

# Technical Memorandum

February 14, 2024

Project# 214640.029

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From: Kittelson & Associates, Inc.

RE: Transportation Safety Action Plan 2023 Update: Revised Draft Safety Recommendations

## INTRODUCTION

This memorandum summarizes the draft safety recommendations, including site-specific infrastructure improvement countermeasures at five high-priority locations, systemic improvement countermeasures, and non-infrastructure recommendations.

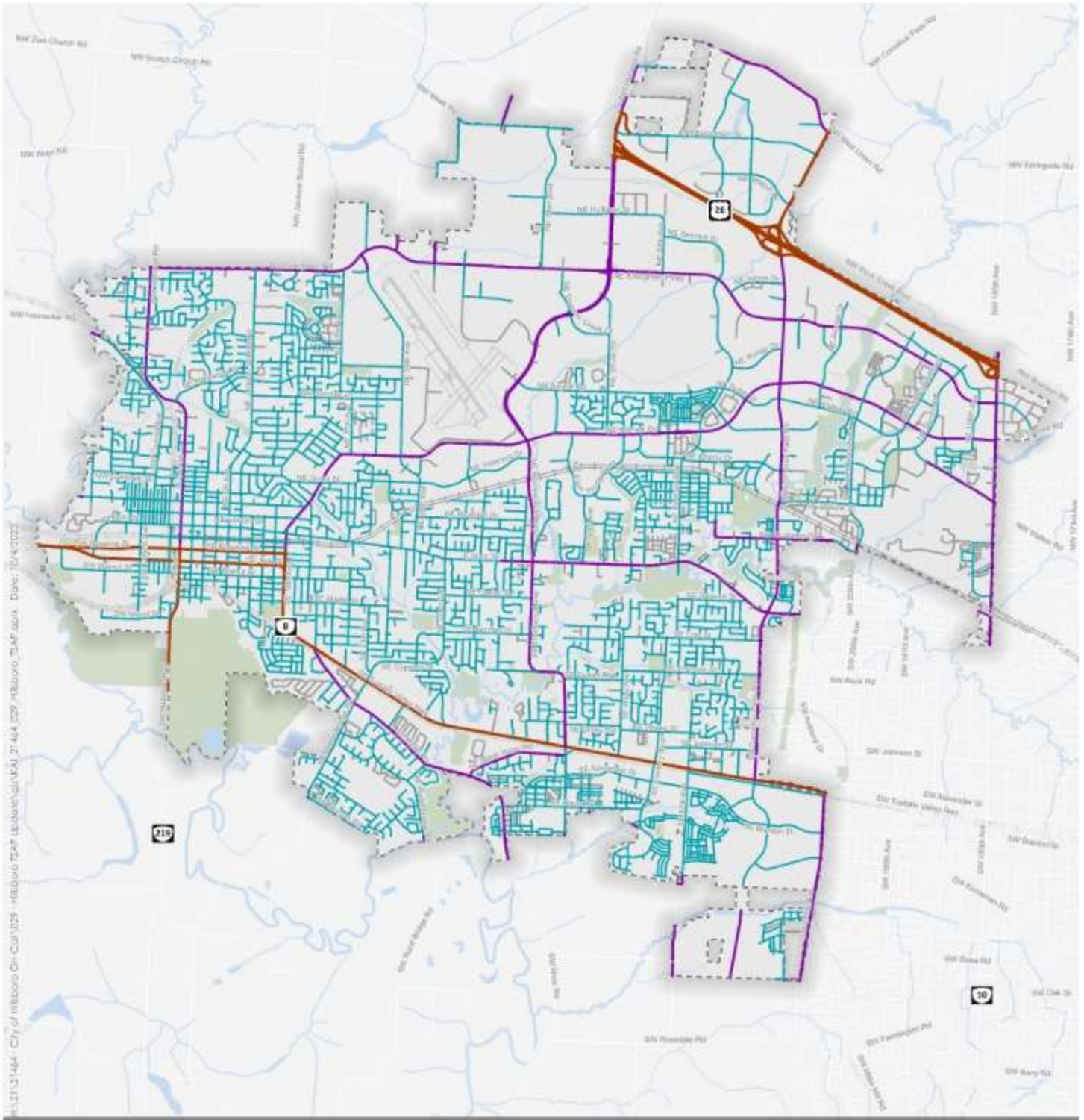
Consistent with the Safe System Approach, recommendations focus on creating redundancy and extend beyond infrastructure recommendations. Recommendations focus on providing the City with an understanding of where improvements can be made to reduce the risk of fatal and serious injury crashes based on crash history, as well as the presence of factors correlated with those crashes. High-priority locations and factors to be addressed with systemic countermeasures are based on the findings identified in the Existing Conditions Analysis Memorandum (Reference 1). This memorandum is organized into the following sections:

Introduction .....	1
Study Area .....	2
Emphasis Areas .....	4
Network Screening .....	5
Safe System Approach .....	8
Countermeasure and Strategies Development .....	11
Systemic Recommendations .....	11
Safer Roads .....	14
Safer Speeds .....	22
Safer People .....	24
Safer Vehicles.....	27
Post-Crash Care.....	27
Site-Specific Infrastructure Improvement Countermeasures .....	28
Next Steps.....	64
References .....	64

## STUDY AREA

The City of Hillsboro is located in Washington County in northwest Oregon. The study area for the Transportation Safety Action Plan (TSAP) Update is the roads located within the city limits. These roads are operated and maintained by three primary jurisdictions: the City of Hillsboro, Washington County, and Oregon Department of Transportation (ODOT).

This TSAP Update analyzes the public roads within the City of Hillsboro's city limits to identify and prioritize safety countermeasures to achieve zero fatal and serious injury crashes by 2035. Figure 1 presents the existing roadway network by roadway jurisdiction and study area for this TSAP Update.



- City of Hillsboro
- Washington County
- ODOT
- Private or Unknown
- City Limits (Study Area)
- Waterbodies
- Parks and Open Spaces
- Light Rail Transit
- Freight Rail



Figure 1

**Study Area  
City of Hillsboro**

## EMPHASIS AREAS

This section summarizes the emphasis areas identified based on the crash data analysis performed in the Existing Condition Analysis Memorandum and feedback from the Steering Committee and general public. The emphasis areas are crash trends with higher risk or frequency of fatal and serious injuries. Site-specific and systemic countermeasures addressing these emphasis areas are developed to reduce the risk of fatal and serious injuries crashes.

### Pedestrian and Bicycle Crashes

- Pedestrian and bicycle crashes represented a small proportion of total crashes but had a higher risk of serious injuries or fatalities.

### Aggressive Driving

- Failure to yield right-of-way, speed, and following too closely were cited as contributing factors in 41% of all crashes and 55% of fatal and suspected serious injury crashes.

### Impaired Driving

- 5% of all crashes and 14% of fatal and suspected serious injury crashes involved impaired driving.

### Intersection Crashes

- Intersection crashes accounted for most of all reported crashes (61%) and fatal and suspected serious injury crashes (61%) between 2017 and 2021.

### Turning Movement and Rear End (on 40+ MPH roadways) Crashes

- Turning and rear-end crashes were the most common crash types in the study area for all crashes and for fatal and suspected serious injury crashes. Rear-end crashes are more likely to result in suspected serious injuries along roadways with speeds over 40 MPH.

### Older Drivers

- Excluding drivers with unreported ages, drivers aged 65 and over are more likely to be involved in fatal and suspected serious injury crashes than all crashes.

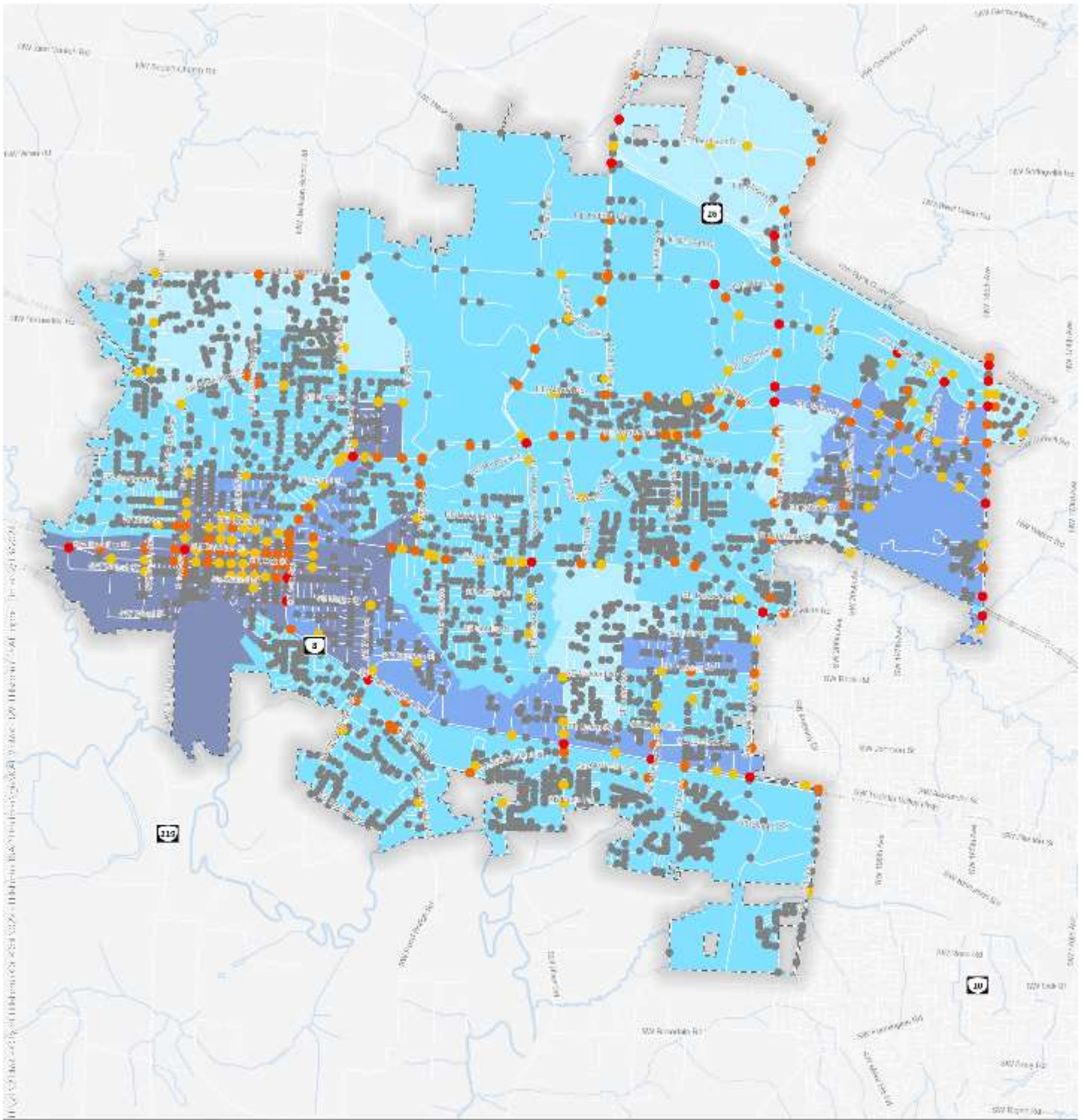
## NETWORK SCREENING

The Existing Conditions Analysis Summary includes an equivalent property damage only (EPDO) network screening of intersections and segments based on crash history and severity<sup>1</sup>. Figure 2 and Figure 3 illustrate the top 1% of sites based on the EPDO network screening overlayed with ODOT's Social Equity Index for intersections and segments, respectively. Appendix B includes tables that present the top 1% of intersections and segments within the study area in terms of highest crash severity score.

Intersections under the City's jurisdiction are considered for site-specific infrastructure improvement countermeasures because the City has more direct influence to apply safety countermeasures at these locations.

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<sup>1</sup> This screening assigns a crash severity score to individual crashes based on the severity of the crashes, with higher weights assigned to more severe crashes. Additional details on the methodology, and tables and figures documenting the results, are described in the Existing Conditions Analysis Summary.



**Intersections: Crash Severity Score**

- > 10% (<2.4)
- > 5 - 10% (>2.4 to 65.6)
- > 1 - 5% (>15.6 to 65.6)
- Top 1% (>65.6 to 159)

**Social Equity Index**

- High Disparity
- Medium High Disparity
- Low Medium Disparity
- Low Disparity

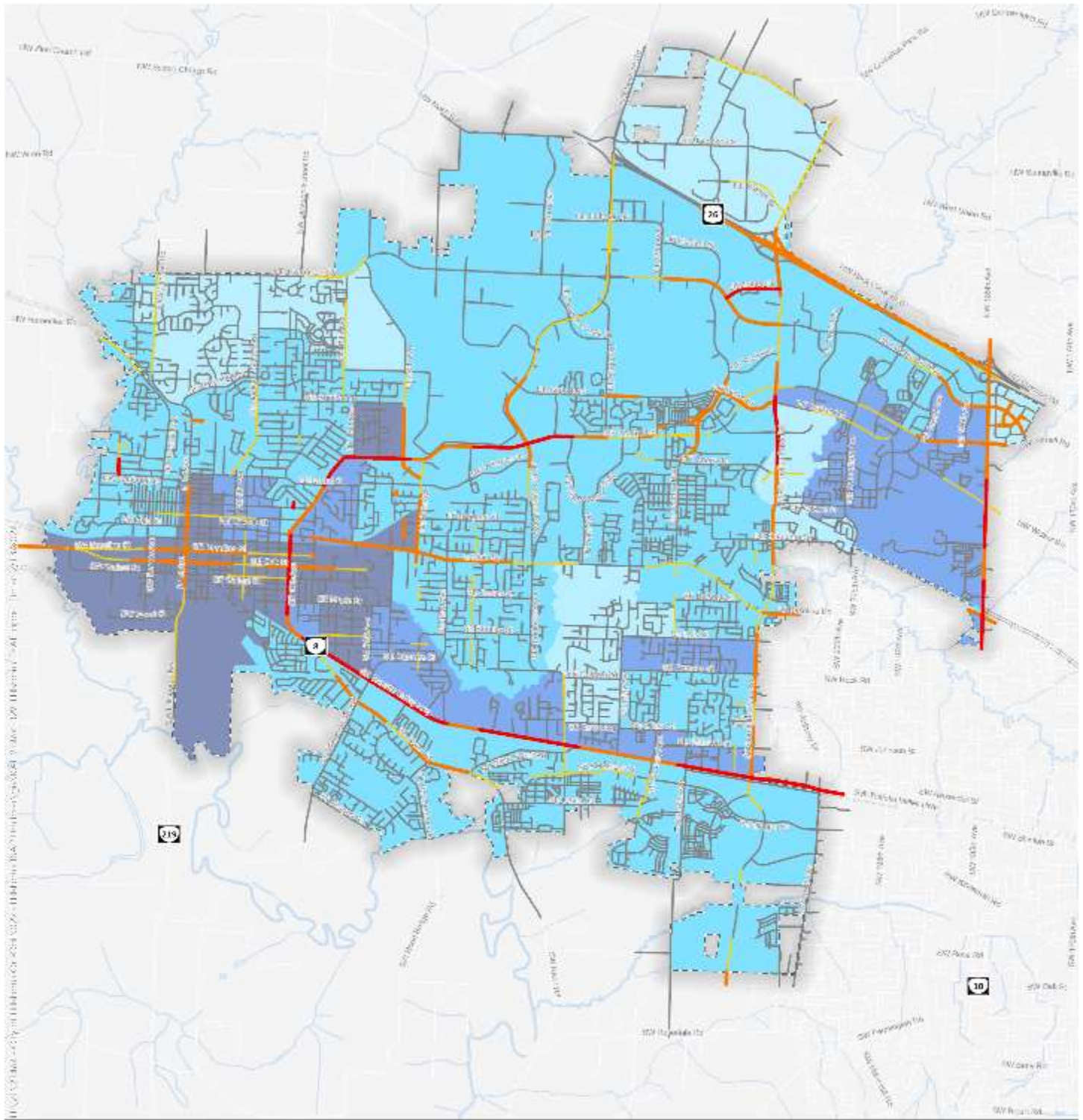
- ⬡ City Limits
- ⚡ Light Rail Transit
- ⚡ Freight Rail



Figure 2

**Intersection Screening Results  
City of Hillsboro**





**Segments: Crash Severity Score**

- > 10% (<11.5)
- > 5 - 10% (>11.5 - 27.2)
- > 1 - 5% (>27.2 - 69.0)
- Top 1% (>69.0 - 122.8)

**Social Equity Index**

- High Disparity
- Medium High Disparity
- Low Medium Disparity
- Low Disparity

- ⬡ City Limits
- ⊕ Light Rail Transit
- ⊕ Freight Rail



Figure 3

**Segment Screening Results  
City of Hillsboro**

## SAFE SYSTEM APPROACH

The Safe System Approach (SSA) has been in use in countries around the world for decades to help them move towards a goal of zero roadway deaths and serious injuries. It has proven to be effective, with countries adopting the approach in a variety of contexts, generally seeing decreases of 33% to nearly 70% in roadway fatalities from 2000 to 2019 (Reference 2). The SSA is a mindset shift from crash prevention to injury/fatality prevention. It puts less emphasis on improving behavior and more emphasis on designing for mistakes that people make so that those mistakes don't result in fatal or severe injury crashes.

Figure 4 illustrates the six principles and five objectives of the SSA. The six SSA principles encompass the fundamental beliefs the approach is built on. A successful Safe System Approach weaves together all six principles. The six principles are shown around the outside ring of the graphic. The five SSA objectives are conduits through which the approach is implemented. They are presented in the middle ring of the graphic. These promote a holistic approach to safety across the entire roadway system and employ the six principles.

Figure 4. Safe System Approach

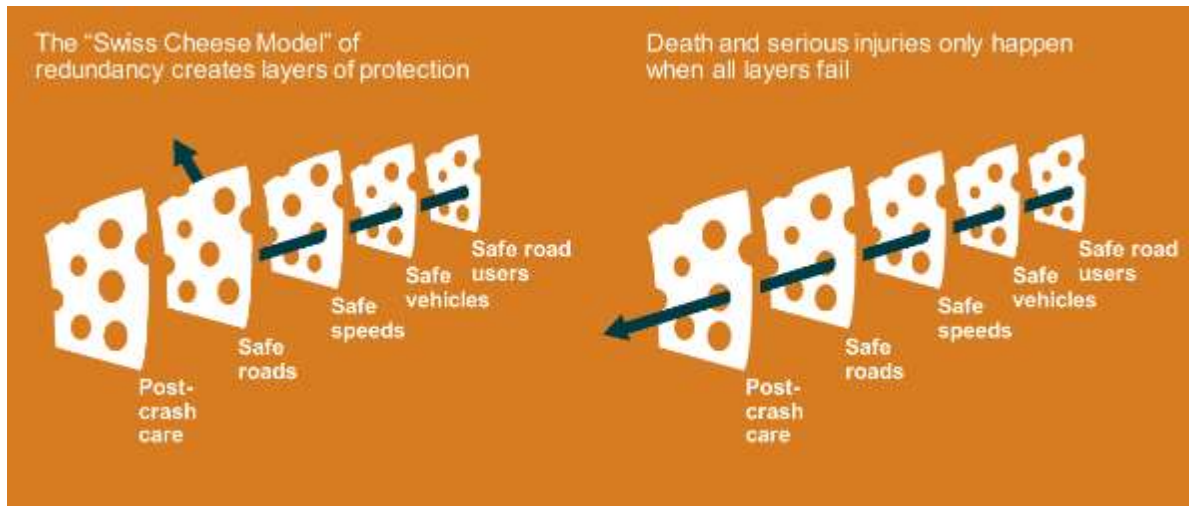


Source: USDOT

Redundancy is a key element of SSA. When one or more layers fails, there are other layers to prevent crashes or reduce the severity of crashes: death and serious injuries only happen when all layers of the SSA fail. Figure 5 illustrates this concept.



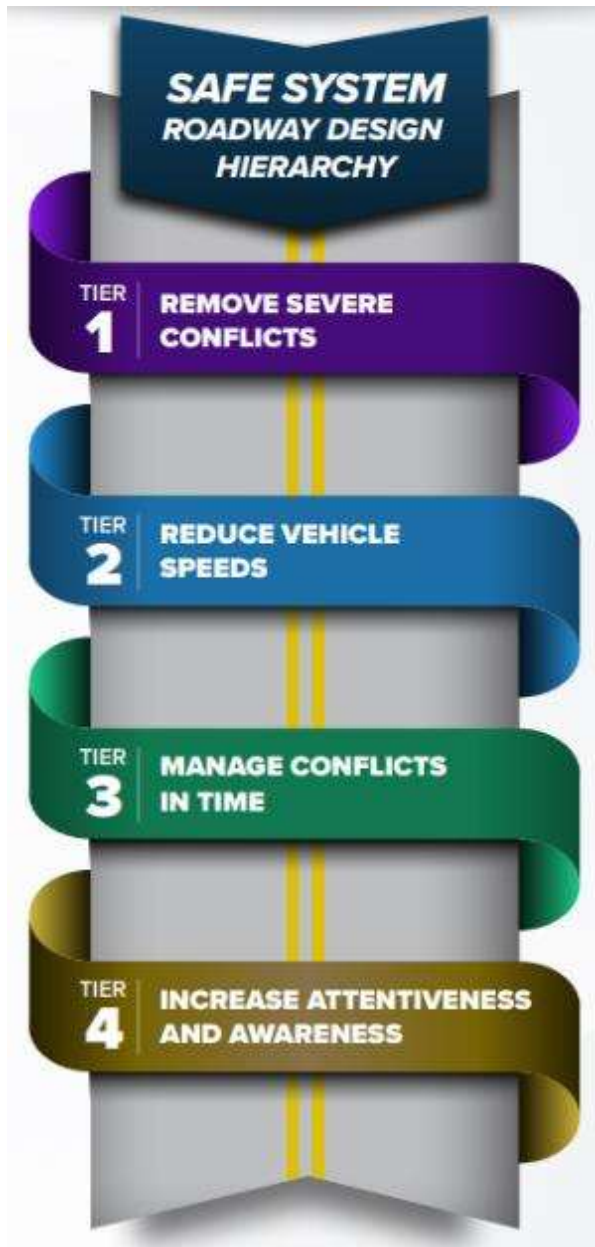
**Figure 5. The Benefit of Redundancy in Addressing Fatal and Serious Injury Crashes**



Source: FHWA

The Federal Highway Administration (FHWA) Safe System Roadway Design Hierarchy is a tool that characterizes engineering and infrastructure-based countermeasures and strategies relative to their alignment with the Safe System Approach. This tool helps agencies identify and prioritize countermeasures and strategies: Tiers 1 through 3 include solutions to remove potential roadway conflicts and Tier 4 provides critical information to road users so they can take appropriate action. Figure 6 illustrates the Safe System Roadway Design Hierarchy.

Figure 6. Safe System Roadway Design Hierarchy



Source: FHWA, Safe System Roadway Design Hierarchy

Countermeasures and strategies identified in this memorandum are sorted according to the Safe System Approach objectives and tiers of the Safe System Roadway Design Hierarchy.

# COUNTERMEASURE AND STRATEGIES DEVELOPMENT

This section identifies site-specific and systemic countermeasures and strategies to reduce the frequency and severity of crashes within the City. Consistent with the Safe System Approach, the Project team considers potential contributing factors that may result to fatal and serious injury crashes such as speeds, conflict points, movement complexity, and identifies infrastructure and non-infrastructure countermeasures and strategies to address these factors.

## Systemic Recommendations

This section documents the infrastructure and non-infrastructure recommendations that can be applied systemically throughout the City to reduce the risk of fatal and serious injury crashes. These recommendations are organized by each of the following Safe System Approach objectives:

- Safer Roads
- Safer Speeds
- Safer People
- Safer Vehicles
- Post-Crash Care

These treatments are documented in the following sections and were identified based on a review of ODOT's All Road Transportation Safety (ARTS) Program (Reference 3), U.S. Department of Transportation's Crash Modification Factor Clearinghouse (Reference 4), Federal Highway Administration's (FHWA) Proven Safety Countermeasures (Reference 5), and a review of the most recent Transportation Safety Action Plans for ODOT, Washington County, and the City. The Project team identified a range of the most promising measures based on the City's infrastructure and crash history. These resources are available for identifying additional countermeasures.

Non-infrastructure recommendations that center equity and include education, enforcement, emergency response, and engagement.

The City can implement these on City-owned facilities directly or partner with the County and State to implement these more broadly. These treatments are summarized in Table 1 and more detail on each strategy or action is provided in the following sections.

**Table 1. Safe System Recommendations**

Strategy/ Action	Lead Agency	Partners
<b>Safer Roads</b>		
Pedestrian and Bicycle Operational Improvements	<ul style="list-style-type: none"> <li>- City Public Works</li> <li>- County Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Oregon Department of Transportation</li> <li>- Bicycle and Pedestrian Advocacy Groups</li> </ul>
Pedestrian and Bicycle Focused Signal Design Improvements	<ul style="list-style-type: none"> <li>- City Public Works</li> <li>- County Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Oregon Department of Transportation</li> <li>- Bicycle and Pedestrian Advocacy Groups</li> </ul>
Improve Visibility of Pedestrians and Bicyclists	<ul style="list-style-type: none"> <li>- City Public Works</li> <li>- County Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Oregon Department of Transportation</li> <li>- Bicycle and Pedestrian Advocacy Groups</li> </ul>
Pedestrian and Bicycle Crossing Improvements	<ul style="list-style-type: none"> <li>- City Public Works</li> <li>- County Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Oregon Department of Transportation</li> <li>- Bicycle and Pedestrian Advocacy Groups</li> </ul>
Signal Phasing Changes	<ul style="list-style-type: none"> <li>- City Public Works</li> <li>- County Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Oregon Department of Transportation</li> </ul>
Improve Intersection Visibility / Warning	<ul style="list-style-type: none"> <li>- City Public Works</li> <li>- County Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Oregon Department of Transportation</li> </ul>
Roadway Design Standards	<ul style="list-style-type: none"> <li>- City Public Works</li> <li>- County Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Oregon Department of Transportation</li> </ul>
Geometric Improvements	<ul style="list-style-type: none"> <li>- City Public Works</li> <li>- County Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Oregon Department of Transportation</li> </ul>
Intersection Control Changes (i.e., Two-Way Stop-Control to All-Way Stop-Control or Roundabout)	<ul style="list-style-type: none"> <li>- City Public Works</li> <li>- County Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Oregon Department of Transportation</li> </ul>
Access Management Standards and Policies	<ul style="list-style-type: none"> <li>- City Public Works</li> <li>- County Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Oregon Department of Transportation</li> </ul>
Policy Changes for Transportation and Land Use Priorities	<ul style="list-style-type: none"> <li>- City Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Oregon Transportation Commission</li> <li>- Advocacy Groups</li> </ul>

Strategy/ Action	Lead Agency	Partners
<b>Safer Speeds</b>		
Traffic Calming	<ul style="list-style-type: none"> <li>- City Public Works</li> <li>- County Public Works</li> <li>- Oregon Department of Transportation</li> </ul>	<ul style="list-style-type: none"> <li>- Neighborhood Associations</li> <li>- City Police Department</li> </ul>
Focused Enforcement	<ul style="list-style-type: none"> <li>- City Police Department</li> </ul>	<ul style="list-style-type: none"> <li>- City Public Works</li> </ul>
Automated Enforcement	<ul style="list-style-type: none"> <li>- City Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- City Police Department</li> </ul>
<b>Safer People</b>		
Positive Culture Framework	<ul style="list-style-type: none"> <li>- City Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Neighborhood Associations</li> <li>- Bicycle and Pedestrian Advocacy Groups</li> </ul>
Education Programs, Media Outreach, and Campaigns	<ul style="list-style-type: none"> <li>- City Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Local News Outlets</li> <li>- School Districts</li> </ul>
Community Outreach and Engagement	<ul style="list-style-type: none"> <li>- City Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Neighborhood Associations</li> <li>- Farmers Markets</li> <li>- City Community Development Department</li> </ul>
Aging Road-User Training	<ul style="list-style-type: none"> <li>- City Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Senior Living Facilities</li> </ul>
Safe Routes to Schools Program	<ul style="list-style-type: none"> <li>- City Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- School District</li> <li>- Neighborhood Associations</li> </ul>
Additional Staff or Training to Support Safety Focus at Agencies	<ul style="list-style-type: none"> <li>- City Public Works</li> <li>- County Public Works</li> </ul>	<ul style="list-style-type: none"> <li>- Federal Highway Administration</li> <li>- Oregon Department of Transportation</li> </ul>
Safety Legislation and Regulations	<ul style="list-style-type: none"> <li>- Oregon Department of Transportation</li> </ul>	<ul style="list-style-type: none"> <li>- City Public Works</li> <li>- Advocacy Groups</li> </ul>
Compliance	<ul style="list-style-type: none"> <li>- City Police Department</li> </ul>	<ul style="list-style-type: none"> <li>- City Public Works</li> </ul>
<b>Safer Vehicles</b>		
Stricter Vehicle Regulations	<ul style="list-style-type: none"> <li>- Oregon Department of Transportation</li> </ul>	<ul style="list-style-type: none"> <li>- City Public Works</li> <li>- Advocacy Groups</li> </ul>

Strategy/ Action	Lead Agency	Partners
Update Vehicle Fleet	- City of Public Works	- City Departments Owning Vehicles
<b>Post-Crash Care</b>		
Enhanced Emergency Vehicle Preemption	- City Emergency Operations	- City Public Works - County Public Works
Enhanced EMS Systems	- Washington County Emergency Medical Services	- City Emergency Operations
Traffic Incident Management	- City Police Department	- City Public Works

## Safer Roads

Safer Roads focuses on designing roadway environments to mitigate human mistakes and account for injury tolerances, to encourage safer behaviors, and to facilitate safe travel by the most vulnerable users. Table 2 describes Safer Roads Strategies identified to reduce the risk and severity of crashes for people walking and biking and at intersections.

