

# ROAD SAFETY AUDIT

Warren Avenue at Market Street

Brockton, Massachusetts

May 6, 2022

Prepared through Old Colony MPO FFY 2022 Unified Planning  
Work Program – Road Safety Audits at Multiple Locations:  
Under Contract with MassDOT



Prepared By:  
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## Background

This Road Safety Audit for Warren Avenue at Market Street was prepared as part of the Old Colony Metropolitan Planning Organization's (MPO) Road Safety Audits at Multiple Locations project in the MPO's FFY 2022 Unified Planning Work Program. The objective of the Road Safety Audits at Multiple Locations project is to identify known issues and potential improvements that can be implemented at high crash locations in a continuing effort to achieve safety performance targets for reducing serious injuries and fatalities on the regional highway network. Locations were selected through a data driven process as part of the MPO's Safety Management System and consultation with the communities of the Old Colony MPO.

## Project Data

This Road Safety Audit was held on May 6, 2022. Out of an abundance of caution and respect to the health and safety of Audit participants, this Road Safety Audit was conducted virtually through a webinar format. Participants were provided crash data and associated analysis (crash characteristics charts, collision diagrams) prior to the Audit for review, and background traffic data (traffic volumes and travel speeds) along with surrounding land use were discussed during the Audit.

During the audit, crash analysis, land use, and traffic data were discussed. Aerial photographs of the intersection along with ground level photographs were provided.

A five-year crash history from January 1, 2017 through December 31, 2021 was analyzed and provided to audit participants. Based on MassDOT and Brockton Police Department data and reports, there were 80 crashes in this five-year period. Sixty-seven (84%) of those crashes were angled collisions, while 57 (71%) involved vehicles traveling in the northbound direction on Warren Avenue. Twenty-five (31%) of crashes occurred outside of daylight hours. Over half of the crashes resulted in injury.

The RSA participants formed a multidisciplinary team representing many fields, including planning and engineering. A list of RSA attendees is shown in Table 1.

Table 1: Participating Audit Team Members

| Audit Team Member    | Agency/Affiliation                                      |
|----------------------|---|
| Brady Winsten        | City of Brockton – Policy and Intergovernmental Affairs |
| Jay DeGrace          | City of Brockton – Constituent Services Liasson         |
| John Fay             | City of Brockton – Planning                             |
| Chief Brian Nardelli | Brockton Fire Department                                |
| Michael Damon        | Brockton Area Transit (BAT)                             |
| Kelly Forrester      | Brockton Area Transit (BAT)                             |
| Al DiGirolamo        | Office of State Senator Michael Brady                   |
| Dakota DelSignore    | MassDOT Traffic and Safety Engineering Section          |
| Kevin Fitzgerald     | MassDOT Traffic and Safety Engineering Section          |
| Raissah Kouame       | MassDOT Office of Transportation Planning               |
| Bianca Marshall      | MassDOT District Five Traffic                           |
| Jason Walters        | MassDOT District Five Projects                          |
| Michael Medeiros     | MassDOT District Five Traffic                           |
| Ray Guarino          | Old Colony Planning Council                             |
| Guoqiang Li          | Old Colony Planning Council                             |
| Shawn Bailey         | Old Colony Planning Council                             |
| Kyle Mowatt          | Old Colony Planning Council                             |
| Bill McNulty         | Old Colony Planning Council                             |

## Project Location and Description

The intersection of Warren Avenue at Market Street is a four-legged unsignalized intersection, with STOP control present on the eastbound approach of Market Street (Market Street is one-way eastbound).

Development around the intersection is high density urban residential. The Warren Avenue Baptist Church is located on the southwest corner, while the Huntington Day School is located on the northwest corner. South Middle School is located one block southwest of the intersection. A playground is also located on the northwest corner of the intersection.

Figure 1 provides an aerial photo of the intersection.

- Warren Avenue:** Warren Avenue is a significant north-south connection in the City of Brockton, connecting Downtown Brockton to densely developed residential areas south of Downtown. It is under the jurisdiction of the City of Brockton. It is a two-lane undivided roadway, functionally classified as an Urban Minor Arterial. There are sidewalks on both sides of the roadway. Parking is allowed on Warren Avenue except for the area immediately adjacent to the intersection. There are no special speed regulations for Warren Avenue, however Brockton has a fundamental prima facie speed limit of 30 MPH throughout the City. There is also a 20 MPH School Zone Speed Limit on Warren Avenue through the intersection during school arrival and dismissal times.

- **Market Street:** Market Street is a one-way (eastbound) local road under jurisdiction of the City of Brockton, it serves as an 0.75-mile-long east-west connection from West Chestnut Street to Montello Street (Route 28). The approach forms two lanes at the intersection: a left turn lane, and a shared right turn and through movement lane. There are sidewalks on both sides of the roadway. There are no special speed regulations for Market Street, however Brockton has a fundamental prima facie speed limit of 30 MPH throughout the City.



Figure 1: Locus Map

## Audit Observations and Potential Safety Enhancements

The following safety issues along with potential safety enhancements were identified for the intersection of Warren Avenue at Market Street.

**Speed:** Of the 80 crashes at this intersection that were analyzed in this Audit, over half of them resulted in injury. Speed of traffic on Warren Avenue could be a significant factor in the severity of crashes occurring at this location. High speeds make it difficult for drivers entering from Market Street to find adequate gaps to enter Warren Avenue, and audit participants noted motorists often accelerate through the intersection due to speed on Warren Avenue. Speed may also be a factor in the high volume of angled collisions, with drivers not having adequate stopping sight distance at prevailing travel speed.

*Potential Safety Enhancements:*

1. *Short Term / Low Cost:* Increased, strict enforcement of existing prima facia speed limit of 30 MPH.
2. *Short-Term / Low-Cost:* Establish Safety Zone with 20 MPH Speed Limit on Warren Avenue and Market Street on approaches to intersection. Existing land use featuring a concentration of churches, schools, and a playground in this area supports enactment of a Safety Zone.
3. *Mid Term / Medium Cost:* Convert Warren Avenue to a Complete Street design with narrower travel lanes, bike lanes, and bus stops to calm speed and make roadway safer for all users.

**Limited or Obstructed Sight Distance:** Several features are present at this location that are limiting sight distance towards and from the intersection with Market Street. While parking is prohibited on the immediate corners of the intersection, existing street parking on Warren Avenue is close enough to still obstruct views of approaching traffic on Warren Avenue. The size and location of the sign in front of the Warren Avenue Baptist Church is obstructing the view of northbound traffic. Despite being well set back from the roadway, the sprawling foliage on the northwest corner obstructs sight lines. With the two-lane exit design of Market Street, drivers in the left lane cannot see traffic approaching from Warren Avenue when a vehicle is present next to them in the right lane. Similarly, drivers on the northbound approach of Warren Avenue have difficulty seeing a vehicle in the left lane on Market Street when it is being obscured by a vehicle in the right lane.

*Potential Safety Enhancements:*

1. *Short-Term / Low-Cost:* Expand and enforce no parking zones around intersection.

2. *Short-Term / Low-Cost:* Work with church to either reduce size of sign or relocate sign.
3. *Short-Term / Low-Cost:* Keep tree canopy on northwest corner trimmed back.
4. *Mid-Term / Low Cost:* Evaluate converting intersection to all-way stop controlled (STOP signs on Warren Avenue)/
5. *Mid-Term / Medium Cost:* Narrow Market Street approach to only one lane. Consider adding parking lane to Market Street for area schools, church, and playground, or physically narrow Market Street with curb and sidewalk extensions at intersection.
6. *Long-Term / High Cost:* Consider installation of traffic signals at the intersection, if warranted.

