X05349	Gaithersburg	X	X
COLESVILLE RD & FENTON ST	X21234	County	X	X
COLUMBIA PIKE & GREENCASTLE RD	X25129	County	X	X
COLUMBIA PIKE & STEWART LN & MILESTONE DR	X23787	County	X	X
CONNECTICUT AVE & BEL PRE RD	X17855	County		X
DEMOCRACY BLVD & SEVEN LOCKS RD	X10303	County		
EAST WEST HWY & 16TH ST	X20795	County	X	
EAST WEST HWY & GRUBB RD	X19520	County	X	X
FALLS RD & RIVER RD	X06164	County	X	
FATHER HURLEY BLVD & WATERS LANDING DR	X01767	County		
FREDERICK AVE & MONTGOMERY VILLAGE AVE	X05936	Gaithersburg	X	X
FREDERICK RD & GUNNERS BRANCH RD	X04054	County	X	X
FREDERICK RD & KING FARM BLVD & SHADY GROVE METRO W RD	X09707	Rockville	X	X
FREDERICK RD & REDLAND RD & REDLAND BLVD	X09984	Rockville	X	
FREDERICK RD & SHAKESPEARE BLVD	X03475	County	X	
GEORGIA AVE & FOREST GLEN RD	X20383	County	X	
GEORGIA AVE & HATHAWAY DR	X18658	County	X	X
GEORGIA AVE & REEDIE DR	X19641	County	X	X
GEORGIA AVE & SHOREFIELD RD	X19631	County	X	X
GERMANTOWN RD & CRYSTAL ROCK DR	X02358	County	X	X
GERMANTOWN RD & SENECA MEADOWS PKWY & GOLDENROD LN	X03009	County	X	
GOSHEN RD & WIGHTMAN RD & SNOUFFER SCHOOL RD	X08116	County		
HUNGERFORD DR & WASHINGTON ST & A ST	X11086	Rockville	X	X
LAYHILL RD & BONIFANT RD & BEL PRE RD	X20233	County	X	
MIDDLEBROOK RD & WARING STATION RD	X02887	County		X
MONTGOMERY VILLAGE AVE & QUINCE ORCHARD RD & RT124 PARK RIDE	X05517	Gaithersburg	X	X
MONTGOMERY VILLAGE AVE & RUSSELL AVE & STATION8 DR	X06161	Gaithersburg	X	X
MONTROSE PKWY & EXECUTIVE BLVD & JEFFERSON ST	X12858	County		
NORBECK RD & LAYHILL RD	X20910	County	X	
REDLAND RD & CRABBS BRANCH WAY	X10683	County		
ROCKVILLE PIKE & CALIFORNIA CIR & BOU AVE	X13404	County	X	
ROCKVILLE PIKE & TWINBROOK PKWY & ROLLINS AVE	X13230	Rockville	X	
RUSSELL AVE & CHRISTOPHER AVE	X05851	Gaithersburg		X
RUSSELL AVE & LAKEFOREST BLVD	X06322	Gaithersburg		X
RUSSELL AVE & ODENDHAL AVE	X06611	Gaithersburg		X
SHADY GROVE RD & CHOKE CHERRY RD	X08173	County		
SHADY GROVE RD & CRABBS BRANCH WAY	X09857	County		
SHADY GROVE RD & DARNESTOWN RD	X07202	County		
SHADY GROVE RD & OAKMONT AVE	X09302	County		X
UNIVERSITY BLVD & INWOOD AVE	X20791	County	X	
VEIRS MILL RD & ATLANTIC AVE	X13765	Rockville	X	X
VEIRS MILL RD & CONNECTICUT AVE	X17318	County	X	
WOODFIELD RD & SNOUFFER SCHOOL RD & MUNCASTER MILL RD	X10522	County	X	X
WOOTTON PKWY & TOWER OAKS BLVD	X11038	Rockville		

## MOTOR VEHICLE STRAIGHT/ANGLE CRASHES AT FOUR-LEGGED INTERSECTIONS

Location	Location ID	Jurisdiction	State Road	EEA
BROADBIRCH DR & CALVERTON BLVD & CHERRY HILL RD	X24753	County		
COLESVILLE RD & FENTON ST	X21234	County	X	X
COLESVILLE RD & UNIVERSITY BLVD	X22171	County	X	
COLUMBIA PIKE & STEWART LN & MILESTONE DR	X23787	County	X	X
CONNECTICUT AVE & ASPEN HILL RD	X16764	County	X	X
CONNECTICUT AVE & RANDOLPH RD	X17475	County	X	X
DEMOCRACY BLVD & SEVEN LOCKS RD	X10303	County		
EAST WEST HWY & GLENDALE RD	X17267	County	X	
FIRSTFIELD RD & QUINCE ORCHARD RD	X05406	Gaithersburg	X	X
FREDERICK AVE & PERRY PKWY & LAKEFOREST BLVD	X06192	Gaithersburg	X	X
FREDERICK RD & GERMANTOWN RD	X03692	County	X	
FREDERICK RD & REDLAND RD & REDLAND BLVD	X09984	Rockville	X	
FREDERICK RD & SHAKESPEARE BLVD	X03475	County	X	
GEORGIA AVE & ARCOLA AVE	X19517	County	X	X
GEORGIA AVE & COLESVILLE RD	X21161	County	X	X
GEORGIA AVE & CONNECTICUT AVE	X16983	County	X	
GEORGIA AVE & DOUGLAS AVE & WINDHAM LN	X19923	County	X	X
GEORGIA AVE & FOREST GLEN RD	X20383	County	X	
GEORGIA AVE & HATHAWAY DR	X18658	County	X	X
GEORGIA AVE & REEDIE DR	X19641	County	X	X
GEORGIA AVE & WELLER RD	X18817	County	X	X
GERMANTOWN RD & AIRCRAFT DR	X02477	County	X	X
GERMANTOWN RD & CRYSTAL ROCK DR	X02358	County	X	X
GERMANTOWN RD & WISTERIA DR	X01883	County	X	
HUNGERFORD DR & WASHINGTON ST & A ST	X11086	Rockville	X	X
LAYHILL RD & BONIFANT RD & BEL PRE RD	X20233	County	X	
MIDCOUNTY HWY & SAYBROOKE OAKS BLVD & WOODFIELD RD	X09207	Gaithersburg	X	
MONTGOMERY VILLAGE AVE & CLUB HOUSE RD	X06647	County		
MONTGOMERY VILLAGE AVE & LOST KNIFE RD & CHRISTOPHER AVE	X06574	County	X	X
NEW HAMPSHIRE AVE & ADELPHI RD & DILSTON RD	X24164	County	X	X
NEW HAMPSHIRE AVE & OAKVIEW DR	X24208	County	X	X
NEW HAMPSHIRE AVE & RANDOLPH RD	X22906	County	X	
OLD COLUMBIA PIKE & FAIRLAND RD	X24695	County		X
OLD GEORGETOWN RD & CORDELL AVE	X15025	County	X	
OLD GEORGETOWN RD & EXECUTIVE BLVD	X13408	County	X	
RANDOLPH RD & LINDELL ST & DENLEY RD	X18574	County		X
RANDOLPH RD & OLD COLUMBIA PIKE	X24547	County		X
RANDOLPH RD & SELFRIDGE RD	X16506	County		X
ROCKVILLE PIKE & EDMONSTON DR	X12204	Rockville	X	X
ROCKVILLE PIKE & GROSVENOR LN	X14731	County	X	
SEVEN LOCKS RD & TUCKERMAN LN	X10619	County		
SHADY GROVE RD & CAVANAUGH DR & PINEY MEETINGHOUSE RD	X05581	County		
SHADY GROVE RD & GAITHER RD &	X08332	County		
SHADY GROVE RD & MILL RUN DR	X11301	County		X
SHADY GROVE RD & MUNCASTER MILL RD & AIRPARK RD	X11479	County	X	X
SHADY GROVE RD & RESEARCH BLVD	X07797	County		
UNIVERSITY BLVD & ELKIN ST	X19713	County	X	X
UNIVERSITY BLVD & MERRIMAC DR	X23559	Takoma Park	X	
UNIVERSITY BLVD & VEIRS MILL RD	X19201	County	X	X
WOODFIELD RD & SNOUFFER SCHOOL RD & MUNCASTER MILL RD	X10522	County	X	X

## SINGLE VEHICLE CRASHES ALONG ROADWAY SEGMENTS

Location	Location ID	Jurisdiction	State Road	EEA
AIRPARK RD BETWEEN STRATOS LN & SHADY GROVE RD/MUNCASTER MILL RD	S28902	County		
AIRPARK RD BETWEEN WOODFIELD RD & STRATOS LN/ANTARES DR	S28599	County		
ASHTON RD BETWEEN TUCKER LN & ASHLAND DR	S29819	County	X	
AVERY RD BETWEEN SOUTHLAWN LN & NORBECK RD	S30027	Rockville		
BEACH DR BETWEEN KNOWLES AVE & GROSVENOR LN	S04906	County		
BEACH DR BETWEEN WEXFORD DR & KNOWLES AVE	S06170	County		
BEALLSVILLE RD BETWEEN DARNESTOWN RD & LYNDENWOOD AVE	S30054	County	X	
BRIGGS CHANEY RD BETWEEN ASTON MANOR DR & GENTRY RIDGE CT	S28329	County		
CLARKSBURG RD BETWEEN LEWISDALE RD & HYATTSTOWN MILL RD/KINGSLEY RD	S29187	County		
CLOPPER RD BETWEEN GAME PRESERVE RD & WARING STATION RD	S29117	County	X	
COLUMBIA PIKE BETWEEN BLACKBURN RD & GREENCASTLE RD	S26732	County	X	
COLUMBIA PIKE BETWEEN BRIGGS CHANEY RD & FAIRLAND RD	S31960	County	X	
COLUMBIA PIKE BETWEEN FAIRLAND RD & MUSGROVE RD	S26733	County	X	X
COLUMBIA PIKE BETWEEN GREENCASTLE RD & BRIGGS CHANEY RD	S26439	County	X	
COLUMBIA PIKE BETWEEN SANDY SPRING RD & BLACKBURN RD	S28217	County	X	
CONNECTICUT AVE BETWEEN BEACH DR & WOODLAWN RD	S28021	County	X	
DAMASCUS RD BETWEEN LONG CORNER RD & JARL DR	S30379	County	X	
DARNESTOWN RD BETWEEN BELLINGHAM DR & WHITES FERRY RD	S29517	County	X	
DARNESTOWN RD BETWEEN BUCKLODGE RD & CATTAIL RD	S30441	County	X	
DARNESTOWN RD BETWEEN BUCKLODGE RD & WHITE GROUND RD	S28811	County	X	
DARNESTOWN RD BETWEEN DICKERSON RD/MARTINSBURG RD & HUNTER RD	S29457	County	X	
FALLS RD BETWEEN GREAT MARYLAND AVE & FALLSMEAD WAY	S29928	Rockville	X	
FREDERICK RD BETWEEN LITTLE BENNETT DR & COMUS RD	S29297	County	X	
FREDERICK RD BETWEEN WHEATFIELD DR & GAME PRESERVE RD/FREDERICK AVE	S28983	County	X	X
GAME PRESERVE RD BETWEEN FREDERICK AVE & CHURCH CUT THRU	S30744	Gaithersburg		X
GEORGIA AVE BETWEEN NEW HAMPSHIRE AVE/DAMASCUS RD & GREGG RD	S32094	County	X	
GERMANTOWN RD AT AIRCRAFT DR	S28301	County	X	X
GOOD HOPE RD BETWEEN CAPE MAY RD & NEW HAMPSHIRE AVE/BONIFANT RD	S31268	County		
GREAT SENECA HWY BETWEEN HORN POINT DR & MATENY RD	S00014	County	X	
GREAT SENECA HWY BETWEEN LAKELANDS DR & HIGH GABLES DR	S00028	Gaithersburg	X	
LAYTONSVILLE RD BETWEEN HAWKINS CREAMERY RD & ROCKY RD	S32014	County	X	
MIDDLEBROOK RD AT OBSERVATION DR	S29974	County		X
MONTGOMERY AVE BETWEEN NELSON ST & HURLEY AVE	S28719	Rockville	X	
MONTROSE PKWY BETWEEN EXECUTIVE BLVD/JEFFERSON ST & MONTROSE RD	S27472	County		
MONTROSE RD BETWEEN MONTROSE PKWY & TILDENWOOD DR	S26703	County		
MUNCASTER MILL RD BETWEEN BOWIE MILL RD & OLDE MILL RUN	S29826	County	X	
NEW HAMPSHIRE AVE BETWEEN BRIGHTON DAM RD & BRIGHTON KNOLLS DR	S29613	County	X	
NEW HAMPSHIRE AVE BETWEEN GOOD HOPE RD & COLESVILLE MANOR DR	S29844	County	X	
NORBECK RD BETWEEN BALTIMORE RD & AVERY RD	S27568	Rockville	X	
OLNEY LAYTONSVILLE RD BETWEEN VOLUNTEER DR & WICKHAM RD	S32368	County	X	
PERRY PKWY BETWEEN FREDERICK AVE/LAKEFOREST BLVD & DIAMOND AVE	S26599	Gaithersburg		X
RANDOLPH RD BETWEEN TOURMALINE CT/WITHAN DR & LAURIE DR	S30793	County		X
RIDGE RD BETWEEN KEMPTOWN RD & HOLSEY RD	S30053	County	X	
SENECA MEADOWS PKWY BETWEEN OBSERVATION DR & GERMANTOWN RD	S25795	County		
SPENCERVILLE RD BETWEEN SANTINI RD & LIONS DEN RD/BURTONSVILLE DR	S29752	County	X	
WATKINS MILL RD BETWEEN GREENRIVER TER & WAYFARER RD	S28423	County		
WHITES FERRY RD BETWEEN ELMER SCHOOL RD & RIVER RD	S29236	County		
WHITES FERRY RD BETWEEN MORROW RD & PARTNERSHIP RD	S31883	County	X	
WHITES FERRY RD BETWEEN PARTNERSHIP RD & HERSPERGER LN/FISHER AVE	S29764	Poolesville	X	
WOODFIELD RD BETWEEN ESSEX VIEW DR & CHURCHILL DOWNS RD	S31450	County	X	

APPENDIX G. HIGH-RISK LOCATIONS BY CONTEXT CHARACTERISTICS

TOTAL CRASH RISK BY CONTEXT CHARACTERISTICS

Context			# Ints.	Intersection Crash Types				# Segs.	Segment Crash Types	
Land Use	Max Lanes	Signalized*		Ped Dark	Bike	Left Turn	Angle		Ped	Single Veh
Urban	1-2	Yes	38	2	1	14	10	502	6	27
		No	2,582	8	6	20	31	5,019	8	45
	3-4	Yes	183	17	10	136	105	465	11	69
		No	337	4	3	22	23	215	2	11
	5+	Yes	168	32	13	158	162	289	12	44
		No	152	5	3	22	29	85	2	6
Suburban	1-2	Yes	83	2	3	22	22	686	3	66
		No	11,018	11	17	53	148	20,819	22	207
	3-4	Yes	128	6	7	84	77	285	4	54
		No	425	3	4	27	46	276	2	25
	5+	Yes	160	12	10	117	119	239	4	57
		No	336	4	6	30	55	233	3	17
Country	1-2	Yes	15	0	0	7	5	47	0	14
		No	996	0	1	13	14	1,842	3	139
	3-4	Yes	1	0	0	0	-	1	0	0
		No	10	0	0	1	0	3	0	0
	5+	Yes	1	0	0	0	-	1	0	0
		No	4	0	0	1	2	4	0	2

Highlighted cells have the highest value for any column.

\* For roadway segments, signalized indicates whether one or both of the intersections at the end of the roadway segment is signalized



### HOT SPOT ANALYSIS (TOP 200 INTERSECTIONS AND SEGMENTS) BY CONTEXT CHARACTERISTICS

Context			# Ints.	Intersection Crash Types				# Segs.	Segment Crash Types	
Land Use	Lanes	Signalized		Ped Dark	Bike	Left Turn	Angle		Ped	Single Veh
Urban	1-2	Yes	38	9	3	2	2	502	21	7
		No	2,582	8	-	-	2	5,019	4	3
	3-4	Yes	183	51	37	48	29	465	50	14
		No	337	1	-	-	2	215	3	-
	5+	Yes	168	80	73	62	56	289	73	14
		No	152	10	-	-	8	85	14	-
Suburban	1-2	Yes	83	3	5	5	4	686	1	25
		No	11,018	-	1	-	10	20,819	4	23
	3-4	Yes	128	7	29	34	22	285	13	16
		No	425	1	1	-	6	276	4	5
	5+	Yes	160	29	47	45	41	239	8	21
		No	336	-	-	1	11	233	4	4
Country	1-2	Yes	15	-	-	1	2	47	-	9
		No	996	-	-	-	1	1,842	1	57
	3-4	Yes	1	-	-	-	-	1	-	-
		No	10	-	-	-	-	3	-	-
	5+	Yes	1	-	-	-	-	1	-	-
		No	4	-	-	-	1	4	-	1

Highlighted cells have the highest value for any column.