These treatments were identified based on the most recent City and County TSAPs and a review of current guidance in ARTS and FHWA Safety Programs on countermeasures intended to reduce the risk and severity of crashes. Additional countermeasures are available, and improvements should be tailored to the issues at a specific location, and in some cases combined with other countermeasures.

**Table 2. Safer Roads Strategies**

Safer Roads Improvement Strategies / Treatments	Details	Priority Application	Emphasis Area	Safe System Roadway Design Hierarchy Tier
<b>Pedestrian and Bicycle Operational Improvements</b>	<ul style="list-style-type: none"> <li>- Implement projects and routes from the Transportation System Plan (TSP) that best accommodate people walking and biking</li> <li>- Fill in gaps in the pedestrian and bicycle network</li> <li>- Create wider sidewalks and bike facilities and add landscape and physical buffers to existing facilities</li> </ul>	<ul style="list-style-type: none"> <li>- Locations in the top 40% of pedestrian and bicycle risk factor scores<sup>2</sup>.</li> <li>- Gaps in the low-stress pedestrian and bicycle networks.</li> </ul>	- Pedestrian and Bicycle	- Tiers 1 – 4

<sup>2</sup> The methodology for identifying pedestrian and bicycle risk factor scores was established under the Oregon Bicycle & Pedestrian Risk Factor Screening (NCHRP 20-44(13): Implementation of NCHRP Research Report 893: The Oregon DOT Statewide Pedestrian and Bicycle Plan, Reference 6).

Safer Roads Improvement Strategies / Treatments	Details	Priority Application	Emphasis Area	Safe System Roadway Design Hierarchy Tier
<b>Pedestrian and Bicycle Focused Signal Design Improvements</b>	Install pedestrian countdown timers - CMF: 0.30 (70% reduction in pedestrian crashes at all severities). Source: ARTS (BP1 – Install Pedestrian Countdown Timers)	- Locations in the top 40% of pedestrian and bicycle risk factor scores. - Signalized intersections	- Pedestrian and Bicycle Intersections	- Tier 3
	Install leading pedestrian intervals <sup>3</sup> - CMF: 0.63 (37% reduction in pedestrian and bicycle crashes at all severities). Source: ARTS (PB3 – Install Leading Pedestrian Interval at Urban Signalized Intersections)	- Locations in the top 40% of pedestrian and bicycle risk factor scores. - Signalized intersections	- Pedestrian and Bicycle Intersections	- Tier 3
	Install bike signal and bicycle detection zones - CMF: 0.55 (45% reduction in bicycle crashes at all severities). Source: ARTS (BP21 – Install Bike Signal)	- Locations in the top 40% of pedestrian and bicycle risk factor scores. - Signalized intersections	- Pedestrian and Bicycle Intersections	- Tier 3
	Prohibit right-turn-on-red - CMF: 0.59 (41% reduction in pedestrian and bicycle crashes at all severities). Source: ARTS (BP25 – Prohibit Right-turn-on-red)	- Locations in the top 40% of pedestrian and bicycle risk factor scores. - Signalized intersections	- Pedestrian and Bicycle Intersections	- Tier 3
	Implement flashing yellow arrow restrictions during pedestrian calls	- Locations in the top 40% of pedestrian and bicycle risk factor scores. - Signalized intersections	- Pedestrian and Bicycle Intersections	- Tier 3
	Implement protected left-turn phasing - CMF: 0.01 (99% reduction in left-turning crashes at all severities). Source: ARTS (Replace Urban Permissive or Protected/Permissive Left Turns to Protected Only)	- Locations in the top 40% of pedestrian and bicycle risk factor scores. - Signalized intersections	- Pedestrian and Bicycle Intersections	- Tier 3
<b>Improve Visibility of Pedestrians and Bicyclists</b>	Lighting improvements, especially near pedestrian crossings	- Locations in the top 40% of pedestrian and bicycle risk factor scores.	- Pedestrian and Bicycle Intersections	- Tier 4

<sup>3</sup> The City of Hillsboro is exploring the consideration of adopting a standard policy for leading pedestrian intervals (LPIs) at all intersections.

Safer Roads Improvement Strategies / Treatments	Details	Priority Application	Emphasis Area	Safe System Roadway Design Hierarchy Tier
	<ul style="list-style-type: none"> <li>CMF: 0.58 (42% reduction in nighttime pedestrian and bicycle crashes at all injury severities). Source: ARTS (BP2 – Provide [Bicycle and Pedestrian] Intersection Illumination)</li> </ul>			
	Install green bike lanes <ul style="list-style-type: none"> <li>CMF: 0.61 (39% reduction in bicycle crashes at all severities). Source: ARTS (BP6 – Install Green Bike Lanes at Conflict Points in Urban Area)</li> </ul>	<ul style="list-style-type: none"> <li>Locations in the top 40% of pedestrian and bicycle risk factor scores.</li> </ul>	<ul style="list-style-type: none"> <li>Pedestrian and Bicycle</li> </ul>	<ul style="list-style-type: none"> <li>Tier 4</li> </ul>
	Install bike boxes <ul style="list-style-type: none"> <li>CMF: 0.65 (35% reduction in bicycle crashes at all severities). Source: ARTS (BP7 – Install Bike Box at Conflict Points)</li> </ul>	<ul style="list-style-type: none"> <li>Locations in the top 40% of pedestrian and bicycle risk factor scores.</li> <li>Signalized intersections</li> </ul>	<ul style="list-style-type: none"> <li>Pedestrian and Bicycle</li> <li>Intersections</li> </ul>	<ul style="list-style-type: none"> <li>Tier 4</li> </ul>
<b>Pedestrian and Bicycle Crossing Improvements<sup>4</sup></b>	Install high visibility pavement markings and advance warning signs <ul style="list-style-type: none"> <li>CMF: 0.85 (15% reduction in pedestrian crashes at all severities). Source: ARTS (BP15 – Install continental Crosswalk Markings and Advance Pedestrian Warning Signs at Uncontrolled locations)</li> </ul>	<ul style="list-style-type: none"> <li>Locations in the top 40% of pedestrian and bicycle risk factor scores.</li> <li>Stop-controlled intersections</li> </ul>	<ul style="list-style-type: none"> <li>Pedestrian and Bicycle</li> <li>Intersections</li> </ul>	<ul style="list-style-type: none"> <li>Tier 4</li> </ul>
	Install curb ramps and extensions <ul style="list-style-type: none"> <li>CMF: 0.63 (37% reduction in pedestrian crashes at all severities). Source: ARTS (BP16 – Install Curb Ramps and Extensions with a Marked Crosswalk and Pedestrian Warning Signs)</li> </ul>	<ul style="list-style-type: none"> <li>Locations in the top 40% of pedestrian and bicycle risk factor scores.</li> <li>Stop-controlled intersections</li> </ul>	<ul style="list-style-type: none"> <li>Pedestrian and Bicycle</li> <li>Intersections</li> </ul>	<ul style="list-style-type: none"> <li>Tier 2</li> </ul>
	Install raised crosswalk <ul style="list-style-type: none"> <li>CMF: 0.70 (30% reduction in pedestrian and bicycle crashes at all severities). Source: ARTS (BP28 – Install Raised Crosswalk)</li> </ul>	<ul style="list-style-type: none"> <li>Locations in the top 40% of pedestrian and bicycle risk factor scores</li> <li>Stop-controlled intersections on roadways with speed limits less than 30 MPH</li> </ul>	<ul style="list-style-type: none"> <li>Pedestrian and Bicycle</li> </ul>	<ul style="list-style-type: none"> <li>Tier 2</li> </ul>

<sup>4</sup> Consult the Federal Highway Administration Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations (Reference 7) when determining the appropriate crossing treatments based on roadway configuration, posted speed limit, and vehicle volumes.



Safer Roads Improvement Strategies / Treatments	Details	Priority Application	Emphasis Area	Safe System Roadway Design Hierarchy Tier
		and an average annual daily traffic below 9,000.		
	Install pedestrian refuge island - 0.68 (32% reduction in pedestrian crashes at all severities). Source: ARTS (BP8 – Install Pedestrian Refuge Island)	- Locations in the top 40% of pedestrian and bicycle risk factor scores - Locations with three or more lanes	- Pedestrian and Bicycle	- Tier 1
	Install rectangular rapid flashing beacons - CMF: 0.44 (56% reduction in pedestrian crashes at all severities). Source: ARTS (BP11 – Install Rectangular Rapid Flashing Beacon on 3-lane or More Roadway with Median) - CMF: 0.90 (10% reduction in pedestrian crashes at all severities). Source: ARTS (BP9 – Install Rectangular Rapid Flashing Beacon on 2-Lane Road) - CMF: 0.90 (10% reduction in pedestrian crashes at all severities). Source: ARTS (BP10 – Install Rectangular Rapid Flashing Beacon on 3-lane or More Roadway without Median)	- Locations in the top 40% of pedestrian and bicycle risk factor scores - Uncontrolled crossing locations with high traffic volumes and speeds	- Pedestrian and Bicycle	- Tier 3
	Install pedestrian hybrid beacons - CMF: 0.45 (55% reduction in pedestrian and bicycle crashes at all severities). Source: ARTS (BP19 – Install Pedestrian Hybrid Beacon)	- Locations in the top 40% of pedestrian and bicycle risk factor scores - Uncontrolled crossing locations with high traffic volumes and speeds	- Pedestrian and Bicycle	- Tier 3
	Install additional pedestrian crossings	- Locations in the top 40% of pedestrian and bicycle risk factor scores - Gaps in the low-stress networks	- Pedestrian and Bicycle	- Varies
<b>Signal Phasing Changes</b>	Install enforcement assistant lights - CMF: 0.96 (6% reduction in all crashes at all severities). Source: CMF Clearinghouse (CMF ID: 8819 – Install Red-Light Indicator Lights)	- Signalized intersections with history of angle crashes and rear-end crashes, especially with history of aggressive driving behaviors	- Intersections	- Tier 3

Safer Roads Improvement Strategies / Treatments	Details	Priority Application	Emphasis Area	Safe System Roadway Design Hierarchy Tier
	Install red light cameras <ul style="list-style-type: none"> <li>- CMF: 0.68 (32% reduction in all crashes at all injury severities). Source: CMF Clearinghouse (CMF ID: 6877)</li> </ul>	<ul style="list-style-type: none"> <li>- Signalized intersections with high crash history</li> </ul>	<ul style="list-style-type: none"> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 4</li> </ul>
	Install time-of-day restrictions <ul style="list-style-type: none"> <li>- See "Pedestrian and Bicycle Focused Signal" Design Improvements</li> </ul>	<ul style="list-style-type: none"> <li>- Signalized intersections with history of turning movement crashes, especially with history of aggressive driving behaviors</li> <li>- Signalized intersections with high traffic volumes and speeds</li> <li>- High pedestrian and bicycle risk factor locations</li> </ul>	<ul style="list-style-type: none"> <li>- Pedestrian &amp; Bicycle</li> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 3</li> </ul>
	Add protected phasing <ul style="list-style-type: none"> <li>- CMF: 0.01 (99% reduction in left-turning crashes at all severities). Source: ARTS (19 – Replace Urban Permissive or Protected/Permissive Left Turns to Protected Only)</li> <li>- CMF: 0.91 (9% reduction in all crashes at all severities). Source: ARTS (129 – Prohibit Right Turn on Red)</li> </ul>	<ul style="list-style-type: none"> <li>- Signalized intersections with history of turning movement crashes</li> <li>- Signalized intersections with permissive phasing along roadways with high traffic volumes and speeds</li> </ul>	<ul style="list-style-type: none"> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 3</li> </ul>
<b>Improve Intersection Visibility / Warning</b>	Install intersection lighting <ul style="list-style-type: none"> <li>- CMF: 0.62 (38% reduction in night crashes at all injury severities). Source: ARTS (11 – Improve Lighting at an Intersection)</li> </ul>	<ul style="list-style-type: none"> <li>- Signalized and unsignalized intersections with history of nighttime crashes</li> </ul>	<ul style="list-style-type: none"> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 4</li> </ul>
	Improve signal hardware <ul style="list-style-type: none"> <li>- CMF: 0.80 to 0.70 (20% to 30% reduction in all crashes at all severities depending on the number of countermeasures applied). Source: ARTS (12 – Improve Signal Hardware: Lenses, Reflectorized Back Plates, Size, and Number)</li> <li>- CMF: 0.85 (15% reduction in all crashes at all severities). Source: ARTS (13 – Add 3-inch Yello Retroreflective Sheeting to Signal Backplates)</li> </ul>	<ul style="list-style-type: none"> <li>- Signalized intersections with high crash history</li> <li>- Signalized intersections along roadways with high traffic speeds and volumes</li> </ul>	<ul style="list-style-type: none"> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 4</li> </ul>

Safer Roads Improvement Strategies / Treatments	Details	Priority Application	Emphasis Area	Safe System Roadway Design Hierarchy Tier
	<ul style="list-style-type: none"> <li>- CMF: 0.83 (17% reduction in rear-end crashes at all severities). Source: ARTS (I6 – Replace Incandescent Traffic Signal Bulbs with Light Emitting Diodes)</li> </ul>			
	Replace doghouse signals with flashing yellow arrow signal heads <ul style="list-style-type: none"> <li>- CMF: 0.75 (25% reduction in left-turning crashes at all severities). Source: ARTS (I8 – Replace Doghouse with Flashing Yellow Arrow Signal Heads)</li> </ul>	<ul style="list-style-type: none"> <li>- Signalized intersections with left-turn lanes</li> <li>- Signalized intersections with high crash history</li> </ul>	<ul style="list-style-type: none"> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 4</li> </ul>
	Install signal ahead signs <ul style="list-style-type: none"> <li>- CMF: 0.65 (35% reduction in angle crashes at all severities). Source: ARTS (I22 – Install Signal Ahead Advance Warning Signs)</li> </ul>	<ul style="list-style-type: none"> <li>- Signalized intersections with history of angle crashes</li> <li>- Signalized intersections with high traffic volumes and speeds</li> </ul>	<ul style="list-style-type: none"> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 4</li> </ul>
	Improve sight distance <ul style="list-style-type: none"> <li>- CMF: 0.52 (48% reduction in all crashes at all severities). Source: ARTS I17 – Increase Triangle Sight Distance)</li> </ul>	<ul style="list-style-type: none"> <li>- Unsignalized intersections with high crash history</li> </ul>	<ul style="list-style-type: none"> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 4</li> </ul>
	Increase the size and number of signs and add advanced warning signage <ul style="list-style-type: none"> <li>- CMF: 0.80 to 0.70 (20% to 30% reduction in all crashes at all severities depending on the number of countermeasures applied). Source: ARTS (I21 – Improve Intersection Warning)</li> </ul>	<ul style="list-style-type: none"> <li>- Unsignalized intersections with high crash history</li> <li>- Unsignalized intersections along roadways with high traffic speeds</li> </ul>	<ul style="list-style-type: none"> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 4</li> </ul>
<b>Roadway Design Standards</b>	<ul style="list-style-type: none"> <li>- Design for appropriate road capacity to reduce crosswalk length and crosswalk conflicts and utilize proven safety countermeasures such as road reconfigurations (4-lane to 3-lane conversions) where appropriate</li> <li>- Provide standards supportive of traffic calming (e.g. reduce the minimum curb radius and/or lane width requirements)</li> <li>- Keep up and incorporate the latest safety design guidance from safety practices, such as the Blueprint for</li> </ul>	<ul style="list-style-type: none"> <li>- Citywide</li> </ul>	<ul style="list-style-type: none"> <li>- Pedestrian and Bicycle</li> </ul>	<ul style="list-style-type: none"> <li>- Tiers 1-4</li> </ul>

Safer Roads Improvement Strategies / Treatments	Details	Priority Application	Emphasis Area	Safe System Roadway Design Hierarchy Tier
	Urban Design (incorporated into ODOT's Highway Design Manual) <ul style="list-style-type: none"> <li>- Complete and utilize a bicycle and pedestrian toolkit</li> <li>- Complete and utilize a traffic calming toolkit</li> </ul>			
<b>Geometric Improvements</b>	Convert intersection from signal or stop-control to roundabout <ul style="list-style-type: none"> <li>- CMF: 0.18 (82% reduction in all crashes at all injury severities). Source: ARTS (H18 – Convert Minor Road Stop Controlled Intersection into Roundabout)</li> <li>- CMF: 0.22 (78% reduction in all crashes at all injury severities). Source: ARTS (H19 – Convert Signalized Intersection into Roundabout)</li> </ul>	<ul style="list-style-type: none"> <li>- Signalized or unsignalized intersections with history of fatal or suspected serious injury crashes or as part of a roundabout corridor</li> </ul>	<ul style="list-style-type: none"> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tiers 1-2</li> </ul>
	Construct curb extensions <ul style="list-style-type: none"> <li>- CMF: 0.70 (30% reduction in all crashes at all severities). Source: ARTS (I33 – Curb Extensions)</li> </ul>	<ul style="list-style-type: none"> <li>- Signalized or unsignalized intersections with high crash history</li> </ul>	<ul style="list-style-type: none"> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 2</li> </ul>
	<ul style="list-style-type: none"> <li>- Reduce intersection corner radii</li> </ul>	<ul style="list-style-type: none"> <li>- Signalized or unsignalized intersections in locations with high pedestrian or bicycle risk factor scores</li> </ul>	<ul style="list-style-type: none"> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 2</li> </ul>
<b>Intersection Control Changes (i.e., Two-Way Stop-Control to All-Way Stop-Control or Roundabout)</b>	Install All-Way Stop-Control <ul style="list-style-type: none"> <li>- CMF: 0.25 (75% reduction in angle crashes at all severities). Source: ARTS (H20-Covert urban 2-way or yield control to all-way stop-control)</li> </ul> See "Geometric Improvements" for CMFs related to roundabouts	<ul style="list-style-type: none"> <li>- Two-way stop-controlled intersections with a pattern of angle and turning crashes</li> </ul>	<ul style="list-style-type: none"> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tiers 1-3</li> </ul>
<b>Access Management Standards and Policies</b>	Access Management can reduce the number and severity of turning-related collision types, especially in the intersection influence areas and on high speed facilities. Update or modify driveway standards or policies to reflect importance on protecting safety of the traveling public in addition to serving business needs and improving operations of the adjacent roadways. The following access management techniques can reduce conflict points: <ul style="list-style-type: none"> <li>- Right-in/right-out</li> <li>- Driveway consolidation</li> <li>- Medians</li> </ul>	<ul style="list-style-type: none"> <li>- Citywide</li> </ul>	<ul style="list-style-type: none"> <li>- Pedestrian and Bicycle</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 1</li> </ul>

Safer Roads Improvement Strategies / Treatments	Details	Priority Application	Emphasis Area	Safe System Roadway Design Hierarchy Tier
	<ul style="list-style-type: none"> <li>- Increased spacing between access points and intersections</li> <li>- Driveway spacing, location and design guidelines</li> <li>- Update roadway standards for project development</li> </ul>			
<b>Policy Changes for Transportation and Land Use Priorities</b>	<ul style="list-style-type: none"> <li>- Include pedestrian and bicycle access and safety as a criterion when siting or redeveloping community services. Include proven pedestrian safety strategies in transportation system plans and roadway design standards</li> <li>- Strengthen safety requirements and analysis in the development review process</li> <li>- Develop and complete streets and neighborhood policies</li> <li>- Adopt "20 is Plenty" policy</li> </ul>	<ul style="list-style-type: none"> <li>- Citywide</li> </ul>	<ul style="list-style-type: none"> <li>- Pedestrian and Bicycle</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 1</li> </ul>

## Safer Speeds

Safer Speeds focuses on promoting safer speeds in all roadway environments through a combination of thoughtful, equitable, context-appropriate roadway design, appropriate speed-limit setting, targeted education, outreach campaigns, and enforcement. Table 3 describes Safer Speeds strategies.

**Table 3. Safer Speeds Strategies**

Safer Speeds Improvement Strategies / Treatments	Details	Priority Application	Emphasis Area	Safe System Roadway Design Hierarchy Tier
<b>Traffic Calming<sup>5</sup></b>	Conduct a road reconfiguration (road diet, lane width reductions) <ul style="list-style-type: none"> <li>CMF: 0.71 (29% reduction in all crashes at all severities). Source: ARTS (H53 – Convert 4-lane Roadway to 3-lane Roadway with Center Turn Lane (road diet))</li> </ul>	<ul style="list-style-type: none"> <li>Roadways with four or more lanes</li> <li>High Pedestrian and Bicycle Risk Factor Locations</li> </ul>	<ul style="list-style-type: none"> <li>Pedestrian and Bicycle</li> </ul>	<ul style="list-style-type: none"> <li>Tier 2</li> </ul>
	Install speed humps (cushions) <ul style="list-style-type: none"> <li>CMF: 0.50 (50% reduction in all crashes at all severities). Source: ARTS (H66 – Install Speed Humps or Table on Non-state Highways)</li> </ul>	<ul style="list-style-type: none"> <li>Neighborhood streets in High and Medium High Social Equity Index Zones</li> <li>High Pedestrian and Bicycle Risk Factor Locations</li> </ul>	<ul style="list-style-type: none"> <li>Pedestrian and Bicycle</li> </ul>	<ul style="list-style-type: none"> <li>Tier 2</li> </ul>
	Install speed feedback signs <ul style="list-style-type: none"> <li>CMF: 0.90 (10% reduction in all crashes at all severities). Source: ARTS (RD12 – Speed Feedback Signs)</li> </ul>	<ul style="list-style-type: none"> <li>High Pedestrian and Bicycle Risk Factor Locations</li> </ul>	<ul style="list-style-type: none"> <li>Pedestrian and Bicycle</li> </ul>	<ul style="list-style-type: none"> <li>Tier 2</li> </ul>
	Left-turn calming treatments <ul style="list-style-type: none"> <li>0.90 (10% reduction in left-turning crashes at all severities). Source: ARTS (I19 – Left-turn Traffic Calming Treatments for Posted Speeds Less Than 35 MPH)</li> </ul>	<ul style="list-style-type: none"> <li>High Pedestrian and Bicycle Risk Factor Locations</li> </ul>	<ul style="list-style-type: none"> <li>Pedestrian and Bicycle</li> <li>Intersections</li> </ul>	<ul style="list-style-type: none"> <li>Tier 2</li> </ul>
	Establish target speeds consistent with facility design, safety goals, context, users, and land use. Apply the Blueprint for Urban Design.	<ul style="list-style-type: none"> <li>Citywide</li> </ul>	<ul style="list-style-type: none"> <li>Aggressive and Impaired Driving</li> </ul>	<ul style="list-style-type: none"> <li>Tier 2</li> </ul>

<sup>5</sup> Additional traffic calming treatments that are identified in The Pedestrian and Bicycle Related Treatments section.

Safer Speeds Improvement Strategies / Treatments	Details	Priority Application	Emphasis Area	Safe System Roadway Design Hierarchy Tier
		<ul style="list-style-type: none"> <li>- In the Vicinity of Schools and Locations where Older Drivers are More Likely to be Present</li> </ul>		
	Other horizontal deflection features, which may include chicanes, diverters, pinch points, edge islands, and curb extensions.	<ul style="list-style-type: none"> <li>- Neighborhood streets in High and Medium High Social Equity Index Zones</li> <li>- High Pedestrian and Bicycle Risk Factor Locations</li> </ul>	<ul style="list-style-type: none"> <li>- Pedestrian and Bicycle</li> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 2</li> </ul>
<b>Focused Enforcement</b>	<ul style="list-style-type: none"> <li>- Continue identifying locations within the city for focused enforcement based on crash data and citizen complaints and assigning officers to work those locations on a rotating basis</li> <li>- Dedicate adequate police staff to safety coordination within the City</li> </ul> Targeted enforcement to impaired driving, speeding, following closely, and events	<ul style="list-style-type: none"> <li>- Locations with History of Speeding and Citizen Complaints</li> </ul>	<ul style="list-style-type: none"> <li>- Aggressive and Impaired Driving</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>
<b>Automated Enforcement</b>	Install red-light running and speeding cameras	<ul style="list-style-type: none"> <li>- Locations with History of Speeding and Citizen Complaints</li> </ul>	<ul style="list-style-type: none"> <li>- Aggressive and Impaired Driving</li> <li>- Intersections</li> </ul>	<ul style="list-style-type: none"> <li>- Tier 2</li> </ul>

## Safer People

Safer People encourages safe, responsible driving and behavior by people who use the roadway and creates conditions that prioritize people's ability to reach their destination unharmed. Table 4 describes Safer People strategies. These strategies were developed based on a review of the most recent City, County, and State TSAPs and national guidance on improving safety for vulnerable road users.