**Failure to Stop or Yield Right of Way:** Analysis of crash data indicated that either failure to stop at the stop sign on Market Street or failure to yield right of way was a substantial factor in crashes occurring at this location. This was further confirmed by observation during sight visits and audit participants.

It was noted during field observation and conformed by Audit participants that drivers are often confused at the intersection and are under the assumption that all approaches are under STOP control. A motorist on Warren Avenue was observed stopping at the intersection, despite no cross-street traffic on Market Street being present.

*Potential Safety Enhancements:*

1. *Short-Term / Low-Cost:* Install “Cross Traffic Does Not Stop” supplemental placards (MUTCD W4-4P) underneath Market Street STOP signs.
2. *Short-Term / Low-Cost:* Increase enforcement on Market Street for compliance with stop condition.
3. *Short-Term / Low-Cost:* Enhance the STOP signs on Market Street with higher profile signs, and advance warning signs on both sides of Market Street approaching the intersection. Consider using brighter, high intensity LED bulbs in overhead flashing beacon.
4. *Short-Term / Low-Cost:* Install advance warning signage of Warren Avenue to increase driver awareness of intersection ahead.

**Lighting:** 25 of 80 crashes occurred outside of daylight hours, indicating lighting may be an issue at this location.

*Potential Safety Enhancements:*

1. *Short-Term, Low-Cost:* Increase nighttime visibility of intersection with retroreflective striping on crosswalks and stop bar.

2. *Mid Term / Medium Cost:* Improve area lighting.

**Pedestrian accommodations:** Curb ramps at the intersection are non-ADA compliant, and there is low visibility of the existing standards crosswalk markings. Schools and playgrounds in the area along with dense residential land use and transit stops along Warren Avenue generate a high volume of pedestrians at this intersection. There was one pedestrian-involved crash during the analysis period that resulted in a non-fatal injury.

*Potential Safety Enhancements:*

1. *Short-Term / Low-Cost:* Upgrade crosswalks with higher visibility design and striping.
2. *Mid-term / Medium Cost:* Consider upgrading curbing and ramps at crosswalks to comply with ADA requirements.

**No bicycle accommodations:** The roadways do not include any existing bicycle accommodations.

*Potential Safety Enhancements:*

3. *Long term / High Cost:* Consider adding bicycle lanes with any planned improvements.

## Summary of Road Safety Audit

Based on the review of data, observations of the intersection made in the field, and group discussion, the RSA team identified possible enhancements that could improve safety at the intersection. Further study and design work will need to be conducted to determine the feasibility of improvements. Table 2 summarizes the estimated time frame and costs, and Table 3 summarizes the safety issues, possible enhancements, estimated safety payoff, time frame, cost, and jurisdiction responsibility. Safety payoff estimates are based on engineering judgment and are categorized as low, medium, and high. The time frame is categorized as short-term (<1 year), midterm (1 to 3 years), or long-term (typically >3 years). Long-term improvements are typically considered to be substantial improvements with an expected time frame for implementation greater than 3 years. The costs are categorized as low (<\$10,000), medium (\$10,001 to \$50,000), or high (>\$50,000)."

Table 2: Estimated Time Frame and Costs Breakdown

| Time Frame |           | Costs  |                   |
|------------|-----------|--------|-------------------|
| Short-Term | <1 Year   | Low    | <\$10,000         |
| Mid-Term   | 1-3 Years | Medium | \$10,001-\$50,000 |
| Long-Term  | >3 Years  | High   | >\$50,000         |



**Table 3: Potential Safety Enhancement Summary**

| <b>Safety Issue</b>                   | <b>Potential Safety Enhancement</b>   | <b>Safety Payoff</b> | <b>Time Frame</b> | <b>Cost</b> | <b>Jurisdiction</b> |
|---------------------------------------|---|----------------------|-------------------|-------------|---------------------|
| Speed                                 | Enforce existing prima facia speed limits   | High                 | Short-Term        | Low         | City of Brockton    |
| Speed                                 | Establish Safety Zones with 20 MPH Speed Limit  | High                 | Short-Term        | Low         | City of Brockton    |
| Speed                                 | Implement Complete Streets design on Warren Avenue  | High                 | Mid-Term          | Medium      | City of Brockton    |
| Sight Distance                        | Expand non parking zones around intersection  | Medium               | Short-Term        | Low         | City of Brockton    |
| Sight Distance                        | Work with church to relocate or resize sign   | Medium               | Short-Term        | Low         | City of Brockton    |
| Sight Distance                        | Keep tree canopy on northwest corner trimmed back to maximize sight distance                                  | Medium               | Short-Term        | Low         | City of Brockton    |
| Sight Distance                        | Evaluate feasibility of All-Way Stop Control  | High                 | Mid-Term          | Low         | City of Brockton    |
| Sight Distance                        | Narrow Market Street approach to only allow one lane  | High                 | Mid-Term          | Medium      | City of Brockton    |
| Sight Distance                        | Reconstruct intersection with traffic signals   | High                 | Long-Term         | High        | City of Brockton    |
| Failure to Stop or Yield Right of Way | Install "Cross Traffic Does Not Stop" supplemental placards (MUTCD W4-4P) underneath Market Street STOP signs | Medium               | Short-Term        | Low         | City of Brockton    |
| Failure to Stop or Yield Right of Way | Increase enforcement on Market Street for compliance with stop  | High                 | Short-Term        | Low         | City of Brockton    |
| Failure to Stop or Yield Right of Way | Enhance stop with advance warning signs and oversized stop signs on both sides of roadway                     | High                 | Short-Term        | Low         | City of Brockton    |

| Safety Issue                          | Potential Safety Enhancement  | Safety Payoff | Time Frame | Cost   | Jurisdiction     |
|---------------------------------------|---|---------------|------------|--------|------------------|
| Failure to Stop or Yield Right of Way | Install advance warning signage on Warren Avenue  | High          | Short-Term | Low    | City of Brockton |
| Lighting                              | Use high visibility retroreflective striping on crosswalks and stop bar to enhance nighttime visibility of intersection | Medium        | Short-Term | Low    | City of Brockton |
| Lighting                              | Improve area lighting   | Medium        | Mid-Term   | Medium | City of Brockton |
| Pedestrian accommodations             | Restripe crosswalks with high visibility design   | High          | Short-Term | Low    | City of Brockton |
| Pedestrian accommodations             | Upgrade curbing and ramps at crosswalks to make ADA compliant   | Medium        | Mid-Term   | Medium | City of Brockton |
| Lack of bicycle accommodations        | Consider adding bicycle lanes to Warren Avenue and Market Street  | Medium        | Mid-Term   | Medium | City of Brockton |

## Appendix A. RSA Meeting Agenda

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## Participating Audit Team Members