\* For roadway segments, signalized indicates whether one or both of the intersections at the end of the roadway segment is signalized

AVERAGE CRASH RISK BY CONTEXT CHARACTERISTICS

Context			# Ints.	Intersection Crash Types				# Segs.	Segment Crash Types	
Land Use	Lanes	Signalized		Ped Dark	Bike	Left Turn	Angle		Ped	Single Veh
Urban	1-2	Yes	38	0.06	0.04	0.36	0.41	502	0.01	0.06
		No	2,582	0.00	0.00	0.01	0.06	5,019	0.00	0.01
	3-4	Yes	183	0.09	0.05	0.74	0.87	465	0.02	0.15
		No	337	0.01	0.01	0.07	0.34	215	0.01	0.05
	5+	Yes	168	0.19	0.08	0.95	1.46	289	0.04	0.15
		No	152	0.04	0.02	0.15	1.17	85	0.03	0.07
Suburban	1-2	Yes	83	0.02	0.03	0.26	0.45	686	0.00	0.10
		No	11,018	0.00	0.00	0.00	0.06	20,819	0.00	0.01
	3-4	Yes	128	0.04	0.06	0.66	0.89	285	0.01	0.19
		No	425	0.01	0.01	0.06	0.38	276	0.01	0.09
	5+	Yes	160	0.07	0.07	0.74	1.28	239	0.02	0.24
		No	336	0.01	0.02	0.09	0.55	233	0.01	0.08
Country	1-2	Yes	15	0.00	0.02	0.47	0.52	47	0.00	0.31
		No	996	0.00	0.00	0.01	0.12	1,842	0.00	0.08
	3-4	Yes	1	-	-	-	-	1	0.00	0.06
		No	10	-	-	-	-	3	0.00	0.15
	5+	Yes	1	0.01	0.01	0.15	-	1	0.01	0.05
		No	4	0.00	0.01	0.13	0.40	4	0.01	0.41

Highlighted cells have the highest value for any column.

\* For roadway segments, signalized indicates whether one or both of the intersections at the end of the roadway segment is signalized

APPENDIX H. SEVERE AND FATAL CRASHES CONTEXT ANALYSIS

Location Type	# Locs.	Total Crashes			Average Crashes		
		Fatalities	Severe Injuries	Total KSI	Fatalities	Severe Injuries	Total KSI
Complete Streets Design Guide Area Type							
Downtown	1,236	7	107	114	0.006	0.092	0.098
Town Center	2,674	17	162	179	0.007	0.064	0.071
Suburban*	35,277	67	572	639	0.002	0.016	0.018
Country	3,101	20	110	130	0.007	0.038	0.044
Other**	6,450	19	136	155	0.003	0.021	0.024
Complete Streets Design Guide Street Type							
Major Highway	38	1	21	22	0.033	0.700	0.733
Boulevard	2,628	59	432	491	0.025	0.185	0.210
Downtown Blvd	325	8	69	77	0.027	0.234	0.261
Town Center Blvd	565	7	89	96	0.014	0.179	0.193
Downtown Street	573	0	25	25	0.000	0.046	0.046
Town Center Street	336	1	13	14	0.003	0.040	0.043
Neighborhood Conn	5,875	9	122	131	0.002	0.021	0.023
Country Conn	557	6	48	54	0.012	0.097	0.110
Country Road	156	0	6	6	0.000	0.040	0.040
Industrial Street	110	0	3	3	0.000	0.028	0.028
Neighborhood Street	30,756	19	139	158	0.001	0.005	0.005
Rustic Road***	530	4	19	23	0.008	0.038	0.046
Equity Area Type							
EEA	8,365	45	309	354	0.006	0.038	0.044
Non-EEA	40,383	85	779	864	0.002	0.020	0.022

Highlighted cells have the highest value for any column.

\* Suburban includes Industrial areas.

\*\* Other includes municipalities with independent planning authority.

\*\*\* Includes Exceptionally Rustic Roads.

The analysis above solely includes severe injuries and fatalities that occurred at intersections and segments included in the Predictive Safety Analysis. About 15% of severe injuries and fatalities between 2015 and 2019 are excluded as they occurred at locations not included in the analysis.

## APPENDIX I. WHERE COUNTERMEASURES ARE APPLIED

Countermeasure Name/Context	Where Countermeasures are Applied
Automated Speed Enforcement	Streets with more than four lanes in Urban and Suburban areas
Centerline Rumble Strip	Roads in Country areas with two lanes
Convert All-Way Stop Control to Mini-Roundabout	All-way-stop-controlled intersections, with speed limits less than 35 mph, daily vehicle volumes < 10,000, and no more than 2 lanes on any approach
Convert Side-Street Stop Control to All-Way Stop	Side-street stop-controlled intersections, with speed limits less than 35 mph, daily vehicle volumes < 10,000, and no more than 2 lanes on any approach
High Visibility Crosswalks - Signalized Intersections where some Crosswalks are Conventional or Not Marked	Signalized intersections with fewer than 2 high-visibility crosswalks
High Visibility Crosswalks - Signalized Intersections with No Crosswalks	Signalized intersections with no marked crosswalks. Intersections with no nearby sidewalks are excluded unless there is a nearby bus stop
High Visibility Crosswalks - Signalized Intersections with Standard Crosswalks	Signalized intersections with standard marked crosswalks, but not high-visibility crosswalks
High Visibility Crosswalks - Unsignalized Intersections with Standard Crosswalks	Unsignalized intersections with standard marked crosswalks, but not high-visibility crosswalks. Intersections without marked crosswalks across the major street are excluded unless there is a nearby bus stop
Increase All Red Clearance Time - Other Street Types	Signalized intersections on street types not listed above
Increase All Red Clearance Time- Boulevards, Downtown Boulevards, Town Center Boulevards, Major Highways	Signalized intersections on Boulevards, Downtown Boulevards, Town Center Boulevards, and Major Highways
Install a Traffic Signal	Stop controlled intersections with more than 20,000 daily vehicles, more than 4 lanes on the major street approach, and located in an urban area or along a transit corridor
Introduce Fully Protected Left Turns	Signalized intersections in urban and suburban areas with a left-turn lane on the major approach and a current protected/permissive phase
Introduce Protected/Permitted Signal Phase	Signalized intersections in urban areas with 4 legs and a left-turn lane on the major street approach
Lighting at Signalized Intersections	Signalized intersections with less than 2 lights within 75 feet of the center of the intersection

Countermeasure Name/Context	Where Countermeasures are Applied
Lighting at Unsignalized Intersections	Unsignalized intersections with less than 2 lights within 75 feet of the center of the intersection
LPI on Downtown Boulevards	Signalized intersections on Downtown Boulevards where a crosswalk is present across the Downtown Boulevard
LPI on Town Center Boulevards, Boulevards, and Major Highways	Signalized intersections on Town Center Boulevards, Boulevards, and Major Highways
Mid-Block High-Visibility Crosswalks	Segments with no marked crosswalk with 2 lanes, speed limits of 25 mph or less, and longer than 400 feet. Segments without sidewalks are excluded unless there is a nearby bus stop
Mid-Block Pedestrian Hybrid Beacon	Segments with existing mid-block marked crosswalks that have 4 or fewer lanes, speed limits of 35 mph or less, and vehicle volumes greater than 3,000 per day
Mid-Block Raised Crossing	Segments with no marked crosswalk with 2 lanes and speed limits of 30 mph
Reduce Speeds by 5 mph	Roads in Country areas with speed limits over 25 mph
Restricted to Left-In Access	Stop controlled intersections with more than 20,000 daily vehicles, more than 4 lanes on the major street approach, and located in a suburban area
Speed Humps	Segments in urban and suburban areas with no marked crosswalk, 2 lanes, speeds of 25 mph or less, and fewer than 15,000 daily vehicles

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## APPENDIX J. CANDIDATE LOCATIONS FOR SYSTEMIC COUNTERMEASURE IMPLEMENTATION

The following pages include the top 50 ranked candidate locations for each countermeasure and its associated contexts. Based on the SPF analysis and the data available, these locations have been identified as candidates for systemic implementation of the selected countermeasures. However, given the countywide nature of this analysis, individual site reviews are needed to confirm that the identified locations are context-appropriate for the selected countermeasures.

## HIGH VISIBILITY CROSSWALK: SIGNALIZED INTERSECTIONS WITH SOME HIGH-VISIBILITY CROSSWALKS

Location	Location ID	Jurisdiction	State Road	EEA
16TH ST & ELKHART ST & 2ND AVE	X20577	County	X	
16TH ST & SPRING ST	X20784	County	X	X
BALTIMORE RD & 1ST ST & NORBECK RD	X12167	Rockville	X	
BRADLEY BLVD & ARLINGTON RD	X15099	County	X	
BROADBIRCH DR & CALVERTON BLVD & CHERRY HILL RD	X24753	County		
COLESVILLE RD & FENTON ST	X21234	County	X	X
COLESVILLE RD & SPRING ST	X21285	County	X	X
COLESVILLE RD & ST ANDREWS WAY & SLIGO CREEK PKWY	X21676	County	X	X
COLUMBIA PIKE & BLACKBURN RD	X25226	County	X	
DEMOCRACY BLVD & FERNWOOD RD	X12248	County		
EAST WEST HWY & CONNECTICUT AVE	X17057	County	X	
EAST WEST HWY & SUNDALE DR & WASHINGTON AVE	X20148	County	X	X
FREDERICK AVE & HUNGERFORD DR	X11084	Rockville	X	X
GEORGIA AVE & ARCOLA AVE	X19517	County	X	X
GEORGIA AVE & HEWITT AVE	X17811	County	X	X
GEORGIA AVE & ROSSMOOR BLVD	X17091	County	X	
GEORGIA AVE & SEMINARY PL	X20537	County	X	
GERMANTOWN RD & AIRCRAFT DR	X02477	County	X	X
GERMANTOWN RD & CRYSTAL ROCK DR	X02358	County	X	X
HUNGERFORD DR & MANNAKEE ST	X11092	Rockville	X	X
INDIANOLA DR & CRABBS BRANCH WAY	X10811	County		
MARINELLI RD & EXECUTIVE BLVD	X13631	County		
MARYLAND AVE & JEFFERSON ST	X11243	Rockville	X	X
MARYLAND AVE & MIDDLE LN	X11246	Rockville		X
MIDDLEBROOK RD & GERMANTOWN RD	X02052	County	X	
MIDDLEBROOK RD & WARING STATION RD	X02887	County		X
MONTGOMERY VILLAGE AVE & CLUB HOUSE RD	X06647	County		
MONTGOMERY VILLAGE AVE & LAKE SHORE DR & WALKERS CHOICE RD	X06797	County		
MONTGOMERY VILLAGE AVE & PLEASANT RIDGE DR & WIGHTMAN RD	X07662	County		
NEW HAMPSHIRE AVE & LOCKWOOD DR	X23608	County	X	
NEW HAMPSHIRE AVE & OAKVIEW DR	X24208	County	X	X
OLD COLUMBIA PIKE & SANDY SPRING RD	X25257	County	X	
OLD GEORGETOWN RD & AUBURN AVE	X14889	County	X	
PARK RD & STONESTREET AVE	X11490	Rockville		
PINEY BRANCH RD & CARROLL AVE	X23600	County	X	X
RANDOLPH RD & GLENMONT CIR	X19977	County		X
ROCKVILLE PIKE	X15275	County	X	
ROCKVILLE PIKE & CALIFORNIA CIR & BOU AVE	X13404	County	X	
ROCKVILLE PIKE & RICHARD MONTGOMERY DR & DODGE ST	X11662	Rockville	X	X
ROCKVILLE PIKE & SECURITY LN	X14197	County	X	
ROCKVILLE PIKE & WOOTTON PKWY & 1ST ST	X11989	Rockville	X	X
SLIGO CREEK PKWY & PINEY BRANCH RD	X22592	County	X	
UNIVERSITY BLVD & DENNIS AVE	X21668	County	X	
UNIVERSITY BLVD & SLIGO CREEK PKWY	X21057	County	X	
VEIRS MILL RD & CLARIDGE RD	X17976	County	X	
VEIRS MILL RD & FERRARA AVE	X17084	County	X	X
VEIRS MILL RD & ROBINDALE DR	X15482	County	X	X
WAYNE AVE & CEDAR ST	X21545	County		
WISCONSIN AVE & WAVERLY ST & ELM ST	X15604	County	X	
WOODMONT AVE & BETHESDA AVE	X15437	County		



HIGH VISIBILITY CROSSWALK: SIGNALIZED INTERSECTIONS WITH ONLY STANDARD CROSSWALKS

Location	Location ID	Jurisdiction	State Road	EEA
CENTURY BLVD & CRYSTAL ROCK DR	X02280	County		
CHESTNUT ST & DIAMOND AVE & MUDDY BRANCH RD	X06515	Gaithersburg	X	X
CLOPPER RD & FIRSTFIELD RD	X05167	Gaithersburg	X	X
CONNECTICUT AVE & PLYERS MILL RD	X17175	County	X	
EAST WEST HWY & WAVERLY ST	X15669	County	X	
ELLSWORTH DR & FENTON ST	X21323	County		X
FATHER HURLEY BLVD & WISTERIA DR	X01498	County		
FREDERICK AVE & PERRY PKWY & LAKEFOREST BLVD	X06192	Gaithersburg	X	X
FREDERICK AVE & WESTLAND DR	X08409	Gaithersburg	X	X
FREDERICK RD & GERMANTOWN RD	X03692	County	X	
FREDERICK RD & KING FARM BLVD & SHADY GROVE METRO W RD	X09707	Rockville	X	X
FREDERICK RD & MIDDLEBROOK RD	X04073	County	X	
FREDERICK RD & REDLAND RD & REDLAND BLVD	X09984	Rockville	X	
GEORGIA AVE & ASPEN HILL RD	X17262	County	X	
GEORGIA AVE & BEL PRE RD	X16842	County	X	X
GEORGIA AVE & CONNECTICUT AVE	X16983	County	X	
GEORGIA AVE & GLENALLAN AVE	X19275	County	X	X
GEORGIA AVE & JUDSON RD & LAYHILL RD	X19619	County	X	X
GEORGIA AVE & POSTGATE TER & HEATHFIELD RD	X16841	County	X	
GEORGIA AVE & RANDOLPH RD	X19744	County	X	X
HUNGERFORD DR & BEALL AVE	X11290	Rockville	X	X
HUNGERFORD DR & WASHINGTON ST & A ST	X11086	Rockville	X	X
LAYHILL RD & GLENALLAN AVE	X19716	County	X	X
MIDCOUNTY HWY & MONTGOMERY VILLAGE AVE	X06778	County	X	X
MIDDLE LN & WASHINGTON ST	X11118	Rockville		X
MONROE ST & JEFFERSON ST	X11338	Rockville	X	X
MONTGOMERY VILLAGE AVE & RUSSELL AVE & STATION8 DR	X06161	Gaithersburg	X	X
MONTROSE PARK RIDE & TOWNE RD & MONTROSE RD	X13484	County		
NEW HAMPSHIRE AVE & NORTHAMPTON DR	X24112	County	X	
NEW HAMPSHIRE AVE & POWDER MILL RD	X24224	County	X	
PINEY BRANCH RD & ARLISS ST	X22971	County	X	X
PINEY BRANCH RD & BARRON ST	X23226	County	X	X
PINEY BRANCH RD & FLOWER AVE	X22767	County	X	X
PINEY BRANCH RD & GREENWOOD AVE	X22882	County	X	X
RANDOLPH RD & VEIRS MILL RD	X16598	County	X	X
REEDIE DR & FERN ST	X19803	County		X
ROCKVILLE PIKE & JONES BRIDGE RD	X15290	County	X	
ROCKVILLE PIKE & TUCKERMAN LN	X14550	County	X	
ROLLINS AVE & JEFFERSON ST	X12839	Rockville		
SHADY GROVE RD & FALLSGROVE BLVD & MEDICAL CENTER WAY	X07356	County		
SOMERVILLE DR & REDLAND RD	X10120	County		
TWINBROOK PKWY & CHAPMAN AVE	X13419	Rockville		
TWINBROOK PKWY & FISHERS LN	X13672	County		X
TWINBROOK PKWY & PARKLAWN DR & WICOMICO AVE	X13670	County		X
VEIRS MILL RD & GAYNOR RD & PARKLAND DR	X15745	County	X	X
VEIRS MILL RD & GRIDLEY RD & SHOP CTR CUT THRU	X16448	County	X	X
VEIRS MILL RD & TWINBROOK PKWY	X14065	County	X	X
WASHINGTON ST & BEALL AVE	X11113	Rockville		X
WAVERLY ST & MONTGOMERY AVE	X15690	County	X	
WOODMONT AVE & BATTERY LN	X15264	County		