**Table 4. Safer People Strategies**

Safer People Improvement Strategies	Details	Priority Application	Emphasis Area	Safe System Roadway Design Hierarchy Tier
<b>Positive Culture Framework</b>	<ul style="list-style-type: none"> <li>- Positive Culture Framework (PCF) is an approach that improves health and safety in communities and organizations by building on shared values, beliefs and attitudes that already exist in a culture to promote health and safety</li> </ul>	<ul style="list-style-type: none"> <li>- Citywide</li> </ul>	<ul style="list-style-type: none"> <li>- Comprehensive</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>
<b>Education Programs, Media Outreach, and Campaigns</b>	<ul style="list-style-type: none"> <li>- Education programs about the dangers of speeding, following closely, and drunk driving,</li> <li>- Bicycle/pedestrian Safety</li> <li>- All Intersections are crosswalks</li> <li>- Designated driving programs</li> <li>- Diversion education programs (evidence-based)</li> <li>- Provide education on benefits of transit, bicycle, and pedestrian modes. Encourage multi-modal transportation to reduce overall demand for vehicle travel. Encouraging mode shifts will increase awareness of the needs of non-auto modes and reduce the number of drivers on the road</li> <li>- Continue the educational program Safety Town, to teach young children different safety concepts including bike, pedestrian, and motor vehicle safety</li> <li>- Continue providing informational brochures concerning rules of the road that highlight some of the most common traffic errors that result in serious injuries or fatalities at public events</li> <li>- Continue providing rules of the road messages through social media</li> <li>- Continue the joint project underway with traffic division and municipal court to provide discounted auto repair for those with faulty vehicle equipment and to restart the Fix-It Ticket Program, where drivers receive a ticket and an educational</li> </ul>	<ul style="list-style-type: none"> <li>- Citywide</li> </ul>	<ul style="list-style-type: none"> <li>- Comprehensive</li> <li>- Pedestrian and Bicycle</li> <li>- Aggressive and Impaired Driving</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>



Safer People Improvement Strategies	Details	Priority Application	Emphasis Area	Safe System Roadway Design Hierarchy Tier
	brochure and then are given the opportunity to take a safety related class to have the ticket fee reduced			
<b>Community Outreach and Engagement</b>	<ul style="list-style-type: none"> <li>- Neighborhood watch for traffic violations</li> <li>- System to track community feedback</li> <li>- Community incentive programs</li> <li>- Social media outreach</li> <li>- Neighborhood Traffic Safety Program. This program is designed to protect the environment and quality of life in neighborhoods through the management and control of traffic on neighborhood streets.<sup>6</sup></li> <li>- Promote safety culture within agencies, organizations, and employers</li> </ul>	<ul style="list-style-type: none"> <li>- Citywide</li> <li>- High and Medium High Social Equity Index Zones</li> </ul>	<ul style="list-style-type: none"> <li>- Comprehensive</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>
<b>Aging Road-User Training</b>	<ul style="list-style-type: none"> <li>- Offer older driver education programs designed to increase awareness of age-related risk, highlight specific driving conditions and situations that are most hazardous to older drivers, and encourage strategies for coping with or avoiding these risky driving conditions</li> <li>- These can include perceptual trainings, eye scanning training, and physical mobility training<sup>7</sup></li> </ul>	<ul style="list-style-type: none"> <li>- Citywide</li> <li>- Census Blocks with High Populations of People Over the Age of 65</li> </ul>	<ul style="list-style-type: none"> <li>- Older Drivers</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>
<b>Safe Routes to Schools (SRTS) Program</b>	<ul style="list-style-type: none"> <li>- Continue expanding the SRTS program</li> </ul>	<ul style="list-style-type: none"> <li>- High Pedestrian and Bicycle Risk Factor Segments</li> <li>- High and Medium High Social Equity Index Zones</li> </ul>	<ul style="list-style-type: none"> <li>- Pedestrian and Bicycle</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>
<b>Additional Staff or Training to Support Safety Focus at Agencies</b>	<ul style="list-style-type: none"> <li>- Target increased funding for a position that is solely focused on transportation safety planning and engineering</li> <li>- Increase training opportunities for officers and crash reconstructionists on causal issues regarding pedestrian safety and pedestrian/motor vehicle crashes</li> <li>- Provide the opportunity for law enforcement to take the Pedestrian Safety Training for Law Enforcement online</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>	<ul style="list-style-type: none"> <li>- Comprehensive</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>

<sup>6</sup> Reference Example: Lee's Summit, Missouri. "Public Works." n.d. Neighborhood Traffic Safety Program. <http://cityofls.net/Public-Works/Traffic-Transit/Neighborhood-Traffic-Safety-Program>. June 2016. 44 City of Vancouver, WA. "Streets, Signals & Lights." Neighborhood Traffic Safety Alliance.

<sup>7</sup> Source: Improving the Safety of Aging Road Users – A Mini-Review. National Library of Medicine. 2014

Safer People Improvement Strategies	Details	Priority Application	Emphasis Area	Safe System Roadway Design Hierarchy Tier
	training free through the National Highway Traffic Safety Administration (NHTSA) <ul style="list-style-type: none"> <li>- Conduct education and outreach to law enforcement to increase understanding and enforcement of traffic, commercial vehicle, pedestrian, and bicycle laws</li> <li>- Provide equity trainings to law enforcement enforcing traffic laws</li> </ul>			
<b>Safety Legislation and Regulations</b>	<ul style="list-style-type: none"> <li>- Lobby to strengthen safety legislation and regulations at the State and Federal level</li> <li>- Include pedestrian and bicycle access and safety as a criterion when siting or redeveloping community services</li> <li>- Include proven pedestrian safety strategies in transportation system plans and roadway design standards</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>	<ul style="list-style-type: none"> <li>- Comprehensive</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>
<b>Compliance</b>	Install enforcement assistant lights <ul style="list-style-type: none"> <li>- CMF: 0.96 (6% reduction in all crashes at all severities). Source: CMF Clearinghouse (CMF ID: 8819 – Install Red-Light Indicator Lights)</li> </ul>	<ul style="list-style-type: none"> <li>- Citywide</li> </ul>	<ul style="list-style-type: none"> <li>- Signalized intersections with history of crashes being caused by drivers disregarding traffic signals</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>
	Install red light cameras <ul style="list-style-type: none"> <li>- CMF: 0.68 (32% reduction in all crashes at all injury severities). Source: CMF Clearinghouse (CMF ID: 6877)</li> </ul>	<ul style="list-style-type: none"> <li>- Citywide</li> </ul>	<ul style="list-style-type: none"> <li>- Signalized intersections with history of crashes being caused by drivers disregarding traffic signals</li> <li>- Intersections with high traffic volumes</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>

## Safer Vehicles

Safer Vehicles expands the availability of vehicle systems and features that help to prevent crashes and minimize the impact of crashes on both occupants and non-occupants. Table 5 describes Safer Vehicle strategies.

**Table 5. Safer Vehicles Strategies**

Safer Vehicle Improvement Strategies	Details	Emphasis Area	Safe System Roadway Design Hierarchy Tier
<b>Stricter Vehicle Regulations</b>	<ul style="list-style-type: none"> <li>Advocate for stronger national regulations.</li> </ul>	<ul style="list-style-type: none"> <li>Comprehensive</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>
<b>Update Vehicle Fleet</b>	<ul style="list-style-type: none"> <li>Explore emerging technology for the City's vehicle fleets.</li> </ul>	<ul style="list-style-type: none"> <li>Comprehensive</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>

## Post-Crash Care

Post-Crash Care enhances the survivability of crashes through expedient access to emergency medical care, while creating a safe working environment for vital first responders and preventing secondary crashes through robust traffic incident management practices. Table 6 describes Post-Crash Care strategies.

**Table 6. Post-Crash Care Strategies**

Post-Crash Care Improvement Strategies	Details	Emphasis Area	Safe System Roadway Design Hierarchy Tier
<b>Enhanced Emergency Vehicle Preemption</b>	<ul style="list-style-type: none"> <li>Provide signal preemption to allow faster response times to reduce the likelihood of fatal crashes</li> </ul>	<ul style="list-style-type: none"> <li>Comprehensive</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>
<b>Enhanced EMS Systems</b>	<ul style="list-style-type: none"> <li>Better location system for 911</li> <li>System to provide recommended routes based on traffic</li> <li>Field triage scheme development</li> <li>Telemedicine applications</li> </ul>	<ul style="list-style-type: none"> <li>Comprehensive</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>
<b>Traffic Incident Management</b>	<ul style="list-style-type: none"> <li>Implement traffic incident management best practices on traffic investigations to reduce traffic delays and secondary crashes</li> </ul>	<ul style="list-style-type: none"> <li>Comprehensive</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>

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## Site-Specific Infrastructure Improvement Countermeasures

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The Project team screened intersections based on crash frequency and severity and the equity factors described in the Existing Conditions Analysis Summary. Based on this analysis, the following intersections under the City's jurisdiction were prioritized for improvements:

- SE Johnson St / SE Century Blvd
- NE John Olsen Ave / NE Wilkins St
- E Main St / NE 5<sup>th</sup> Ave
- NE John Olsen Ave / NE Walker Rd
- SE 9<sup>th</sup> Ave / SE Walnut St
- E Main St / SE 24<sup>th</sup> Ave

The Project team conducted a site diagnosis, including preliminary desktop review for the top six<sup>8</sup> sites from the network screening, to determine context sensitive countermeasures for each site. For each location the site diagnosis includes a review of the following elements:

1. Crash and volume data trends;
2. Pending or recently completed projects;
3. Safety View by INRIX and GM Future Roads behavioral information<sup>9</sup>;
4. Field conditions using aerial imagery; and
5. Community concerns.

Further details on each of these locations are documented below.

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<sup>8</sup> Initially the top five sites were selected, however the list was expanded to six because the City is actively making changes to the intersection of NE John Olsen Ave / NE Wilkins St.

<sup>9</sup> INRIX Safety View provides behavioral information gathered from General Motors (GM) vehicles and Bluetooth data for the following:

- Forward Collision Alert
- Pedestrian Collision Mitigation Alert
- Automatic Pedestrian Breaking
- Automatic Emergency Breaking
- Hard Breaking
- Hard Acceleration
- Hard Cornering
- Speeding
- Vehicle Body Type
- Seatbelt Wearing

Data from Q2 (April 1 – June 30) 2023 were reviewed at each site.

## SE Johnson St / SE Century Blvd

Figure 7 summarizes the intersection characteristics, surrounding context, and planned projects within the vicinity of the SE Johnson St / SE Century Blvd intersection. The intersection is located in a medium-high disparity social equity index zone and has several pedestrian generators, including Fred Meyer, Foodlandia food carts, transit stops, Rosewood Park Memory Care, Rosewood Park Assisted Living, and Century High School.

### Site Diagnosis

This section documents the crash history, planned, pending, or recently completed projects, behavioral data, field conditions, and community concerns.

#### Crash History

Figure 8 presents the crash diagram for the SE Johnson St / SE Century Blvd intersection based on the five most recent years of reported crashes. There were 8 reported crashes at this intersection between January 1, 2017 to December 31, 2021.

In reviewing the reported crashes at the SE Johnson St / SE Century Blvd intersection, the following trends were identified by the Project team:

- Four of the eight reported crashes, including the fatal crash involving a pedestrian, occurred under "darkness" conditions.<sup>10</sup>
- No crashes were reported as involving impaired driving.
- All crashes were reported as being due to failure to yield the right of way or stopping past the stop sign.
- Three crashes were angle crashes involving someone travelling eastbound colliding with someone traveling southbound.
- There was a fatal crash where a driver making a southbound left hit a pedestrian crossing the street.

Appendix A includes the full list of reported crashes.

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<sup>10</sup> Light fixtures appear to have been added when ADA ramps were upgrade as part of the project widening the south leg.



Social Equity Index Zone: Medium High Disparity

SE Johnson St / SE Century Blvd  
Hillsboro, Oregon

Figure  
7



H:\21464 - City of Hillsboro - Hillsboro TSAP Update\design\CD\21464-Crash-Diagrams-11182023.dwg Feb 13, 2024 - 9:18am - agf/rlh Layout Tab 1

SE Johnson St / SE Century Blvd Crash Diagram  
Hillsboro, OR

Figure  
8

### Pending or Recently Completed Projects

Hillsboro Transportation System Plan (TSP) Project 13-011 to widen the south leg of Century Blvd to five lanes between Alexander St and Johnston St was completed in early 2022.

### Safety View by INRIX and GM Future Roads

Safety View included behavioral data from Q2 2023. Overall, this intersection has a **medium** risk score. The speed risk score is **high** along the north and east legs of the intersection and the seatbelt risk score is **high** along the north leg of the intersection. Safety View figures for each intersection are provided in Appendix B.

### Virtual Site Visit

Three of the eight crashes that occurred between January 1, 2017 to December 31, 2021 were angle crashes involving someone travelling eastbound colliding with someone traveling southbound. Improved visibility may help reduce the risk of these crashes occurring. Figure 9 illustrates the vegetation that may be limiting visibility from the west leg of the intersection; sight distance should be reviewed in the field.

**Figure 9. Vegetation at the Northwest Corner of the Intersection**



Source: Google

### Community Concerns

Transportation safety concerns expressed by community members and submitted to City staff relevant to the SE Johnson St / SE Century Boulevard Intersection are summarized in Table 7. A total of two comments have been received. Both comments related to adding an enhanced crossing to the intersection location.

**Table 7: Community Concerns: SE Johnson St / SE Century Blvd**

ID	Type	Comment	City Response
1	Crosswalk	Request for lighted crosswalk at SE Johnson St / SE Century Blvd near the Rosewood Park retirement community	Investigating
2	Crosswalk	Request for flashing crosswalk / RRFB at SE Johnson St / SE Century Blvd near the Rosewood Park retirement community	Investigating



## Recommended Projects/Countermeasures

Figure 10 summarizes the proposed recommendations to address the site diagnosis. The TSP includes a project to install a traffic signal once the intersection meets warrants. In the interim the City could implement the following projects<sup>11</sup>:

- Install a pedestrian hybrid beacon (PHB) or rectangular rapid flashing beacon (RRFB)<sup>12</sup> across the northern or southern leg of the intersection to facilitate pedestrian and bicyclist crossings. This would also address the transportation safety concerns expressed by community members (identified in Table 7).
- Implement channelization at the intersection to restrict vehicle movements by precluding vehicles from turning left or traveling straight through from SE Johnson St or the Foodlandia driveway.
- Conduct sight distance checks evaluating visibility to and from the west leg of the intersection.

Table 8 documents the crash modification factors (CMFs) for each recommended project.

**Table 8. Crash Modification Factors for Recommended Projects**

Countermeasure	Crash Modification Factor	Source
Install Traffic Signal	0.33 (67% reduction in angle crashes at all severities) 2.43 (143% increase in rear-end crashes at all severities)	ARTS (H22/H23- Install traffic signal at urban intersection)
Install Crosswalk Visibility Enhancements	0.60 (40% reduction in pedestrian crashes at all injury severities <sup>13</sup> ) Note: This Crash Modification Factor applies when the countermeasure is implemented at uncontrolled intersections.	FHWA's Proven Safety Countermeasures (Crosswalk Visibility Enhancements – High-Visibility Crosswalks)
Implement Intersection Channelization	Not available, but eliminates movements involved in five of eight crashes	
Install Pedestrian Hybrid Beacon	0.90 (10% reduction in pedestrian crashes at all severities)	ARTS (BP12-Install pedestrian activated beacon at intersection)
Install Rectangular Rapid Flashing Beacon	0.90 (10% reduction in pedestrian and bicycle crashes at all severities)	ARTS (BP10-Install Rectangular Rapid Flashing Beacon on 3-lane or More Roadway without Median)
Provide Adequate Sight Distance	0.52 (48% reduction in all crashes at all severities)	ARTS I17 – Increase Triangle Sight Distance)

### Cost Estimates

The estimated cost for installing a traffic signal and implementing crosswalk visibility enhancements is \$530,000<sup>14</sup>. Appendix E provides more details on the cost estimates. The cost of providing adequate sight distance is assumed to be negligible.

Intersection channelization and a PHB or RRFB would no longer be applicable once a traffic signal is installed, therefore a cost estimate was not developed for these interim projects.

<sup>11</sup> Intersection channelization and the PHB/RRFB would no longer be applicable once a traffic signal is installed.

<sup>12</sup> Selection of a PHB or RRFB pending analysis of Manual of Uniform Traffic Control Devices (MUTCD) PHB warrants.

<sup>13</sup> CMFs indicating all injury severities exclude crashes that are property-damage only.

<sup>14</sup> Project costs that need to be considered for grant funding: design, mobilization, traffic control, stormwater improvements, construction administration, and other contingencies.



SE Johnson St / SE Century Blvd Proposed Recommendations Hillsboro, OR

Figure 10

## NE John Olsen Ave / NE Wilkins St

Figure 11 summarizes the intersection characteristics, surrounding context, and planned projects within the vicinity of the NE John Olsen Ave / NE Wilkins St intersection. The intersection is located in a medium-high disparity social equity index zone in a residential area.

### Site Diagnosis

This section documents the crash history, site history, behavioral data, field conditions, and community concerns.

#### Crash History

Figure 12 presents the crash diagram for the NE John Olsen Ave / NE Wilkins St intersection based on the five most recent years of reported crashes. There were 29 reported crashes at this intersection between January 1, 2017 to December 31, 2021.

In reviewing the reported crashes at the NE John Olsen Ave / NE Wilkins St intersection, the following trends were identified by the Project team.

- Ten crashes occurred under darkness conditions.
- Two crashes were reported as involving impaired driving.
- Eight crashes occurred where an eastbound driver collided with a westbound driver turning left onto NE John Olsen Ave.
- Nine crashes occurred where a westbound driver collided with an eastbound driver turning right onto NE John Olsen Ave.
- There were no reported pedestrian or bicycle crashes.

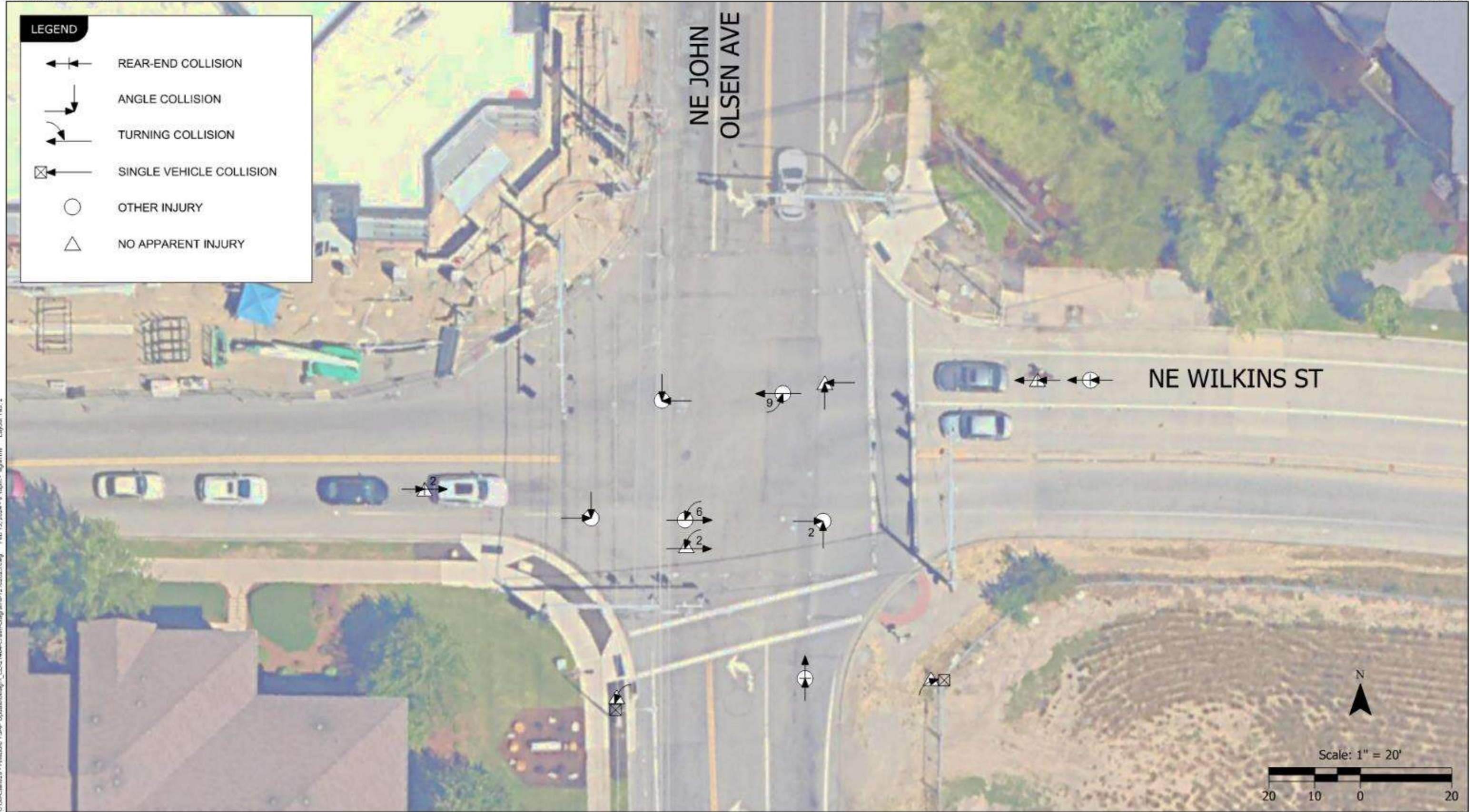
Appendix A includes the full list of reported crashes.



Social Equity Index Zone: Medium High Disparity

NE John Olsen Ave / NE Wilkins St  
Hillsboro, Oregon

Figure  
11



NE John Olsen Ave / NE Wilkins St Crash Diagram Hillsboro, OR

Figure 12

#### Pending or Recently Completed Projects

Apartments were constructed at the northwest corner of this intersection in 2022; this development included adding an eastbound left turn lane. The City is updating the signal with a flashing-yellow arrow signal head. Pedestrian call restrictions will be implemented at this intersection and time-of-day restrictions may be added if determined necessary by the City.

#### Safety View by INRIX and GM Future Roads

Safety View included behavioral data from Q2 2023. Overall, this intersection has a **medium** risk score. The speed risk score is **high** along the south leg of the intersection. Safety View figures for each intersection are provided in Appendix B.

#### Virtual Site Visit

The City reported that there is limited visibility for the eastbound left turn during the flashing yellow arrow phase when there are vehicles waiting in the westbound left turn lane due to the curvature on the east side of the intersection.

#### Community Concerns

Transportation safety concerns expressed by community members and submitted to City staff relevant to the NE John Olsen Ave / NE Wilkins St Intersection are summarized in Table 9. A total of six comments have been received.

DRAFT

**Table 9: Community Concerns: NE John Olson Ave / NE Wilkins St**

ID	Type	Comment	City Response
1	Signal Phasing	Request to change signal heads from 5 section to 3 section at NE John Olson Ave / NE Wilkins St	Current signal head functions as programmed. The signal head at John Olson/Wilkins will be upgraded with new development.
2	Sidewalks	Request for sidewalks on along the east side of NE John Olson Ave south of NE Wilkins St	Provided information on the current Bicycle & Pedestrian Capital Improvement Program (BPCIP) project.
3	Turn Lane	Request for a turn lane on Wilkins eastbound turning onto NE John Olson Ave	A turn lane is being planned as part of a private development. <sup>15</sup>
4	Signage	Request to reinstall missing intersection warning sign on NE John Olson Ave prior to Arbor Crossing	Signs have been installed
5	Traffic Signal	Concerned with the signal phasing at the intersection of NE John Olson Ave / NE Wilkins St	Investigating
6	Traffic Signal	Concerned with the signal phasing at the intersection of NE John Olson Ave / NE Wilkins St	Staff found a few faulty inputs that were causing the signal to have issues. Operations has corrected the issue.

### Recommended Projects/Countermeasures

Figure 13 summarizes the proposed recommendations to address the site diagnosis by constructing a left-turn lane on the west leg of the intersection and updating the signal. Adding the left-turn lane would improve visibility and provide opportunity operate the leg on split phasing to reduce conflicts.

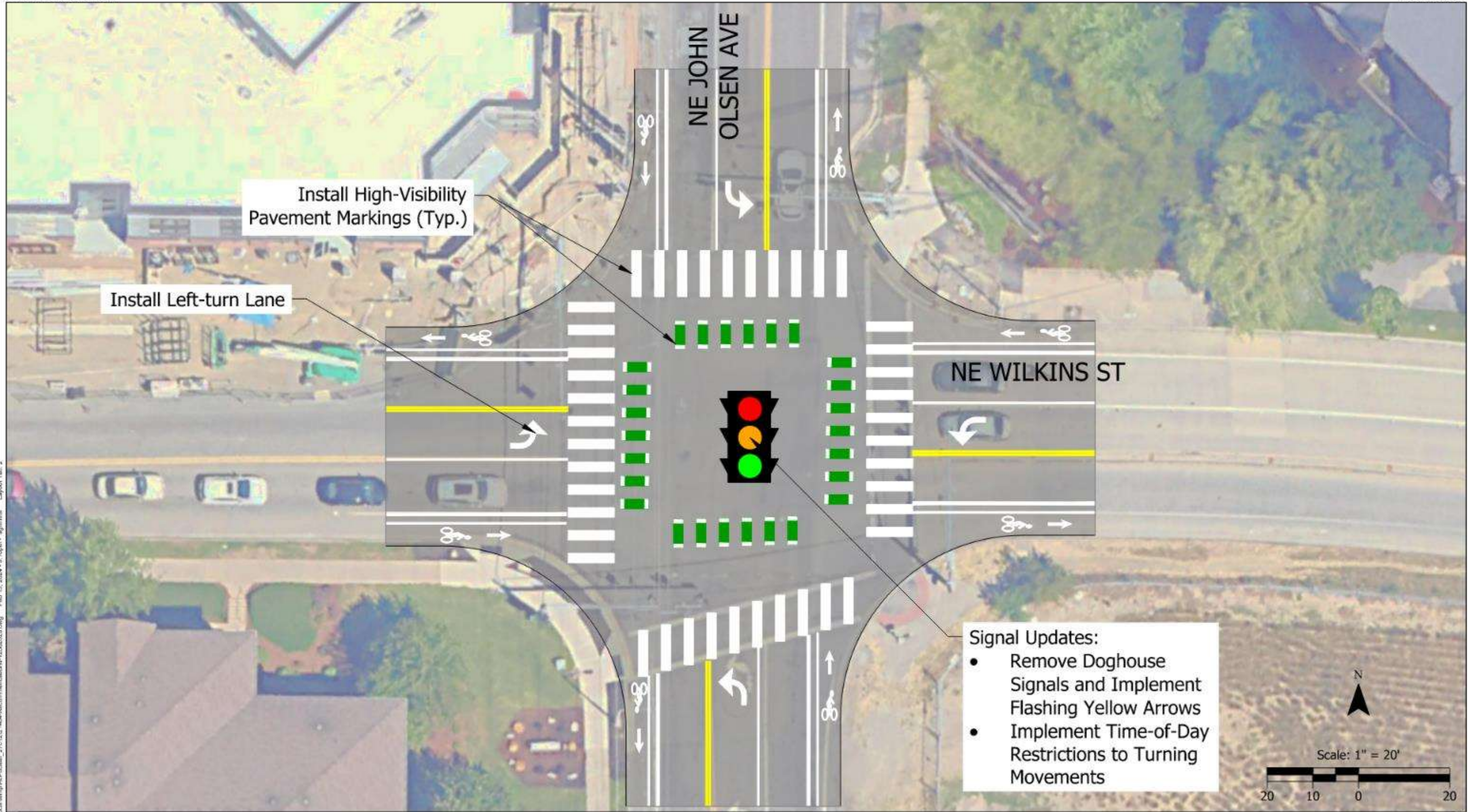
Implementing time-of-day restrictions for the flashing yellow arrows could restrict turning movements during peak hours or at nighttime to protected-only to reduce opportunities for conflicts. The flashing yellow arrows can be restricted when there are pedestrian calls at the signals to prevent the conflict point.

Table 10 documents the CMFs for each recommended project. Installing high-visibility pavement markings at signalized intersections and implementing time-of-day restrictions do not have available CMFs. The City is in the process of implementing some of these projects and can consider implementing the other projects in the future.