Date: May 6 2022

Location: Warren Avenue at Market Street, Brockton

| <b>Audit Team Members</b> | <b>Agency/Affiliation</b>                               |
|---------------------------|---|
| Brady Winsten             | City of Brockton – Policy and Intergovernmental Affairs |
| Jay DeGrace               | City of Brockton – Constituent Services Liasson         |
| John Fay                  | City of Brockton – Planning                             |
| Chief Brian Nardelli      | Brockton Fire Department                                |
| Michael Damon             | Brockton Area Transit (BAT)                             |
| Kelly Forrester           | Brockton Area Transit (BAT)                             |
| Al DiGirolamo             | Office of State Senator Michael Brady                   |
| Dakota DelSignore         | MassDOT Traffic and Safety Engineering Section          |
| Kevin Fitzgerald          | MassDOT Traffic and Safety Engineering Section          |
| Raissah Kouame            | MassDOT Office of Transportation Planning               |
| Bianca Marshall           | MassDOT District Five Traffic                           |
| Jason Walters             | MassDOT District Five Projects                          |
| Michael Medeiros          | MassDOT District Five Traffic                           |
| Ray Guarino               | Old Colony Planning Council                             |
| Guoqiang Li               | Old Colony Planning Council                             |
| Shawn Bailey              | Old Colony Planning Council                             |
| Kyle Mowatt               | Old Colony Planning Council                             |
| Bill McNulty              | Old Colony Planning Council                             |

## Appendix C. Detailed Crash Data

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# Crash Data Summary Table

Warren Avenue at Market Street, Brockton, MA  
2017-2021

| Crash Diagram Ref # | Crash Date | Crash Day | Time of Day | Manner of Collision       | Light Condition        | Weather Condition | Road Surface | Driver Contributing Code                          | Ages |    |    | Comments   |
|---------------------|------------|-----------|-------------|---------------------------|------------------------|-------------------|--------------|---|------|----|----|------------|
|                     | m/d/y      |           |             | Type                      | Type                   | Type              | Type         | Type  | D1   | D2 | D3 |            |
| 1                   | 1/14/17    | Saturday  | 10:05 AM    | Angle                     | Daylight               | Clear             | Dry          | Failed to yield right of way                      | 80   | 54 |    | 17-87-AC   |
| 2                   | 3/1/17     | Wednesday | 5:28 PM     | Angle                     | Dark - lighted roadway | Clear             | Dry          | Failed to yield right of way                      | 52   | 53 |    | 17-377-AC  |
| 3                   | 6/12/17    | Monday    | 4:07 PM     | Angle                     | Daylight               | Clear             | Dry          | Unknown   | 32   | 49 |    | 17-1087-AC |
| 4                   | 7/2/17     | Sunday    | 6:11 PM     | Angle                     | Daylight               | Clear             | Dry          | Failed to yield right of way                      | 22   | 29 |    | 17-1200-AC |
| 5                   | 7/16/17    | Sunday    | 6:12 PM     | Angle                     | Daylight               | Clear             | Dry          | Failed to yield right of way                      | 27   | 43 | 48 | 17-1301-AC |
| 6                   | 8/5/17     | Saturday  | 10:51 PM    | Angle                     | Dark - lighted roadway | Clear             | Dry          | Failed to yield right of way                      | 63   | 25 |    | 17-1418-AC |
| 7                   | 9/7/17     | Thursday  | 9:25 PM     | Angle                     | Dark - lighted roadway | Clear             | Dry          | Inattention                                       | 18   | 19 |    | 17-1609-AC |
| 8                   | 10/10/17   | Tuesday   | 2:15 AM     | Rear-end                  | Dark - lighted roadway | Clear             | Wet          | Fatigued/asleep                                   | 53   |    |    | 17-1822-AC |
| 9                   | 12/5/17    | Tuesday   | 4:43 PM     | Angle                     | Dark - lighted roadway | Rain              | Wet          | Failed to yield right of way                      | 24   | 32 |    | 17-2253-AC |
| 10                  | 1/10/18    | Wednesday | 4:41 PM     | Angle                     | Dusk                   | Clear             | Dry          | Unknown   | 64   | 39 |    | 18-100-AC  |
| 11                  | 1/27/18    | Saturday  | 12:45 PM    | Angle                     | Daylight               | Clear             | Dry          | Failed to yield right of way                      | 63   | 22 |    | 18-221-AC  |
| 12                  | 3/1/18     | Thursday  | 9:56 AM     | Angle                     | Daylight               | Clear             | Dry          | Failed to yield right of way                      | 25   | 75 |    | 18-434-AC  |
| 13                  | 3/2/18     | Friday    | 3:22 PM     | Angle                     | Daylight               | Rain              | Wet          | Unknown   | 19   | 37 |    | 18-441-AC  |
| 14                  | 3/15/18    | Thursday  | 9:02 AM     | Angle                     | Daylight               | Clear             | Dry          | No Improper Driving                               | 19   | 23 |    | 18-533-AC  |
| 15                  | 4/1/18     | Sunday    | 1:15 PM     | Single Vehicle Crash      | Daylight               | Clear             | Dry          | No Improper Driving                               | 17   | 39 |    | 18-644-AC  |
| 16                  | 5/5/18     | Saturday  | 11:21 PM    | Angle                     | Dark - lighted roadway | Clear             | Dry          | Failed to yield right of way                      | 32   | 34 |    | 18-866-AC  |
| 17                  | 5/12/18    | Saturday  | 12:11 PM    | Angle                     | Daylight               | Rain              | Wet          | Failed to yield right of way                      | 44   | 48 |    | 18-913-AC  |
| 18                  | 7/14/18    | Saturday  | 6:18 PM     | Single Vehicle Crash      | Daylight               | Clear             | Dry          | Failed to yield right of way                      | 32   | 26 |    | 18-1331-AC |
| 19                  | 7/20/18    | Friday    | 5:28 PM     | Angle                     | Daylight               | Clear             | Dry          | Inattention                                       | 18   | 60 |    | 18-1361-AC |
| 20                  | 8/7/18     | Tuesday   | 2:59 PM     | Angle                     | Daylight               | Clear             | Dry          | Unknown   | 22   | 50 |    | 18-1480-AC |
| 21                  | 8/23/18    | Thursday  | 7:14 PM     | Angle                     | Dusk                   | Clear             | Dry          | Failed to yield right of way                      | 36   | 34 |    | 18-1575-AC |
| 22                  | 9/4/18     | Tuesday   | 8:05 PM     | Angle                     | Dark - lighted roadway | Clear             | Dry          | Unknown   | 54   | 74 |    | 18-1657-AC |
| 23                  | 9/30/18    | Sunday    | 12:33 PM    | Angle                     | Daylight               | Clear             | Dry          | Disregarded traffic signs, signals, road markings | 35   | 32 |    | 18-1818-AC |
| 24                  | 10/19/18   | Friday    | 12:42 PM    | Angle                     | Daylight               | Clear             | Dry          | Unknown   | 31   | 40 |    | 18-1932-AC |
| 25                  | 10/25/18   | Thursday  | 1:14 PM     | Angle                     | Daylight               | Clear             | Dry          | Failed to yield right of way                      | 26   | 30 |    | 18-1966-AC |
| 26                  | 11/5/18    | Monday    | 11:01 AM    | Sideswipe, same direction | Daylight               | Clear             | Dry          | Failed to yield right of way                      | 70   | 60 |    | 18-2043-AC |
| 27                  | 11/19/18   | Monday    | 3:08 PM     | Sideswipe, same direction | Daylight               | Clear             | Dry          | No Improper Driving                               | 20   | 39 |    | 18-2162-AC |
| 28                  | 12/2/18    | Sunday    | 3:30 PM     | Angle                     | Daylight               | Cloudy            | Wet          | Failed to yield right of way                      | 48   | 29 |    | 18-2241-AC |
| 29                  | 12/10/18   | Monday    | 3:43 PM     | Angle                     | Daylight               | Clear             | Dry          | Failed to yield right of way                      | 72   | 53 |    | 18-2308-AC |
| 30                  | 12/22/18   | Saturday  | 10:39 PM    | Angle                     | Dark - lighted roadway | Clear             | Dry          | Failed to yield right of way                      | 30   | 49 |    | 18-2397-AC |
| 31                  | 12/24/18   | Monday    | 6:20 PM     | Angle                     | Dark - lighted roadway | Clear             | Wet          | Failed to yield right of way                      | 63   | 59 |    | 18-2421-AC |
| 32                  | 2/9/19     | Saturday  | 6:37 PM     | Angle                     | Dark - lighted roadway | Clear             | Dry          | Failed to yield right of way                      | 56   | 33 |    | 19-254-AC  |