HIGH VISIBILITY CROSSWALK: UNSIGNALIZED INTERSECTIONS WITH ONLY STANDARD CROSSWALKS

Location	Location ID	Jurisdiction	State Road	EEA
ADRIAN ST & PARKLAND DR	X15812	County		X
BLUERIDGE AVE & GRANDVIEW AVE	X19422	County		X
COLESVILLE RD & RAMSEY AVE	X21115	County	X	X
CONNECTICUT AVE & BALTIMORE ST	X17155	County	X	
CONNECTICUT AVE & EVERTON ST	X17510	County	X	X
CORDELL AVE & WILSON LN	X14991	County	X	
ELKIN ST & HICKERSON DR	X19740	County		X
ELMCROFT BLVD & KING FARM BLVD	X09619	Rockville		
FERN ST & PRICE AVE	X19801	County		X
FIDLER LN & RAMSEY AVE	X21082	County		X
FREDERICK AVE & DE SELLMUM AVE	X07318	Gaithersburg	X	X
FREDERICK AVE & FULKS CORNER AVE & CEDAR AVE	X07217	Gaithersburg	X	X
FREDERICK AVE & WALKER AVE	X06841	Gaithersburg	X	X
FREDERICK AVE & WESTLAND DR	X08223	Gaithersburg	X	X
FREDERICK RD & APPLIEDOWRE WAY	X03943	County	X	
FREDERICK RD & COLLINS DR & NEELSVILLE CHURCH RD	X03598	County	X	
FREDERICK RD & OXBRIDGE DR	X03775	County	X	
GEORGIA AVE & DENLEY RD	X19122	County	X	X
GEORGIA AVE & HICKERSON DR	X19534	County	X	X
GEORGIA AVE & SHERATON ST	X19701	County	X	X
GEORGIA AVE & WEISMAN RD	X19623	County	X	X
GILBERT PL & BARRON ST	X23229	County		X
GIST AVE & FENTON ST	X21417	County		
GREAT SENECA HWY & GREY EAGLE CT	X02240	County	X	X
GREAT SENECA HWY & GROTTO LN	X02041	County	X	
HALPINE RD & ARDENNES AVE	X13506	Rockville		X
MARINELLI RD & LANDSDOWN ST	X14042	County		
MONROE ST & MONROE PL	X11357	Rockville		X
NORMANDY CROSSING DR & HOMECREST RD & LONGMEAD CROSSING DR	X19335	County		
OLD GEORGETOWN RD & DEL RAY AVE	X14955	County	X	
OLD GEORGETOWN RD & FAIRMONT AVE	X15165	County	X	
OLD GEORGETOWN RD & MOORLAND LN	X15257	County	X	
PARK AVE & BROOKES AVE	X07333	Gaithersburg		X
PINEY BRANCH RD & MANCHESTER RD	X22649	County	X	
RANDOLPH RD & ATHERTON DR	X17099	County		X
RANDOLPH RD & BUSHEY DR	X16972	County		X
ROCKVILLE PIKE & MT VERNON PL	X11820	Rockville	X	
ROEDER RD & FENTON ST	X21286	County		X
RUSSELL AVE & BROOKES AVE	X07189	Gaithersburg		X
RUSSELL AVE & WALKER AVE	X07108	Gaithersburg		X
SLIGO CREEK PKWY & HILLTOP RD & MAPLE AVE	X22759	Takoma Park		
TRAVIS AVE & WATKINS MILL RD	X05793	Gaithersburg		X
UNIVERSITY BLVD & DEARBORN AVE & MOSS AVE	X22944	County	X	
UNIVERSITY BLVD & GILBERT ST	X23374	County	X	X
UNIVERSITY BLVD & SEEK LN	X23435	County	X	X
VALLEYWOOD DR & ANDREW ST	X18088	County		X
VEIRS MILL RD & GRIDLEY RD	X16422	County	X	X
WILLOW LN & 46TH ST	X15845	County		
WISCONSIN AVE & MAPLE AVE	X15361	County	X	
WISCONSIN AVE & MILLER AVE	X15691	County	X	

HIGH VISIBILITY CROSSWALK: SIGNALIZED INTERSECTIONS WITH NO CROSSWALKS

Location	Location ID	Jurisdiction	State Road	EEA
ATTEBORO RD & EUBIE BLAKE WAY & NORWOOD RD	X21880	County		
BONIFANT RD & NOTLEY RD	X22030	County		
BRADLEY BLVD & BRADMOOR DR & HUNTINGTON PKWY	X13454	County	X	
BRADLEY BLVD & BURDETTE RD	X11930	County	X	
BRADLEY BLVD & FERNWOOD RD	X12239	County	X	
COLUMBIA PIKE & STEWART LN & MILESTONE DR	X23787	County	X	X
DEER PARK DR & RAILROAD ST	X08801	Washington Grove		
DEMOCRACY BLVD & FALLS RD & GLEN RD	X06584	County	X	
EDNOR RD & NORWOOD RD & LAYHILL RD	X21207	County	X	
EMORY GROVE RD & GOSHEN RD	X07638	County		
FALLS RD & BELLS MILL RD	X07369	County	X	
FALLS RD & GLEN RD	X07677	County	X	
FREDERICK RD & CLARKSBURG RD	X01195	County	X	
GEORGIA AVE & GOLD MINE RD	X18859	County	X	
GERMANTOWN RD & SPRING MEADOWS DR & DARNESTOWN RD	X00498	County	X	
GOSHEN RD & VILLAGE AVE	X08229	County		
KINGS VALLEY RD & RIDGE RD	X04801	County	X	
MARWOOD HILL DR & RIVER RD & PINEY MEETINGHOUSE RD	X04516	County	X	
NEW HAMPSHIRE AVE & ASHTON RD & OLNEY SANDY SPRING RD	X22199	County	X	
NEWBRIDGE DR & DEMOCRACY BLVD	X08366	County		
OLD COLUMBIA PIKE & COLUMBIA PIKE	X23851	County	X	X
OLNEY SANDY SPRING RD & NORWOOD RD	X21117	County	X	
RANDOLPH RD & LINDELL ST & DENLEY RD	X18574	County		X
SERVICE RD & NORBECK RD & MUNCASTER MILL RD	X16799	County	X	
SEVEN LOCKS RD & ORACLE PL & BELLS MILL RD	X10433	County		
STATION10 DR & RIVER RD	X10117	County	X	
STATION26 DR & DEMOCRACY BLVD	X12053	County		
SWEEPSTAKES RD & WOODFIELD RD	X06750	County	X	
UNIVERSITY BLVD & WHITESTONE RD	X22585	County	X	
VEIRS MILL RD & MONTERREY DR & NORRIS DR	X18489	County	X	
WARFIELD RD & WOODFIELD RD	X11124	County	X	
WOODFIELD RD & BRINK RD	X09696	County	X	
WOODFIELD RD & HAWKINS CREAMERY RD	X06600	County	X	

LIGHTING: SIGNALIZED INTERSECTIONS

Location	Location ID	Jurisdiction	State Road	EEA
2ND AVE & FENWICK LN	X20956	County		X
ASBURY DR & LOST KNIFE RD & ODENDHAL AVE	X07089	Gaithersburg		X
BALTIMORE RD & 1ST ST & NORBECK RD	X12167	Rockville	X	
BOU AVE & CHAPMAN AVE	X13561	County		
CENTURY BLVD & CRYSTAL ROCK DR	X02280	County		
CHESTNUT ST & DIAMOND AVE & MUDDY BRANCH RD	X06515	Gaithersburg	X	X
CLOPPER RD & METROPOLITAN GROVE RD & TWELVE OAKS DR	X04889	Gaithersburg	X	X
CONNECTICUT AVE & BEL PRE RD	X17855	County		X
CONTOUR RD & ODEND HAL AVE	X07251	Gaithersburg		X
EAST WEST HWY & SUNDALE DR & WASHINGTON AVE	X20148	County	X	X
FATHER HURLEY BLVD & WATERS LANDING DR	X01767	County		
FATHER HURLEY BLVD & WISTERIA DR	X01498	County		
FENTON ST & PHILADELPHIA AVE & BURLINGTON AVE	X21446	County	X	X
FLOWER AVE & CARROLL AVE	X23132	Takoma Park	X	
FREDERICK RD & SHAKESPEARE BLVD	X03475	County	X	
GEORGIA AVE & OLNEY LAYTONSVILLE RD & OLNEY SANDY SPRING RD	X18182	County	X	
GRANT AVE & CARROLL AVE & ETHAN ALLEN AVE	X22575	Takoma Park	X	
GREAT SENECA HWY & QUINCE ORCHARD RD	X04135	Gaithersburg	X	
GREAT SENECA HWY & WISTERIA DR	X02330	County	X	X
JEFFERSON ST & HALPINE RD	X12786	Rockville		
LAYHILL RD & BONIFANT RD & BEL PRE RD	X20233	County	X	
MIDCOUNTY HWY & SAYBROOKE OAKS BLVD & WOODFIELD RD	X09207	Gaithersburg	X	
MIDCOUNTY HWY & WASHINGTON GROVE LN	X09691	County		X
MIDDLEBROOK RD & SWEETGUM CIR & FATHER HURLEY BLVD	X01667	County		
MONROE ST & FLEET ST	X11298	Rockville		X
MONTGOMERY VILLAGE AVE & CENTERWAY RD	X06641	County		
MONTGOMERY VILLAGE AVE & CLUB HOUSE RD	X06647	County		
MONTGOMERY VILLAGE AVE & PLEASANT RIDGE DR & WIGHTMAN RD	X07662	County		
MONTROSE PARK RIDE & TOWNE RD & MONTROSE RD	X13484	County		
MONTROSE PKWY & TOWNE RD	X13457	County		
MONTROSE RD & JEFFERSON ST	X12862	County		
ODENDHAL AVE & GOSHEN RD	X07602	Gaithersburg		X
PARK RD & STONESTREET AVE	X11490	Rockville		
PARKLAWN DR & PARKLAWN DR ACCESS DR	X14502	County		X
PHILADELPHIA AVE & MAPLE AVE	X22331	Takoma Park	X	
RANDOLPH RD & LAUDERDALE DR & PARKLAWN DR	X14644	County		X
RANDOLPH RD & PARKLAWN DR	X14435	County		X
RICHARD MONTGOMERY DR & FLEET ST	X11616	Rockville		X
ROCK SPRING DR & MARRIOTT DR & FERNWOOD RD	X12123	County		
ROCK SPRING DR & ROCKLEDGE DR	X12439	County		
ROLLINS AVE & JEFFERSON ST	X12839	Rockville		
RUSSELL AVE & ODENDHAL AVE	X06611	Gaithersburg		X
SLIGO CREEK PKWY & WAYNE AVE	X22310	County		X
STATION2 DR & CARROLL AVE & PHILADELPHIA AVE	X22504	Takoma Park	X	
TWINBROOK PKWY & CHAPMAN AVE	X13419	Rockville		
VEIRS MILL RD & 1ST ST	X12059	Rockville	X	X
VEIRS MILL RD & ROBINDALE DR	X15482	County	X	X
VEIRS MILL RD & TWINBROOK PKWY	X14065	County	X	X
W DIAMOND AVE ACCESS RD & PERRY PKWY & DIAMOND AVE	X06149	Gaithersburg	X	X
WOODFIELD RD & SNOUFFER SCHOOL RD & MUNCASTER MILL RD	X10522	County	X	X

LIGHTING: UNSIGNALIZED INTERSECTIONS

Location	Location ID	Jurisdiction	State Road	EEA
1ST ST & GRANDIN AVE	X12083	Rockville	X	
1ST ST & VEIRS MILL SERV RD RD & GRANDIN AVE	X12074	Rockville		
ADRIAN ST & PARKLAND DR	X15812	County		X
BLAIR MILL RD & EASTERN DR	X21019	County		
BRIGGS CHANEY RD & ROBEY RD	X24969	County		X
CALIFORNIA CIR & JEFFERSON ST	X12861	County		
CAMERON HILL CT	X21060	County		X
CAMERON HILL CT	X21034	County		X
CONTOUR RD & LOST KNIFE RD	X06869	County		X
CORDELL AVE & WILSON LN	X14991	County	X	
DOMER AVE & GREENWOOD AVE	X22909	County		X
EAST WEST HWY & CAREY LN	X20746	County	X	X
EAST WEST HWY & FALKLAND LN	X20873	County	X	
ELKIN ST & BLUERIDGE AVE	X19750	County		X
ELMCROFT BLVD & REDLAND BLVD	X09886	Rockville		
FLOWER AVE & KENNEBEC AVE	X22942	Takoma Park	X	
FOREST PRESERVE DR & TOWN CENTER BLVD & WATKINS MILL RD	X04692	Gaithersburg		X
FREDERICK RD & APPLIEDOWRE WAY	X03943	County	X	
FREDERICK RD & COLLINS DR & NEELSVILLE CHURCH RD	X03598	County	X	
FREDERICK RD & OXBRIDGE DR	X03775	County	X	
FRIENDSHIP BLVD & PARK AVE	X16012	County		
GARLAND AVE & DOMER AVE	X23123	County		X
HAMPDEN LN & ARLINGTON RD	X15128	County		
HUNGERFORD DR & CHOICE HOTELS CIR	X11366	Rockville	X	X
KING JAMES WAY & HARMONY HALL RD & MUDDY BRANCH RD	X06456	County		X
LIVINGSTON ST & FLACK ST	X19350	County		X
MAIN ST & KENTLANDS BLVD	X04031	Gaithersburg		
MARKET ST & KENTLANDS BLVD	X04365	Gaithersburg		
MAYOR LN & SILVER SPRING AVE	X21299	County		X
MINERAL SPRINGS DR & WASHINGTON GROVE LN & FLOWER HILL WAY	X10220	County		X
MONROE ST & MONROE PL	X11357	Rockville		X
NORMANDY CROSSING DR & HOMECREST RD & LONGMEAD CROSSING DR	X19335	County		
PEAR TREE LN & BEL PRE RD	X18003	County		X
PINEY BRANCH RD & GARLAND AVE	X23116	County	X	X
PINEY BRANCH RD & MANCHESTER RD	X22649	County	X	
RANDOLPH RD & PUTNAM RD	X14723	County		X
REXMORE DR & CRYSTAL ROCK DR	X02247	County		
RUSSELL AVE & WALKER AVE	X07108	Gaithersburg		X
SPRING ST & ROEDER RD	X21332	County		X
STEWART LN & APRIL LN	X24037	County		X
THE HILLS PLZ & PARK AVE	X16099	County		
TRAVIS AVE & WATKINS MILL RD	X05793	Gaithersburg		X
TSCHIFFELY SQUARE RD & KENT OAKS WAY	X03413	Gaithersburg		
VALLEYWOOD DR & ANDREW ST	X18088	County		X
VEIRS MILL RD & DODGE ST	X11699	Rockville	X	X
WALTER JOHNSON RD & WISTERIA DR	X01969	County		X
WAYNE AVE & MANCHESTER RD	X22353	County		X
WHITE OAK VISTA DR & STEWART LN	X23960	County		X
WILLOW LN & 46TH ST	X15845	County		
WYETH ST & LAYHILL RD	X19861	County	X	X