**Table 10. Crash Modification Factors for Recommended Projects**

Countermeasure	Crash Modification Factor	Source
Install High-Visibility Pavement Markings	Not available for signalized intersections	
Install Left-turn Lane	0.90 (10% reduction in all crashes at all severities)	ARTS (H12 – Left-turn Lane on Single Major Road Approach at Urban 4-leg Signalized Intersection)
Replace Doghouse with Flashing Yellow Arrow Signal Heads	0.75 (25% reduction in left-turning crashes at all severities)	ARTS (I8 – Replace doghouse with flashing yellow arrow signal heads)
Implement Time-of-Day Restrictions	Not available, however eliminating permitted phasing during the PM peak period (4 PM – 7 PM) reduces potential for the conflict involved in nine out of 17 turning movement crashes.	

<sup>15</sup> Construction of this turn lane is complete.



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NE John Olsen Ave / NE Wilkins St Proposed Recommendations Hillsboro, OR

Figure 13



## E Main St / NE 5<sup>th</sup> Ave

Figure 14 summarizes the intersection characteristics and surrounding context of the E Main St / NE 5<sup>th</sup> Ave intersection. The intersection is located in a medium-high disparity social equity index zone in downtown Hillsboro.

### Site Diagnosis

This section documents the crash history, site history, behavioral data, field conditions, and community concerns.

#### Crash History

As shown in Figure 15 presents the crash diagram for the E Main St / NE 5<sup>th</sup> Ave intersection based on the five most recent years of reported crashes. There were 19 reported crashes at this intersection between January 1, 2017 to December 31, 2021.

In reviewing the reported crashes at the E Main St / NE 5<sup>th</sup> Ave intersection, the following trends were identified by the Project team:

- Thirteen of the 19 crashes occurred during clear, daylight conditions.
- No crashes were reported as involving impaired driving.
- Eleven of the 19 crashes were reported as being caused by drivers making improper turns.
- Thirteen of the 19 crashes involved a driver making an eastbound left turn colliding with a driver making an eastbound through movement.
- The Safety View data shows a high speed risk score along Main St, which may be contributing to the crash severities at this site.
- There were no reported pedestrian or bicycle crashes.

Appendix A includes the full list of crashes.








Social Equity Index Zone: Medium High Disparity

E Main St / NE 5th Ave  
Hillsboro, Oregon

Figure 14

**LEGEND**

-  ANGLE COLLISION
-  TURNING COLLISION
-  FATAL/SUSPECTED SERIOUS INJURY
-  OTHER INJURY
-  NO APPARENT INJURY



E Main St / NE 5th Ave Crash Diagram  
Hillsboro, OR

Figure  
15

### Pending or Recently Completed Projects

There were no construction projects or traffic modification projects at this intersection between January 1, 2017 – present (the period overlapping with the crash history or Safety View behavioral data through present day).

TSP Project 04-001: Downtown Core Conversion is unlikely to be realized in the near-term and is not assumed as part of the Recommended Projects/Countermeasures for the site.

### Safety View by INRIX and GM Future Roads

Safety View included behavioral data from Q2 2023. Overall, this intersection has a **medium** risk score. The speed risk score is **high** along the east and west legs of the intersection. Safety View figures for each intersection are provided in Appendix B.

### Community Concerns

Transportation safety concerns expressed by community members and submitted to City staff relevant to the E Main St / NE 5<sup>th</sup> Ave Intersection are summarized in Table 11. A total of four comments have been received.

**Table 11: Community Concerns: E Main St / NE 5<sup>th</sup> Ave**

ID	Type	Comment	City Response
1	Loading bay	Request for a loading bay at 512 E Main Street.	The request is not warranted. The requestor has been informed to make use of the loading bay on 5 <sup>th</sup> Ave.
2	Speed Feedback Sign Request	Request for speed feedback sign on E Main St between 6 <sup>th</sup> Ave and 5 <sup>th</sup> Ave to address speeding issue.	Speeds are high for road. Signs cannot be placed on that section of road. Information forwarded to police department (PD).
3	General	Mention that the intersection had a near miss, wide/long crossing, and not enough ped/bike separation from the roadway.	Pending
4	Construction	Concern with the lack of a clear pedestrian detour to the north of the intersection; people are crossing in the middle of the roadway.	Pending

### Recommended Projects/Countermeasures

Figure 16 summarizes the proposed recommendations to address the site diagnosis. E Main St transitions from two-way east of NE 6<sup>th</sup> St to one-way west of NE 6<sup>th</sup> St. This transition may lead to driver confusion about what lane a westbound left-turn can be executed from.

Adding turn arrows and advanced signage indicating the appropriate movements and installing a median on the east leg to prevent drivers turning left from the northern lane may reduce the frequency of these crashes. Additionally, converting the intersection to an all-way stop-control and installing curb extensions can provide traffic calming.

Table 12 documents the CMFs for each recommended project. In the long-term, it is likely that the planned two-way conversion identified in the TSP would change travel patterns and conflict points, resulting in different crash patterns.

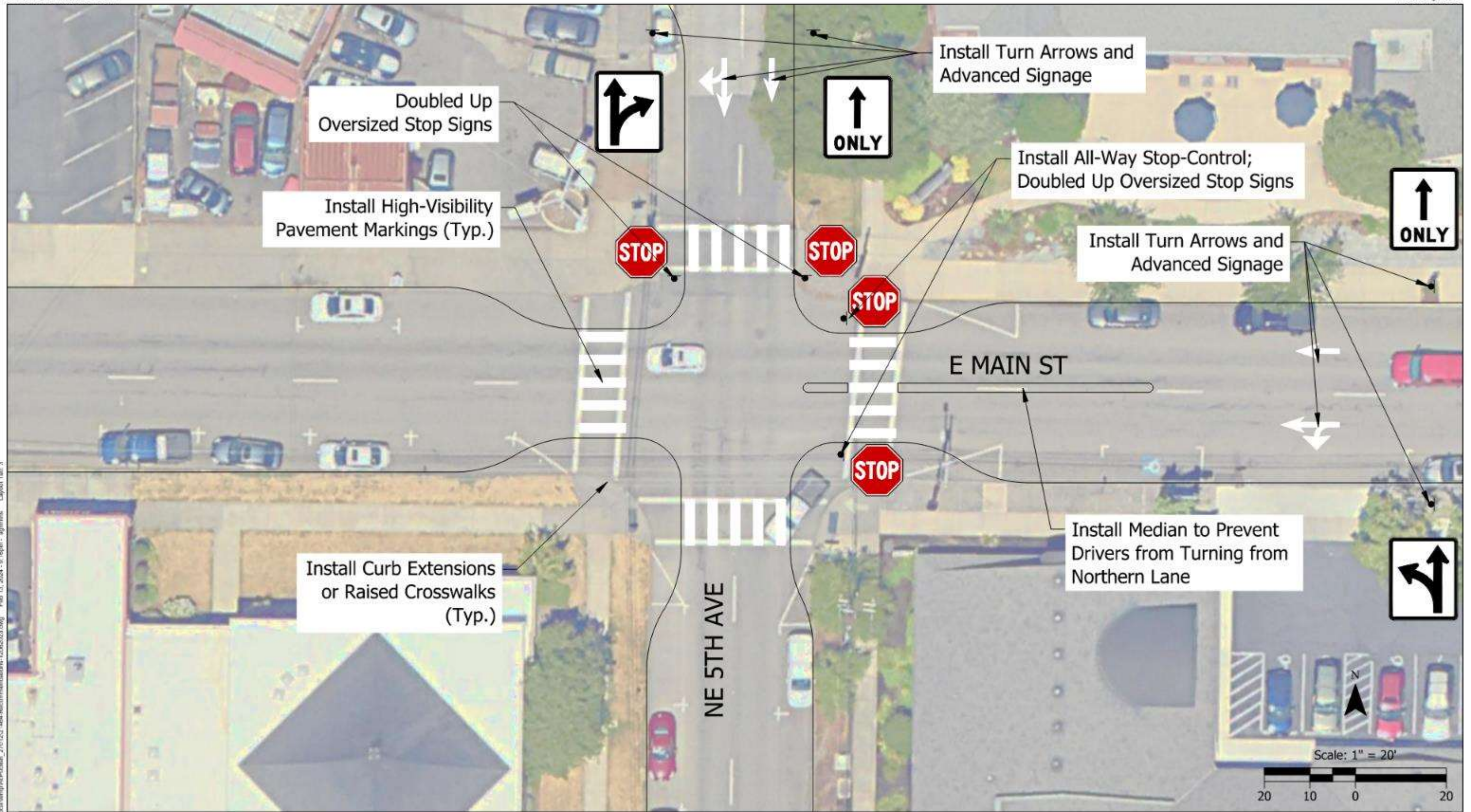
**Table 12. Crash Modification Factors for Recommended Projects**

Countermeasure	Crash Modification Factor	Source
Install All-Way Stop-Control	0.25 (75% reduction in angle crashes at all severities)	ARTS (H20-Covert urban 2-way or yield control to all-way stop-control)
Improve Intersection Warning	0.80 (20% reduction in all crashes at all severities)	ARTS (I21-Improve intersection warning, 1-2 countermeasures)
Install Curb Ramps and Extensions with a Marked Crosswalk	0.63 (37% reduction in all pedestrian crashes at all severities)	ARTS (BP16-Install curb ramps and extensions with a marked crosswalk and pedestrian warning signs)
Install Crosswalk Visibility Enhancements	0.60 (40% reduction in pedestrian crashes at all injury severities) Note: This Crash Modification Factor applies when the countermeasure is implemented at uncontrolled intersections, the crash reduction factor would likely be lower for all-way stop-controlled intersections.	FHWA (Crosswalk Visibility Enhancements – High-Visibility Crosswalks)
Install Median	Not available, but would reduce the potential for the conflict involved in 13 of 18 crashes.	

**Cost Estimates**

The estimated cost for installing the projects in Table 12 is \$120,000<sup>16</sup>. Appendix E provides more details on the cost estimates.

<sup>16</sup> Project costs that need to be considered for grant funding: design, mobilization, traffic control, stormwater improvements, construction administration, and other contingencies.



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E Main St / NE 5th Ave Proposed Recommendations  
Hillsboro, OR

Figure  
16

## NE John Olsen Ave / NE Walker Rd

Figure 17 summarizes the intersection characteristics and surrounding context of the NE John Olsen Ave / NE Walker Rd Ave intersection. The intersection is located in a medium high disparity social equity index zone surrounded by apartments, schools, and offices.

### Site Diagnosis

This section documents the crash history, site history, behavioral data, field conditions, and community concerns.

#### Crash History

Figure 18 presents the crash diagram for the NE John Olsen Ave / NE Walker Rd intersection based on the five most recent years of reported crashes. There were 13 reported crashes at this intersection between January 1, 2017 to December 31, 2021.

In reviewing the reported crashes at the NE John Olsen Ave / NE Walker Rd intersection, the following trends were identified by the Project team:

- Seven of the 13 reported crashes occurred during clear, daylight conditions.
- No crashes were reported as involving impaired driving.
- Ten of the 13 crashes were reported to be caused by drivers disregarding the traffic signal.
- Eight of the 13 reported crashes that occurred involved a driver traveling eastbound colliding with a driver traveling northbound.
- There were two reported pedestrian and bicycle crashes. Both crashes resulted in suspected moderate injuries.

Appendix A includes the full list of reported crashes.



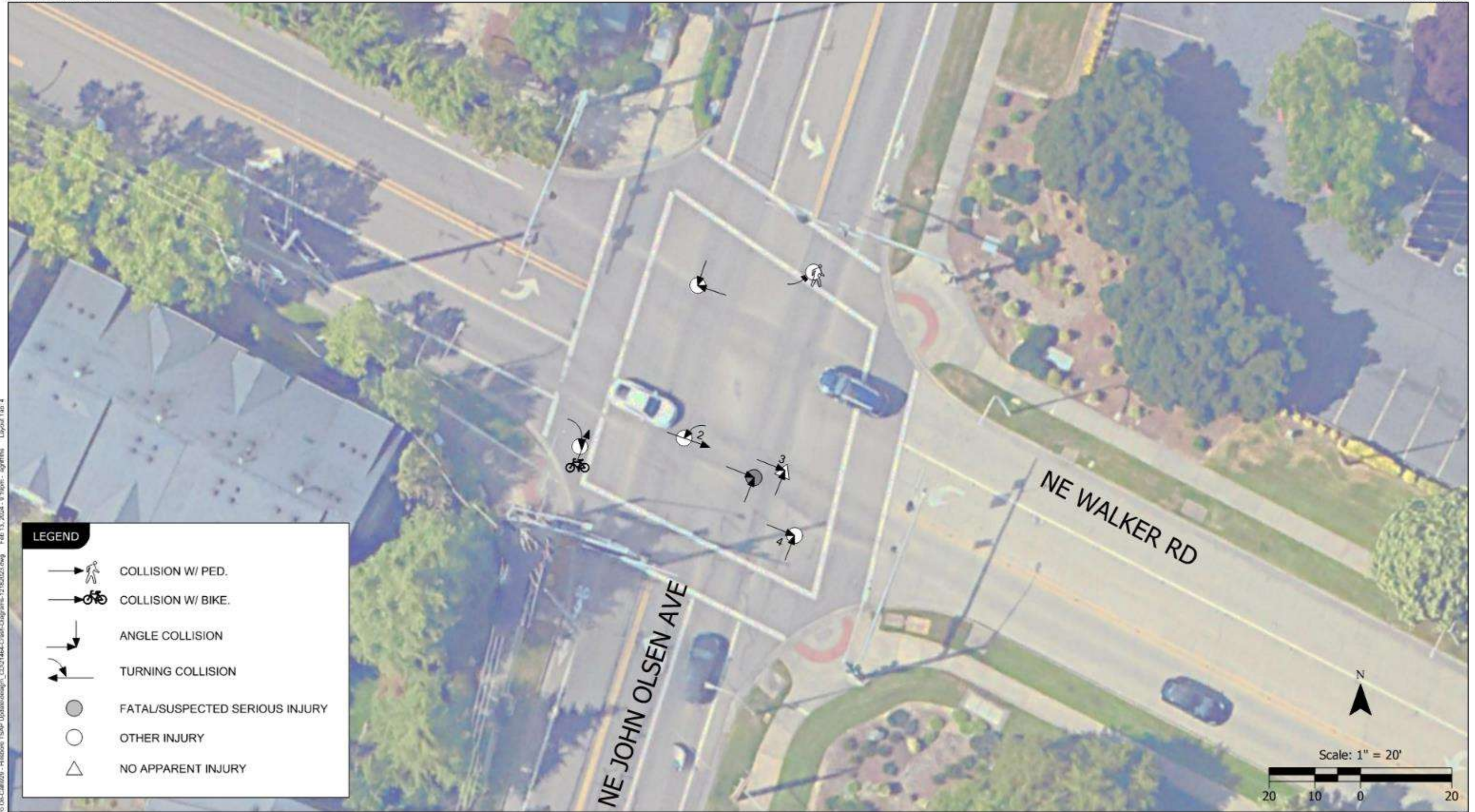
Google Earth

Social Equity Index Zone: Medium High Disparity

E John Olsen Ave / NE Walker Rd  
Hillsboro, Oregon

Figure  
17





NE John Olsen Ave / NE Walker Rd Crash Diagram  
Hillsboro, OR

Figure  
18

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### Pending or Recently Completed Projects

TSP Project 213 to construct an eastbound left-turn lane was completed in 2023.

Note: The City is considering replacing all four doghouse style signal heads with flashing yellow arrows, reducing conflict with left turning vehicles and pedestrian phase. Leading pedestrian intervals have also been discussed as an option if replacing the signal heads is not feasible due to hardware limitations, funds, etc.

### Safety View by INRIX and GM Future Roads

Safety View included behavioral data from Q2 2023. Overall, this intersection has a **medium** risk score. The speed risk score is **high** along all legs of the intersection. Safety View figures for each intersection are provided in Appendix B.

### Virtual Site Visit

Eight of the 13 reported crashes that occurred between January 1, 2017 to December 31, 2021 were angle crashes involving a driver traveling eastbound colliding with a driver traveling northbound. Improved visibility may help reduce the risk of these crashes occurring. Figure 19 illustrates the vegetation that may be limiting visibility between the south and west legs of the intersection; sight distance should be reviewed in the field.

**Figure 19. Vegetation at the Southwest Corner of the Intersection**



Source: Google

### Community Concerns

Transportation safety concerns expressed by community members and submitted to City staff relevant to the NE John Olsen Ave / NE Walker Rd Intersection are summarized in Table 13. A total of two comments have been received.

**Table 13: Community Concerns: NE John Olsen Ave / NE Walker Rd**

ID	Type	Comment	City Response
1	Signal Phasing	Request to change signal heads from 5 section to 3 section at NE John Olsen Ave / NE Walker Rd.	The current signal head functions as programmed. Signal head at NE John Olsen Ave / NE Walker Rd is not planned for upgrade.
2	Truck Traffic	Cal Portland trucks leaving plant use the NE John Olsen Ave / NE	Contacted PD to determine if trucks on a non-truck route was enforceable. PD responded with saying this issue is not enforceable because ORS 811.450 allows trucks to travel on non-truck routes to get to a destination. Contact Cal Portland and they were unable to provide

ID	Type	Comment	City Response
		Walker Rd intersection to access Cornell Rd.	exact truck routing information. Their representative said that routing was dependent on destination. They could not assure the City that a specific route could/would be taken by drivers. Trucks are not in violation.

### Recommended Projects/Countermeasures

Figure 20 summarizes the proposed recommendations to address the site diagnosis.

- Increase enforcement of red-light running. Consider implementing red-light running cameras.
- Replacing the doghouse signal with flashing yellow arrow signal heads. The flashing yellow arrow signal head can be restricted when there are pedestrian calls at the signals to prevent the conflict point.
- Time-of-day restrictions can be implemented to reduce opportunities for conflict during peak hours or at nighttime.
- This is the first signal in over half a mile traveling eastbound. Install high-visibility back plates and advanced signage indicating a signal is ahead.

In the long term, a roundabout could be considered at this location to reduce crashes and provide additional traffic calming.

Table 14 documents the CMFs for each recommended project. Conducting visibility checks and implementing time-of-day restrictions on turning movements do not have available CMFs.

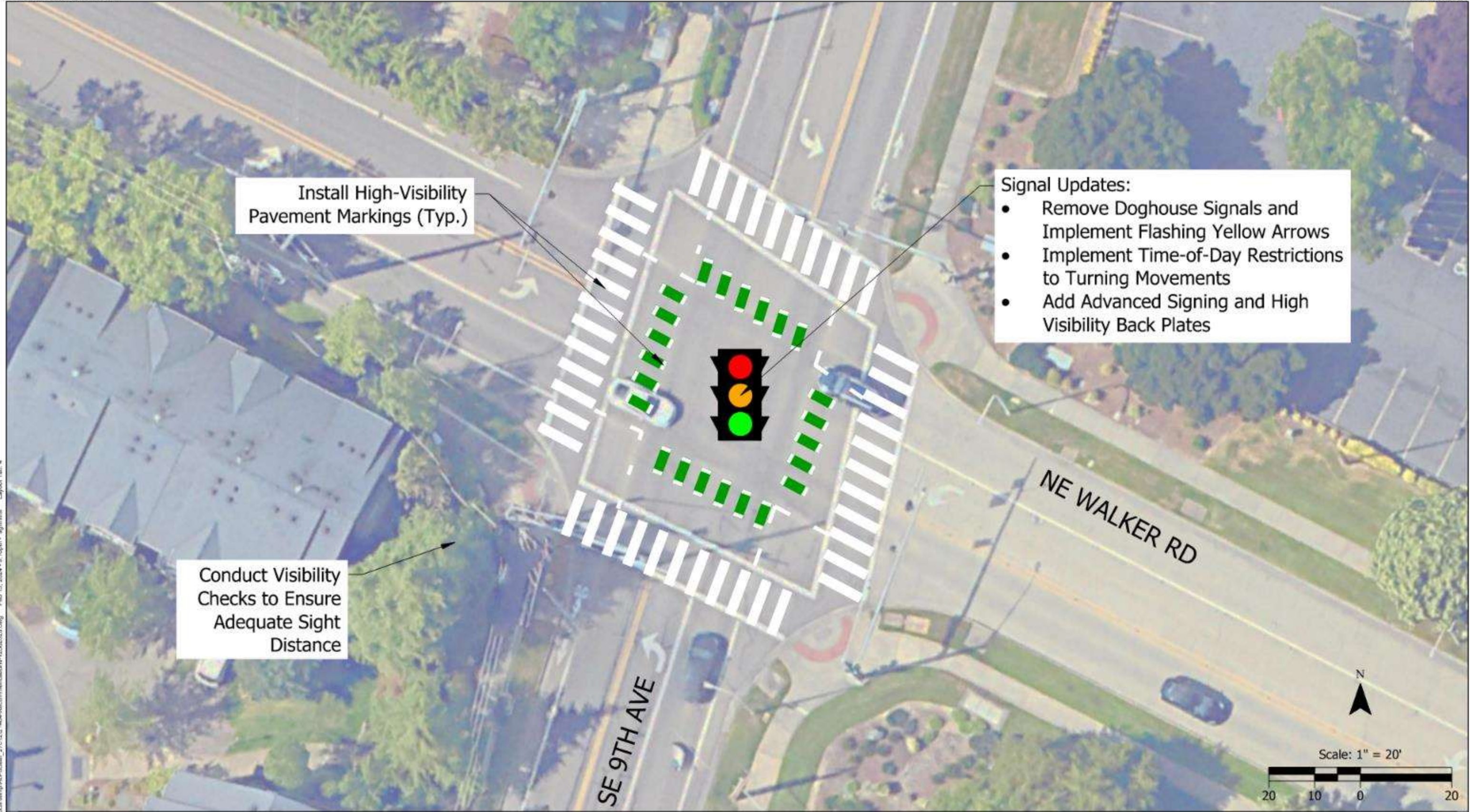
**Table 14. Crash Modification Factors for Recommended Projects**

Countermeasure	Crash Modification Factor	Source
Install High-Visibility Pavement Markings	Not Available for signalized intersections	
Replace Doghouse with Flashing Yellow Arrow Signal Heads	0.75 (25% reduction in left-turning crashes at all severities)	ARTS (I8- Replace doghouse with flashing yellow arrow signal heads)
Implement Time-of-Day Restrictions to Turning Movements	Not available, could reduce potential for crashes where there is higher pedestrian activity.	
Add Advanced Signing	0.65 (35% reduction in angle crashes at all severities)	ARTS (I22- Install signal ahead advance warning signs)
Install High Visibility Back Plates	0.85 (15% reduction in all crashes at all severities)	ARTS (I3- Add 3-inch yellow retroreflective sheeting to signal backplates)
Provide Adequate Sight Distance	0.52 (48% reduction in all crashes at all severities)	ARTS I17 – Increase Triangle Sight Distance)

### Cost Estimates

The estimated cost for installing the projects in Table 14 is \$210,000<sup>17</sup>. Appendix E provides more details on the cost estimates. The costs of implementing time-of-day restrictions to turning movements and providing adequate sight distance is assumed to be negligible.

<sup>17</sup> Project costs that need to be considered for grant funding: design, mobilization, traffic control, stormwater improvements, construction administration, and other contingencies.



NE John Olsen Ave / NE Walker Rd Proposed Recommendations Hillsboro, OR

Figure 20

## SE 9<sup>th</sup> Ave / SE Walnut St

Figure 21 summarizes the intersection characteristics and surrounding context of the SE 9<sup>th</sup> Ave / SE Walnut St intersection. The intersection is located in a high disparity social equity index zone in downtown Hillsboro. There is a TSP project to potentially convert SE 9<sup>th</sup> Ave and SE 10<sup>th</sup> Ave to a couplet.

### Site Diagnosis

This section documents the crash history, site history, behavioral data, field conditions, and community concerns.

#### Crash History

Figure 22 presents the crash diagram for the SE 9<sup>th</sup> Ave / SE Walnut St intersection based on the five most recent years of reported crashes. There were 9 reported crashes at this intersection between January 1, 2017 to December 31, 2021.

In reviewing the reported crashes at the SE 9<sup>th</sup> Ave / SE Walnut St intersection, the following trends were identified by the Project team:

- Eight of the nine reported crashes occurred during clear, daylight conditions.
- One crash was reported to involve impaired driving.
- Eight of the nine crashes were reported to be caused by drivers failing to yield the right-of-way.
- There were two reported pedestrian crashes involving pedestrians crossing Walnut St. One crash resulted in a suspected moderate injury and the other resulted in a suspected minor injury.

Appendix A includes the full list of reported crashes.









Google Earth

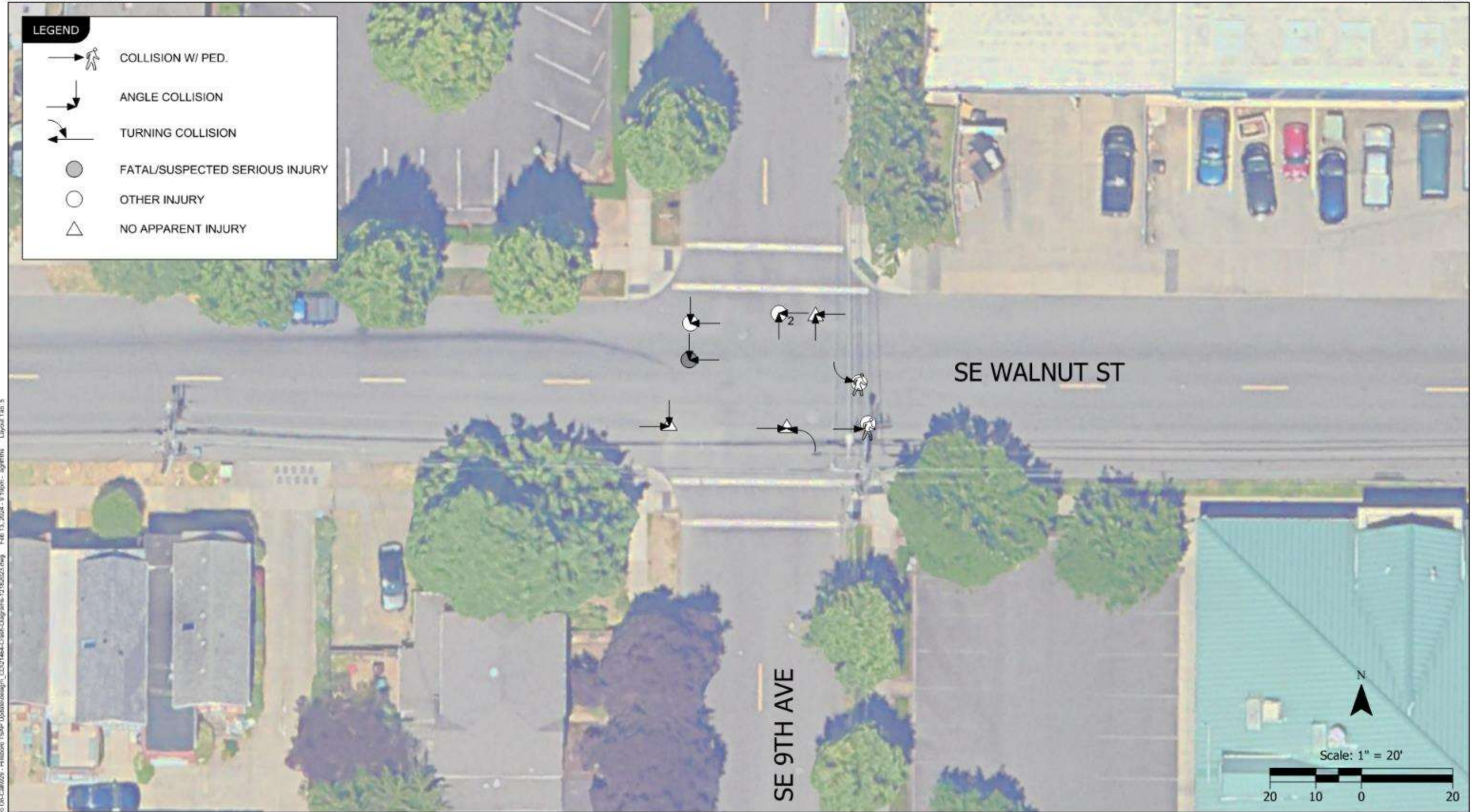
Social Equity Index Zone: High Disparity

SE 9th Ave / SE Walnut St  
Hillsboro, Oregon

Figure  
21

**LEGEND**

-  COLLISION W/ PED.
-  ANGLE COLLISION
-  TURNING COLLISION
-  FATAL/SUSPECTED SERIOUS INJURY
-  OTHER INJURY
-  NO APPARENT INJURY



SE 9th Ave / SE Walnut St Crash Diagram  
Hillsboro, OR

Figure  
22

### Pending or Recently Completed Projects

There were no construction projects or traffic modification projects at this intersection between January 1, 2017 – present (the period overlapping with the crash history or Safety View behavioral data through present day).