# Crash Data Summary Table

Warren Avenue at Market Street, Brockton, MA  
2017-2021

| Crash Diagram Ref # | Crash Date   | Crash Day | Time of Day | Manner of Collision<br><i>Type</i> | Light Condition<br><i>Type</i> | Weather Condition<br><i>Type</i> | Road Surface<br><i>Type</i> | Driver Contributing Code<br><i>Type</i>           | Ages      |           |           | Comments   |
|---------------------|--------------|-----------|-------------|------------------------------------|--------------------------------|----------------------------------|-----------------------------|---|-----------|-----------|-----------|------------|
|                     | <i>m/d/y</i> |           |             |                                    |                                |                                  |                             |   | <i>D1</i> | <i>D2</i> | <i>D3</i> |            |
| 33                  | 2/17/19      | Sunday    | 1:53 PM     | Angle                              | Daylight                       | Clear                            | Dry                         | Unknown   | 51        | 22        | 43        | 19-291-AC  |
| 34                  | 3/18/19      | Monday    | 12:40 PM    | Angle                              | Daylight                       | Clear                            | Dry                         | Disregarded traffic signs, signals, road markings | 26        | 47        |           | 19-481-AC  |
| 35                  | 4/27/19      | Saturday  | 2:03 PM     | Angle                              | Daylight                       | Cloudy                           | Dry                         | Failed to yield right of way                      | 36        | 52        |           | 19-742-AC  |
| 36                  | 6/28/19      | Friday    | 1:35 PM     | Angle                              | Daylight                       | Clear                            | Dry                         | Failed to yield right of way                      | 17        | 65        |           | 19-1148-AC |
| 37                  | 7/1/19       | Monday    | 3:50 PM     | Angle                              | Daylight                       | Clear                            | Dry                         | Failed to yield right of way                      | 50        | 24        |           | 19-1173-AC |
| 38                  | 7/22/19      | Monday    | 6:18 AM     | Angle                              | Daylight                       | Clear                            | Dry                         | Failed to yield right of way                      | 71        | 23        |           | 19-1305-AC |
| 39                  | 7/31/19      | Wednesday | 5:53 PM     | Angle                              | Daylight                       | Cloudy                           | Dry                         | Failed to yield right of way                      | 36        | 33        |           | 19-1366-AC |
| 40                  | 9/9/19       | Monday    | 6:58 PM     | Angle                              | Daylight                       | Clear                            | Dry                         | Failed to yield right of way                      | 49        | 53        |           | 19-1641-AC |
| 41                  | 9/16/19      | Monday    | 8:07 AM     | Angle                              | Daylight                       | Clear                            | Dry                         | Inattention                                       | 27        | 27        |           | 19-1683-AC |
| 42                  | 10/6/19      | Sunday    | 10:08 AM    | Angle                              | Daylight                       | Clear                            | Dry                         | No Improper Driving                               | 28        | 62        |           | 19-1815-AC |
| 43                  | 10/16/19     | Wednesday | 9:29 PM     | Angle                              | Dark - lighted roadway         | Rain                             | Wet                         | Disregarded traffic signs, signals, road markings | 28        | 39        |           | 19-1891-AC |
| 44                  | 11/17/19     | Sunday    | 1:19 PM     | Angle                              | Daylight                       | Cloudy                           | Dry                         | Failed to yield right of way                      | 47        | 23        |           | 19-2133-AC |
| 45                  | 12/4/19      | Wednesday | 5:40 PM     | Angle                              | Dark - lighted roadway         | Snow                             | Ice                         | Visibility Obstructed                             | 29        | 31        |           | 19-2274-AC |
| 46                  | 12/11/19     | Wednesday | 12:13 PM    | Angle                              | Daylight                       | Clear                            | Wet                         | Failed to yield right of way                      | 41        | 63        |           | 19-2330-AC |
| 47                  | 1/14/20      | Tuesday   | 3:53 PM     | Angle                              | Daylight                       | Clear                            | Dry                         | Failed to yield right of way                      | 16        | 42        |           | 20-77-AC   |
| 48                  | 1/15/20      | Wednesday | 9:00 AM     | Angle                              | Daylight                       | Clear                            | Dry                         | Failed to yield right of way                      | 52        | 50        |           | 20-80-AC   |
| 49                  | 1/20/20      | Monday    | 4:21 PM     | Angle                              | Dawn                           | Clear                            | Dry                         | Failed to yield right of way                      | 34        | 19        |           | 20-134-AC  |
| 50                  | 2/11/20      | Tuesday   | 5:20 PM     | Single Vehicle Crash               | Dark - lighted roadway         | Clear                            | Wet                         | Unknown   | 49        | 41        |           | 20-260-AC  |
| 51                  | 7/2/20       | Thursday  | 10:15 PM    | Angle                              | Dark - lighted roadway         | Clear                            | Dry                         | Failed to yield right of way                      | 43        | 20        |           | 20-891-AC  |
| 52                  | 8/7/20       | Friday    | 4:24 PM     | Angle                              | Daylight                       | Clear                            | Dry                         | Failed to yield right of way                      | 43        | 32        |           | 20-1080-AC |
| 53                  | 8/13/20      | Thursday  | 5:16 PM     | Sideswipe, opposite direction      | Daylight                       | Clear                            | Dry                         | Failed to yield right of way                      | 23        | 69        |           | 20-1132-AC |
| 54                  | 9/5/20       | Saturday  | 12:25 PM    | Angle                              | Daylight                       | Clear                            | Dry                         | No Improper Driving                               | 51        | 44        |           | 20-1260-AC |
| 55                  | 9/7/20       | Monday    | 8:18 PM     | Angle                              | Dusk                           | Clear                            | Dry                         | Unknown   | 20        | 26        |           | 20-1281-AC |
| 56                  | 10/17/20     | Saturday  | 3:24 AM     | Single Vehicle Crash               | Dark - lighted roadway         | Rain                             | Wet                         | Unknown   | 35        | 19        |           | 20-1514-AC |
| 57                  | 11/5/20      | Thursday  | 5:16 PM     | Angle                              | Dark - lighted roadway         | Clear                            | Dry                         | Failed to yield right of way                      | 24        | 69        |           | 20-1654-AC |
| 58                  | 11/18/20     | Wednesday | 6:45 PM     | Angle                              | Dark - lighted roadway         | Clear                            | Dry                         | Failed to yield right of way                      | 21        | 44        |           | 20-1719-AC |
| 59                  | 12/2/20      | Wednesday | 1:15 PM     | Angle                              | Daylight                       | Clear                            | Dry                         | Unknown   | 44        | 65        |           | 20-1811-AC |
| 60                  | 12/2/20      | Wednesday | 5:29 PM     | Single Vehicle Crash               | Dark - lighted roadway         | Clear                            | Dry                         | Unknown   | 36        |           |           | 20-1813-AC |
| 61                  | 12/5/20      | Saturday  | 5:47 AM     | Sideswipe, same direction          | Dark - lighted roadway         | Rain                             | Wet                         | Failed to yield right of way                      | 31        | 37        |           | 20-1833-AC |
| 62                  | 12/5/20      | Saturday  | 10:39 AM    | Angle                              | Daylight                       | Rain                             | Wet                         | Disregarded traffic signs, signals, road markings | 29        | 22        |           | 20-1835-AC |
| 63                  | 12/11/20     | Friday    | 6:22 AM     | Angle                              | Daylight                       | Clear                            | Dry                         | Failed to yield right of way                      | 28        | 30        |           | 20-1868-AC |
| 64                  | 12/22/20     | Tuesday   | 10:44 AM    | Angle                              | Daylight                       | Clear                            | Dry                         | Failed to yield right of way                      | 23        | 22        |           | 20-1950-AC |