MID-BLOCK HIGH-VISIBILITY CROSSWALK

Location	Location ID	Jurisdiction	State Road	EEA
1ST AVE BETWEEN SPRING ST & FENWICK LN	S08915	County		
APPLE RIDGE RD BETWEEN MONTGOMERY VILLAGE AVE & SWALLOW POINT RD	S31736	County		
BOILING BROOK PKWY BETWEEN ROCKING HORSE RD & BOILING BROOK PL	S24786	County		X
BONIFANT ST BETWEEN FENTON ACCESS ST & GEORGIA AVE	S10289	County		X
CAMERON ST BETWEEN FENTON ST & GEORGIA AVE	S12448	County		X
CAMERON ST BETWEEN GEORGIA AVE & RAMSEY AVE	S08851	County		X
CARROLL AVE BETWEEN OSAGE ST & UNIVERSITY BLVD	S12352	County		X
CARROLL AVE BETWEEN STATION2 DR/PHILADELPHIA AVE & PARK AVE	S29317	Takoma Park	X	
CENTURY BLVD BETWEEN TOWN COMMONS DR & MIDDLEBROOK RD	S20281	County		
CONTOUR RD BETWEEN LOST KNIFE CIR & LOST KNIFE RD	S14437	County		X
CONTOUR RD BETWEEN TUNSTALL DR & COPPS HILL DR	S16805	County		X
CRYSTAL ROCK DR AT GERMANTOWN RD	S24183	County		X
DETRICK AVE BETWEEN HOWARD AVE & KNOWLES AVE	S08081	County		
DIXON AVE BETWEEN DISCOVERY PL/WAYNE AVE & BONIFANT ST	S00933	County		X
EDMONSTON DR BETWEEN LEWIS AVE & ROCKVILLE PIKE	S02080	Rockville		
ELLSWORTH DR BETWEEN FENTON ST & GEORGIA AVE	S00439	County		X
ETHAN ALLEN AVE BETWEEN EAST WEST HWY/NEW HAMPSHIRE AVE & ELM AVE	S28520	Takoma Park	X	
FENTON ST BETWEEN COLESVILLE RD & CAMERON ST	S13360	County		X
FENTON ST BETWEEN SILVER SPRING AVE & SLIGO AVE	S29157	County		
FENTON ST BETWEEN THAYER AVE & SILVER SPRING AVE	S31133	County		
FERRARA DR AT FERRARA AVE	S05371	County		X
FLOWER AVE BETWEEN PINEY BRANCH RD & DOMER AVE	S30377	Takoma Park	X	X
GILBERT PL BETWEEN GILBERT ST & BARRON ST	S07311	County		X
GREENWOOD AVE BETWEEN PINEY BRANCH RD & DOMER AVE	S10848	County		X
IVY LEAGUE LN AT HUNGERFORD DR	S19144	Rockville		X
JEFFERSON ST BETWEEN HALPINE RD & ROLLINS AVE	S03214	Rockville		
LOST KNIFE CIR	S13888	County		X
LYTTONSVILLE RD BETWEEN LYTTONSVILLE PL & ROSS RD	S30169	County		X
MAPLE AVE BETWEEN HILLTOP RD/SLIGO CREEK PKWY & LINCOLN AVE	S30984	Takoma Park		
MAPLEWOOD AVE BETWEEN FLOWER AVE & EDINBURGH LN/MAPLE AVE	S32254	Takoma Park		
MEEM AVE BETWEEN WATER ST/DIAMOND AVE & CHESTNUT ST	S18577	Gaithersburg		X
METROPOLITAN AVE BETWEEN ST PAUL ST & CONCORD ST/PLYERS MILL RD	S30422	County	X	
PARAMOUNT PARK DR BETWEEN FREDERICK AVE & SPECTRUM BLVD	S22775	Gaithersburg		X
PEAR TREE CT	S01264	County		X
PHILADELPHIA AVE BETWEEN MAPLE AVE & CEDAR AVE	S32419	Takoma Park	X	
RAMSEY AVE BETWEEN WAYNE AVE & BONIFANT ST	S09876	County		X
ROEDER RD BETWEEN SPRING ST & FENTON ST	S10935	County		X
ROLLINS AVE BETWEEN ROCKVILLE PIKE/TWINBROOK PKWY & STATION23 DR	S31059	Rockville		
ROLLINS AVE BETWEEN STATION23 DR & JEFFERSON ST	S31058	Rockville		
RUSSELL AVE AT ODEND HAL AVE	S00099	Gaithersburg		X
SEMINARY RD BETWEEN STATION19 DR & LINDEN LN/2ND AVE	S30362	County		
SERVICE ROAD A RD BETWEEN FREDERICK AVE & DIAMOND AVE	S29367	Gaithersburg	X	X
SHOP CTR CUT THRU BETWEEN COLIE DR & GRIDLEY RD/VEIRS MILL RD	S26942	County		X
SLIGO CREEK PKWY BETWEEN SCHUYLER RD & WAYNE AVE/WAYNE AVE	S28890	County		X
TEAGARDEN CIR	S00774	County		X
THAYER AVE BETWEEN FENTON ST & MAYOR LN	S29798	County		
VEIRS MILL SERVICE RD BETWEEN SAMPSON RD & RANDOLPH RD	S02867	County		X
WALKER AVE BETWEEN RUSSELL AVE & FREDERICK AVE	S23798	Gaithersburg		X
WAYNE AVE BETWEEN MANCHESTER PL & MANCHESTER RD	S28428	County		X
WILLARD AVE BETWEEN SHOEMAKER FARM LN & PARK AVE	S30740	County		



## MID-BLOCK RAISED CROSSING

Location	Location ID	Jurisdiction	State Road	EEA
ARCOLA AVE BETWEEN HOYT ST/APARTMENT CUT THRU & UNIVERSITY BLVD	S31415	County		X
ARCOLA AVE BETWEEN KENBROOK DR/APARTMENT CUT THRU & HOYT ST	S30632	County		X
ARCOLA AVE BETWEEN KERSEY RD & LAMBERTON DR	S27899	County		X
ARCOLA AVE BETWEEN LAMBERTON DR & WATERMILL LN	S31026	County		X
ARLISS ST BETWEEN WALDEN RD/GARLAND AVE & FLOWER AVE	S11503	County		X
ASPEN HILL RD BETWEEN MARGOT DR/BALTIC AVE & ADRIAN ST	S30007	County		X
AUTOMOBILE BLVD	S00113	County		
BROOKVILLE RD AT GARFIELD AVE	S30182	County		X
BROOKVILLE RD BETWEEN TALBOT AVE & STEWART AVE	S31030	County		X
BURLINGTON AVE BETWEEN SELIM RD & 13TH ST/GEORGIA AVE	S28051	County	X	X
CARROLL AVE BETWEEN LONG BRANCH PKWY & GARLAND AVE	S31191	Takoma Park	X	
CARROLL AVE BETWEEN MERRIMAC DR & CHESTER ST/WILDWOOD DR	S31076	Takoma Park	X	X
CHESTNUT ST BETWEEN DIAMOND AVE & MEEM AVE	S21648	Gaithersburg		X
DIAMOND AVE BETWEEN FREDERICK AVE & CHESTNUT ST	S28052	Gaithersburg		X
DIAMOND AVE BETWEEN GIRARD ST & MELVIN ST	S29709	Gaithersburg		X
DIAMOND AVE BETWEEN MELVIN ST & SUMMIT AVE/SUMMIT AVE	S30282	Gaithersburg		X
DIAMOND AVE BETWEEN PARK AVE & RUSSELL AVE	S31935	Gaithersburg		X
DIAMOND AVE BETWEEN RAILROAD ST/WASHINGTON GROVE LN & GIRARD ST	S29573	Gaithersburg		X
DIAMOND AVE BETWEEN RUSSELL AVE & FREDERICK AVE	S31787	Gaithersburg		X
GLENALLAN AVE BETWEEN RANDOLPH RD & LAYHILL RD	S28602	County		X
GRAND PRE RD BETWEEN BEL PRE RD & CONNECTICUT AVE	S01679	County		X
GREENCASTLE RD BETWEEN TURBRIDGE DR & SWAN HOUSE CT	S31594	County		
INDUSTRIAL PKWY BETWEEN OLD COLUMBIA PIKE & TECH RD	S21572	County		
KNOWLES AVE BETWEEN DETRICK AVE & SUMMIT AVE	S30420	County	X	
LOCKWOOD DR AT COLUMBIA PIKE	S30322	County		
LOCKWOOD DR BETWEEN BURNT MILLS AVE & BURNT MILLS CT	S30481	County		
LOFSTRAND LN BETWEEN TAFT ST & SOUTHLAWN LN	S00476	Rockville		
LONGMEAD CROSSING DR BETWEEN HOMECREST RD & NORMANDY CROSSING DR	S31168	County		
LONGMEAD CROSSING DR BETWEEN SNOWBIRD TER & TELLURIDE PL	S30978	County		
LONGMEAD CROSSING DR BETWEEN TELLURIDE PL & NORMANDY CROSSING DR	S32229	County		
LONGMEAD CROSSING DR BETWEEN LADYMEADE DR & NORMANDY CROSSING DR	S30811	County		
OAKMONT AVE BETWEEN RAILROAD ST & CITATION DR	S30041	County		X
OLDE TOWNE AVE BETWEEN SUMMIT AVE & FULKS CORNER AVE	S23716	Gaithersburg		X
PHILADELPHIA AVE BETWEEN CHICAGO AVE & FENTON ST/BURLINGTON AVE	S31190	Takoma Park	X	
PINEY BRANCH RD BETWEEN SILVER SPRING AVE & BELMONT CT/SLIGO AVE	S29465	County	X	
PINEY BRANCH RD BETWEEN SLIGO CREEK PKWY & PARK CREST DR	S30018	County	X	
ROBEY RD BETWEEN PALMER HOUSE WAY & ROBEY TER	S31983	County		
SLIGO AVE BETWEEN FENTON ST & MAYOR LN	S09947	County		X
SOUTHLAWN LN AT LOFSTRAND LN	S19059	Rockville		
STEWART LN BETWEEN APRIL LN & WHITE OAK VISTA DR	S18280	County		X
STEWART LN BETWEEN NOVEMBER CIR & LOCKWOOD DR	S19301	County		X
STEWART LN BETWEEN WHITE OAK VISTA DR & OLD COLUMBIA PIKE	S19092	County		X
WARING STATION RD BETWEEN MIDDLEBROOK RD & HOTTINGER CIR	S29598	County		X
WESTLAKE TER BETWEEN AUTO PARK AVE & WESTLAKE DR	S28879	County		
WISTERIA DR BETWEEN CIRCLE GATE DR & GREAT SENECA HWY	S32366	County		X
WISTERIA DR BETWEEN CRYSTAL ROCK DR & CIRCLE GATE DR	S32033	County		X
WISTERIA DR BETWEEN CRYSTAL ROCK DR & DOCTORS DR	S29672	County		X
WISTERIA DR BETWEEN GREAT SENECA HWY & MISTY MEADOW TER	S32365	County		X
WISTERIA DR BETWEEN WILLOW SPRING DR & BENT WILLOW CT	S29497	County		X
WOOTTON PKWY BETWEEN FLEET ST & EDMONSTON DR	S30558	Rockville		

PEDESTRIAN HYBRID BEACON

Location	Location ID	Jurisdiction	State Road	EEA
AIRCRAFT DR BETWEEN CENTURY BLVD & GERMANTOWN RD	S25729	County		X
ARLISS ST BETWEEN WALDEN RD/GARLAND AVE & PINEY BRANCH RD	S06814	County		X
ASBURY DR AT FELLOWSHIP CIR	S25563	Gaithersburg		X
BATTERY LN BETWEEN WOODMONT AVE & KEYSTONE AVE	S29349	County		
BEL PRE RD BETWEEN BEL PRE DR & RIPPLING BROOK DR	S30608	County		
BETHESDA AVE AT WISCONSIN AVE	S24625	County		
BRADLEY BLVD BETWEEN STRATHMORE ST & OFFUTT LN	S29036	County	X	
BUREAU DR BETWEEN FIRSTFIELD RD & DIAMOND AVE	S23188	Gaithersburg		X
CAMPUS DR AT MANNAKEE ST	S16016	Rockville		
CARROLL AVE BETWEEN TULIP AVE & WESTMORELAND AVE	S29420	Takoma Park	X	
CENTERWAY RD BETWEEN KINGLET PL/BLUE HERON LN & HARKNESS LN	S32367	County		
CENTURY BLVD BETWEEN DORNIER PL & AIRCRAFT DR	S25794	County		
CHAPMAN AVE BETWEEN BOUIC AVE & HALPINE RD/ROCKVILLE PIKE	S27166	Rockville		X
CHRISTOPHER AVE BETWEEN GALLOP HILL RD & RUSSELL AVE	S28832	Gaithersburg		X
CONTOUR RD BETWEEN HORIZON RUN RD & LOST KNIFE CIR	S20781	County		X
CRABBS BRANCH WAY BETWEEN REDLAND RD & MOCCASIN LN	S30736	County		
CRYSTAL ROCK DR BETWEEN MIDDLEBROOK RD & WISTERIA DR	S21705	County		X
DARNESTOWN RD BETWEEN QUINCE ORCHARD RD & BRIAR ROCK DR	S29843	Gaithersburg	X	
EAST WEST HWY BETWEEN COLESVILLE RD & BLAIR MILL RD	S00072	County	X	
EDGEMOOR LN BETWEEN OLD GEORGETOWN RD & WOODMONT AVE	S28424	County		
EDMONSTON DR BETWEEN ROCKVILLE PIKE & WOOTTON PKWY	S02033	Rockville		X
FLEET ST BETWEEN PARK AVE & MONROE ST	S00817	Rockville		X
FLOWER AVE BETWEEN ARLISS ST & PINEY BRANCH RD	S28894	County		X
FLOWER AVE BETWEEN DIVISION ST & CARROLL AVE	S30695	Takoma Park	X	
FLOWER HILL WAY BETWEEN WOODFIELD RD & MINERAL SPRINGS DR	S32184	County		
HEWITT AVE BETWEEN BLUE SPRUCE LN & GEORGIA AVE	S26510	County		
JONES MILL RD BETWEEN FORSYTHE AVE/STONEBROOK DR & LE VELLE DR	S31988	County		X
KNOWLES AVE BETWEEN SUMMIT AVE & EWELL AVE	S28076	County	X	
LOST KNIFE RD BETWEEN CONTOUR RD & ASBURY DR/ODEND HAL AVE	S27397	Gaithersburg		X
LOST KNIFE RD BETWEEN LOST KNIFE CIR & CONTOUR RD	S27395	County		X
MANNAKEE ST BETWEEN HUNGERFORD DR & CAMPUS DR	S16865	Rockville		
MARINELLI RD BETWEEN ROCKVILLE PIKE & EXECUTIVE BLVD	S03075	County		
MATENY RD BETWEEN BARLEYCORN WAY/WHEATRIDGE DR & GREAT SENECA HWY	S18303	County		
RESEARCH BLVD BETWEEN RESEARCH PL & GUDE DR	S32205	Rockville		
ROBEY RD BETWEEN ROBEY TER & BRIGGS CHANEY RD	S31877	County		
ROCK SPRING DR AT OLD GEORGETOWN RD	S25550	County		
ROCK SPRING DR BETWEEN ROCKLEDGE DR & JACOBSEN ST	S05009	County		
ROCKLEDGE DR BETWEEN ROCK FOREST DR/ROCKLEDGE BLVD & BREUER ST	S24929	County		
ROCKLEDGE DR BETWEEN ROCK SPRING DR & DEMOCRACY BLVD	S05047	County		
SANGAMORE RD BETWEEN SENTINEL DR & BROOKES LN	S32437	County		
SHAKESPEARE BLVD BETWEEN AMBER RIDGE CIR & SENECA MEADOWS PKWY	S25068	County		
SPARTAN RD BETWEEN BUEHLER RD & MORNINGWOOD DR/GEORGIA AVE	S14915	County		
STEDWICK RD BETWEEN MONTGOMERY VILLAGE AVE & MILLS CHOICE RD	S31737	County		X
WASHINGTONIAN BLVD BETWEEN SHADY ELM ST & WATERFRONT PL	S16945	Gaithersburg		
WATKINS MILL RD BETWEEN CLUB HOUSE RD & STEDWICK RD	S31611	County		X
WATKINS MILL RD BETWEEN COLTFIELD CT & WATKINS MILL DR	S31956	County		X
WATKINS MILL RD BETWEEN TOWN CENTER BLVD & CLOPPER RD	S20300	Gaithersburg		X
WAYNE AVE BETWEEN FENTON ST & GEORGIA AVE	S28978	County		X
WESTBARD AVE AT WESTBARD CIR	S30800	County		
WISCONSIN CIR BETWEEN WESTERN AVE & WILLARD AVE/WISCONSIN AVE	S12842	County		