### Safety View by INRIX and GM Future Roads

Safety View included behavioral data from Q2 2023. Overall, this intersection has a **medium** risk score. The speed risk score is **high** along the east and west legs of the intersection. Safety View figures for each intersection are provided in Appendix B.

### Community Concerns

Transportation safety concerns expressed by community members and submitted to City staff relevant to the SE 9<sup>th</sup> Ave / SE Walnut St Intersection are summarized in Table 15. One comment has been received.

**Table 15: Community Concerns: SE 9<sup>th</sup> Ave / SE Walnut St**

ID	Type	Comment	City Response
1	Vision Obstruction	Request to investigate vegetation causing a vision obstruction at SE 9 <sup>th</sup> Ave / SE Walnut St.	Letter to trim down vegetation to code was sent. Inspection on 10/20 confirmed vegetation had been trimmed.

### Recommended Projects/Countermeasures

Figure 23 summarizes the proposed recommendations to address the site diagnosis. Installing an all-way stop-control, curb extensions, and high-visibility pavement markings provides traffic calming and makes it safer and easier for people to cross the street at this intersection.

Table 16 documents the CMFs for each recommended project.

**Table 16. Crash Modification Factors for Recommended Projects**

Countermeasure	Crash Modification Factor	Source
Install All-Way Stop-Control	0.25 (75% reduction in angle crashes at all severities)	ARTS (H20-Covert urban 2-way or yield control to all-way stop-control)
Install Curb Ramps and Extensions with a Marked Crosswalks	0.63 (37% reduction in all pedestrian crashes at all severities)	ARTS (BP16-Install curb ramps and extensions with a marked crosswalk and pedestrian warning signs)
Install Crosswalk Visibility Enhancements	0.60 (40% reduction in pedestrian crashes at all injury severities)  Note: This Crash Modification Factor applies when the countermeasure is implemented at uncontrolled intersections, the crash reduction factor would likely be lower for all-way stop-controlled intersections.	FHWA (Crosswalk Visibility Enhancements – High-Visibility Crosswalks)

### Cost Estimates

The estimated cost for installing the projects in Table 16 is \$100,000<sup>18</sup>. Appendix E provides more details on the cost estimates.

<sup>18</sup> Project costs that need to be considered for grant funding: design, mobilization, traffic control, stormwater improvements, construction administration, and other contingencies.





SE 9th Ave / SE Walnut St Proposed Recommendations  
Hillsboro, OR

Figure  
23

## E Main St / SE 24<sup>th</sup> Ave

Figure 24 summarizes the intersection characteristics and surrounding context of the E Main St / SE 24<sup>th</sup> Ave intersection. The intersection is located in a high disparity social equity index zone in a residential area. There is TSP project to construct sidewalks and bike facilities along 24<sup>th</sup> Ave south of the intersection.

### Site Diagnosis

This section documents the crash history, site history, behavioral data, field conditions, and community concerns.

#### Crash History

Figure 25 presents the crash diagram for the E Main St / SE 24<sup>th</sup> Ave intersection based on the five most recent years of reported crashes. There were 12 reported crashes at this intersection between January 1, 2017 to December 31, 2021.

In reviewing the reported crashes at the E Main St / SE 24<sup>th</sup> Ave intersection, the following trends were identified by the Project team:

- Ten of the twelve reported crashes occurred during clear or cloudy daylight conditions.
- No crashes were reported to involve impaired driving.
- Crashes were reported to be caused by drivers failing to yield the right-of-way, failing to avoid the vehicle ahead, making improper turns, disregarding the traffic signal, inattention, and improper overtaking.
- There was one reported pedestrian crash resulting in a suspected minor injury. This crash involved a driver making a westbound left colliding with a person crossing the street from east to west in a crosswalk.

Appendix A includes the full list of reported crashes.



Social Equity Index Zone: High Disparity

E Main St / SE 24<sup>th</sup> Ave  
Hillsboro, Oregon

Figure  
24



E Main St / SE 24th Ave Crash Diagram  
Hillsboro, OR

Figure  
25

### Pending or Recently Completed Projects

In 2021, a 39-unit multi-family residential development was constructed. There is a proposal for a development on the Valley Hope Community Church Property that would include constructing a new dead-end east-west street connecting to 24<sup>th</sup> Ave to serve 20 townhome units.

### Safety View by INRIX and GM Future Roads

Safety View included behavioral data from Q2 2023. Overall, this intersection has a **medium** risk score. The speed risk score is **high** along E Main Street. Safety View figures for each intersection are provided in Appendix B.

### Community Concerns

Transportation safety concerns expressed by community members and submitted to City staff relevant to the E Main St / SE 24<sup>th</sup> Ave Intersection are summarized in Table 17. Eight comments were received and generally include requests for sidewalks, bike lanes, and traffic calming along SE 24<sup>th</sup> Ave.

**Table 17: Community Concerns: E Main St / SE 24<sup>th</sup> Ave**

ID	Type	Comment	City Response
1	Bicycle & Pedestrian Capital Improvement Program (BPCIP)	Concerned with the evaluation criteria and would like project on 24 <sup>th</sup> Ave near W.L. Henry Elementary School elevated in priority.	Provided additional information on BPCIP criteria and why 24 <sup>th</sup> Avenue cannot be adjusted on the priority list.
2	Sidewalks	Request for sidewalks and/or street improvements on SE 24 <sup>th</sup> Ave between Main St and Maple St.	This section of roadway has been identified in the draft BPCIP and will be further prioritized.
3	Sidewalks	Request for sidewalks on SE 24 <sup>th</sup> Ave between Main St and Maple St.	Provided information on BPCIP process
4	Traffic Calming	Request to add SE 24 <sup>th</sup> Ave between Main St and Maple St to the electronic speed display sign program.	Location has been added to the sign rotation.
5	Sidewalks	Request for sidewalk on SE 24 <sup>th</sup> Ave.	Sidewalks at this location are not budgeted at this time. Provided information on the TSP Update
6	Speeding	Request to install speed feedback signs on SE 24 <sup>th</sup> Ave south of Main St.	Location has been added to the sign rotation.
7	Sidewalks	Request to install sidewalks on SE 24 <sup>th</sup> Ave from Main St to the south	Provided information on TSP update and BPCIP project selection process. Added Mr. Brown to BPCIP notification list
8	Sidewalks	Request for sidewalks on SE 24 <sup>th</sup> Ave between Main St and Maple St.	Provided background on sidewalks and BPCIP program

### Recommended Projects/Countermeasures

Figure 26 summarizes the proposed recommendations to address the site diagnosis. These projects provide traffic calming, reduce the potential for crashes, and make it easier for people to cross the street at this intersection.<sup>19</sup>

<sup>19</sup> Striping and full pedestrian and bicycle improvements should be considered in the design phase.

Table 18 documents the CMFs for each recommended project.

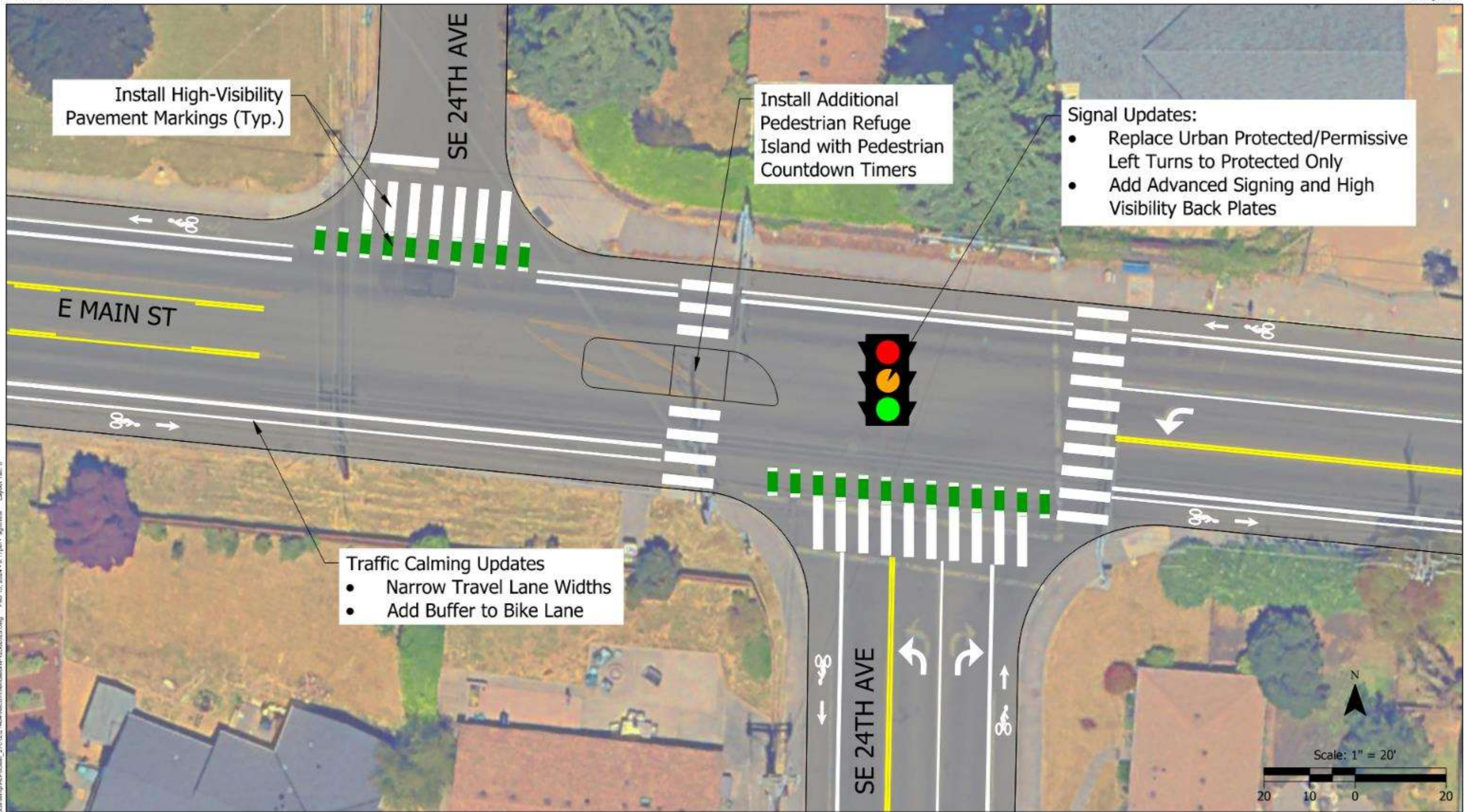
**Table 18. Crash Modification Factors for Recommended Projects**

Countermeasure	Crash Modification Factor	Source
Install High-Visibility Pavement Markings	Not available for signalized intersections	
Replace Urban Protected/Permissive Left Turns to Protected Only	0.01 (99% reductions in left-turning crashes at all severities)	ARTS (I9 – Replace Protected/Permissive Left Turns to Protected Only)
Add Advanced Signing	0.65 (35% reduction in angle crashes at all severities)	ARTS (I22- Install signal ahead advance warning signs)
Install High Visibility Back Plates	0.85 (15% reduction in all crashes at all severities)	ARTS (I3- Add 3-inch yellow retroreflective sheeting to signal backplates)
Install Pedestrian Refuge Island	Not available for signalized intersections	
Install Pedestrian Countdown Timers	0.30 (70% reduction in pedestrian crashes at all severities)	ARTS (BP1- Install Pedestrian Countdown Timer(s))
Traffic Calming Updates (Narrow Travel Lane Widths and Add Buffer to Bike Lane)	Not available, however it is a Tier 2 action in the Safe System Roadway Design Hierarchy as it helps create self-enforcing roadways for speed management	

**Cost Estimates**

The estimated cost for installing the projects in Table 18 is \$90,000<sup>20</sup>. Appendix E provides more details on the cost estimates.

<sup>20</sup> Project costs that need to be considered for grant funding: design, mobilization, traffic control, stormwater improvements, construction administration, and other contingencies.



E Main St / SE 24th Ave Proposed Recommendations Hillsboro, OR

Figure 26


## NEXT STEPS

This memorandum documents the recommended projects and infrastructure and non-infrastructure countermeasures according to the Safe System Approach. This memorandum will be refined based on feedback from the Steering Committee and the public. Next, performance measures will be developed to measure how well the TSAP is being implemented and how effective the TSAP is at reducing crash risk.

## REFERENCES

1. Kittelson & Associates, Inc. *Existing Conditions Analysis Memorandum*. December 2023.
2. Federal Highway Administration. *The Safe System Approach Presentation*. January 2023
3. Oregon Department of Transportation. *All Roads Transportation Safety Crash Reduction Factor Manual*. January 2023.
4. U.S. Department of Transportation. *Crash Modification Factor Clearinghouse*. Varies.
5. Federal Highway Administration. *Proven Safety Countermeasures*. Varies.
6. National Cooperative Highway Research Program. *NCHRP 20-44(13): Implementation of NCHRP Research Report 893: The Oregon DOT Statewide Pedestrian and Bicycle Plan*. August 2019.
7. Federal Highway Administration. *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations*. July 2018.
8. Oregon Department of Transportation. *Oregon Intersection Safety Implementation Plan Update*. September 2023.





## Appendix A. Priority Locations for Implementing Pedestrian and Bicycle Treatments

# PRIORITY LOCATIONS FOR IMPLEMENTING PEDESTRIAN AND BICYCLE TREATMENTS

The [Oregon Bicycle & Pedestrian Safety Implementation Plan](#) methodology is used to identify priority locations for the City to systemically identify high-risk locations and implement pedestrian and bicycle countermeasures to reduce risk for people walking and biking.

The Oregon Bicycle & Pedestrian Safety Implementation Plan identifies factors contributing to pedestrian and bicycle crashes based on analyzing crash, traffic, infrastructure, land-use, and demographic data. Table 19 provides the screening weights for these factors. The plan also identifies factors that could not be screened for based on available data, but are still useful for site investigations:

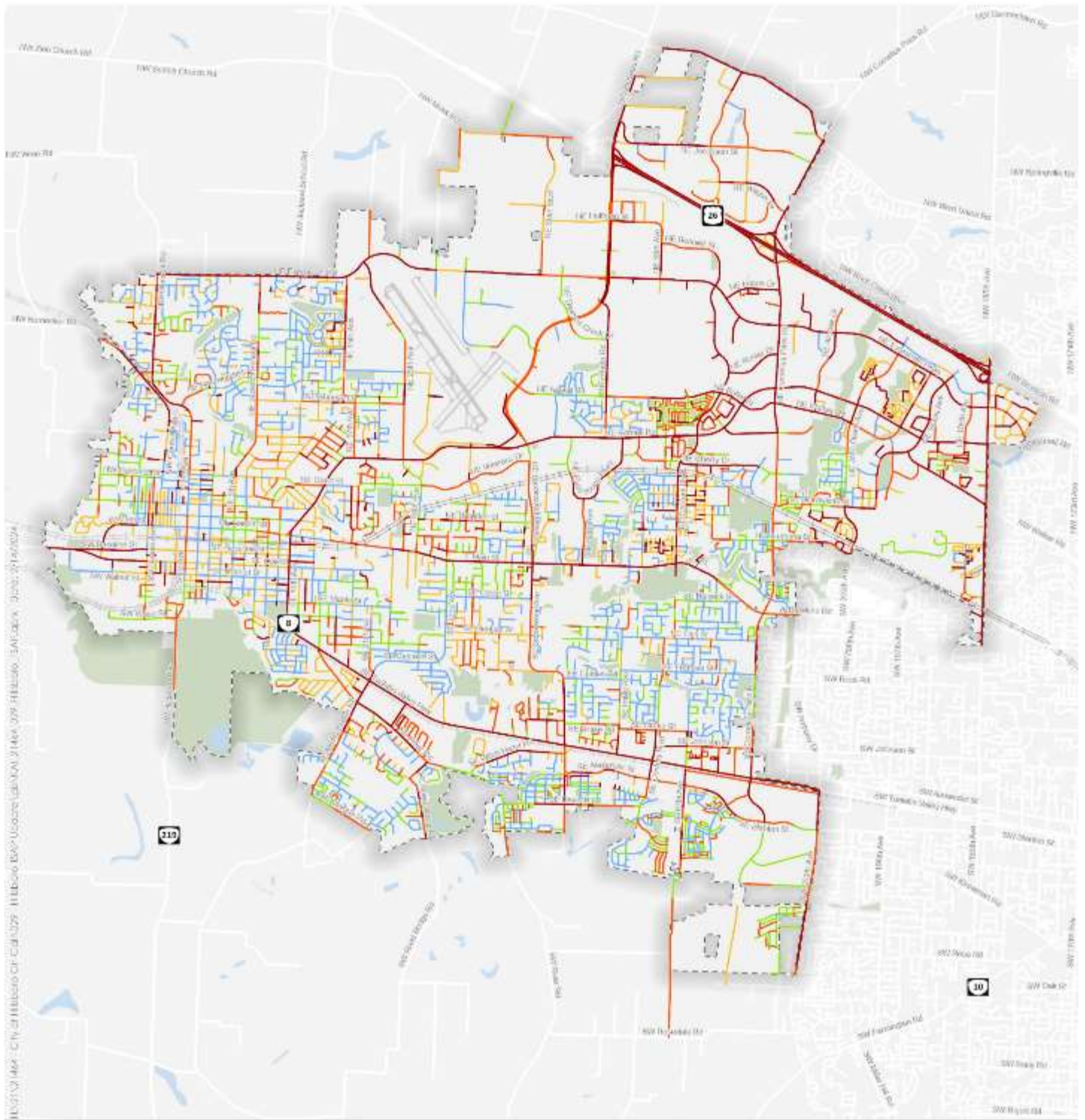
- High turning volumes at intersections
- Permissive left-turn signal phasing
- Lack of lighting
- Propensity for mid-block crossings
- Scenic Bikeways
- Exposure (Volumes)

**Table 19. Oregon Bicycle & Pedestrian Safety Implementation Plan Risk Factor Screening Weights**

Risk Factor	Pedestrian Risk Factor Screening Weight	Bicyclist Risk Factor Screening Weight
Principal Arterial	1.24	1.13
Minor Arterials	-	1.07
Number of Lanes (>=4 Lanes)	1.55	1.08
High-Access Density	1.64	1.02
No Sidewalks (or Only One Side)	1.38	-
Posted Speed (>=35 mph)	1.83	1.11
No Bike Lane	-	1.06
Mixed Use Zoning	1.00	1.00
Proximity to Schools (1 Mile)	1.03	1.01
Proximity to Transit Stops (1/4 Mile)	1.08	1.03
High Population over the Age of 64	1.00	1.00

Figure 27 and Figure 28 illustrate the systemic screening for pedestrians and bicyclists, respectively<sup>21</sup>. Locations within the top 40% risk factor scores should be prioritized for pedestrian and bicycle systemic treatments. Segments of NE Evergreen Pkwy, NE Cornelius Pass Rd, NE Walker Rd, NE Cornell Rd, E Main St, SE Tualatin Valley Hwy, and SW 209<sup>th</sup> Ave are identified within the top 20% risk factor scores for both pedestrians and bicyclists.

<sup>21</sup> Access density was not available in GIS; therefore this risk factor was excluded from the screening.



**Pedestrian Risk Factor Score**

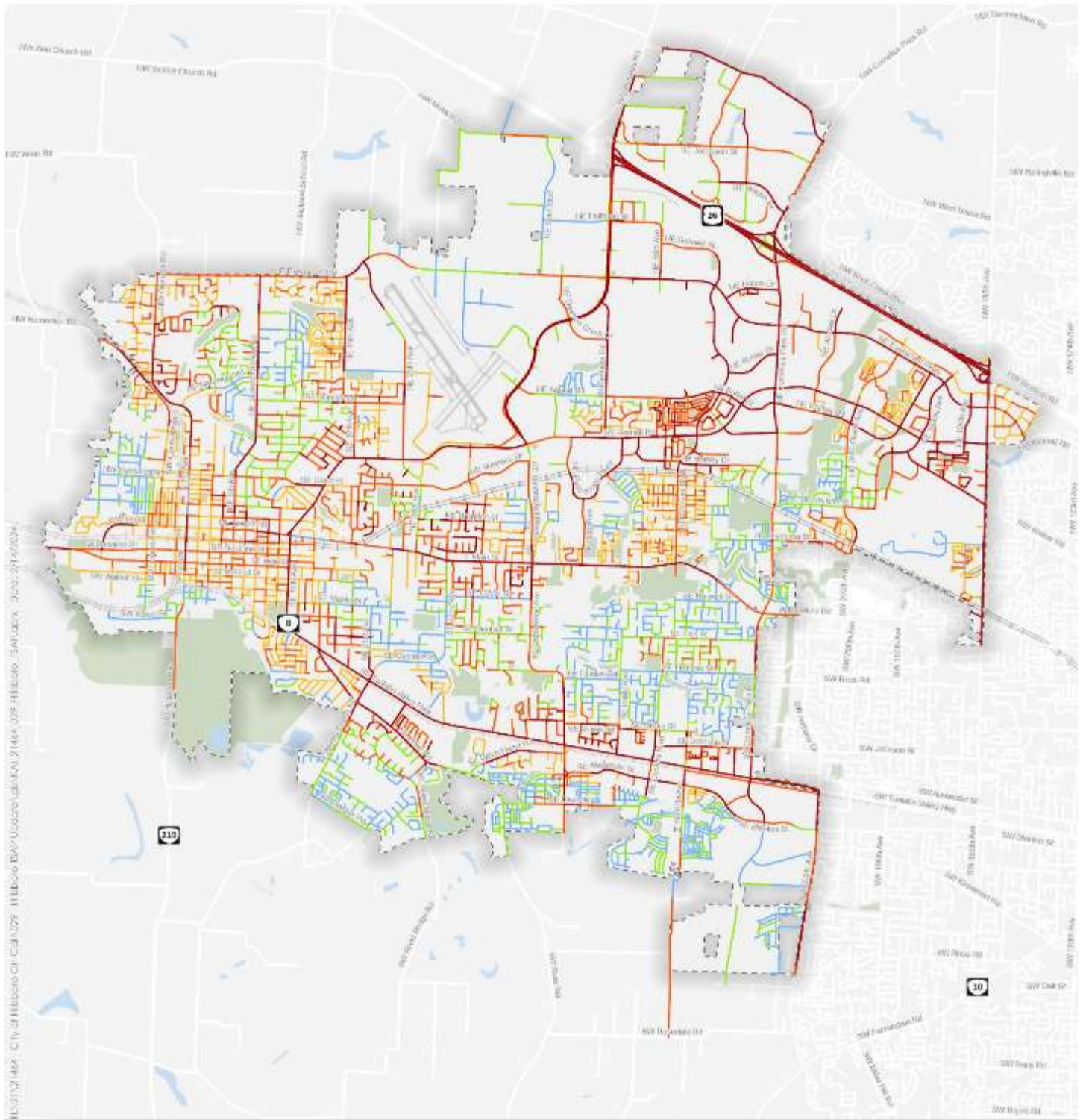
- Top 20%
- Second 20%
- Third 20%
- Fourth 20%
- Lowest 20%

- City Limits
- Waterbodies
- Parks and Open Spaces



Figure 27

**Priority Locations for Systemic Pedestrian Treatments  
City of Hillsboro**



**Bicycle Risk Factor Score**

- Top 20%
- Second 20%
- Third 20%
- Fourth 20%
- Lowest 20%

- City Limits
- Waterbodies
- Parks and Open Spaces



Figure 28

**Priority Locations for Systemic Bicycle Treatments  
City of Hillsboro**

## Appendix B. Priority Locations for Safer Roads and Safer Speeds Related Treatments

# PRIORITY LOCATIONS FOR IMPLEMENTING SAFER ROADS AND SAFER SPEEDS RELATED TREATMENTS

The Existing Conditions Analysis Summary included an EPDO network screening of intersections and segments based on crash history and severity<sup>22</sup>. The results from this screening, overlaid with ODOT's Social Equity Index, are documented in Figure 2 and Figure 3. Table 20 and Table 21 present the top 1% of intersections and segments within the study area in terms of highest crash severity score. Most of these intersections and segments require coordination with ODOT or the County, tables with intersections under the City's full jurisdiction are provided in the Existing Conditions memo.

**Table 20. Intersections with Highest Crash Severity Scores (Top 1% Sites)**

Rank	Intersection	Traffic Control	Jurisdiction(s)	Crash Severity Score	Total Crashes			Social Equity Index
					Fatal/ Suspected Serious Injury	Suspected Minor/ Possible Injury	No Apparent Injury (PDO)	
1	SE Cornelius Pass Rd / E Main St – W Baseline St	Signal	Washington County	159	4	38	15	Low Medium Disparity
2	SE Brookwood Ave / E Main St	Signal	Washington County	157.2	3	47	16	Low Medium Disparity
3	SW 185 <sup>th</sup> Ave / W Baseline Rd	Signal	Washington County	153.2	3	45	16	Medium High Disparity
4	SE Tualatin Valley Hwy / SE Cornelius Pass Rd	Signal	ODOT / Washington County / City of Hillsboro	121.6	2	39	18	Medium High Disparity
5	NE Cornell Rd / NE Cornelius Pass Rd	Signal	Washington County	121.2	3	29	16	Low Medium Disparity
6	NE Stucki Ave / NE Evergreen Pkwy	Signal	City of Hillsboro / Washington County	105	3	21	15	Medium High Disparity

<sup>22</sup> This screening assigns a crash severity score to individual crashes based on the severity of the crashes, with higher weights assigned to more severe crashes. Additional details on the methodology, and tables and figures documenting the results, are described in the Existing Conditions Analysis Summary.