# Crash Data Summary Table

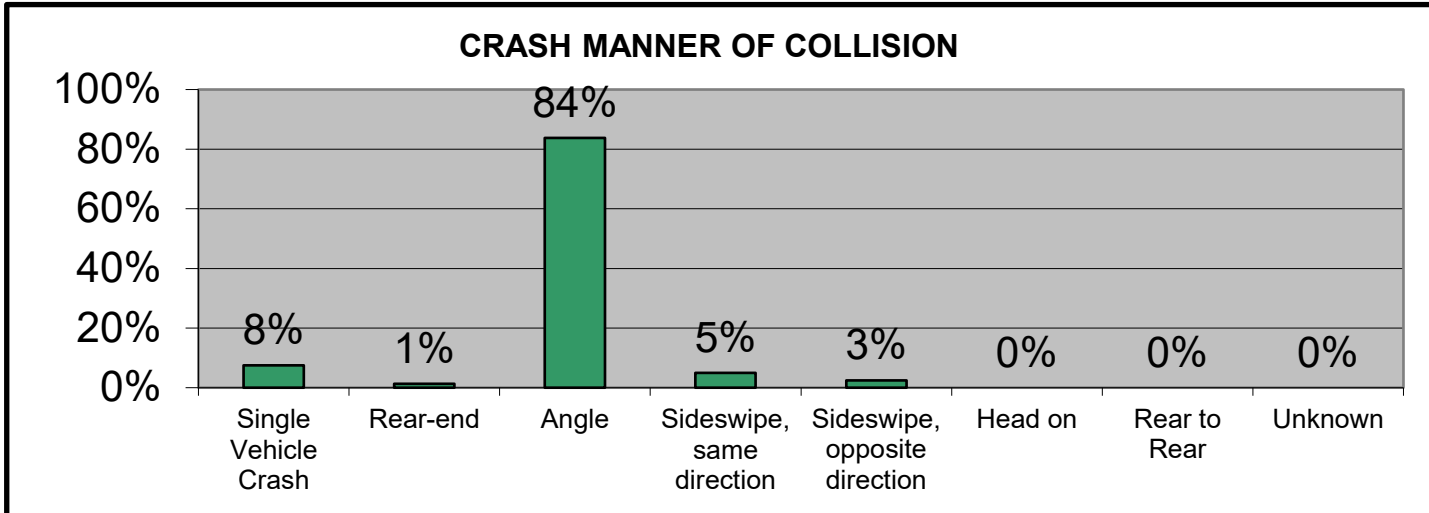
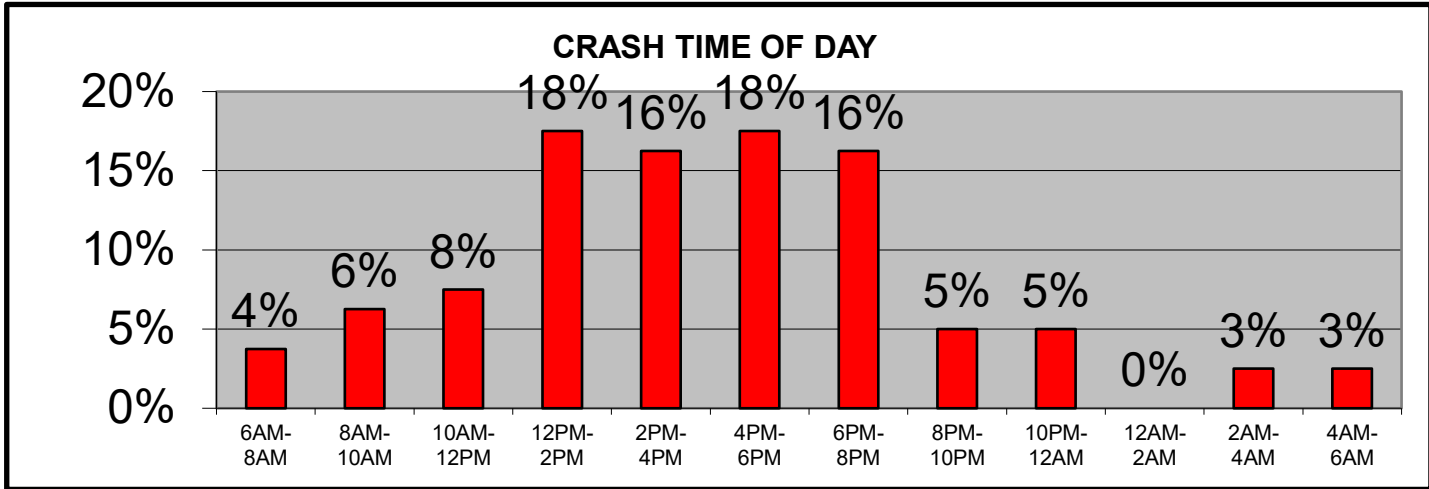
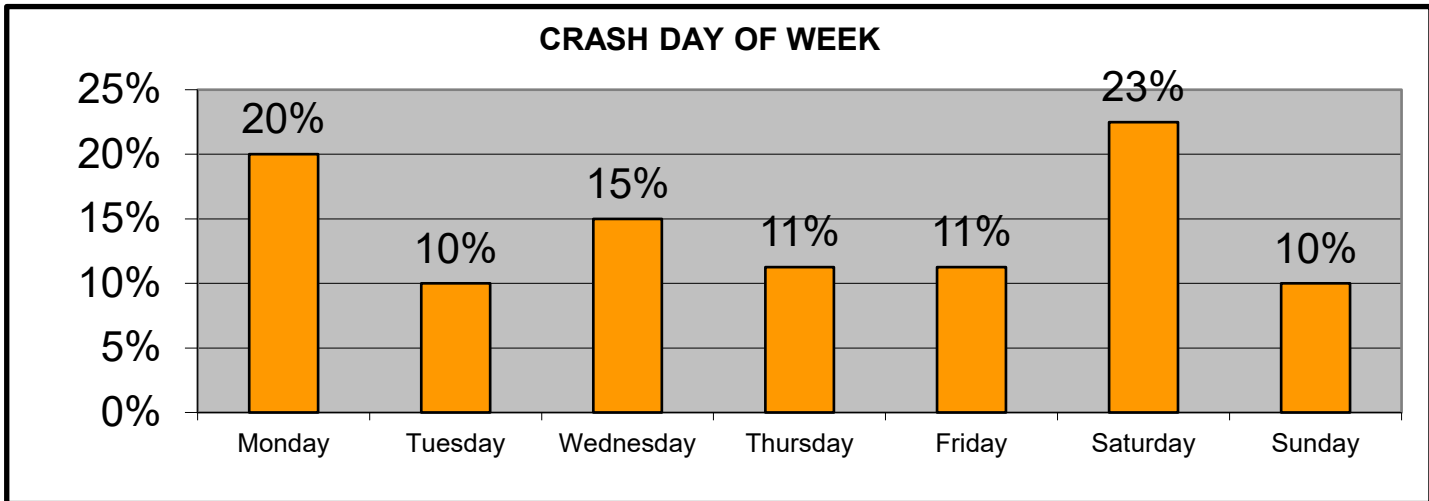
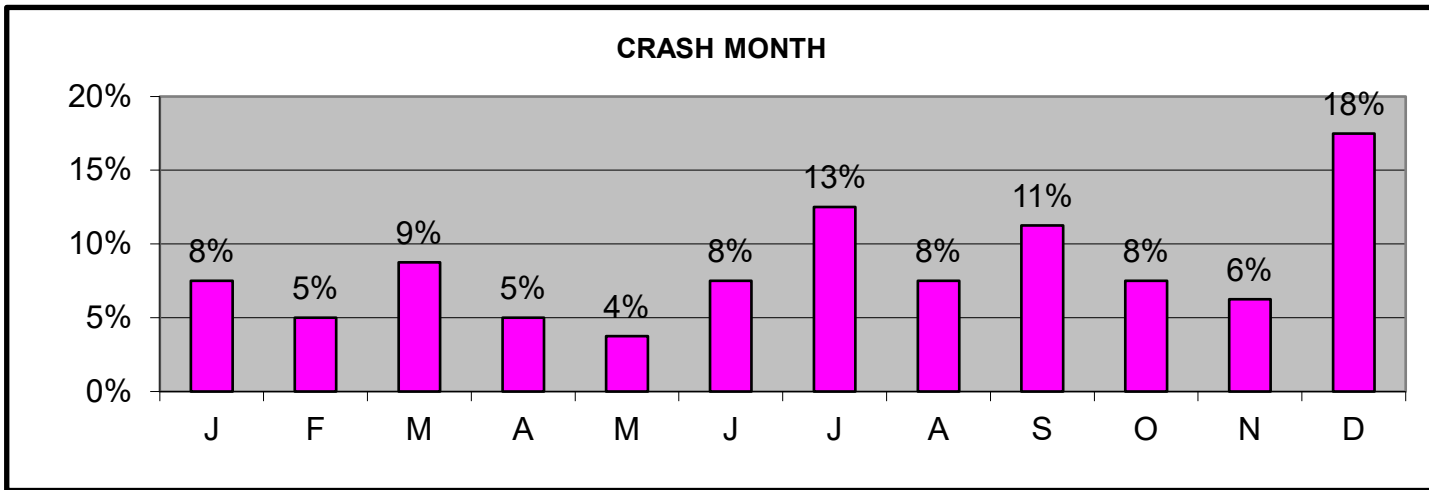
Warren Avenue at Market Street, Brockton, MA  
2017-2021