## SPEED HUMPS

Location	Location ID	Jurisdiction	State Road	EEA
BONIFANT ST AT DIXON AVE	S25695	County		X
BONIFANT ST BETWEEN FENTON ACCESS ST & GEORGIA AVE	S10289	County		X
CAMERON ST BETWEEN GEORGIA AVE & RAMSEY AVE	S08851	County		X
CAMERON ST BETWEEN RAMSEY AVE & 2ND AVE	S10916	County		X
CARROLL AVE BETWEEN WILLOW ST & EASTERN AVE	S29425	Takoma Park	X	
CENTURY BLVD BETWEEN TOWN COMMONS DR & MIDDLEBROOK RD	S20281	County		
COMMERCE LN	S28706	County		
CONNECTICUT AVE BETWEEN STATION25 DR & BEL PRE RD	S31163	County		
DISCOVERY PL AT DIXON AVE/WAYNE AVE	S10424	County		X
ELLSWORTH DR BETWEEN FENTON ST & GEORGIA AVE	S00439	County		X
ETHAN ALLEN AVE BETWEEN EAST WEST HWY/NEW HAMPSHIRE AVE & ELM AVE	S28520	Takoma Park	X	
EXECUTIVE PARK CIR AT EXECUTIVE PARK TER	S21161	County		
FENTON ST BETWEEN COLESVILLE RD & CAMERON ST	S13360	County		X
FENTON ST BETWEEN EASLEY ST & THAYER AVE	S30915	County		
FENTON ST BETWEEN SILVER SPRING AVE & SLIGO AVE	S29157	County		
FENTON ST BETWEEN THAYER AVE & SILVER SPRING AVE	S31133	County		
FENTON ST BETWEEN WAYNE AVE & BONIFANT ST	S30020	County		
FIDLER LN BETWEEN GEORGIA AVE & RAMSEY AVE	S08965	County		X
FLOWER AVE BETWEEN PINEY BRANCH RD & DOMER AVE	S30377	Takoma Park	X	X
GILBERT PL BETWEEN GILBERT ST & BARRON ST	S07311	County		X
GRANDVIEW AVE BETWEEN BLUERIDGE AVE & CLAIRMONT VIEW TER	S32292	County		X
GRANDVIEW AVE BETWEEN CLAIRMONT VIEW TER & KENSINGTON BLVD	S32223	County		X
GRANDVIEW AVE BETWEEN KENSINGTON BLVD & UNIVERSITY BLVD	S32222	County		X
LOST KNIFE CIR	S13888	County		X
LOST KNIFE CIR AT CONTOUR RD	S15412	County		X
LYTTONSVILLE RD BETWEEN LYTTONSVILLE PL & ROSS RD	S30169	County		X
MAPLE AVE BETWEEN HILLTOP RD/SLIGO CREEK PKWY & LINCOLN AVE	S30984	Takoma Park		
MAPLE AVE BETWEEN LINCOLN AVE & RITCHIE AVE	S31202	Takoma Park		
MAPLE AVE BETWEEN RITCHIE AVE & SHERMAN AVE	S31266	Takoma Park		
METROPOLITAN AVE BETWEEN ST PAUL ST & CONCORD ST/PLYERS MILL RD	S30422	County	X	
PLYERS MILL RD BETWEEN NASH PL & CONCORD ST/METROPOLITAN AVE	S28447	County		
PRICE AVE BETWEEN FERN ST & ELKIN ST	S25510	County		X
RAMSEY AVE BETWEEN FIDLER LN & COLESVILLE RD	S10280	County		X
RAMSEY AVE BETWEEN WAYNE AVE & BONIFANT ST	S09876	County		X
REEDIE DR BETWEEN GEORGIA AVE & TRIANGLE LN	S08752	County		X
REEDIE DR BETWEEN GRANDVIEW AVE & VEIRS MILL RD	S11769	County		X
REEDIE DR BETWEEN TRIANGLE LN & GRANDVIEW AVE	S05858	County		X
RIPLEY ST AT DIXON AVE	S25855	County		X
ROEDER RD BETWEEN SPRING ST & FENTON ST	S10935	County		X
ROLLINS AVE BETWEEN ROCKVILLE PIKE/TWINBROOK PKWY & STATION23 DR	S31059	Rockville		
ROLLINS AVE BETWEEN STATION23 DR & JEFFERSON ST	S31058	Rockville		
SELFRIDGE RD BETWEEN RANDOLPH RD & SIGSBEE RD	S05987	County		X
SEMINARY RD BETWEEN GEORGIA AVE & COLUMBIA BLVD	S31408	County		
SEMINARY RD BETWEEN SELWAY LN & SUTTON PL	S28094	County		
SEMINARY RD BETWEEN SUTTON PL & STATION19 DR	S28311	County		
SLIGO CREEK PKWY BETWEEN CARROLL AVE & HILLTOP RD/MAPLE AVE	S30985	Takoma Park		
SUMMIT AVE BETWEEN DIAMOND AVE & WELLS AVE	S31936	Gaithersburg		X
TOWNE RD BETWEEN ROCKVILLE PIKE & MONTROSE RD	S30967	County		
VEIRS MILL SERVICE RD BETWEEN SAMPSON RD & RANDOLPH RD	S02867	County		X
WILSON LN BETWEEN ST ELMO AVE/OLD GEORGETOWN RD & CORDELL AVE	S32243	County	X	

LEADING PEDESTRIAN INTERVAL: DOWNTOWN BOULEVARDS

Location	Location ID	Jurisdiction	State Road	EEA
BRADLEY BLVD & ARLINGTON RD	X15099	County	X	
BRADLEY BLVD & LELAND ST & HILLANDALE RD	X15277	County	X	
COLESVILLE RD & FENTON ST	X21234	County	X	X
COLESVILLE RD & SPRING ST	X21285	County	X	X
COLESVILLE RD & WAYNE AVE & 2ND AVE	X21066	County	X	X
DEMOCRACY BLVD & FERNWOOD RD	X12248	County		
EAST WEST HWY & 16TH ST	X20795	County	X	
EAST WEST HWY & COLESVILLE RD	X20972	County	X	
EAST WEST HWY & PEARL ST	X15839	County	X	
EAST WEST HWY & WISCONSIN AVE & OLD GEORGETOWN RD	X15532	County	X	
GEORGIA AVE & BLUERIDGE AVE	X19515	County	X	X
GEORGIA AVE & BONIFANT ST	X21253	County	X	X
GEORGIA AVE & CAMERON ST	X21090	County	X	X
GEORGIA AVE & COLESVILLE RD	X21161	County	X	X
GEORGIA AVE & ELLSWORTH DR	X21224	County	X	X
GEORGIA AVE & REEDIE DR	X19641	County	X	X
GEORGIA AVE & SILVER SPRING AVE	X21267	County	X	X
GEORGIA AVE & SLIGO AVE	X21260	County	X	X
GEORGIA AVE & THAYER AVE	X21258	County	X	X
GEORGIA AVE & UNIVERSITY BLVD	X19555	County	X	X
GEORGIA AVE & VEIRS MILL RD	X19772	County	X	X
GEORGIA AVE & WAYNE AVE	X21244	County	X	X
OLD GEORGETOWN RD & BATTERY LN	X14674	County	X	
OLD GEORGETOWN RD & DEMOCRACY BLVD	X12918	County	X	
OLD GEORGETOWN RD & EDGEMOOR LN & COMMERCE LN	X15377	County	X	
OLD GEORGETOWN RD & GRAND PARK AVE	X13614	County	X	
OLD GEORGETOWN RD & ST ELMO AVE & ARLINGTON RD & WILSON LN	X15097	County	X	
OLD GEORGETOWN RD & WOODMONT AVE	X15283	County	X	
ROCKVILLE PIKE & CALIFORNIA CIR & BOU AVE	X13404	County	X	
ROCKVILLE PIKE & HUBBARD DR	X13501	County	X	
ROCKVILLE PIKE & MARINELLI RD	X13981	County	X	
ROCKVILLE PIKE & NICHOLSON LN	X14092	County	X	
ROCKVILLE PIKE & OLD GEORGETOWN RD	X13869	County	X	
ROCKVILLE PIKE & SECURITY LN	X14197	County	X	
SHADY GROVE RD & FALLSGROVE BLVD & MEDICAL CENTER WAY	X07356	County		
SHADY GROVE RD & RESEARCH BLVD	X07797	County		
UNIVERSITY BLVD & AMHERST AVE	X19932	County	X	
UNIVERSITY BLVD & GRANDVIEW AVE	X19428	County	X	X
UNIVERSITY BLVD & VALLEY VIEW AVE	X18776	County	X	X
UNIVERSITY BLVD & VEIRS MILL RD	X19201	County	X	X
WISCONSIN AVE & 47TH ST	X15628	County	X	
WISCONSIN AVE & BRADLEY LN & BRADLEY BLVD	X15866	County	X	
WISCONSIN AVE & CHELTENHAM DR & NORFOLK AVE	X15441	County	X	
WISCONSIN AVE & MONTGOMERY LN & MONTGOMERY AVE	X15570	County	X	
WISCONSIN AVE & MONTGOMERY ST & PARK AVE	X16199	County	X	
WISCONSIN AVE & SOMERSET TER	X16116	County	X	
WISCONSIN AVE & STANFORD ST	X15815	County	X	
WISCONSIN AVE & WAVERLY ST & ELM ST	X15604	County	X	
WISCONSIN AVE & WISCONSIN CIR & WILLARD AVE	X16287	County	X	
WISCONSIN AVE & WOODMONT AVE & LELAND ST	X15718	County	X	

LEADING PEDESTRIAN INTERVAL: TOWN CENTER BOULEVARDS, BOULEVARDS, AND MAJOR HIGHWAYS

Location	Location ID	Jurisdiction	State Road	EEA
AIRPARK RD & STRATOS LN & ANTARES DR	X11610	County		
AIRPARK RD & WOODFIELD RD	X11026	County	X	
BRADLEY BLVD & GLENBROOK RD	X14545	County	X	
BUREAU DR & DIAMOND AVE	X05543	Gaithersburg	X	
COLESVILLE RD & ST ANDREWS WAY & SLIGO CREEK PKWY	X21676	County	X	X
COLESVILLE RD & UNIVERSITY BLVD	X22131	County	X	
CONNECTICUT AVE & ASPEN HILL RD	X16764	County	X	X
CONNECTICUT AVE & BEACH DR	X16780	County	X	
CONNECTICUT AVE & KENSINGTON PKWY & JONES BRIDGE RD	X17078	County	X	
DARNESTOWN RD & MUDDY BRANCH RD	X05354	County	X	
DARNESTOWN RD & QUINCE ORCHARD RD	X02931	Gaithersburg	X	
EAST WEST HWY & BEACH DR	X18438	County	X	
EAST WEST HWY & GRUBB RD	X19520	County	X	X
EAST WEST HWY & MEADOWBROOK LN	X18695	County	X	X
EAST WEST HWY & SUNDALE DR & WASHINGTON AVE	X20148	County	X	X
FREDERICK RD & GERMANTOWN RD	X03692	County	X	
FREDERICK RD & MIDDLEBROOK RD	X04073	County	X	
FREDERICK RD & PLUMMER DR	X04294	County	X	X
GEORGIA AVE & FOREST GLEN RD	X20383	County	X	
GEORGIA AVE & JUDSON RD & LAYHILL RD	X19619	County	X	X
GEORGIA AVE & OLNEY LAYTONSVILLE RD & OLNEY SANDY SPRING RD	X18182	County	X	
GEORGIA AVE & RANDOLPH RD	X19744	County	X	X
GEORGIA AVE & SPRING ST	X20999	County	X	
GREAT SENECA HWY & CLIMBING IVY DR	X01847	County	X	
GREAT SENECA HWY & CLOPPER RD	X01550	County	X	
GREAT SENECA HWY & KEY WEST AVE	X06402	County	X	X
GREAT SENECA HWY & MATENY RD	X01587	County	X	
GREAT SENECA HWY & MUDDY BRANCH RD	X05564	Gaithersburg	X	X
GREAT SENECA HWY & QUEENSTOWN LN	X01341	County	X	
GREAT SENECA HWY & QUINCE ORCHARD RD	X04135	Gaithersburg	X	
GUDE DR & SOUTHLAWN LN	X12148	Rockville		
KEY WEST AVE & BROSCART RD & DIAMONDBACK DR	X06836	County	X	
MC DONALD CHAPEL DR & QUINCE ORCHARD RD & HILLSTONE RD	X03037	County	X	
MIDCOUNTY HWY & SAYBROOKE OAKS BLVD & WOODFIELD RD	X09207	Gaithersburg	X	
MONTROSE PKWY & EXECUTIVE BLVD & JEFFERSON ST	X12858	County		
NEW HAMPSHIRE AVE & ADELPHI RD & DILSTON RD	X24164	County	X	X
NEW HAMPSHIRE AVE & SPENCERVILLE RD & NORBECK RD	X23676	County	X	
OBSERVATION DR & RIDGE RD	X02916	County	X	
OLNEY SANDY SPRING RD & OLD VIC BLVD	X20025	County	X	
OLNEY SANDY SPRING RD & PRINCE PHILIP DR	X18976	County	X	
RANDOLPH RD & DEWEY RD	X15983	County		X
RANDOLPH RD & VEIRS MILL RD	X16598	County	X	X
ROCKVILLE PIKE & JONES BRIDGE RD	X15290	County	X	
SENECA MEADOWS PKWY & OBSERVATION DR & SHAKESPEARE BLVD	X02853	County		
SHADY GROVE RD & DARNESTOWN RD	X07202	County		
SHADY GROVE RD & MUNCASTER MILL RD & AIRPARK RD	X11479	County	X	X
UNIVERSITY BLVD & CARROLL AVE	X23491	County	X	X
UNIVERSITY BLVD & NEWPORT MILL RD & DECATUR AVE	X17608	County	X	
UNIVERSITY BLVD & PINEY BRANCH RD	X23339	County	X	X
UNIVERSITY BLVD & SLIGO CREEK PKWY	X21057	County	X	

TRAFFIC SIGNAL (LEFT-TURN CRASHES)

Location	Location ID	Jurisdiction	State Road	EEA
COLESVILLE RD & HASTINGS DR & GRANVILLE DR	X21898	County	X	
COLESVILLE RD & LEIGHTON AVE	X21850	County	X	
COLESVILLE RD & LORAIN AVE	X22274	County	X	
CONNECTICUT AVE & HOWARD AVE	X17147	County	X	
CONNECTICUT AVE & WARNER ST	X17102	County	X	
FREDERICK RD & GAME PRESERVE RD & FREDERICK AVE	X04946	County	X	X
FREDERICK RD & SCENERY DR & GUNNERS BRANCH RD	X04103	County	X	X
GEORGIA AVE & BALLARD ST	X20928	County	X	
GEORGIA AVE & BATCHELLORS FOREST RD & HILLCROFT DR	X17529	County	X	
GEORGIA AVE & BONNYWOOD LN & TILTON DR	X20310	County	X	
GEORGIA AVE & DAWSON AVE & LEESBOROUGH DR	X19502	County	X	X
GEORGIA AVE & DAYTON ST & PREDELLA DR	X20023	County	X	
GEORGIA AVE & HENDERSON AVE	X19562	County	X	X
GEORGIA AVE & HIGHLAND DR	X20760	County	X	
GEORGIA AVE & KING ST	X21261	County	X	X
GEORGIA AVE & LINDELL ST & GEORGIAN WAY	X19686	County	X	X
GEORGIA AVE & MASON ST	X19728	County	X	X
GEORGIA AVE & NOYES DR	X20856	County	X	
GEORGIA AVE & PARKER AVE	X19539	County	X	X
GEORGIA AVE & WELLER RD	X18817	County	X	X
GEORGIA AVE & WENDY LN	X17452	County	X	X
RANDOLPH RD & GOODHILL RD	X17777	County		X
ROCKVILLE PIKE & LOCUST HILL RD & CEDAR CROFT DR	X15223	County	X	
ROCKVILLE PIKE & MEETING ST	X13823	County	X	
SIESTA KEY WAY & KEY WEST AVE	X07363	County	X	
UNIVERSITY BLVD & BAYFIELD ST	X23463	County	X	X
UNIVERSITY BLVD & DEARBORN AVE & MOSS AVE	X22944	County	X	
UNIVERSITY BLVD & DRUMM AVE & HILLSDALE DR	X18616	County	X	
UNIVERSITY BLVD & ELKIN ST	X19713	County	X	X
UNIVERSITY BLVD & FORSTON ST	X23481	County	X	X
UNIVERSITY BLVD & LANGLEY DR	X23323	County	X	X
UNIVERSITY BLVD & MELBOURNE AVE	X23051	County	X	
UNIVERSITY BLVD & PERRY AVE	X17470	County	X	
UNIVERSITY BLVD & ST LAWRENCE DR	X22471	County	X	
VEIRS MILL RD & MONTERREY DR & SCHOOLHOUSE CIR	X18720	County	X	X
VEIRS MILL RD & PENDLETON DR	X18132	County	X	
WISCONSIN AVE & AVONDALE ST & COMMERCE LN	X15498	County	X	
WISCONSIN AVE & CHASE AVE	X15413	County	X	
WISCONSIN AVE & CHEVY CHASE BLVD	X15944	County	X	
WISCONSIN AVE & CUMBERLAND AVE	X16028	County	X	
WISCONSIN AVE & DAVIDSON DR	X15930	County	X	
WISCONSIN AVE & DE RUSSEY PKWY	X15969	County	X	
WISCONSIN AVE & DRUMMOND AVE	X16008	County	X	
WISCONSIN AVE & FAIRMONT AVE	X15426	County	X	
WISCONSIN AVE & HUNT AVE	X15997	County	X	
WISCONSIN AVE & LANGDRUM LN	X15981	County	X	
WISCONSIN AVE & MIDDLETON LN	X15470	County	X	
WISCONSIN AVE & MORGAN DR	X15953	County	X	
WISCONSIN AVE & NORWOOD DR	X15913	County	X	
WISCONSIN AVE & NOTTINGHAM DR	X15899	County	X	