Rank	Intersection	Traffic Control	Jurisdiction(s)	Crash Severity Score	Total Crashes			Social Equity Index
					Fatal/ Suspected Serious Injury	Suspected Minor/ Possible Injury	No Apparent Injury (PDO)	
7	NW 185 <sup>th</sup> Ave / NE Evergreen Pkwy	Signal	Washington County / City of Hillsboro	104.6	1	40	23	Low Medium Disparity
8	SE Walnut St / SE 10 <sup>th</sup> Ave	Signal	City of Hillsboro / ODOT	102.6	3	20	13	High Disparity
9	SE Tualatin Valley Hwy / SE Brookwood Ave	Signal	ODOT / Washington County / City of Hillsboro	97.2	1	37	16	Medium High Disparity
10	Sunset Hwy / NE 185 <sup>th</sup> Ave	Signal (Interchange Ramp)	ODOT / Washington County	96.8	1	36	24	Low Medium Disparity
11	SE Tualatin Valley Hwy / SE Century Blvd	Signal	ODOT / City of Hillsboro	95.6	2	26	18	Medium High Disparity
12	Sunset Hwy / NE Cornelius Pass Rd	Signal (Interchange Ramp)	ODOT	95.0	3	16	15	Low Disparity
13	NE Evergreen Pkwy / NE Century Blvd	Signal	Washington County /City of Hillsboro	94.4	2	26	12	Low Medium Disparity
14	SE Tualatin Vally Hwy- SW Baseline St / SW 17 <sup>th</sup> Ave	Signal	ODOT / City of Hillsboro	90.2	3	14	11	High Disparity
15	NE Cornell Rd / NE Brookwood Pkwy	Signal	Washington County	86.2	0	41	21	Low Medium Disparity
16	NE Evergreen Pkwy / NE Cornelius Pass Rd	Signal	Washington County	86.0	2	22	10	Low Medium Disparity
17	SE Tualatin Valley Hwy / SE Minter Bridge Rd – SE Cypress St	Signal	ODOT / City of Hillsboro	84.6	1	31	13	High Disparity

Rank	Intersection	Traffic Control	Jurisdiction(s)	Crash Severity Score	Total Crashes			Social Equity Index
					Fatal/Suspected Serious Injury	Suspected Minor/Possible Injury	No Apparent Injury (PDO)	
18	NE Walker Rd – NE Butler St / NE Cornelius Pass Rd	Signal	City of Hillsboro / Washington County	84.4	3	11	12	Low Medium Disparity
19	SE Baseline St / S 1 <sup>st</sup> Ave	Signal	ODOT / Washington County	84.4	2	21	12	High Disparity
20	SW 185 <sup>th</sup> Ave / SE Edgeway Dr – SW Salix Ter	Signal	Washington County / City of Hillsboro	74.4	2	16	12	Medium High Disparity
21	NW Sunset Hwy / NE 185 <sup>th</sup> Ave	Signal (Interchange Ramp)	ODOT / Washington County	71.4	1	24	17	Low Disparity
22	NW Sunset Hwy / NE Brookwood Pkwy	Signal (Interchange Ramp)	ODOT / Washington County	71.4	2	14	17	Low Medium Disparity
23	NE Evergreen Pkwy / NE John Olson Ave	Signal	Washington County / City of Hillsboro	71.0	2	15	5	Low Disparity
24	NE Cornell RD / NE 17 <sup>th</sup> Ave	Two-Way Stop-Controlled (TWSC)	Washington County / City of Hillsboro	70.6	2	14	13	High Disparity
25	NW Helvetia Rd / NE Jacobson St	TWSC	Washington County / ODOT	66.6	1	22	13	Low Disparity
26	NW 185 <sup>th</sup> Ave / NE Walker Rd	Signal	Washington County	66.4	1	22	12	Low Medium Disparity
27	SE 10 <sup>th</sup> Ave / SE Maple St	Signal	ODOT / City of Hillsboro	66.0	1	22	10	High Disparity



**Table 21. Roadway Segments with the Highest Crash Severity Scores (Top 1% Sites)**

Rank	Roadway Segment	Functional Classification	Total Milage	Jurisdiction	Crash Severity Score Normalized by Mileage	Total Crashes			Social Equity Index
						Fatal/Suspected Serious Injury	Suspected Minor/Possible Injury	No Apparent Injury (PDO)	
1	Tualatin Valley (OR8): 520 feet west of SE 40 <sup>th</sup> Ave to 560 feet east of Brookwood Ave	Urban Arterial	0.75	ODOT	237.1	5	37	19	Medium High Disparity
2	NE Imbrie Dr: NE Evergreen Pkwy to NE Cornelius Pass Rd	Major Collector	0.4	City of Hillsboro	209.0	1	30	18	Low Medium Disparity
3	SW 185 <sup>th</sup> Ave: 670 feet north of SW Salix Ter to city limits	Urban Arterial	0.5	Washington County	198.8	2	27	27	Medium High Disparity
4	Tualatin Valley (OR8): 215 feet west of SE 11 <sup>th</sup> Ave to 60 feet East of SE 32 <sup>nd</sup> Ave	Urban Arterial	1.25	ODOT	169.3	5	53	28	Medium High Disparity
5	SE 10 <sup>th</sup> Avenue: From E Main Street to 480 feet south of Maple St	Urban Arterial	0.59	ODOT	165.4	2	26	28	High Disparity

Rank	Roadway Segment	Functional Classification	Total Mileage	Jurisdiction	Crash Severity Score Normalized by Mileage	Total Crashes			Social Equity Index
						Fatal/Suspected Serious Injury	Suspected Minor/Possible Injury	No Apparent Injury (PDO)	
6	Cornelius Pass: 230 feet north of NE Walker Rd to 210 feet south of NE Nicholas Ct	Urban Arterial	0.5	Washington County	146.4	3	6	6	Low Medium Disparity
7	SW 185 <sup>th</sup> Ave: 200 feet north of Sunset Square Main Entr to 110 feet south of NE Holly Street	Urban Arterial	0.5	Washington County	142.8	1	24	17	High Disparity
8	Tualatin Valley (OR8): 260 feet west of SE 73 <sup>rd</sup> Ave to city limits	Urban Arterial	1.27	ODOT	129.8	5	31	14	Medium High Disparity
9	NE Cornell Rd: 100 feet east of NE 34 <sup>th</sup> Ave to 60 feet east of NE Elam Young Pkwy	Urban Arterial	0.84	Washington County	120.7	3	18	27	Low Medium Disparity
10	NE Cornell Rd: from NE Grant Street to 260 feet east of NE 25 <sup>th</sup> Ave	Urban Arterial	1.26	Washington County	98.9	3	30	23	Medium High Disparity

Additionally, the Oregon Intersection Safety Implementation Plan Update (Reference 8) provides a methodology for systemically screening networks to identify priority intersections for safety treatments. This methodology prioritizes sites with the characteristics summarized in Table 22. The City could apply this methodology to prioritize sites, intersection screening characteristics were factored into the priority locations identified in this document.

**Table 22. Intersection Screening Characteristics**

Category	Signalized Intersection Characteristic	Stop Controlled Intersection Characteristic
Functional Classification	<ul style="list-style-type: none"> <li>- Arterial (Minor)</li> <li>- Arterial (Principal)</li> <li>- Other Freeways and Expressways</li> <li>- Arterial (Principal + Minor)</li> </ul>	<ul style="list-style-type: none"> <li>- Arterial (Principal + Minor)</li> <li>- Arterial (Principal)</li> </ul>
Posted Speed	<ul style="list-style-type: none"> <li>- 50 MPH or higher</li> <li>- 40 – 50 MPH</li> <li>- 35 MPH</li> </ul>	
Average Annual Daily Traffic (AADT)	<ul style="list-style-type: none"> <li>- 40,000 or greater</li> <li>- Between 25,000 and 40,000</li> </ul>	<ul style="list-style-type: none"> <li>- 10,000 or greater</li> </ul>
Approach Characteristics	<ul style="list-style-type: none"> <li>- Left-turn lane</li> <li>- Right-turn lane</li> <li>- Four or more through lanes</li> </ul>	<ul style="list-style-type: none"> <li>- Right-turn lane</li> <li>- Three or more through lanes</li> <li>- Left-turn lane</li> </ul>
Equity	<ul style="list-style-type: none"> <li>- Medium High or High Equity Disparity</li> </ul>	
Active Transportation	<ul style="list-style-type: none"> <li>- High bicycle and pedestrian volumes; presence of a bicycle lane and presence of a sidewalk lane are used as proxies because bicycle and pedestrian volume data is not available from ODOT at a statewide scale.</li> </ul>	

## Appendix C. Site-Specific Crash History

## SITE SPECIFIC CRASH HISTORY

The tables below document the crash history at the intersections identified for site-specific recommendations.

### Crash History at Johnson St / SE Century Blvd

Crash ID	Collision Type	Collision Severity	Cause	Weather	Light	Alcohol / Drugs
1731070	Angle	Suspected Moderate Injury	Did not yield right-of-way	Cloudy	Daylight	No
1751293	Turning Movement	No Apparent Injury	Did not yield right-of-way	Rain	Darkness – no street lights	No
1761956	Pedestrian	Fatal	Did not yield right-of-way	Cloudy	Darkness – with street lights	No
1791698	Angle	Suspected Minor Injury	Did not yield right-of-way	Cloudy	Daylight	No
1838114	Angle	Suspected Moderate Injury	Did not yield right-of-way	Rain	Daylight	No
1855014	Turning Movement	No Apparent Injury	Did not yield right-of-way	Clear	Darkness – with street lights	No
1915372	Angle	Suspected Serious Injury	Passed stop sign or red flasher	Clear	Daylight	No
1937003	Turning Movement	Suspected Moderate Injury	Did not yield right-of-way	Clear	Darkness – no street lights	No

### Crash History at NE John Olsen Ave / NE Wilkins St

Crash ID	Collision Type	Collision Severity	Cause	Weather	Light	Alcohol / Drugs
1717992	Angle	Suspected Minor Injury	Disregarded traffic signal	Rain	Darkness – with street lights	No
1731135	Turning Movement	Suspected Moderate Injury	Disregarded traffic signal	Rain	Daylight	No
1732009	Turning Movement	Suspected Moderate Injury	Did not yield right-of-way	Clear	Daylight	No

Crash ID	Collision Type	Collision Severity	Cause	Weather	Light	Alcohol / Drugs
1732555	Turning Movement	Suspected Minor Injury	Disregarded traffic signal	Clear	Daylight	No
1737049	Turning Movement	Suspected Minor Injury	Did not yield right-of-way	Clear	Darkness – with street lights	No
1753151	Fixed-Object or Other-Object	No Apparent Injury	*Other improper driving	Rain	Daylight	No
1753643	Fixed-Object or Other-Object	No Apparent Injury	Speed too fast for conditions (Not exceeding limit)	Clear	Dusk (Twilight)	Yes
1777023	Turning Movement	Suspected Moderate Injury	Did not yield right-of-way	Clear	Daylight	No
1778595	Turning Movement	Suspected Minor Injury	Did not yield right-of-way	Clear	Darkness – with street lights	No
1791626	Turning Movement	Suspected Moderate Injury	Did not yield right-of-way	Clear	Daylight	No
1791947	Angle	Suspected Moderate Injury	Disregarded traffic signal	Clear	Daylight	No
1800137	Angle	Suspected Moderate Injury	Disregarded traffic signal	Clear	Darkness – with street lights	No
1800659	Rear-End	Suspected Minor Injury	Followed too closely	Clear	Daylight	No
1802004	Turning Movement	Suspected Minor Injury	Did not yield right-of-way	Clear	Daylight	No
1820657	Turning Movement	Suspected Moderate Injury	Did not yield right-of-way	Clear	Daylight	No
1822026	Rear-End	No Apparent Injury	Failed to avoid vehicle ahead	Clear	Darkness – with street lights	No
1840087	Turning Movement	Suspected Minor Injury	Did not yield right-of-way	Clear	Daylight	No
1841218	Turning Movement	Suspected Moderate Injury	Did not yield right-of-way	Clear	Daylight	No
1843521	Rear-End	Suspected Minor Injury	Inattention	Cloudy	Daylight	Yes

Crash ID	Collision Type	Collision Severity	Cause	Weather	Light	Alcohol / Drugs
1854553	Angle	No Apparent Injury	Disregarded traffic signal	Rain	Daylight	No
1856710	Rear-End	No Apparent Injury	Failed to avoid vehicle ahead	Clear	Dawn (Twilight)	No
1859855	Rear-End	No Apparent Injury	Failed to avoid vehicle ahead	Clear	Daylight	No
1877828	Turning Movement	Suspected Moderate Injury	Did not yield right-of-way	Rain	Darkness – with street lights	No
1878884	Turning Movement	Suspected Minor Injury	Disregarded traffic signal	Clear	Darkness – with street lights	No
1891463	Angle	Suspected Moderate Injury	Disregarded traffic signal	Clear	Darkness – with street lights	No
1895087	Turning Movement	Suspected Minor Injury	Did not yield right-of-way	Rain	Darkness – with street lights	No
1912780	Turning Movement	No Apparent Injury	Did not yield right-of-way	Clear	Dusk (Twilight)	No
1917293	Turning Movement	Suspected Moderate Injury	Disregarded traffic signal	Clear	Daylight	No
1939766	Turning Movement	No Apparent Injury	Did not yield right-of-way	Cloudy	Darkness – with street lights	No

## Crash History at E Main St / NE 5<sup>th</sup> Ave

Crash ID	Collision Type	Collision Severity	Cause	Weather	Light	Alcohol / Drugs
1717264	Turning Movement	Suspected Minor Injury	Made improper turn	Rain	Daylight	No
1730782	Turning Movement	Suspected Minor Injury	Made improper turn	Clear	Daylight	No
1732759	Angle	Suspected Minor Injury	Wrong way on one-way roadway	Clear	Daylight	No
1735669	Turning Movement	Suspected Minor Injury	Improper overtaking	Cloudy	Daylight	No
1737126	Turning Movement	Suspected Minor Injury	Made improper turn	Clear	Daylight	No

Crash ID	Collision Type	Collision Severity	Cause	Weather	Light	Alcohol / Drugs
1738363	Turning Movement	Suspected Serious Injury	Inattention	Clear	Daylight	No
1751280	Turning Movement	No Apparent Injury	Made improper turn	Clear	Daylight	No
1751827	Turning Movement	No Apparent Injury	Made improper turn	Clear	Daylight	No
1784703	Angle	Moderate Injury	Passed stop sign or red flasher	Clear	Darkness - with street lights	No
1786871	Angle	Suspected Minor Injury	Passed stop sign or red flasher	Clear	Daylight	No
1794376	Turning Movement	Moderate Injury	Made improper turn	Clear	Daylight	No
1798891	Turning Movement	Suspected Minor Injury	Made improper turn	Clear	Daylight	No
1804160	Angle	No Apparent Injury	Did not yield right-of-way	Clear	Dusk (Twilight)	No
1820651	Turning Movement	No Apparent Injury	Made improper turn	Clear	Daylight	No
1821826	Turning Movement	No Apparent Injury	Made improper turn	Clear	Daylight	No
1831798	Turning Movement	Suspected Minor Injury	Made improper turn	Clear	Daylight	No
1867273	Angle	No Apparent Injury	Did not yield right-of-way	Rain	Dawn (Twilight)	No
1878732	Angle	Moderate Injury	Passed stop sign or red flasher	Rain	Daylight	No
1947556	Turning Movement	No Apparent Injury	Made improper turn	Clear	Daylight	No

## Crash History at John Olsen Ave / NE Walker Rd

Crash ID	Collision Type	Collision Severity	Cause	Weather	Light	Alcohol / Drugs
1718161	Angle	Moderate Injury	Disregarded traffic signal	Clear	Daylight	No
1728679	Turning Movement	Moderate Injury	Did not yield right-of-way	Clear	Daylight	No
1733671	Turning Movement	Suspected Minor Injury	Did not yield right-of-way	Clear	Daylight	No



Crash ID	Collision Type	Collision Severity	Cause	Weather	Light	Alcohol / Drugs
1736733	Angle	Suspected Serious Injury	Disregarded traffic signal	Cloudy	Daylight	No
1749158	Angle	No Apparent Injury	Disregarded traffic signal	Rain	Daylight	No
1776572	Angle	Suspected Minor Injury	Disregarded traffic signal	Cloudy	Darkness - with street lights	No
1783834	Turning Movement	Suspected Minor Injury	Did not yield right-of-way	Rain	Daylight	No
1804084	Angle	Moderate Injury	Disregarded traffic signal	Rain	Daylight	No
1822016	Angle	No Apparent Injury	Disregarded traffic signal	Clear	Daylight	No
1828786	Angle	Suspected Minor Injury	Disregarded traffic signal	Clear	Daylight	No
1886643	Angle	Suspected Minor Injury	Disregarded traffic signal	Clear	Dusk (Twilight)	No
1912291	Angle	No Apparent Injury	Disregarded traffic signal	Clear	Daylight	No
1921410	Pedestrian	Moderate Injury	Did not yield right-of-way	Clear	Daylight	No

## Crash History at SE 9<sup>th</sup> Ave / SE Walnut St

Crash ID	Collision Type	Collision Severity	Cause	Weather	Light	Alcohol / Drugs
1728931	Angle	Suspected Serious Injury	Did not yield right-of-way	Clear	Daylight	No
1732734	Angle	Suspected Moderate Injury	Did not yield right-of-way	Clear	Daylight	No
1736743	Pedestrian	Suspected Moderate Injury	Did not yield right-of-way	Unknown	Darkness - with street lights	No
1737011	Angle	Suspected Minor Injury	Did not yield right-of-way	Clear	Daylight	Yes
1799119	Angle	Suspected Minor Injury	Did not yield right-of-way	Clear	Daylight	No
1799849	Pedestrian	Suspected Minor Injury	Did not yield right-of-way	Clear	Daylight	No
1821613	Angle	No Apparent Injury	Did not yield right-of-way	Clear	Daylight	No
1854448	Angle	No Apparent Injury	Did not yield right-of-way	Clear	Daylight	No

Crash ID	Collision Type	Collision Severity	Cause	Weather	Light	Alcohol / Drugs
1913703	Turning Movement	No Apparent Injury	Passed stop sign or red flasher	Clear	Daylight	No

## Crash History at E Main St / SE 24<sup>th</sup> Ave

Crash ID	Collision Type	Collision Severity	Cause	Weather	Light	Alcohol / Drugs
1718880	Rear-End	Suspected Minor Injury	Inattention	Clear	Daylight	No
1748374	Turning Movement	No Apparent Injury	Made improper turn	Clear	Daylight	No
1778525	Turning Movement	Suspected Minor Injury	Did not yield right-of-way	Clear	Dawn (Twilight)	No
1799534	Rear-End	Suspected Minor Injury	Failed to avoid vehicle ahead	Clear	Daylight	No
1856030	Rear-End	No Apparent Injury	Failed to avoid vehicle ahead	Clear	Daylight	No
1863439	Rear-End	No Apparent Injury	Failed to avoid vehicle ahead	Clear	Daylight	No
1910008	Rear-End	No Apparent Injury	Improper overtaking	Clear	Daylight	No
1927529	Turning Movement	Suspected Serious Injury	Disregarded traffic signal	Cloudy	Daylight	No
1936101	Turning Movement	Suspected Moderate Injury	Disregarded traffic signal	Clear	Daylight	No
1938004	Pedestrian	Suspected Minor Injury	Did not yield right-of-way	Rain	Darkness - with street lights	No
1939014	Turning Movement	Suspected Minor Injury	Did not yield right-of-way	Cloudy	Daylight	No
1948358	Turning Movement	No Apparent Injury	Made improper turn	Clear	Daylight	No

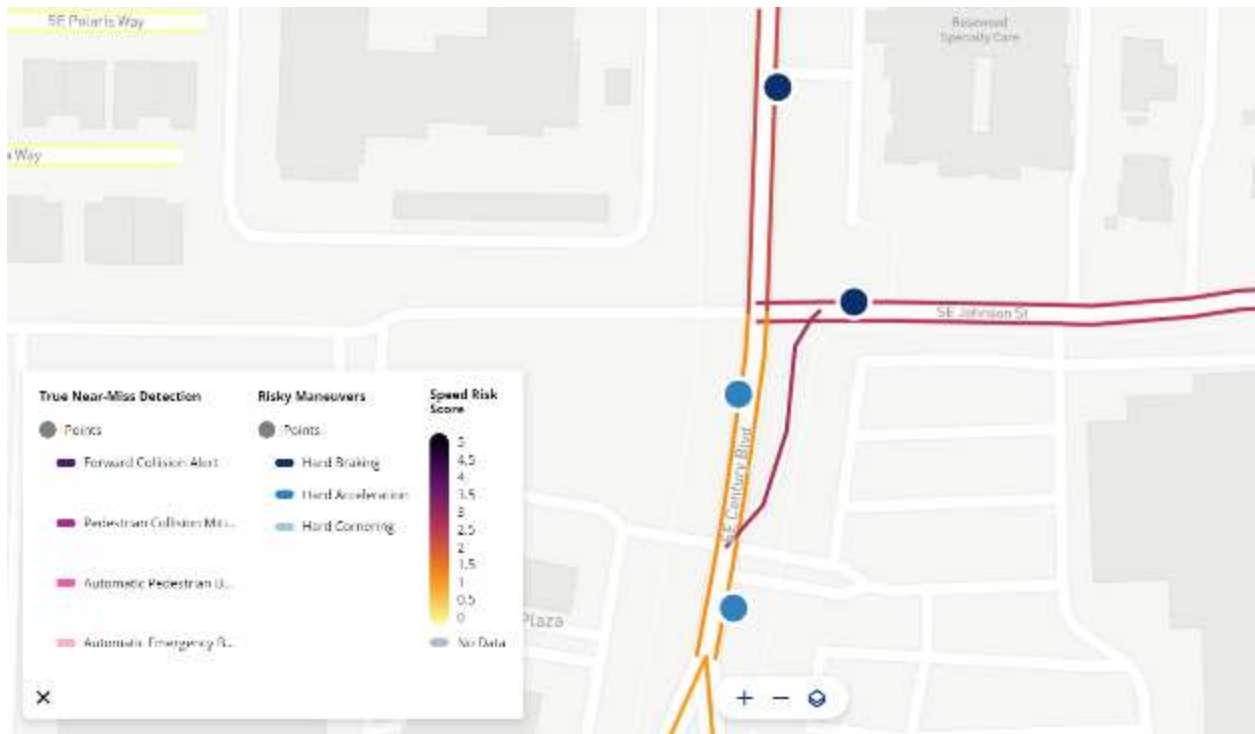
## Appendix D. Safety View by INRIX and GM Future Roads

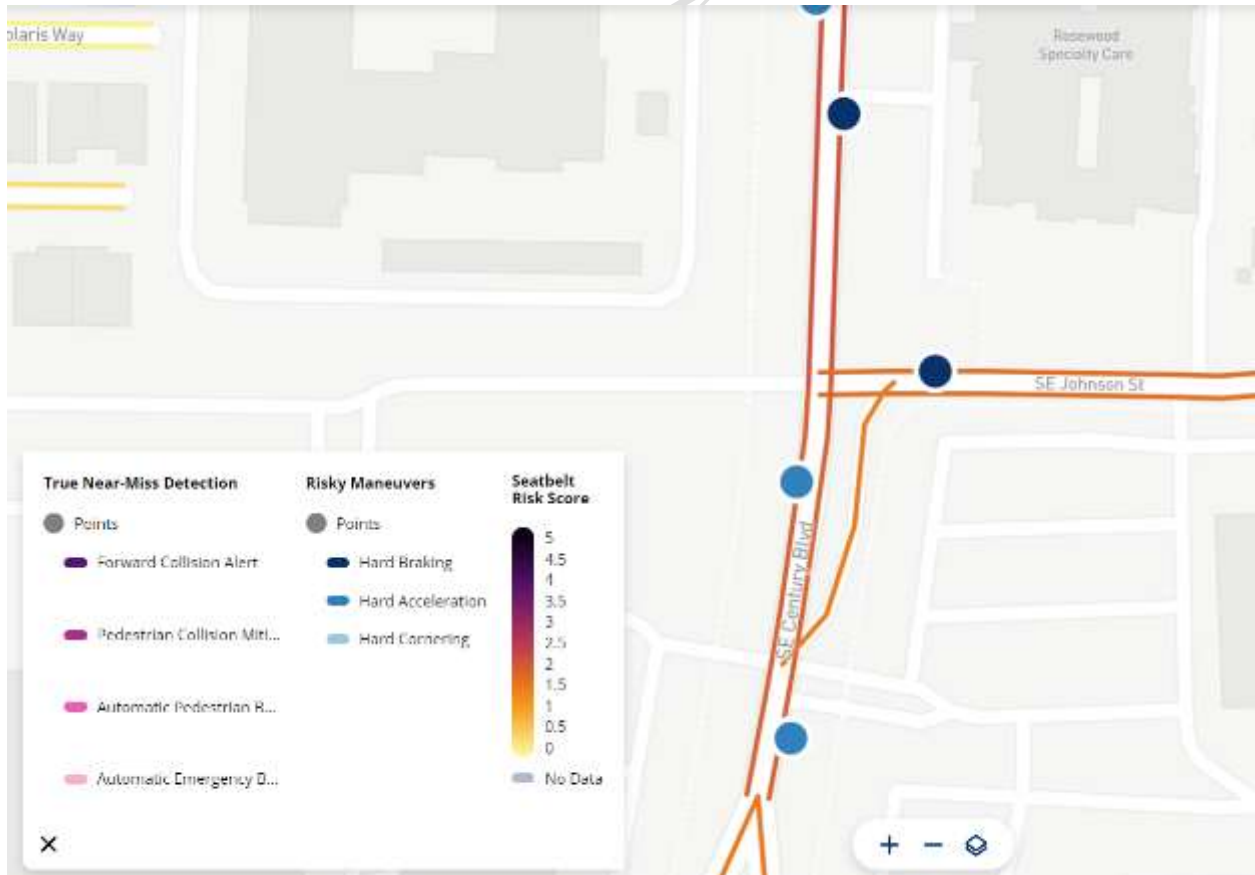
# SAFETY VIEW BY INRIX AND GM FUTURE ROADS

The figures below document the Safety View data at the intersections identified for site-specific recommendations.