| Crash Diagram Ref # | Crash Date | Crash Day | Time of Day | Manner of Collision           | Light Condition        | Weather Condition | Road Surface | Driver Contributing Code     | Ages |    |    | Comments   |
|---------------------|------------|-----------|-------------|-------------------------------|------------------------|-------------------|--------------|------------------------------|------|----|----|------------|
|                     | m/d/y      |           |             | Type                          | Type                   | Type              | Type         | Type                         | D1   | D2 | D3 |            |
| 65                  | 2/20/21    | Saturday  | 3:01 PM     | Angle                         | Daylight               | Clear             | Dry          | Failed to yield right of way | 37   | 26 |    | 21-252-AC  |
| 66                  | 3/13/21    | Saturday  | 3:14 PM     | Angle                         | Daylight               | Cloudy            | Dry          | No Improper Driving          | 27   | 24 |    | 21-343-AC  |
| 67                  | 3/29/21    | Monday    | 2:12 PM     | Angle                         | Daylight               | Clear             | Dry          | Failed to yield right of way | 44   | 20 |    | 21-448-AC  |
| 68                  | 4/19/21    | Monday    | 9:13 AM     | Angle                         | Daylight               | Clear             | Dry          | Failed to yield right of way | 75   | 21 |    | 21-588-AC  |
| 69                  | 4/26/21    | Monday    | 5:20 AM     | Angle                         | Unknown                | Clear             | Dry          | Unknown                      | 49   | 34 |    | 21-638-AC  |
| 70                  | 5/22/21    | Saturday  | 4:40 PM     | Angle                         | Daylight               | Clear             | Dry          | No Improper Driving          | 25   | 28 |    | 21-801-AC  |
| 71                  | 6/5/21     | Saturday  | 6:21 PM     | Angle                         | Daylight               | Clear             | Dry          | Unknown                      | 59   | 21 |    | 21-894-AC  |
| 72                  | 6/9/21     | Wednesday | 11:52 AM    | Angle                         | Daylight               | Clear             | Dry          | Other improper action        | 57   | 57 |    | 21-917-AC  |
| 73                  | 6/14/21    | Monday    | 7:18 PM     | Angle                         | Dusk                   | Rain              | Wet          | Failed to yield right of way | 66   | 38 |    | 21-966-AC  |
| 74                  | 6/15/21    | Tuesday   | 2:12 PM     | Angle                         | Daylight               | Cloudy            | Dry          | Failed to yield right of way | 21   | 24 |    | 21-971-AC  |
| 75                  | 7/3/21     | Saturday  | 6:15 PM     | Angle                         | Daylight               | Rain              | Wet          | Failed to yield right of way | 52   | 28 |    | 21-1096-AC |
| 76                  | 7/30/21    | Friday    | 3:09 PM     | Sideswipe, same direction     | Daylight               | Clear             | Dry          | Failed to yield right of way | 60   | 27 |    | 21-1275-AC |
| 77                  | 8/11/21    | Wednesday | 1:14 PM     | Sideswipe, opposite direction | Daylight               | Cloudy            | Dry          | Unknown                      | 73   | 27 |    | 21-1381-AC |
| 78                  | 9/3/21     | Friday    | 6:25 PM     | Single Vehicle Crash          | Daylight               | Clear             | Dry          | Unknown                      | 51   | 34 |    | 21-1556-AC |
| 79                  | 9/17/21    | Friday    | 7:12 AM     | Angle                         | Daylight               | Clear             | Dry          | Failed to yield right of way | 33   | 20 |    | 21-1652-AC |
| 80                  | 12/2/21    | Thursday  | 6:42 PM     | Angle                         | Dark - lighted roadway | Clear             | Wet          | No Improper Driving          | 18   | 21 |    | 21-2198-AC |