PROTECTED/PERMITTED SIGNAL PHASE

Location	Location ID	Jurisdiction	State Road	EEA
CLOPPER RD & LONGDRAFT RD	X04115	Gaithersburg	X	X
CLOPPER RD & METROPOLITAN GROVE RD & TWELVE OAKS DR	X04889	Gaithersburg	X	X
CLOPPER RD & WATKINS MILL RD & PHEASANT RUN DR	X04539	Gaithersburg	X	X
ELM ST & ARLINGTON RD	X15130	County		
FRIENDSHIP BLVD & WILLARD AVE	X16020	County		
GEORGIA AVE & BONIFANT ST	X21253	County	X	X
GEORGIA AVE & SILVER SPRING AVE	X21267	County	X	X
MONROE ST & FLEET ST	X11298	Rockville		X
NEW HAMPSHIRE AVE & GLENSIDE DR & ERSKINE ST	X23677	Takoma Park	X	
QUINCE ORCHARD RD & SIOUX LN & ORCHARD RIDGE DR	X04493	Gaithersburg	X	
RUSSELL AVE & CHRISTOPHER AVE	X05851	Gaithersburg		X
SLIGO AVE & FENTON ST	X21415	County		X
SOMERVILLE DR & REDLAND RD	X10120	County		
WISCONSIN AVE & CHELTENHAM DR & NORFOLK AVE	X15441	County	X	
WOODMONT AVE & ELM ST	X15344	County		
WOODMONT AVE & HAMPDEN LN	X15337	County		

FULLY PROTECTED LEFT TURN

Location	Location ID	Jurisdiction	State Road	EEA
16TH ST & ELKHART ST & 2ND AVE	X20577	County	X	
ASBURY DR & LOST KNIFE RD & ODENDHAL AVE	X07089	Gaithersburg		X
BUREAU DR & DIAMOND AVE	X05543	Gaithersburg	X	
CLOPPER RD & FIRSTFIELD RD	X05167	Gaithersburg	X	X
CONNECTICUT AVE & RANDOLPH RD	X17475	County	X	X
EAST WEST HWY & BEACH DR	X18438	County	X	
EAST WEST HWY & GRUBB RD	X19520	County	X	X
FREDERICK AVE & WESTLAND DR	X08409	Gaithersburg	X	X
GEORGIA AVE & COLESVILLE RD	X21161	County	X	X
GEORGIA AVE & JUDSON RD & LAYHILL RD	X19619	County	X	X
GEORGIA AVE & WAYNE AVE	X21244	County	X	X
GERMANTOWN RD & CRYSTAL ROCK DR	X02358	County	X	X
GERMANTOWN RD & SENECA MEADOWS PKWY & GOLDENROD LN	X03009	County	X	
GREAT SENECA HWY & CLIMBING IVY DR	X01847	County	X	
GREAT SENECA HWY & CLOPPER RD	X01550	County	X	
GREAT SENECA HWY & MATENY RD	X01587	County	X	
GREAT SENECA HWY & RICHTER FARM RD	X01469	County	X	
GREAT SENECA HWY & WISTERIA DR	X02330	County	X	X
MADAKET RD & SANGAMORE RD & MAC ARTHUR BLVD	X13596	County		
MIDCOUNTY HWY & SAYBROOKE OAKS BLVD & WOODFIELD RD	X09207	Gaithersburg	X	
MONTGOMERY VILLAGE AVE & RUSSELL AVE & STATION8 DR	X06161	Gaithersburg	X	X
NEW HAMPSHIRE AVE & SPENCERVILLE RD & NORBECK RD	X23676	County	X	
OBSERVATION DR & RIDGE RD	X02916	County	X	
OLD GEORGETOWN RD & EXECUTIVE BLVD	X13408	County	X	
OLD GEORGETOWN RD & ST ELMO AVE & ARLINGTON RD & WILSON LN	X15097	County	X	
OLNEY SANDY SPRING RD & PRINCE PHILIP DR	X18976	County	X	
OLNEY SANDY SPRING RD & SPARTAN RD	X18576	County	X	
PINEY BRANCH RD & CARROLL AVE	X23600	County	X	X
RANDOLPH RD & DALEWOOD DR	X18004	County		X
RANDOLPH RD & DEWEY RD	X15983	County		X
ROCKVILLE PIKE	X15275	County	X	
ROCKVILLE PIKE & EDMONSTON DR	X12204	Rockville	X	X
ROCKVILLE PIKE & JONES BRIDGE RD	X15290	County	X	
ROCKVILLE PIKE & MARINELLI RD	X13981	County	X	
ROCKVILLE PIKE & OLD GEORGETOWN RD	X13869	County	X	
RUSSELL AVE & ODENDHAL AVE	X06611	Gaithersburg		X
SEVEN LOCKS RD & WOOTTON PKWY	X10386	Rockville		
SHADY GROVE RD & DARNESTOWN RD	X07202	County		
SHADY GROVE RD & FALLSGROVE BLVD & MEDICAL CENTER WAY	X07356	County		
SLIGO CREEK PKWY & WAYNE AVE	X22310	County		X
UNIVERSITY BLVD & CARROLL AVE	X23491	County	X	X
UNIVERSITY BLVD & GRANDVIEW AVE	X19428	County	X	X
UNIVERSITY BLVD & NEWPORT MILL RD & DECATUR AVE	X17608	County	X	
UNIVERSITY BLVD & PINEY BRANCH RD	X23339	County	X	X
UNIVERSITY BLVD & SLIGO CREEK PKWY	X21057	County	X	
VEIRS MILL RD & 1ST ST	X12059	Rockville	X	X
WISCONSIN AVE & BRADLEY LN & BRADLEY BLVD	X15866	County	X	
WISCONSIN AVE & MONTGOMERY LN & MONTGOMERY AVE	X15570	County	X	
WISCONSIN AVE & WOODMONT AVE & LELAND ST	X15718	County	X	
WOOTTON PKWY & TOWER OAKS BLVD	X11038	Rockville		

INCREASE ALL-RED CLEARANCE INTERVAL: BOULEVARDS, DOWNTOWN BOULEVARDS, TOWN CENTER BOULEVARDS, MAJOR HIGHWAYS

Location	Location ID	Jurisdiction	State Road	EEA
CASTLE BLVD & BRIGGS CHANEY RD & AUTOMOBILE BLVD	X24946	County		X
COLESVILLE RD & FENTON ST	X21234	County	X	X
COLESVILLE RD & SPRING ST	X21285	County	X	X
COLESVILLE RD & UNIVERSITY BLVD	X22131	County	X	
COLESVILLE RD & UNIVERSITY BLVD	X22171	County	X	
COLESVILLE RD & WAYNE AVE & 2ND AVE	X21066	County	X	X
CONNECTICUT AVE & ASPEN HILL RD	X16764	County	X	X
CONNECTICUT AVE & BEL PRE RD	X17855	County		X
CONNECTICUT AVE & RANDOLPH RD	X17475	County	X	X
EAST WEST HWY & GRUBB RD	X19520	County	X	X
EAST WEST HWY & SUNDALE DR & WASHINGTON AVE	X20148	County	X	X
FREDERICK RD & MIDDLEBROOK RD	X04073	County	X	
GEORGIA AVE & BEL PRE RD	X16842	County	X	X
GEORGIA AVE & CONNECTICUT AVE	X16983	County	X	
GEORGIA AVE & JUDSON RD & LAYHILL RD	X19619	County	X	X
GEORGIA AVE & RANDOLPH RD	X19744	County	X	X
GEORGIA AVE & REEDIE DR	X19641	County	X	X
GEORGIA AVE & UNIVERSITY BLVD	X19555	County	X	X
GEORGIA AVE & WAYNE AVE	X21244	County	X	X
GERMANTOWN RD & CRYSTAL ROCK DR	X02358	County	X	X
GERMANTOWN RD & WISTERIA DR	X01883	County	X	
GREAT SENECA HWY & MUDDY BRANCH RD	X05564	Gaithersburg	X	X
GREAT SENECA HWY & WISTERIA DR	X02330	County	X	X
INDIANOLA DR & CRABBS BRANCH WAY	X10811	County		
LAYHILL RD & BONIFANT RD & BEL PRE RD	X20233	County	X	
MIDDLEBROOK RD & CRYSTAL ROCK DR	X02232	County		X
MONTGOMERY VILLAGE AVE & LOST KNIFE RD & CHRISTOPHER AVE	X06574	County	X	X
NEW HAMPSHIRE AVE & ADELPHI RD & DILSTON RD	X24164	County	X	X
NEW HAMPSHIRE AVE & LOCKWOOD DR	X23608	County	X	
NEW HAMPSHIRE AVE & OAKVIEW DR	X24208	County	X	X
NEW HAMPSHIRE AVE & RANDOLPH RD	X22906	County	X	
OLD COLUMBIA PIKE & FAIRLAND RD	X24695	County		X
RANDOLPH RD & DALEWOOD DR	X18004	County		X
RANDOLPH RD & GLENALLAN AVE	X20211	County		X
RANDOLPH RD & OLD COLUMBIA PIKE	X24547	County		X
RANDOLPH RD & VEIRS MILL RD	X16598	County	X	X
ROCKVILLE PIKE & CALIFORNIA CIR & BOU AVE	X13404	County	X	
ROCKVILLE PIKE & MARINELLI RD	X13981	County	X	
ROCKVILLE PIKE & TUCKERMAN LN	X14550	County	X	
SHADY GROVE RD & MUNCASTER MILL RD & AIRPARK RD	X11479	County	X	X
TWINBROOK PKWY & FISHERS LN	X13672	County		X
TWINBROOK PKWY & PARKLAWN DR & WICOMICO AVE	X13670	County		X
UNIVERSITY BLVD & PINEY BRANCH RD	X23339	County	X	X
UNIVERSITY BLVD & VEIRS MILL RD	X19201	County	X	X
VEIRS MILL RD & CONNECTICUT AVE	X17318	County	X	
VEIRS MILL RD & FERRARA AVE	X17084	County	X	X
VEIRS MILL RD & GAYNOR RD & PARKLAND DR	X15745	County	X	X
VEIRS MILL RD & GRIDLEY RD & SHOP CTR CUT THRU	X16448	County	X	X
VEIRS MILL RD & TWINBROOK PKWY	X14065	County	X	X
WOODFIELD RD & SNOUFFER SCHOOL RD & MUNCASTER MILL RD	X10522	County	X	X



INCREASE ALL-RED CLEARANCE INTERVAL: ALL OTHER STREET TYPES

Location	Location ID	Jurisdiction	State Road	EEA
2ND AVE & FENWICK LN	X20956	County		X
ASBURY DR & LOST KNIFE RD & ODENDHAL AVE	X07089	Gaithersburg		X
BALTIMORE RD & 1ST ST & NORBECK RD	X12167	Rockville	X	
BONIFANT ST & FENTON ST	X21402	County		
CHERRY LAUREL LN & MOONEY DR & SNOUFFER SCHOOL RD	X10038	County		
CLOPPER RD & FIRSTFIELD RD	X05167	Gaithersburg	X	X
CLOPPER RD & METROPOLITAN GROVE RD & TWELVE OAKS DR	X04889	Gaithersburg	X	X
CLOPPER RD & WATKINS MILL RD & PHEASANT RUN DR	X04539	Gaithersburg	X	X
CROFTON HILL LN & MONTGOMERY AVE & RESEARCH BLVD	X08749	Rockville	X	
ELLSWORTH DR & FENTON ST	X21323	County		X
FENTON ST & PHILADELPHIA AVE & BURLINGTON AVE	X21446	County	X	X
FIRSTFIELD RD & QUINCE ORCHARD RD	X05406	Gaithersburg	X	X
FOREST GLEN RD & SEMINARY RD & CAPITOL VIEW AVE	X19250	County	X	
FREDERICK AVE & DEER PARK DR & DEER PARK RD	X07947	Gaithersburg	X	X
FREDERICK AVE & MONTGOMERY VILLAGE AVE	X05936	Gaithersburg	X	X
FREDERICK AVE & PERRY PKWY & LAKEFOREST BLVD	X06192	Gaithersburg	X	X
FREDERICK AVE & SUMMIT AVE	X07425	Gaithersburg	X	X
FREDERICK AVE & TRAVIS AVE & SPECTRUM AVE	X05227	Gaithersburg	X	X
FREDERICK AVE & WATKINS MILL RD	X05461	Gaithersburg	X	X
FREDERICK AVE & WESTLAND DR	X08409	Gaithersburg	X	X
GREAT SENECA HWY & ORCHARD RIDGE DR & KENTLANDS BLVD	X04638	Gaithersburg	X	
HUNGERFORD DR & WASHINGTON ST & A ST	X11086	Rockville	X	X
MONTROSE PKWY & CHAPMAN AVE & RANDOLPH DR	X13932	County		
MONTROSE RD & JEFFERSON ST	X12862	County		
ODENDHAL AVE & GOSHEN RD	X07602	Gaithersburg		X
OLD GEORGETOWN RD & EXECUTIVE BLVD	X13408	County	X	
PARKLAND DR & ASPEN HILL RD	X16216	County		X
PINEY BRANCH RD & DEVON RD & PINEY BRANCH RD	X22404	County	X	
RANDOLPH RD & NEBEL ST	X14147	County		
ROCK SPRING DR & MARRIOTT DR & FERNWOOD RD	X12123	County		
ROCKVILLE PIKE & CHAPMAN AVE & HALPINE RD	X13005	Rockville	X	X
ROCKVILLE PIKE & EDMONSTON DR	X12204	Rockville	X	X
ROCKVILLE PIKE & MIDDLE LN & PARK RD	X11402	Rockville	X	X
ROCKVILLE PIKE & RICHARD MONTGOMERY DR & DODGE ST	X11662	Rockville	X	X
ROCKVILLE PIKE & TWINBROOK PKWY & ROLLINS AVE	X13230	Rockville	X	
ROCKVILLE PIKE & WOOTTON PKWY & 1ST ST	X11989	Rockville	X	X
ROLLINS AVE & JEFFERSON ST	X12839	Rockville		
RUSSELL AVE & CHRISTOPHER AVE	X05851	Gaithersburg		X
RUSSELL AVE & ODENDHAL AVE	X06611	Gaithersburg		X
SLIGO AVE & FENTON ST	X21415	County		X
SLIGO CREEK PKWY & WAYNE AVE	X22310	County		X
THAYER AVE & FENTON ST	X21408	County		
TWINBROOK PKWY & CHAPMAN AVE	X13419	Rockville		
VEIRS MILL RD & 1ST ST	X12059	Rockville	X	X
VEIRS MILL RD & BROADWOOD DR	X13028	Rockville	X	X
WAYNE AVE & DIXON AVE & DISCOVERY PL	X21175	County		X
WAYNE AVE & FENTON ST	X21388	County		X
WAYNE AVE & RAMSEY AVE	X21114	County		X
WESTLAKE TER & WESTLAKE DR	X11427	County		
WOODFIELD RD & MAIN ST	X06840	County	X	



## MINI-ROUNDBOUT

Location	Location ID	Jurisdiction	State Road	EEA
2ND AVE & BALLARD ST	X20817	County		
2ND AVE & HANOVER ST	X20457	County		
2ND AVE & LUZERNE AVE	X20348	County		
2ND AVE & ROOKWOOD RD	X20329	County		
AMHERST AVE & ELKIN ST	X19950	County		X
ARDENNES AVE & CRAWFORD DR	X13344	Rockville		X
BAUER DR & ARCTIC AVE	X15538	County		
BLUERIDGE AVE & GRANDVIEW AVE	X19422	County		X
BRUNETT AVE & FOREST GLEN RD	X21569	County		
DAIRYMAID DR & METZ DR	X01825	County		
DEBORAH DR & BELLS MILL RD	X09874	County		
DUVALL LN & DEER PARK RD	X06868	Gaithersburg		X
EDINBURGH LN & MAPLE AVE & MAPLEWOOD AVE	X22773	Takoma Park		
ELGIN RD & FISHER AVE	X00097	Poolesville	X	
EXECUTIVE BLVD & WOODGLEN DR	X13942	County		
FERRARA DR & CHARLES RD	X16468	County		X
FLOWER AVE & DOMER AVE	X22819	Takoma Park	X	
FLOWER AVE & HOUSTON AVE	X22912	Takoma Park	X	
FLOWER AVE & KENNEBEC AVE	X22942	Takoma Park	X	
FLOWER AVE & WABASH AVE	X22892	Takoma Park	X	X
GAINSBOROUGH RD & BELLS MILL RD	X09352	County		
GATESHEAD MANOR WAY & ASTON MANOR DR	X25138	County		X
GRANDVIEW AVE & ENNALLS AVE	X19456	County		X
GRIDLEY LN & INWOOD AVE	X20842	County		
GROVE ST & THAYER AVE	X21537	County		
HALPINE RD & ARDENNES AVE	X13506	Rockville		X
HERITAGE HILLS DR & QUEEN ELIZABETH DR	X17758	County		
HILDEGARD LN & THOMPSON RD & PEACH ORCHARD RD	X24598	County		
HOLLY AVE & PHILADELPHIA AVE	X22109	Takoma Park	X	
JAMES ST & CEDAR AVE	X07032	Gaithersburg		X
LANARK WAY & LORAIN AVE	X21861	County		
MEADOW HALL DR & MC AULIFFE DR	X13977	Rockville		
NORMANDY CROSSING DR & HOMECREST RD & LONGMEAD CROSSING DR	X19335	County		
PARK AVE & BROOKES AVE	X07333	Gaithersburg		X
PINNACLE DR & CENTURY BLVD	X02176	County		
QUINTON RD & SUNDALE DR	X20082	County		X
RAINBOW DR & GOOD HOPE RD	X24157	County		
ROCKING HORSE RD & BOILING BROOK PKWY	X15151	County		X
RUSSELL AVE & BROOKES AVE	X07189	Gaithersburg		X
SHAKESPEARE BLVD & NEELSVILLE CHURCH RD	X04098	County		
SPENCER RD & RICHLAND ST & SUNDALE DR	X20130	County		X
ST PAUL ST & PLYERS MILL RD	X17828	County		
SUMMIT HALL RD & DEER PARK RD	X07169	Gaithersburg		X
TAYLOR ST & BROOKVILLE RD	X17734	County	X	
TSCHIFFELY SQUARE RD & KENT OAKS WAY	X03413	Gaithersburg		
TULIP AVE & MAPLE AVE	X22123	Takoma Park		
WEISMAN RD & GRANDVIEW AVE	X19500	County		X
WELLER RD & HATHAWAY DR	X18499	County		X
WINDHAM LN & INWOOD AVE	X20820	County		
WINDMILL LN & GOOD HOPE RD	X23911	County		