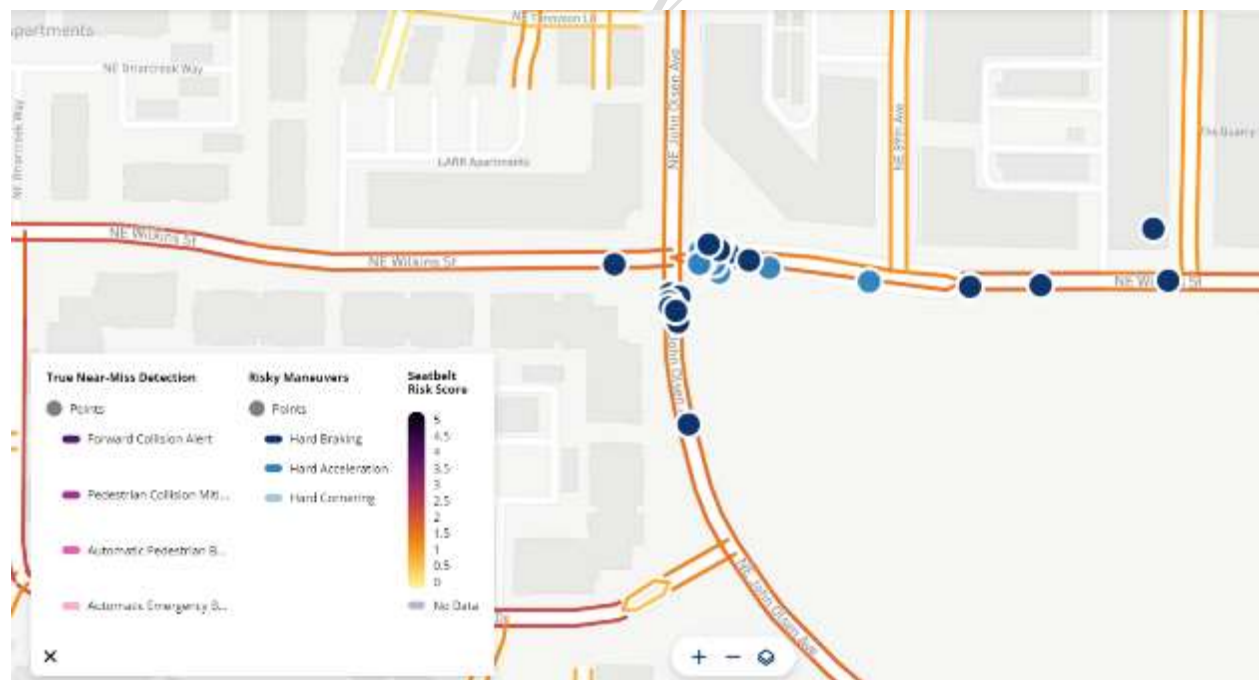
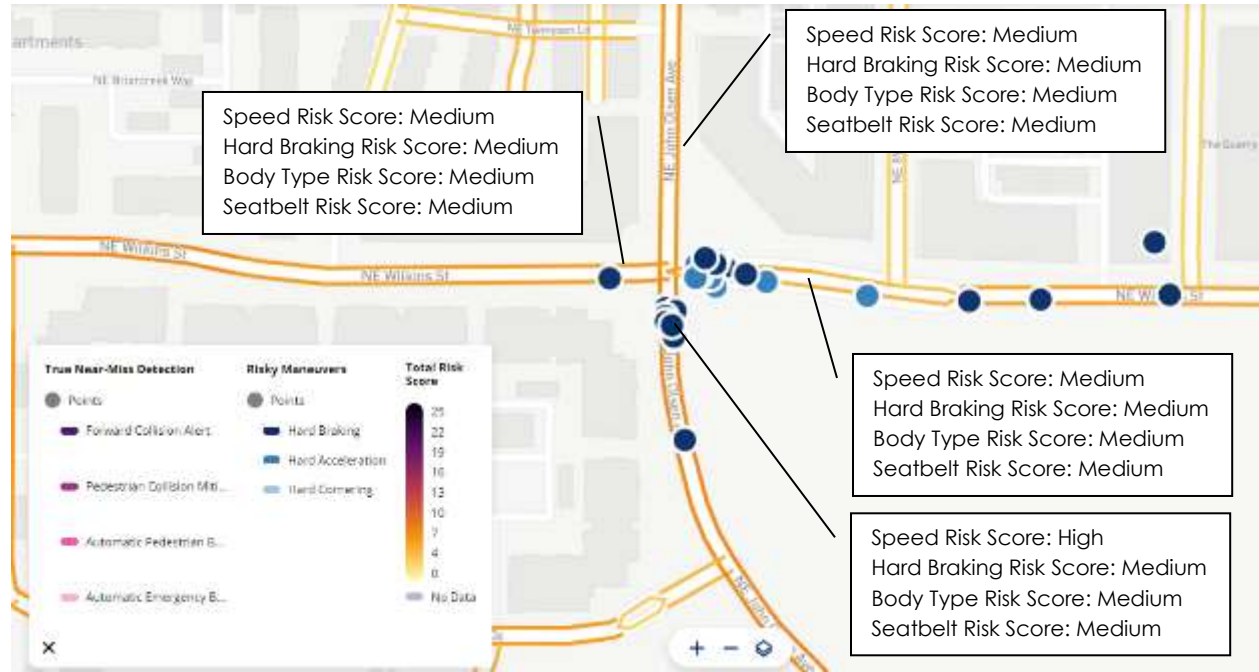
## Safety View Data at SE Johnson St / SE Century Blvd

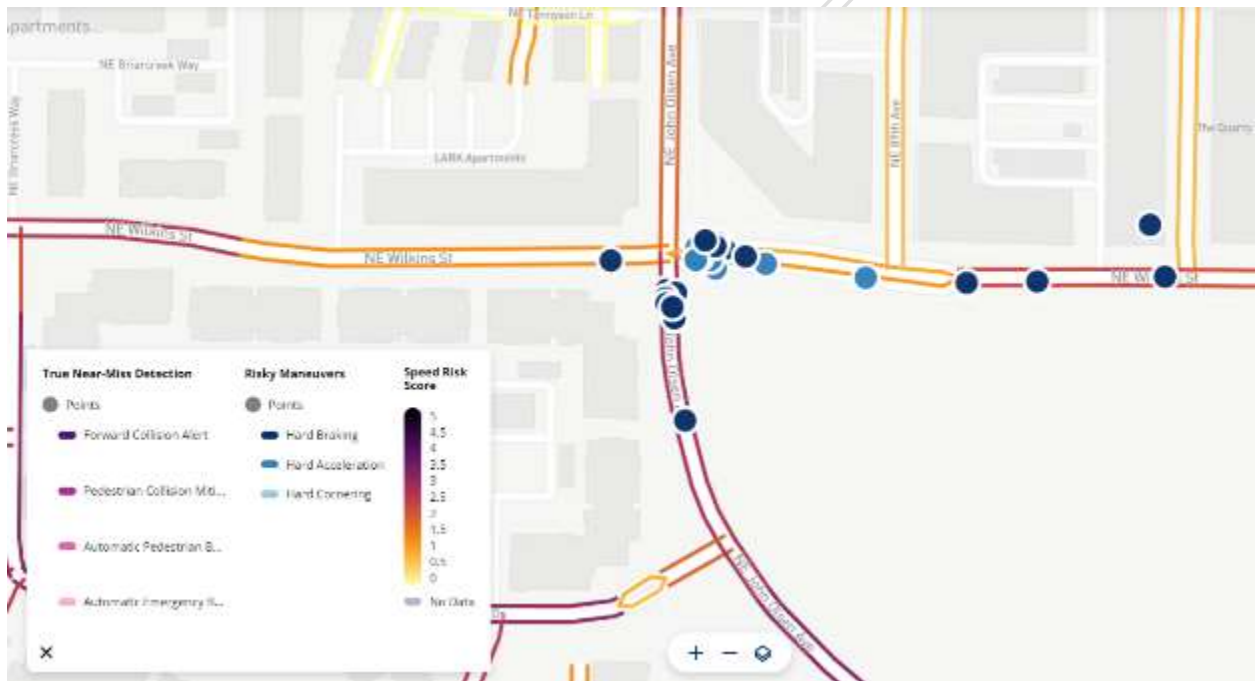
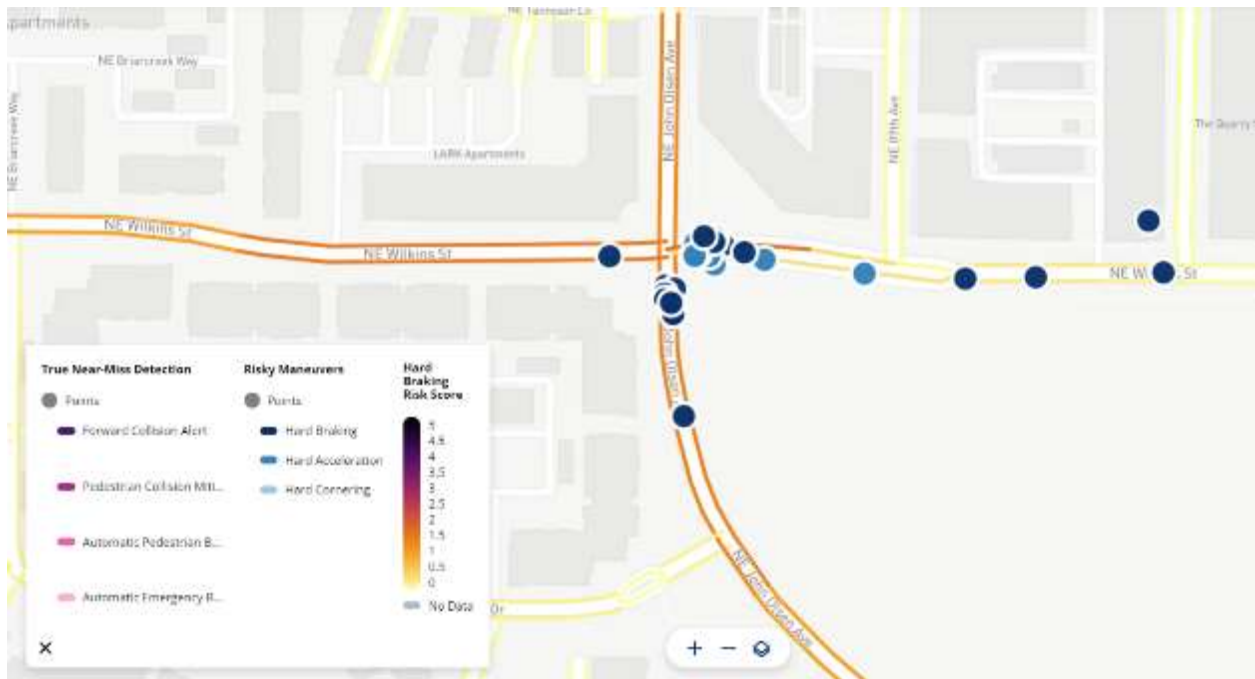




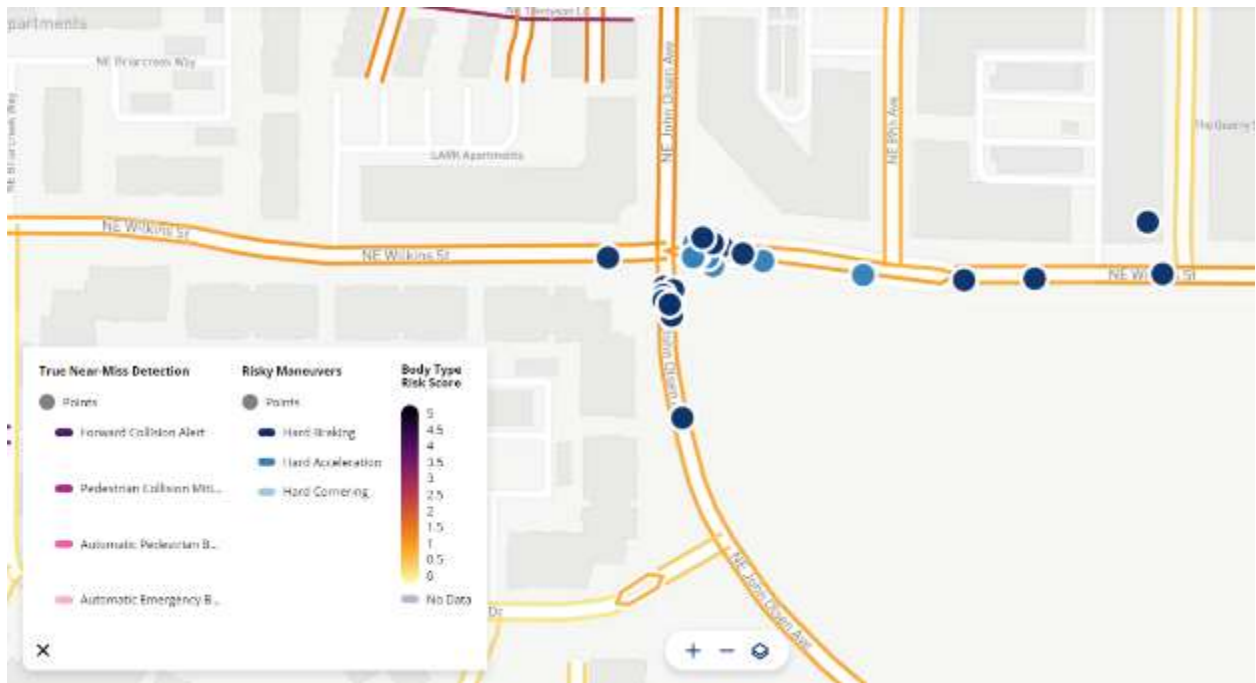


# Safety View Data at NE Wilkins St / NE John Olsen Ave

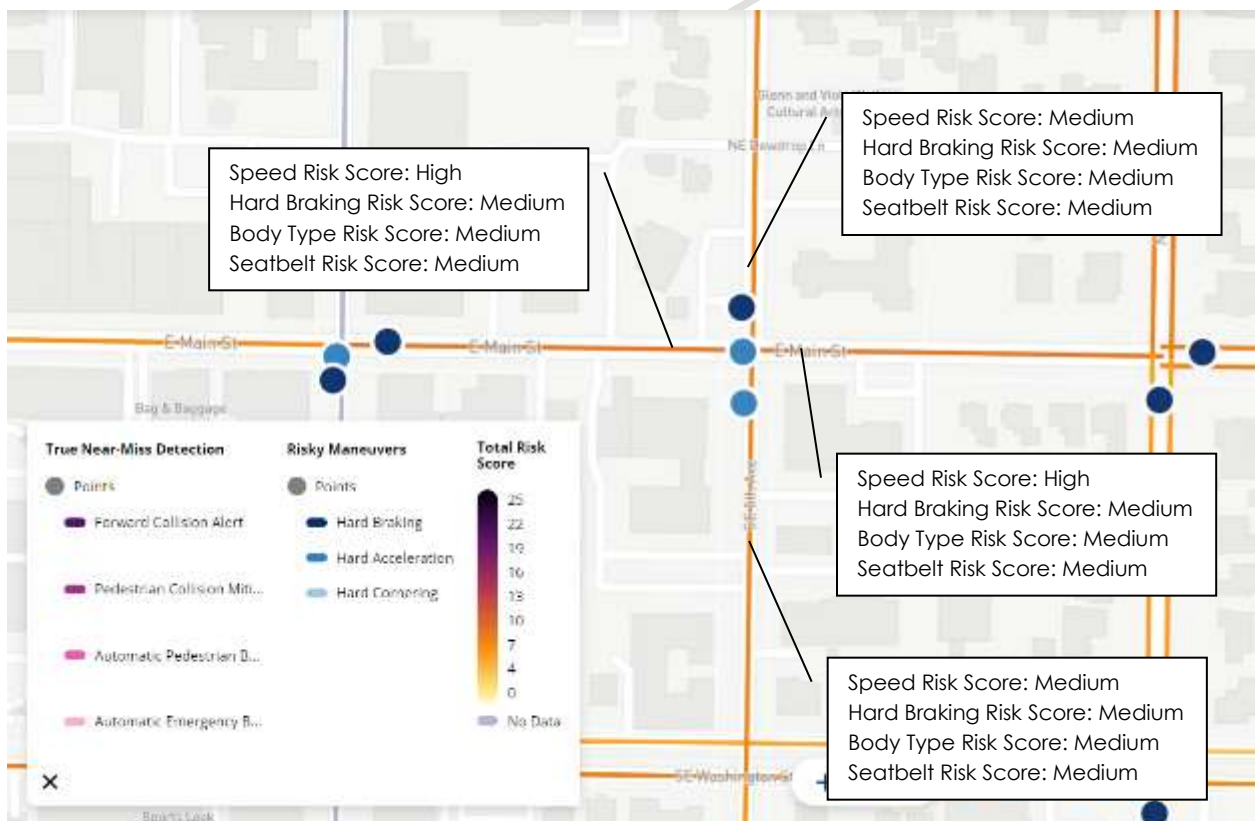


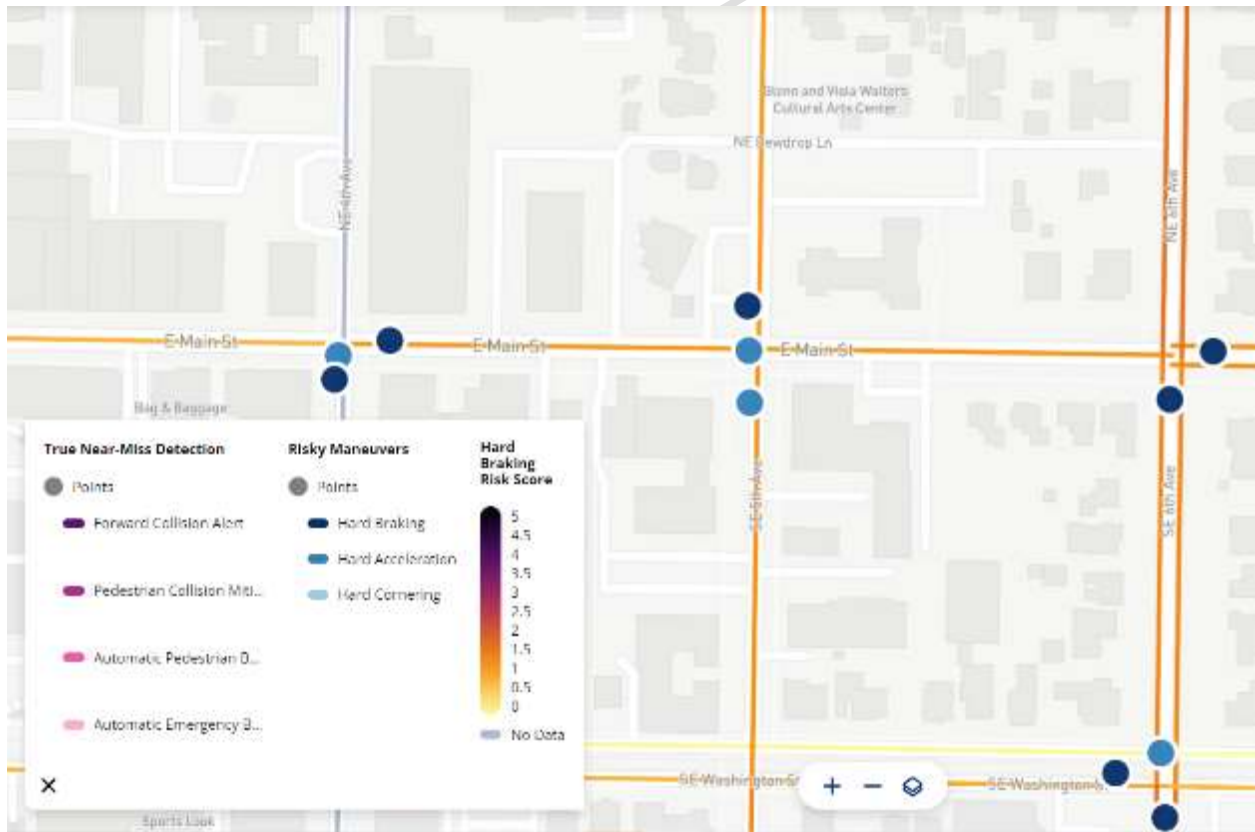






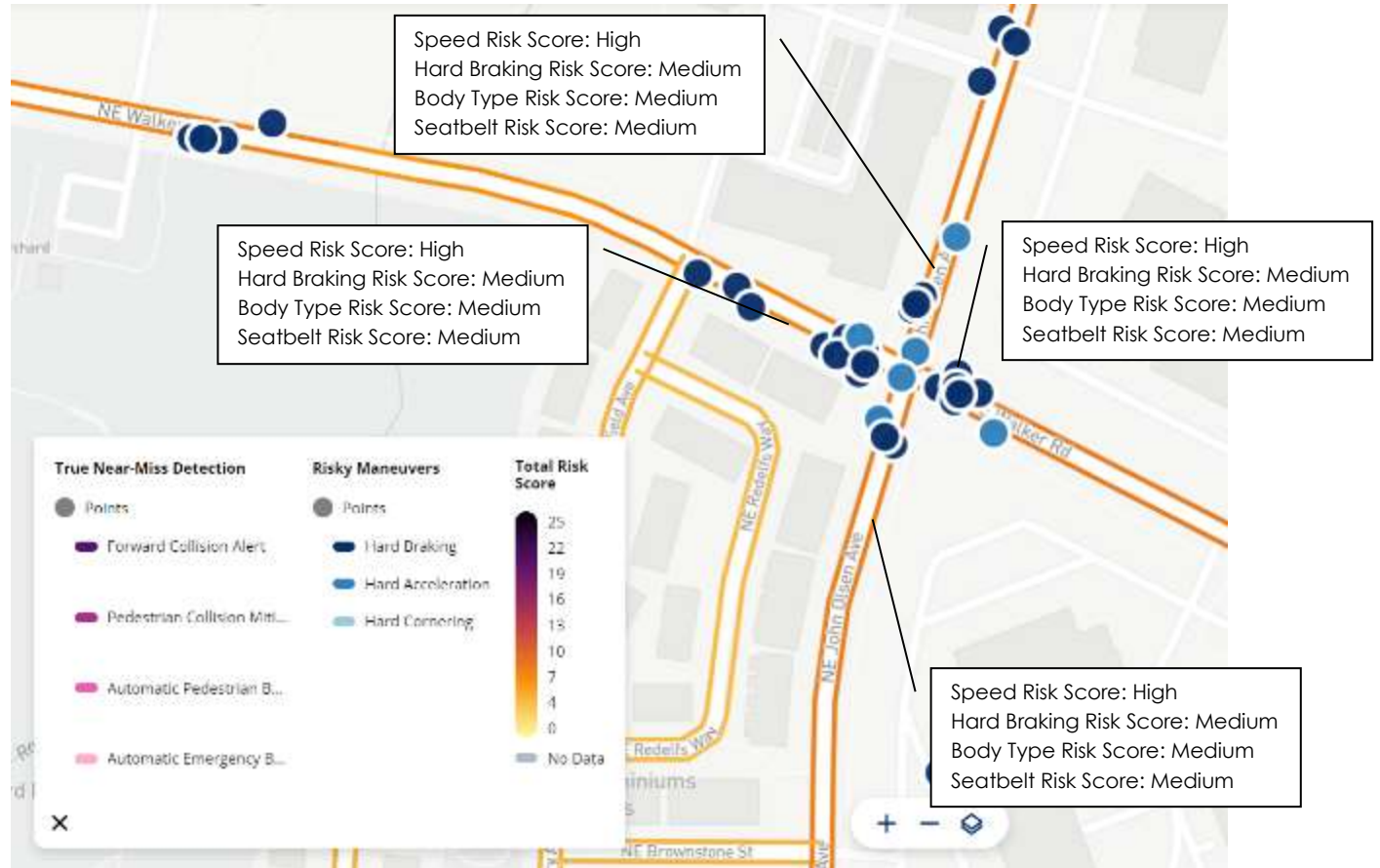
## Safety View Data at E Main St / NE 5<sup>th</sup> Ave