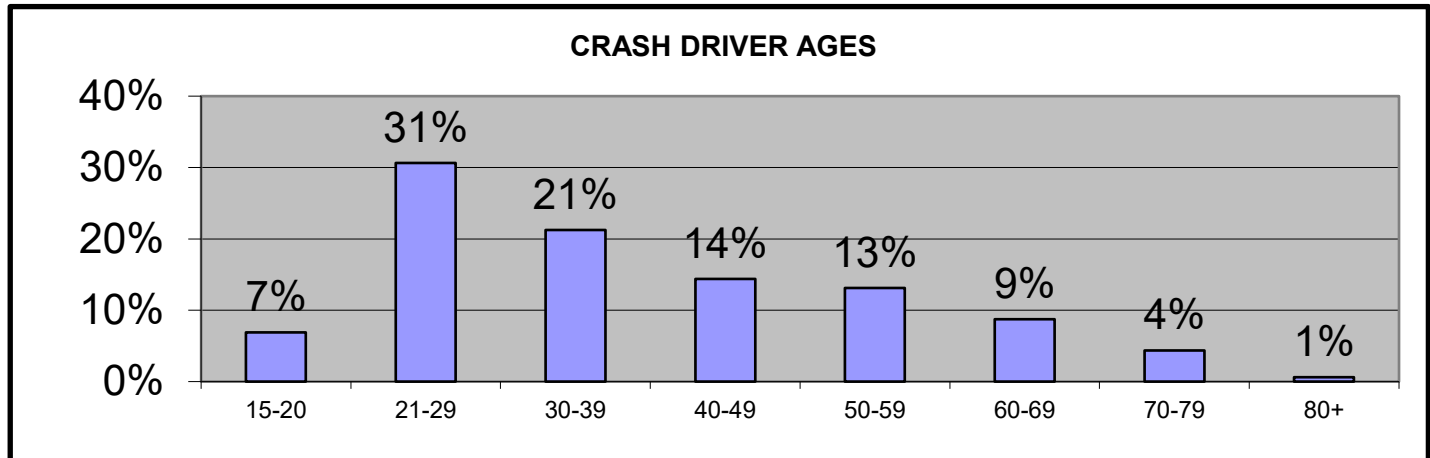
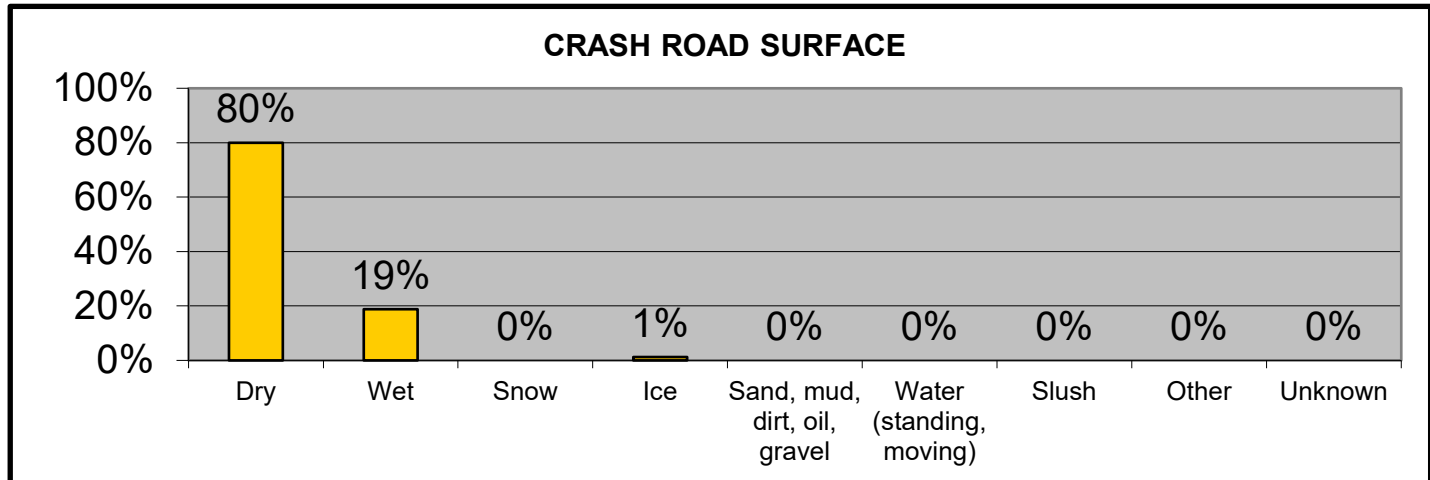
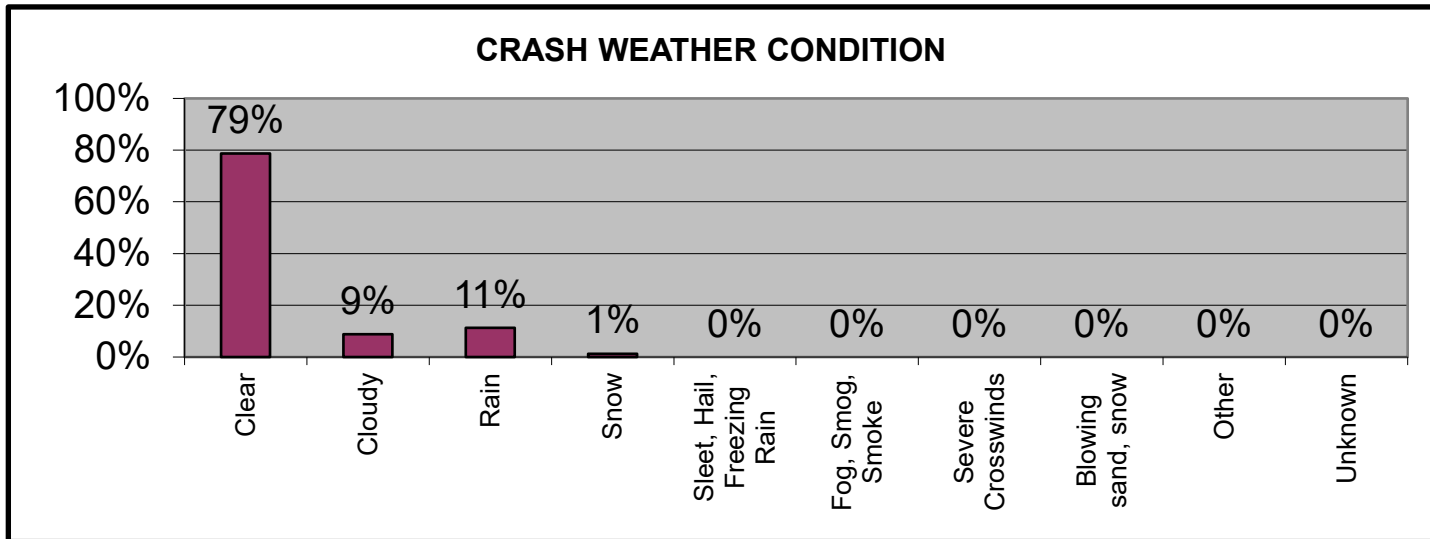
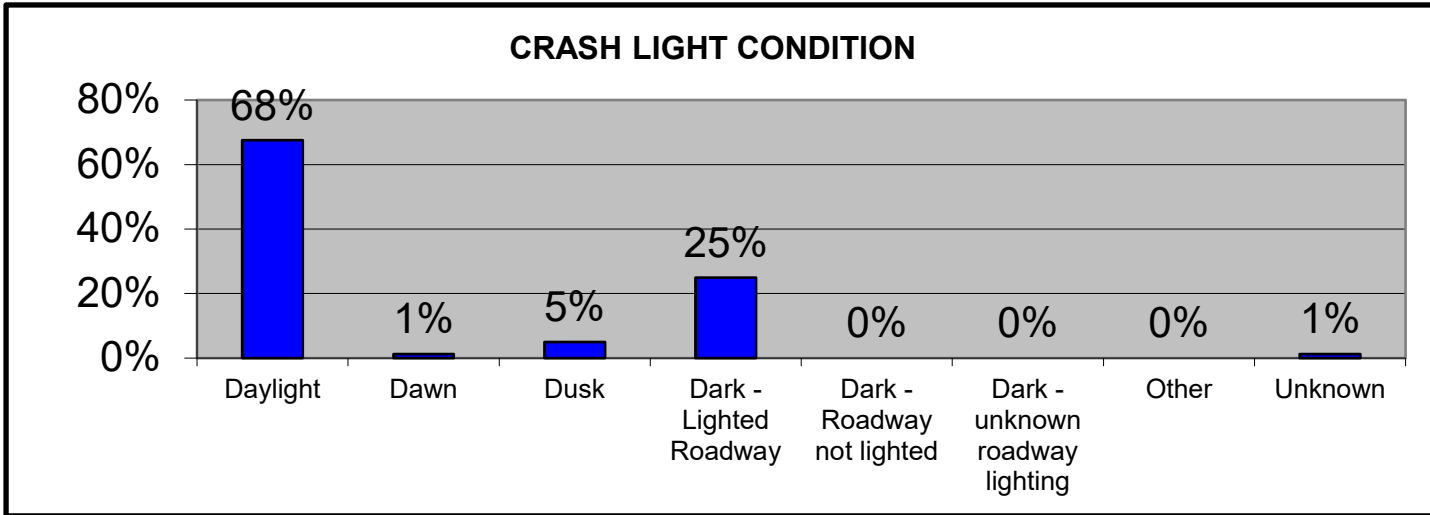
\*Courtesy Crash - A term used to describe a crash that occurs subsequent to a non-involved mainline driver who gives the right of way, contrary to the rules of the road, to another driver.