## ALL-WAY STOP CONTROL

Location	Location ID	Jurisdiction	State Road	EEA
2ND AVE & GLEN ROSS RD	X20366	County		
AMBASSADOR DR & DEERWATER DR & WATERS LANDING DR	X01156	County		
ANN DYKE WAY & WATERS LANDING DR	X01030	County		
ARCOLA AVE & GRANDVIEW AVE	X19421	County		X
ARGYLE CLUB LN & VILLAGE GATE DR & LONGMEAD CROSSING DR	X20107	County		
BENT WILLOW CT & PARTRIDGE WOOD DR & WISTERIA DR	X02519	County		X
BRADFORD RD & MANCHESTER RD	X22527	County		X
BRADMOOR DR & GREENTREE RD	X13237	County		
BRIGHTON DR & DEER PARK RD	X07305	Gaithersburg		X
BRUNSWICK AVE & PLYERS MILL RD	X19233	County		
CAROLINE AVE & FRANKLIN AVE	X22173	County		X
CHESTER ST & WILDWOOD DR & CARROLL AVE	X23447	County	X	X
COLLEGE VIEW DR & NEWPORT MILL RD	X18236	County		
COLSTON DR & GRUBB RD	X19622	County		X
DALLAS AVE & FOREST GLEN RD	X21439	County		
DRUMM AVE & PLYERS MILL RD	X18180	County		
EADES ST & ASPEN HILL RD	X15434	County		X
ELM AVE & ETHAN ALLEN AVE	X23253	Takoma Park	X	
EPPING RD & SHERATON ST & DENLEY PL & DENLEY RD	X18730	County		X
EVANS PKWY & MEDICAL PARK DR & DENNIS AVE	X20517	County		
FLOWER AVE & HUDSON AVE	X22891	Takoma Park	X	X
FLOWER AVE & MELBOURNE AVE	X22487	County		
FLOWER AVE & SCHUYLER RD	X22560	County		
FOREST BROOK RD & WARING STATION RD	X03139	County		
FOREST BROOK RD & WINDING CREEK WAY & WARING STATION RD	X03136	County		
GIST AVE & FENTON ST	X21417	County		
GRANT AVE & MAPLE AVE	X22373	Takoma Park		
GRUBB RD & WASHINGTON AVE	X19880	County		X
HOTTINGER CIR & STONEY BOTTOM RD & WARING STATION RD	X02895	County		
IRIS PL & ASPEN HILL RD	X15664	County		X
IRIS ST & ASPEN HILL RD	X15586	County		X
JULEP AVE & DENNIS AVE	X20869	County		
LAWRENCE AVE & NEWPORT MILL RD	X17599	County		
LEATHERBARK DR & FOREST BROOK RD & WARING STATION RD	X03266	County		
LITTLE SENECA PKWY & SPICEBUSH DR	X03419	County		
LUND PL & MADISON ST & NEWPORT MILL RD	X17730	County		
MARTINS LANDING DR & SILVERGATE WAY & WISTERIA DR	X02846	County		
MONROE ST & SEMINARY RD	X20018	County		
MORNINGSIDE DR & TAMARACK RD	X23858	County		
NORMANDY CROSSING DR & LADYMEADE DR & LONGMEAD CROSSING DR	X19556	County		
OCALA ST & FRANKLIN AVE	X22249	County		X
ORIENTAL ST & ASPEN HILL RD	X15527	County		X
SAYBROOK AVE & FRANKLIN AVE	X22376	County		
SPENCER RD & GRUBB RD	X19420	County		X
STONEY BOTTOM RD & ESMOND TER & WARING STATION RD	X03003	County		
TWINBROOK PKWY & MEADOW HALL DR	X14115	Rockville		
WAYNE AVE & BRADFORD RD	X22565	County		X
WELLER RD & FLACK ST	X18672	County		X
WIMBLEDON DR & LADYMEADE DR & LONGMEAD CROSSING DR	X19963	County		
WIRE AVE & FRANKLIN AVE	X22318	County		X

TRAFFIC SIGNAL (ANGLE CRASHES)

Location	Location ID	Jurisdiction	State Road	EEA
BELLS MILL RD & DEMOCRACY BLVD	X12551	County		
COLESVILLE RD & HASTINGS DR & GRANVILLE DR	X21898	County	X	
COLESVILLE RD & LORAIN AVE	X22274	County	X	
COLESVILLE RD & TIMBERWOOD AVE	X22222	County	X	
COLUMBIA PIKE & NORTHWEST DR	X23093	County	X	
COLUMBIA PIKE & OAK LEAF DR	X23308	County	X	
CONNECTICUT AVE & DECATUR AVE	X17296	County	X	
CONNECTICUT AVE & DUPONT AVE	X17234	County	X	
CONNECTICUT AVE & HOWARD AVE	X17147	County	X	
FREDERICK RD & GAME PRESERVE RD & FREDERICK AVE	X04946	County	X	X
FREDERICK RD & SCENERY DR & GUNNERS BRANCH RD	X04103	County	X	X
GEORGIA AVE & BALLARD ST	X20928	County	X	
GEORGIA AVE & BATCHELLORS FOREST RD & HILLCROFT DR	X17529	County	X	
GEORGIA AVE & BONNYWOOD LN & TILTON DR	X20310	County	X	
GEORGIA AVE & DAWSON AVE & LEESBOROUGH DR	X19502	County	X	X
GEORGIA AVE & DAYTON ST & PREDELLA DR	X20023	County	X	
GEORGIA AVE & EVANS PKWY & EVANS DR	X20067	County	X	
GEORGIA AVE & HENDERSON AVE	X19562	County	X	X
GEORGIA AVE & HIGHLAND DR	X20760	County	X	
GEORGIA AVE & KAYSON ST	X18464	County	X	X
GEORGIA AVE & KING ST	X21261	County	X	X
GEORGIA AVE & LINDELL ST & GEORGIAN WAY	X19686	County	X	X
GEORGIA AVE & NOYES DR	X20856	County	X	
GEORGIA AVE & PARKER AVE	X19539	County	X	X
GEORGIA AVE & WELLER RD	X18817	County	X	X
NEW HAMPSHIRE AVE & ELDRID DR	X23012	County	X	
NEW HAMPSHIRE AVE & OAKLAWN CT & OAKLAWN DR	X24087	County	X	
NEW HAMPSHIRE AVE & PARKMAN RD & OVERLOOK DR	X24146	County	X	
NEW HAMPSHIRE AVE & SHAW AVE	X22831	County	X	
NEW HAMPSHIRE AVE & TANLEY RD	X23434	County	X	
RANDOLPH RD & ATHERTON DR	X17099	County		X
RANDOLPH RD & BREGMAN RD	X22652	County		
RANDOLPH RD & BUSHEY DR	X16972	County		X
RANDOLPH RD & CHARLES RD	X16301	County		X
RANDOLPH RD & ENGLISH ORCHARD CT & HEURICH RD	X20445	County		X
RANDOLPH RD & GOODHILL RD	X17777	County		X
ROCKVILLE PIKE & BROAD BROOK DR & ELSMERE AVE	X15158	County	X	
ROCKVILLE PIKE & WICKSHIRE WAY & FLANDERS AVE	X14310	County	X	
UNIVERSITY BLVD & DEARBORN AVE & MOSS AVE	X22944	County	X	
UNIVERSITY BLVD & DRUMM AVE & HILLSDALE DR	X18616	County	X	
UNIVERSITY BLVD & ELKIN ST	X19713	County	X	X
UNIVERSITY BLVD & INDIAN SPRING DR	X22761	County	X	
UNIVERSITY BLVD & KERWIN RD	X21655	County	X	
UNIVERSITY BLVD & LANGLEY DR	X23323	County	X	X
UNIVERSITY BLVD & LORAIN AVE	X22001	County	X	
UNIVERSITY BLVD & MELBOURNE AVE	X23051	County	X	
UNIVERSITY BLVD & PERRY AVE	X17470	County	X	
VEIRS MILL RD & MONTERREY DR & SCHOOLHOUSE CIR	X18720	County	X	X
VEIRS MILL RD & PENDLETON DR	X18132	County	X	
WISCONSIN AVE & AVONDALE ST & COMMERCE LN	X15498	County	X	

RESTRICT TO LEFT-IN ACCESS

Location	Location ID	Jurisdiction	State Road	EEA
16TH ST & GRACE CHURCH RD	X20580	County	X	
CLIFF PINE DR & BRENISH DR & WOODFIELD RD	X11280	County	X	
CLOPPER RD & LIBERTY MILL RD	X01153	County	X	
CONNECTICUT AVE & BALTIMORE ST	X17155	County	X	
CONNECTICUT AVE & BLACKTHORN ST	X17055	County	X	
CONNECTICUT AVE & BRIGHTVIEW ST	X17376	County	X	X
CONNECTICUT AVE & DUNNEL LN	X16783	County	X	
CONNECTICUT AVE & FRANKLIN ST	X16955	County	X	
CONNECTICUT AVE & GREENLY ST	X17524	County	X	X
CONNECTICUT AVE & IRVING ST	X17037	County	X	
CONNECTICUT AVE & KIRKE ST	X17033	County	X	
CONNECTICUT AVE & LELAND ST	X17051	County	X	
CONNECTICUT AVE & LENOX ST	X17034	County	X	
CONNECTICUT AVE & MELROSE ST	X17038	County	X	
CONNECTICUT AVE & NEWLANDS ST	X17027	County	X	
CONNECTICUT AVE & NEWLANDS ST	X17031	County	X	
CONNECTICUT AVE & OXFORD ST	X17039	County	X	
CONNECTICUT AVE & THORNAPPLE ST	X17047	County	X	
CONNECTICUT AVE & UNDERWOOD ST	X17042	County	X	
CONNECTICUT AVE & VIRGILIA ST & WILLIAMS LN	X17048	County	X	
CONNECTICUT AVE & WOODBINE ST	X17046	County	X	
DARNESTOWN RD & ARGOSY DR & DUFIEF MILL RD	X05148	County	X	
GERMANTOWN RD & MILLENIUM CT & CIDER BARREL DR	X03457	County	X	
OLD GEORGETOWN RD & ALTA VISTA RD	X14066	County	X	

CENTERLINE RUMBLE STRIP

Location	Location ID	Jurisdiction	State Road	EEA
ASHTON RD BETWEEN TUCKER LN & ASHLAND DR	S29819	County	X	
BARNESVILLE RD BETWEEN SUGAR RIDGE TER & PEACH TREE RD	S31695	County		
BEALLSVILLE RD BETWEEN ALMANNA FRM CUT THRU & BIG WOODS RD	S32029	County	X	
BUCKLODGE RD BETWEEN MOORE RD & DARNESTOWN RD	S31874	County	X	
BUCKLODGE RD BETWEEN OLD BUCKLODGE LN & WHITES STORE RD	S29528	County	X	
BUCKLODGE RD BETWEEN WHITES STORE RD & MOORE RD	S31827	County	X	
BURNT HILL RD BETWEEN KINGSTEAD RD & KINGSLEY RD	S29142	County		
BURNT HILL RD BETWEEN PRICES DISTILLERY RD & KINGSTEAD RD	S29063	County		
CLARKSBURG RD BETWEEN HYATTSTOWN MILL RD & SNOWDEN FARM PKWY	S29618	County		
CLARKSBURG RD BETWEEN LEWISDALE RD & HYATTSTOWN MILL RD/KINGSLEY RD	S29187	County		
CLARKSBURG RD BETWEEN OLD BALTIMORE RD & CHRISMAN HILL DR	S31253	County	X	
DAMASCUS RD BETWEEN FARM ACCESS RD & WINDCREST LN	S31698	County	X	
DARNESTOWN RD BETWEEN BELLINGHAM DR & WHITES FERRY RD	S29517	County	X	
DARNESTOWN RD BETWEEN BUCKLODGE RD & CATTAIL RD	S30441	County	X	
DARNESTOWN RD BETWEEN BUCKLODGE RD & WHITE GROUND RD	S28811	County	X	
DARNESTOWN RD BETWEEN DICKERSON RD/MARTINSBURG RD & HUNTER RD	S29457	County	X	
DARNESTOWN RD BETWEEN EDEN ROCK CT & SPRING MEADOWS DR	S31007	County	X	
DARNESTOWN RD BETWEEN JERUSALEM RD & BEALLSVILLE RD	S29600	County	X	
DARNESTOWN RD BETWEEN GERMANTOWN RD & BERRYVILLE RD	S31300	County	X	
DICKERSON RD BETWEEN DICKERSON CHURCH RD & DARNESTOWN RD	S31471	County	X	
EDWARDS FERRY RD BETWEEN WASCHE RD/WHITES FERRY RD & CLUB HOLLOW RD	S29690	County		
EDWARDS FERRY RD BETWEEN WESTERLY RD & OFFUTT RD	S29790	County		
ELMER SCHOOL RD AT WHITES FERRY RD	S29754	County		
GEORGIA AVE BETWEEN NEW HAMPSHIRE AVE/DAMASCUS RD & GREGG RD	S32094	County	X	
GERMANTOWN RD BETWEEN BLACK ROCK RD & CITIZENS LN	S31559	County	X	
GREGG RD BETWEEN GEORGIA AVE & GREGG CT	S29139	County		
HUNTER RD BETWEEN DARNESTOWN RD & WASCHE RD	S32170	County		
LAYTONSVILLE RD BETWEEN HAWKINS CREAMERY RD & ROCKY RD	S32014	County	X	
MARTINSBURG RD BETWEEN DICKERSON CP ENT & WHITES FERRY RD	S30242	County		
PARTNERSHIP RD BETWEEN SUGARLAND RD & RIVER RD	S31524	County		
PARTNERSHIP RD BETWEEN WHITES FERRY RD & SUGARLAND RD	S31788	County		
PEACH TREE RD BETWEEN BARNESVILLE RD & SELLMAN RD	S31669	County		
PEACH TREE RD BETWEEN BETH FARM CUT THRU/MOORE RD & DARNESTOWN RD	S29530	County		
PEACH TREE RD BETWEEN COMUS RD & OLD BALTIMORE RD	S31636	County		
RIDGE RD BETWEEN BROWN CHURCH RD & KEMPTOWN RD	S29635	County	X	
RIVER RD BETWEEN HUNTING QUARTER RD & HUGHES RD	S28058	County		
RIVER RD BETWEEN MAIDENS BOWER DR/LONGACRES PRESERVE CT & PETTIT WAY	S27884	County	X	
RIVER RD BETWEEN PARTNERSHIP RD & HUNTING QUARTER RD	S31635	County		
SLIDELL RD BETWEEN COMUS RD & OLD BALTIMORE RD	S31513	County		
SLIDELL RD BETWEEN OLD BALTIMORE RD & BARNESVILLE RD	S31748	County		
SUGARLAND RD BETWEEN MONTEVIDEO RD & PARTNERSHIP RD	S31820	County		
SUGARLAND RD BETWEEN SUGARLAND LN & HUGHES RD	S29104	County		
WASCHE RD AT HUNTER RD	S29665	County		
WHITES FERRY RD BETWEEN ELMER SCHOOL RD & RIVER RD	S29236	County		
WHITES FERRY RD BETWEEN MORROW RD & PARTNERSHIP RD	S31883	County	X	
WHITES FERRY RD BETWEEN SUGARLAND RD & MORROW RD	S32015	County	X	
WHITES STORE RD BETWEEN BUCKLODGE RD & PEACH TREE RD	S31889	County		
WILLARD RD BETWEEN OFFUTT RD & IZAAK WALTON WAY	S30294	County		
WOODFIELD RD BETWEEN WATKINS RD & DEANNA DR	S32057	County	X	
ZION RD BETWEEN RIGGS RD & BROOKEVILLE RD	S29439	County		