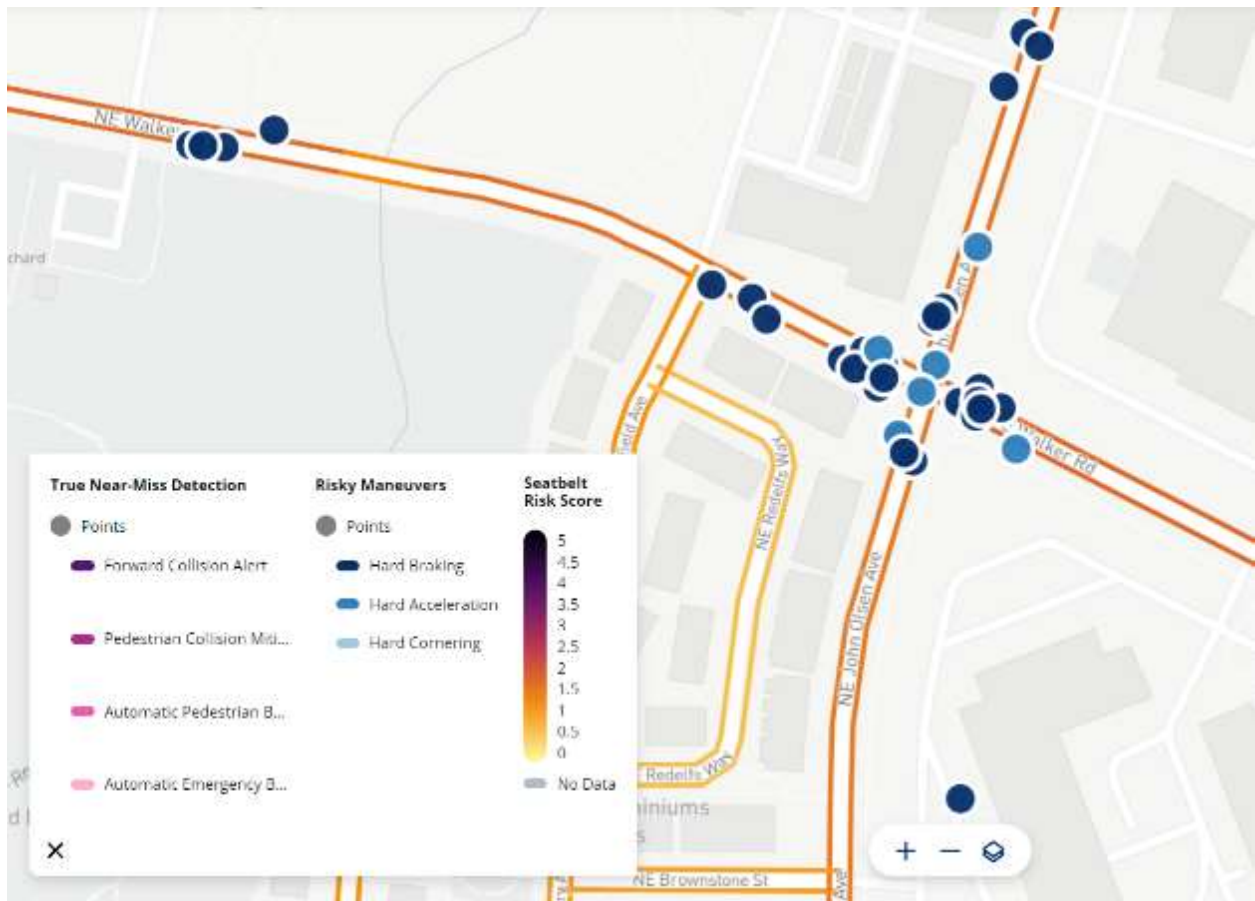




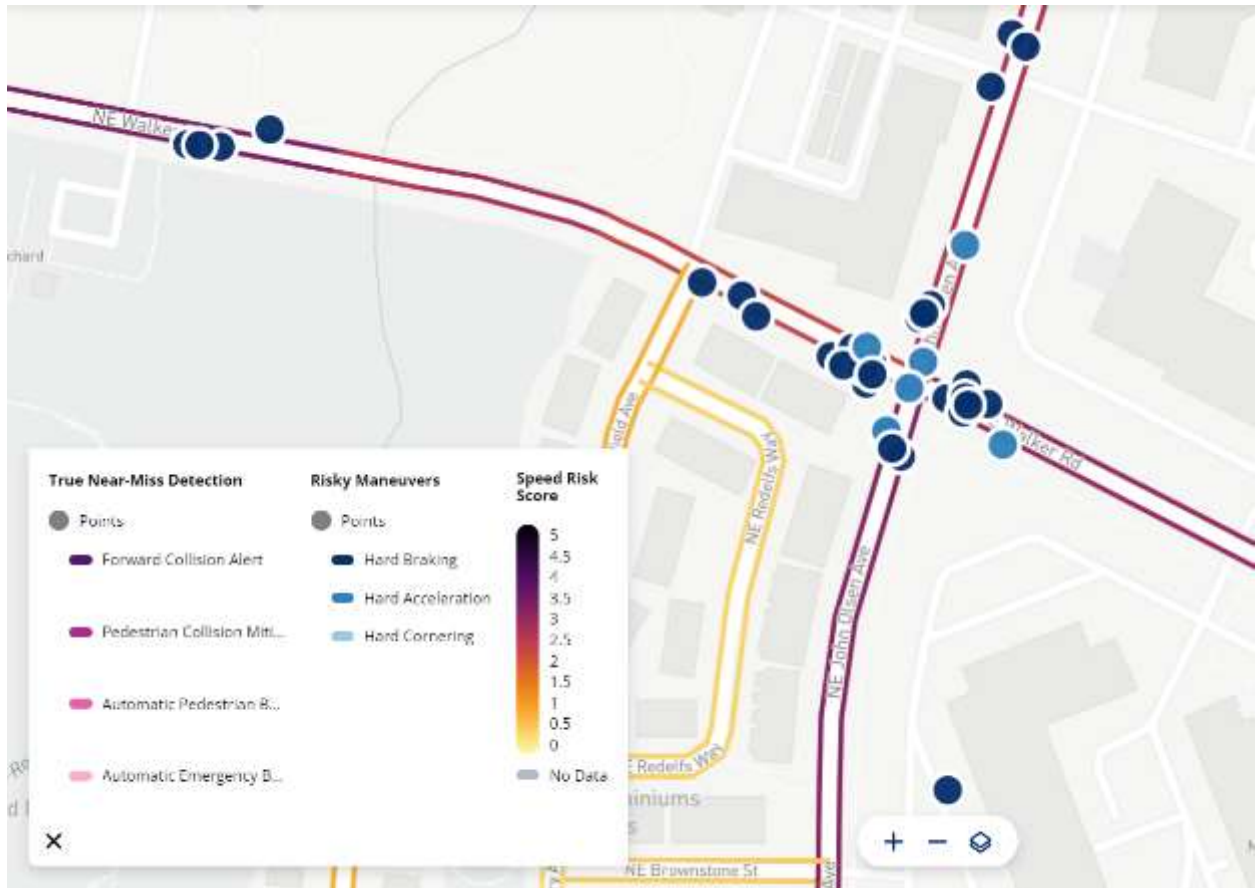


# Safety View Data at NE Wilkins St / NE John Olsen Ave





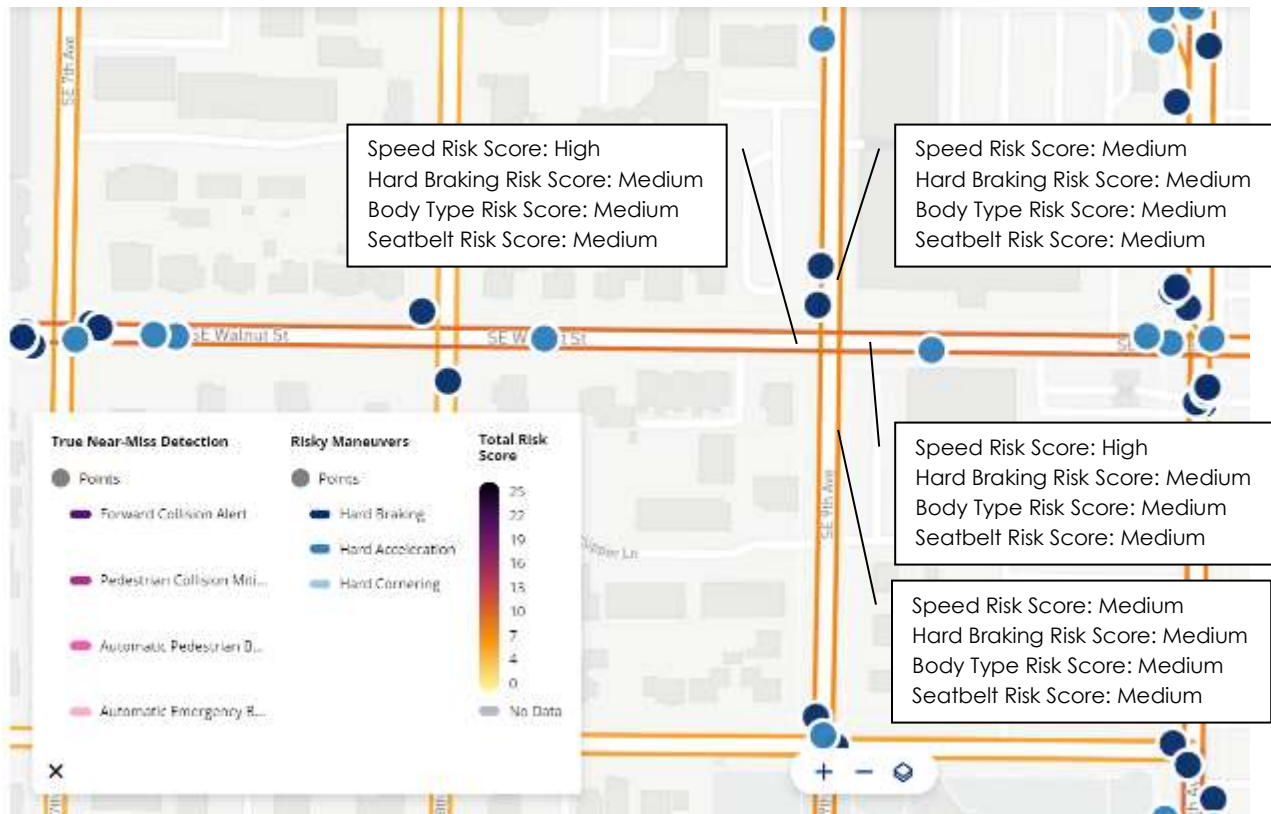


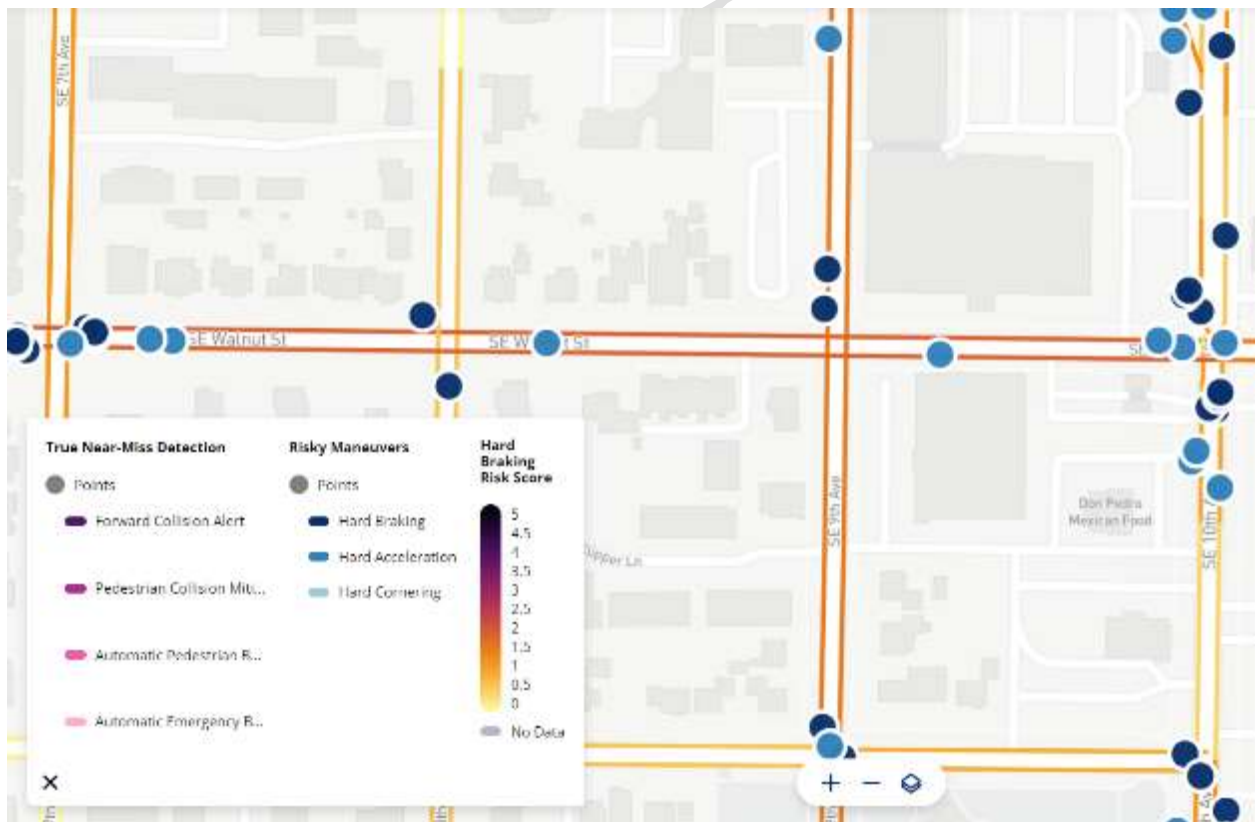


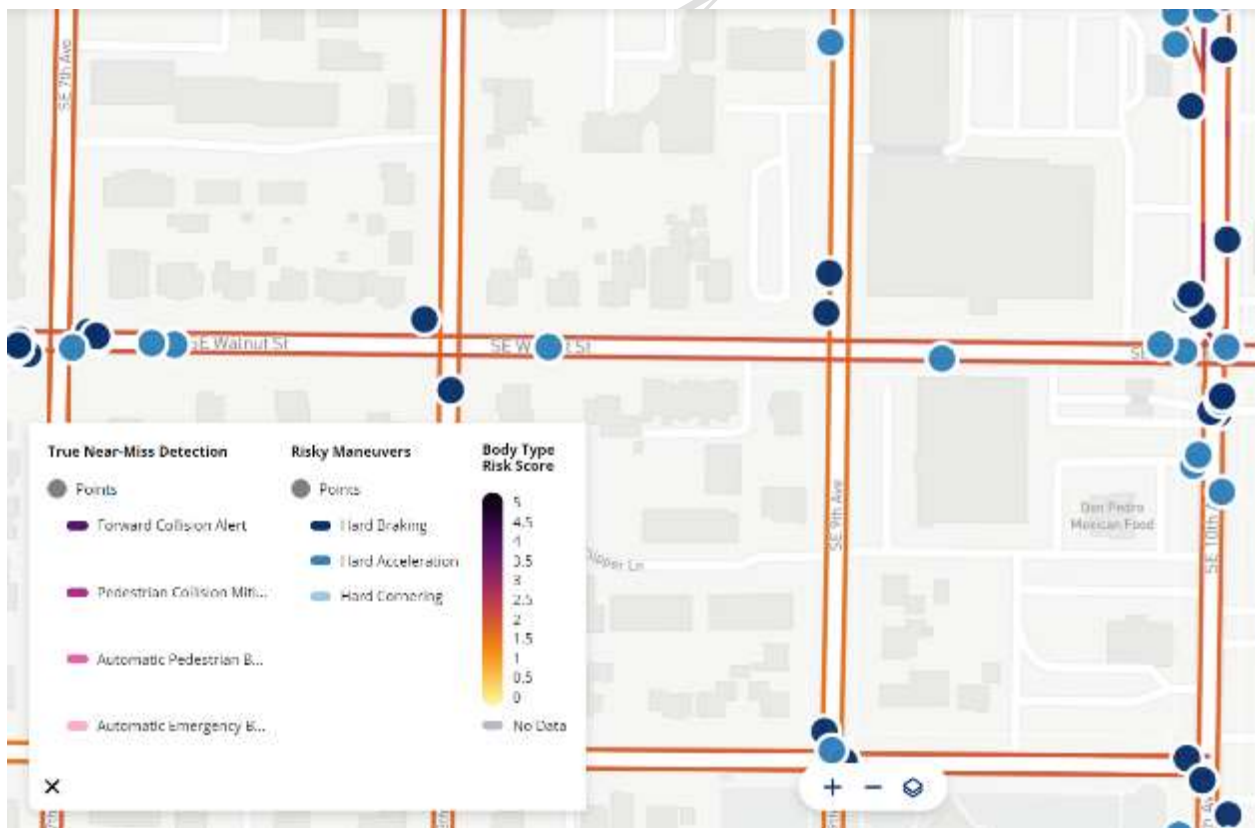
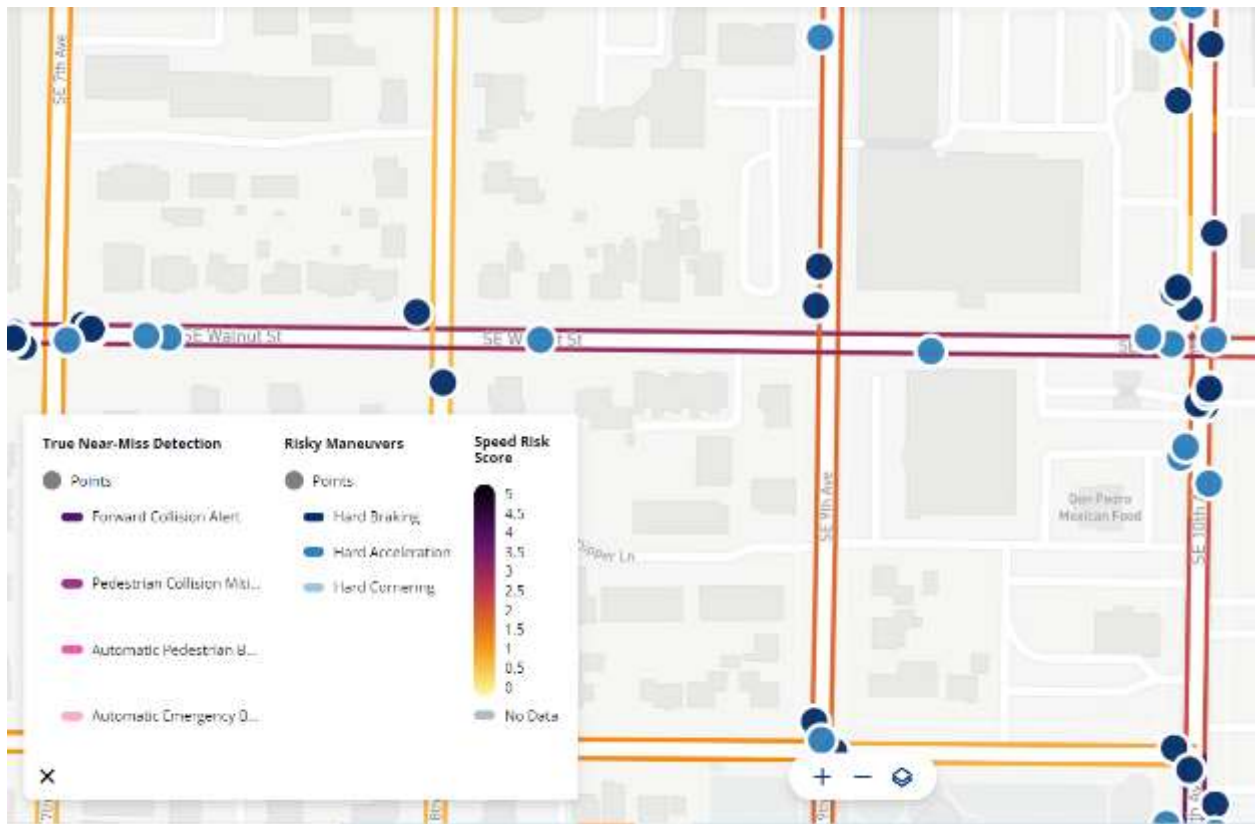




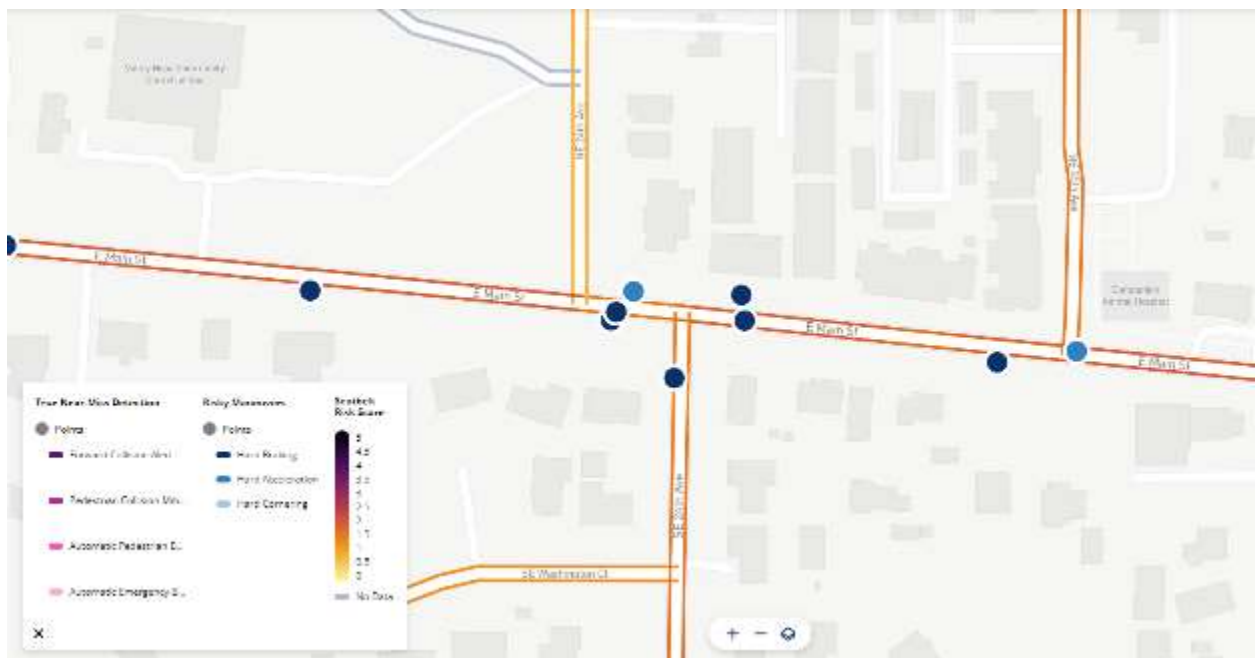
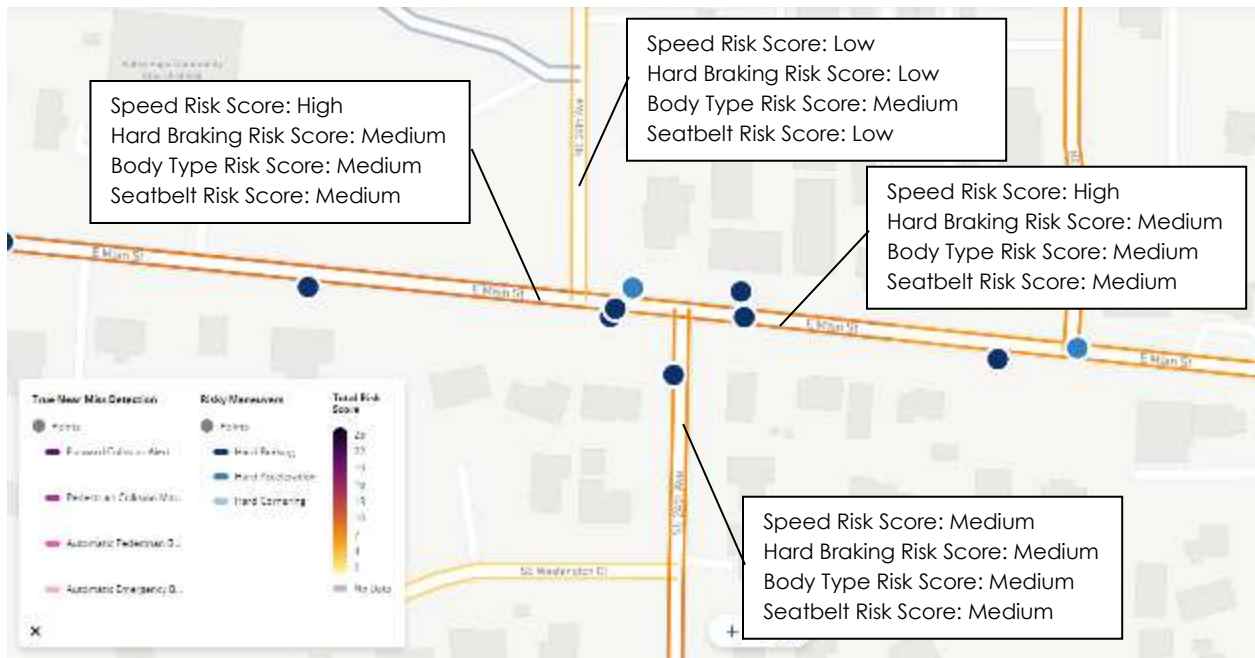
## Safety View Data at SE Walnut St / SE 9th Ave

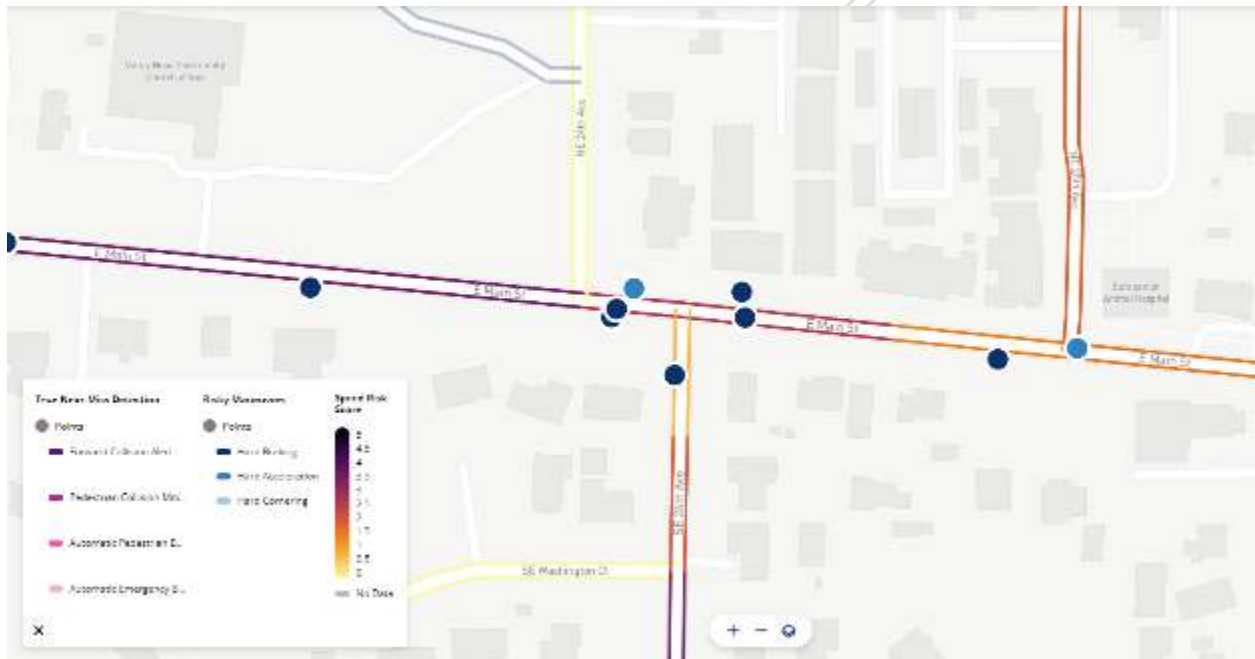






## Safety View Data at E Main St / SE 24<sup>th</sup> Ave







## Appendix E. Cost Estimates

Cost Estimates					
Item	Reference	Unit Cost	Quantity	Notes/Assumptions	Cost (Rounded up to Nearest \$10,000)
SE JOHNSON ST / SE CENTURY BLVD					
Install Traffic Singal		\$500,000	1	Assume dual mast arm, based assumptions on recent projects in Washinton County	\$530,000
Install Crosswalk Visibility Enhancements - High Visibility		\$22,000	1	Striping quantities based on CAD sheets, unit costs based on recent projects	
E MAIN ST / NE 5TH AVE					
Install All-Way Stop Control	<i>Camas LSRP</i>	\$7,500	1	Factored up cost from reference to account for oversized signs and inflation.	\$120,000
Improve Intersection Warning	<i>Camas LSRP</i>	\$700	4	Assume 4 advanced warning signs indicating lane movements.	
Install Curb Ramps and Extensions	<a href="https://safety.fhwa.dot.gov/safer_journey1/Library/countermeasures/23.htm#:~:text=Estimated%20Cost,costs%20would%20also%20be%20higher.">https://safety.fhwa.dot.gov/safer_journey1/Library/countermeasures/23.htm#:~:text=Estimated%20Cost,costs%20would%20also%20be%20higher.</a>	\$20,000	4	Assume high end of FHWA estimate.	
Install Crosswalk Visibility Enhancements		\$11,000	1	Striping quantities based on CAD sheets, unit costs based on recent projects	
Install Median	<a href="https://safety.fhwa.dot.gov/safer_journey1/library/countermeasures/16.htm#:~:text=The%20cost%20for%20adding%20a,or%20other">https://safety.fhwa.dot.gov/safer_journey1/library/countermeasures/16.htm#:~:text=The%20cost%20for%20adding%20a,or%20other</a>	\$15,000	0.75	Unit cost provided per 100 feet, estimating 75-foot long median.	



	<a href="#">%20street%20construction%20pr oject.</a>				
<b>NE JOHN OLSEN AVE / NE WALKER RD</b>					
Replace Doghouse Signal with FYA	<i>Camas LSRP</i>	\$200,000	1	Assumes 4 new installations	\$210,000
Advanced Signing	<i>Camas LSRP</i>	\$700	4	Assume 4 advanced warning signs	
High Visibility Backplates		\$350	8	Assume 8 backplates replaced based on recent project costs	
Install Crosswalk Visibility Enhancements		\$24,000	1	Striping quantities based on CAD sheets, unit costs based on recent projects	
<b>SE 9TH AVE / SE WALNUT ST</b>					
Install All-Way Stop Control		\$7,500	1	Factored up cost from reference to account for oversized signs and inflation.	\$100,000
Install Curb Ramps and Extensions	<a href="https://safety.fhwa.dot.gov/safer_journey1/Library/countermeasures/23.htm#:~:text=Estimated%20Cost,costs%20would%20also%20be%20higher.">https://safety.fhwa.dot.gov/safer_journey1/Library/countermeasures/23.htm#:~:text=Estimated%20Cost,costs%20would%20also%20be%20higher.</a>	\$20,000	4	Assume high end of FHWA estimate.	
Install Crosswalk Visibility Enhancements		\$8,000	1	Striping quantities based on CAD sheets, unit costs based on recent projects	
<b>E MAIN ST / SE 24TH AVE</b>					
Add Advanced Signing	<i>Camas LSRP</i>	\$700	4	Assumes 4 advanced warning signs	\$90,000
High Visibility Backplates		\$350	8		

Pedestrian Refuge Island	<a href="https://safety.fhwa.dot.gov/saferjourney1/Library/countermeasures/25.htm#:~:text=Estimated%20cost&amp;text=The%20cost%20for%20installing%20a, island%20or%20one%20without%20landscaping.">https://safety.fhwa.dot.gov/saferjourney1/Library/countermeasures/25.htm#:~:text=Estimated%20cost&amp;text=The%20cost%20for%20installing%20a, island%20or%20one%20without%20landscaping.</a>	\$9,000	1	
Pedestrian Countdown Timers	<i>Camas LSRP (Excludes push button and pole cost)</i>	\$1,500	2	Assumes timers are able to be posted on existing poles and existing conduit.
Replace 4-section Vehicle Signal Display with 3-section Vehicle Signal Display		\$1,000	1	Unit costs based on recent projects
Traffic Calming (Restriping) & High Visibility Pavement Markings		see below	see below	Striping quantities based on CAD sheets, unit costs based on recent projects
Remove Existing Pavement Markings	<i>Hydroblasting - \$1 per linear foot</i>	\$1	2500	
Add New Pavement Markings		\$64,000	1	

Project costs that need to be considered for grant funding: design, mobilization, traffic control, stormwater improvements, construction administration, and other contingencies,.