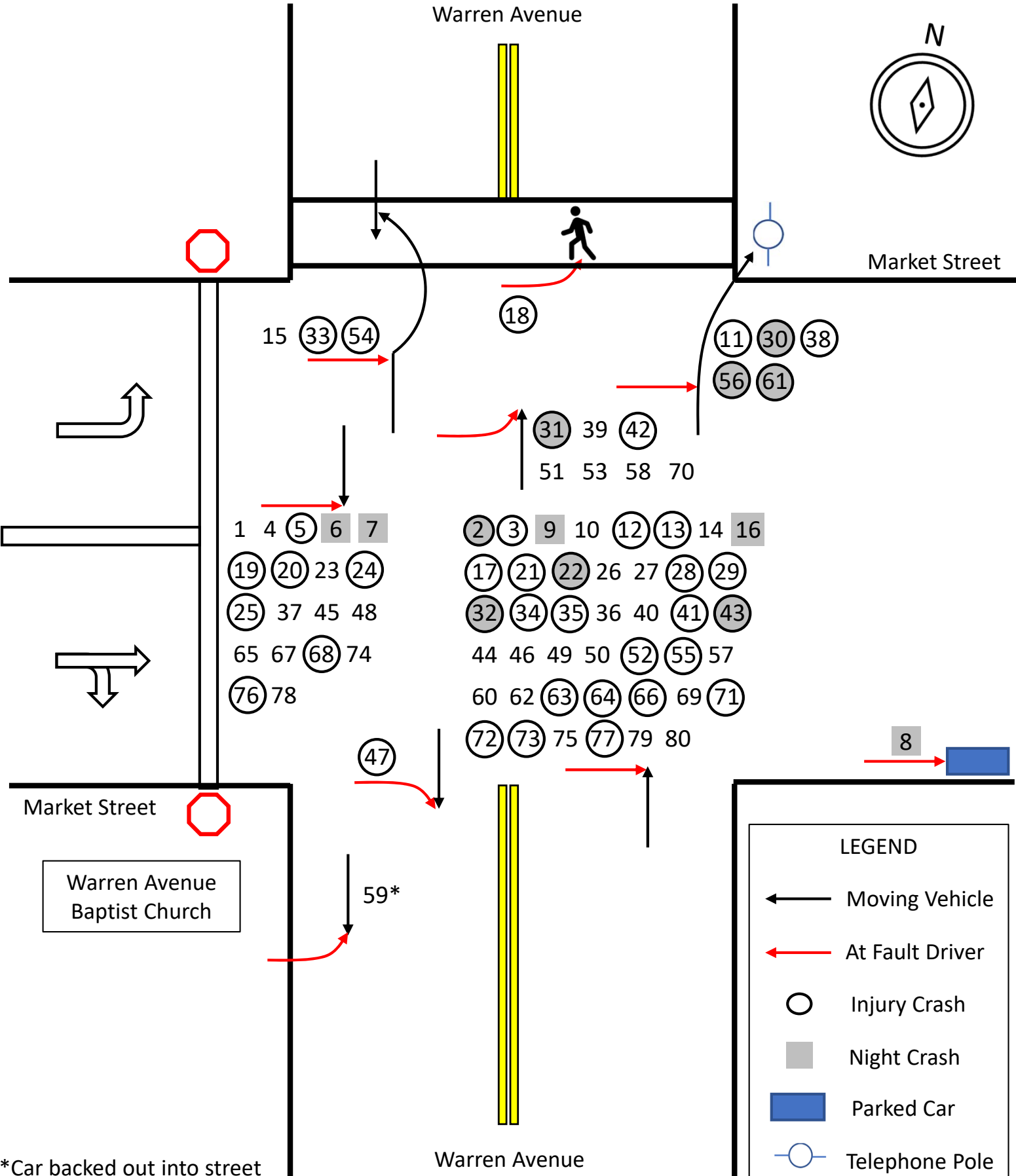
**Crash Data Summary Tables and Charts**  
Warren Avenue at Market Street, Brockton, MA



**Crash Data Summary Tables and Charts**  
Warren Avenue at Market Street, Brockton, MA



**COLLISION DIAGRAM**  
 Warren Avenue at Market Street  
 Collision Diagram for Crashes (2017-2021)  
 Prepared by OCPC (SB 1/2022) (Source: Brockton Police Dept.)



\*Car backed out into street

## Appendix D. Additional Information

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## Appendix E. Road Safety Audit References

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## Road Safety Audit References

*FHWA Office of Safety - Proven Safety Countermeasures*, U.S. Department of Transportation, Federal Highway Administration <https://safety.fhwa.dot.gov/provencountermeasures/>.

*Road Safety Audits, A Synthesis of Highway Practice*. NCHRP Synthesis 336. Transportation Research Board, National Cooperative Highway Research Program, 2004.

*Road Safety Audits*. U.S. Department of Transportation, Federal Highway Administration, <https://safety.fhwa.dot.gov/rsa/>

*FHWA Road Safety Audit Guidelines*. U.S. Department of Transportation, Federal Highway Administration, 2006.

*Road Safety Audit*, 2<sup>nd</sup> edition. Austroads, 2000.

*Road Safety Audits*. ITE Technical Council Committee 4S-7. Institute of Transportation Engineers, February 1995.