REDUCE SPEEDS BY 5 MPH

Location	Location ID	Jurisdiction	State Road	EEA
ASHTON RD BETWEEN TUCKER LN & ASHLAND DR	S29819	County	X	
BARNESVILLE RD BETWEEN CLARKSBURG RD & GANLEY RD	S31109	County	X	
BARNESVILLE RD BETWEEN SUGAR RIDGE TER & PEACH TREE RD	S31695	County		
BEALLSVILLE RD BETWEEN ALMANNA FRM CUT THRU & BIG WOODS RD	S32029	County	X	
BROOKEVILLE RD BETWEEN GRAYHEAVEN MANOR RD & ZION RD	S32422	County		
BUCKLODGE RD BETWEEN MOORE RD & DARNESTOWN RD	S31874	County	X	
BUCKLODGE RD BETWEEN OLD BUCKLODGE LN & WHITES STORE RD	S29528	County	X	
BUCKLODGE RD BETWEEN WHITES STORE RD & MOORE RD	S31827	County	X	
BURNT HILL RD BETWEEN KINGSTEAD RD & KINGSLEY RD	S29142	County		
BURNT HILL RD BETWEEN PRICES DISTILLERY RD & KINGSTEAD RD	S29063	County		
CLARKSBURG RD BETWEEN BARNES RD & PRICES DISTILLERY RD	S29593	County		
CLARKSBURG RD BETWEEN HYATTSTOWN MILL RD & SNOWDEN FARM PKWY	S29618	County		
CLARKSBURG RD BETWEEN LEWISDALE RD & HYATTSTOWN MILL RD/KINGSLEY RD	S29187	County		
CLARKSBURG RD BETWEEN OLD BALTIMORE RD & CHRISMAN HILL DR	S31253	County	X	
CLARKSBURG RD BETWEEN WOODVIEW DR & MOXLEY RD	S29550	County		
DAMASCUS RD BETWEEN FARM ACCESS RD & WINDCREST LN	S31698	County	X	
DAMASCUS RD BETWEEN NEW HAMPSHIRE AVE/GEORGIA AVE & SUNDOWN RD	S31487	County	X	
DARNESTOWN RD BETWEEN EDEN ROCK CT & SPRING MEADOWS DR	S31007	County	X	
DARNESTOWN RD BETWEEN JERUSALEM RD & BEALLSVILLE RD	S29600	County	X	
DICKERSON RD BETWEEN DICKERSON CHURCH RD & DARNESTOWN RD	S31471	County	X	
EDWARDS FERRY RD BETWEEN WASCHE RD/WHITES FERRY RD & CLUB HOLLOW RD	S29690	County		
EDWARDS FERRY RD BETWEEN WESTERLY RD & OFFUTT RD	S29790	County		
ELMER SCHOOL RD AT WHITES FERRY RD	S29754	County		
GEORGIA AVE BETWEEN NEW HAMPSHIRE AVE/DAMASCUS RD & GREGG RD	S32094	County	X	
GERMANTOWN RD BETWEEN BLACK ROCK RD & CITIZENS LN	S31559	County	X	
GREGG RD BETWEEN GEORGIA AVE & GREGG CT	S29139	County		
HAWKINS CREAMERY RD BETWEEN HAWKINS CREAMERY CT & HAWKINS LANDING	S31606	County		
HUNTER RD BETWEEN DARNESTOWN RD & WASCHE RD	S32170	County		
LAYTONSVILLE RD BETWEEN ROCKY RD & GRIFFITH RD	S31750	County	X	
MARTINSBURG RD BETWEEN DICKERSON CP ENT & WHITES FERRY RD	S30242	County		
MONTEVIDEO RD BETWEEN THOROBRED DR & OLD RIVER RD	S31725	County		
PARTNERSHIP RD BETWEEN SUGARLAND RD & RIVER RD	S31524	County		
PARTNERSHIP RD BETWEEN WHITES FERRY RD & SUGARLAND RD	S31788	County		
PEACH TREE RD BETWEEN BARNESVILLE RD & SELLMAN RD	S31669	County		
PEACH TREE RD BETWEEN BETH FARM CUT THRU/MOORE RD & DARNESTOWN RD	S29530	County		
PEACH TREE RD BETWEEN COMUS RD & OLD BALTIMORE RD	S31636	County		
RIDGE RD BETWEEN KEMPTOWN RD & HOLSEY RD	S30053	County	X	
SLIDELL RD BETWEEN COMUS RD & OLD BALTIMORE RD	S31513	County		
SLIDELL RD BETWEEN OLD BALTIMORE RD & BARNESVILLE RD	S31748	County		
SPENCERVILLE RD BETWEEN OURSLER RD & PEACH ORCHARD RD	S29445	County	X	
SUGARLAND RD BETWEEN MONTEVIDEO RD & PARTNERSHIP RD	S31820	County		
SUGARLAND RD BETWEEN SUGARLAND LN & HUGHES RD	S29104	County		
WASCHE RD AT HUNTER RD	S29665	County		
WASCHE RD BETWEEN HUNTER RD & EDWARDS FERRY RD/WHITES FERRY RD	S29164	County		
WHITES FERRY RD BETWEEN MORROW RD & PARTNERSHIP RD	S31883	County	X	
WHITES FERRY RD BETWEEN SUGARLAND RD & MORROW RD	S32015	County	X	
WHITES STORE RD BETWEEN BUCKLODGE RD & PEACH TREE RD	S31889	County		
WILLARD RD BETWEEN OFFUTT RD & IZAAK WALTON WAY	S30294	County		
WOODFIELD RD BETWEEN EXODUS DR & BRINK RD	S32189	County	X	
ZION RD BETWEEN RIGGS RD & BROOKEVILLE RD	S29439	County		



## AUTOMATED SPEED ENFORCEMENT

Location	Location ID	Jurisdiction	State Road	EEA
COLESVILLE RD BETWEEN LANARK WAY & HASTINGS DR/GRANVILLE DR	S26501	County	X	
COLESVILLE RD BETWEEN TOMS DR/COLUMBIA PIKE & CRESTMOOR DR	S28613	County	X	
COLUMBIA PIKE BETWEEN BLACKBURN RD & GREENCASTLE RD	S26732	County	X	
COLUMBIA PIKE BETWEEN BRIGGS CHANEY RD & FAIRLAND RD	S31960	County	X	
COLUMBIA PIKE BETWEEN FAIRLAND RD & MUSGROVE RD	S26733	County	X	X
COLUMBIA PIKE BETWEEN GREENCASTLE RD & BRIGGS CHANEY RD	S26439	County	X	
COLUMBIA PIKE BETWEEN INDUSTRIAL PKWY & OLD COLUMBIA CUTOVER PIKE	S27077	County	X	
COLUMBIA PIKE BETWEEN MUSGROVE RD & RANDOLPH RD/CHERRY HILL RD	S27557	County	X	X
COLUMBIA PIKE BETWEEN RANDOLPH RD/CHERRY HILL RD & TECH RD	S26235	County	X	X
COLUMBIA PIKE BETWEEN SANDY SPRING RD & BLACKBURN RD	S28217	County	X	
COLUMBIA PIKE BETWEEN STEWART LN & NEW HAMPSHIRE AVE	S27214	County	X	X
CONNECTICUT AVE AT DENFELD AVE	S28662	County	X	
CONNECTICUT AVE BETWEEN BEACH DR & WOODLAWN RD	S28021	County	X	
CONNECTICUT AVE BETWEEN DENFELD AVE & LAWRENCE AVE	S27067	County	X	
CONNECTICUT AVE BETWEEN INDEPENDENCE ST & DEAN RD	S27902	County	X	X
FREDERICK AVE BETWEEN CHRISTOPHER AVE & MONTGOMERY VILLAGE AVE	S26333	Gaithersburg	X	X
FREDERICK AVE BETWEEN MONTGOMERY VILLAGE AVE & PERRY PKWY	S26404	Gaithersburg	X	X
FREDERICK AVE BETWEEN TRAVIS AVE/SPECTRUM AVE & PARAMOUNT PARK DR	S27204	Gaithersburg	X	X
FREDERICK AVE BETWEEN WATKINS MILL RD & CHRISTOPHER AVE	S26291	Gaithersburg	X	X
FREDERICK RD BETWEEN INDIANOLA DR/WATKINS POND BLVD & GUDE DR	S27276	Rockville	X	
FREDERICK RD BETWEEN RIDGEMONT AVE & SHADY GROVE RD	S29045	Rockville	X	X
FREDERICK RD BETWEEN WHEATFIELD DR & GAME PRESERVE RD/FREDERICK AVE	S28983	County	X	X
GEORGIA AVE BETWEEN BATCHELLORS FOREST RD & THISTLEBRIDGE DR	S26140	County	X	
GEORGIA AVE BETWEEN ROSSMOOR BLVD & BEL PRE RD	S28211	County	X	X
GEORGIA AVE BETWEEN SLIGO AVE & BLAIR MILL RD	S32125	County	X	X
GERMANTOWN RD BETWEEN BOWMAN MILL DR & DAWSON FARM RD	S28022	County	X	
GERMANTOWN RD BETWEEN OBSERVATION DR & SENECA MEADOWS PKWY	S28731	County	X	
HUNGERFORD DR BETWEEN WASHINGTON ST/A ST & STATION3 DR	S26698	Rockville	X	X
MIDDLEBROOK RD AT OBSERVATION DR	S29974	County		X
MONTGOMERY VILLAGE AVE BETWEEN FREDERICK AVE & QUINCE ORCHARD RD	S26299	Gaithersburg	X	X
MONTGOMERY VILLAGE AVE BETWEEN LOST KNIFE RD & RUSSELL AVE	S26461	Gaithersburg	X	
MONTROSE RD BETWEEN TILDENWOOD DR & FARM HAVEN DR/HITCHING POST LN	S28566	County		
NEW HAMPSHIRE AVE BETWEEN ELTON RD & OAKVIEW DR	S31745	County	X	X
NEW HAMPSHIRE AVE BETWEEN BONIFANT RD & COLESVILLE MANOR DR	S29844	County	X	
NEW HAMPSHIRE AVE BETWEEN RODNEY RD & OAKLAWN CT/OAKLAWN DR	S27964	County	X	X
RANDOLPH RD BETWEEN DEWEY RD & GAYNOR RD/ROCKING HORSE RD	S26730	County		X
RIDGE RD AT FATHER HURLEY BLVD	S28778	County	X	
RIDGE RD AT OBSERVATION DR	S28874	County	X	
RIDGE RD BETWEEN BRINK RD & HENDERSON CORNER RD	S28570	County	X	
RIDGE RD BETWEEN FREDERICK RD & OBSERVATION DR	S28999	County	X	
ROCKVILLE PIKE BETWEEN TALBOTT ST & TEMPLETON PL	S28727	Rockville	X	X
SHADY GROVE RD BETWEEN CHOKE CHERRY RD & CORPORATE BLVD/RESEARCH CT	S30304	Gaithersburg		
SHADY GROVE RD BETWEEN CRABBS BRANCH WAY & OAKMONT AVE	S29029	County		
SHADY GROVE RD BETWEEN TUPELO DR/EPSILON DR & BRIARDALE RD	S29250	County		
VEIRS MILL RD BETWEEN HAVARD ST & TURKEY BRANCH PKWY	S26711	County	X	X
VEIRS MILL RD BETWEEN TURKEY BRANCH PKWY & GAYNOR RD/PARKLAND DR	S28486	County	X	X
VEIRS MILL RD BETWEEN WHEATON PLZ ENTRANCE CUT/REEDIE DR & GEORGIA AVE	S28708	County	X	X
WISCONSIN AVE BETWEEN EAST WEST HWY& MONTGOMERY LN	S29681	County	X	
WOODFIELD RD BETWEEN CYPRESS HILL DR/RICKENBACKER DR & AIRPARK RD	S28514	County	X	
WOODFIELD RD BETWEEN ROSEWOOD MANOR LN & HADLEY FARMS DR	S26575	County	X	

## APPENDIX K. COUNTERMEASURE COSTS

Countermeasure	Cost	Unit	Source*
All-Way Stop Control	\$5,000	per location	MCDOT
Automated Speed Enforcement	\$0	per location	MCDOT (Costs are offset by revenue)
Centerline Rumble Strip	\$1.50	per foot	MCDOT
Fully Protected Left Turn	\$50,000	per location	MCDOT
High-Visibility Crosswalks	\$3,070	per location	PedBikeSafe
Increase All Red Clearance Interval	\$3,000	per location	PedBikeSafe (comparable to LPI)
Leading Pedestrian Interval	\$3,000	per location	PedBikeSafe
"Left-In-Only" Median	\$50,000	per location	PedBikeSafe
Lighting	\$5,000	per location	PedBikeSafe
Lower Speed Limit by 5 mph	\$1,500	per location	MCDOT
Mini-Roundabout	\$200,000	Per location	MCDOT
Pedestrian Hybrid Beacon	\$175,000	per location	MCDOT
Protected/Permitted Left Turn	\$50,000	per location	MCDOT
Raised Pedestrian Crosswalk	\$15,000	per location	PedBikeSafe
Speed Humps	\$5,000	per location	Speed Humps
Traffic Signal	\$350,000	per location	MCDOT

\* PedBikeSafe countermeasures can be found at <http://www.pedbikesafe.org/pedsafe/countermeasures.cfm>.



## APPENDIX L. AREAS OF FUTURE STUDY

While the Predictive Safety Analysis provides an in-depth look at systemic safety issues in Montgomery County, additional research and analysis could further serve the county's safety goals. A few potential next steps could address the following:

- **Assess Additional Countermeasures and Countermeasure Scenarios:** Continue to work with agency partners to identify systemic safety solutions to reduce crashes throughout the roadway network. Identify additional countermeasures for review and systemic contexts in which they may be applied.
- **Evaluate Additional Crash Types:** This analysis focused on six common crash types in Montgomery County, covering almost 50% of the county's severe injuries and fatalities between 2015 and 2019. Future analysis could evaluate additional crash types, increasing the overall percentage of crashes and severe injuries and fatalities included in the study. A specific focus of additional analysis could be motor vehicle crash types, as only about 40% of motor vehicle severe injuries and fatalities are included in the studied crash types.
- **Collect Additional Transportation Attributes:** The transportation attributes included in this analysis were limited to those available countywide. Some transportation attributes potentially associated with safety were unable to be included in the project, such as information about signal timing (e.g., protected left-turns, all-red time, etc.) and intersection configuration (e.g., presence and number of turn lanes, and if right-turns are channelized). Incorporating new variables into a future analysis could identify new safety issues not currently addressed in the Predictive Safety Analysis.
- **Conduct Before-and-After Studies:** Only countermeasures with existing research about crash reduction are included in the countermeasure evaluation tool. The county could complete before-and-after studies at locations with systemic treatments to identify the observed crash reduction associated with these safety improvements. This data would not only support a more local understanding of crash mitigation, but also could also serve as a communications tool to demonstrate the value of implementing these treatments.
- **Refine Existing Transportation Attributes:** The Predictive Safety Analysis estimated crashes at the intersection and segment levels. Many of the bicycle and pedestrian variables used in the analysis were derived from the Bicycle Level of Traffic Stress (LTS) and the Pedestrian Level of Comfort (PLOC), which summarize these attributes where they exist – along the sides of the road or as individual crossings. Unfortunately, there is not currently a “crosswalk” or an ID that links these crossings, pathways, and bike lanes to their respective intersections and segments. In order to use the LTS and PLOC data for the Predictive Safety Analysis, proximity analyses were conducted, which generalize the bicycle and pedestrian features. In the future, an ID linking these datasets could be created to allow for more precise inclusion of bicycle and pedestrian variables.
- **Modify Volume Estimates:** A key step of the Predictive Safety Analysis was developing volume estimation models based on annualized existing counts. In this analysis, all short-duration counts were included in the model development, and these counts ranged from two-hour to multi-day

counts. While the developed models provide insight into pedestrian, bicyclist, and motorist behavior, limiting the short-duration counts to those at least eight hours or more could potentially provide a better fitting model, which in turn, could result in updated and/or better fitting SPFs. Many of the variables included in the SPFs were related to exposure, and more precise volume models could potentially result in new significant variables. This effort may just require conducting additional counts, rather than just reanalyzing a subset of the existing counts.