City and County of Denver
Vision Zero
Road Safety Audit
Quebec Street

FEBRUARY 2022
Felsburg Holt and Ullevig
Fehr & Peers
NOT FOR CONSTRUCTION – Recommendations contained in this document are intended ONLY for use by the local agency in determining possible future changes at the RSA location.

Information provided in this report does not reflect the opinion of any one team member. The recommendations reflect the collective suggestions of all team members based on their individual education, training, and experience.

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# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>City and County of Denver RSA Process</td>
<td>1</td>
</tr>
<tr>
<td>RSA Team</td>
<td>2</td>
</tr>
<tr>
<td>Background Information, Observations, and Recommendations</td>
<td>2</td>
</tr>
<tr>
<td>- Pre-Audit Meeting</td>
<td>3</td>
</tr>
<tr>
<td>- Observation Process</td>
<td>3</td>
</tr>
<tr>
<td>- Recommendation Process</td>
<td>3</td>
</tr>
<tr>
<td>Quebec Street Corridor</td>
<td>4</td>
</tr>
<tr>
<td>- Background Information</td>
<td>4</td>
</tr>
<tr>
<td>- Crash Review</td>
<td>5</td>
</tr>
<tr>
<td>- Crash Data Summary</td>
<td>6</td>
</tr>
<tr>
<td>- Pre-Audit Comments</td>
<td>6</td>
</tr>
<tr>
<td>- Corridor-Wide Observations</td>
<td>7</td>
</tr>
<tr>
<td>- Corridor-Wide Recommendations</td>
<td>11</td>
</tr>
<tr>
<td>I. Quebec Street &amp; 26th Avenue</td>
<td>13</td>
</tr>
<tr>
<td>- Background Information</td>
<td>13</td>
</tr>
<tr>
<td>- Crash Review</td>
<td>13</td>
</tr>
<tr>
<td>- Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting</td>
<td>14</td>
</tr>
<tr>
<td>- Observations</td>
<td>14</td>
</tr>
<tr>
<td>- Recommendations</td>
<td>15</td>
</tr>
<tr>
<td>II. Quebec Street &amp; 28th Avenue</td>
<td>16</td>
</tr>
<tr>
<td>- Background Information</td>
<td>16</td>
</tr>
<tr>
<td>- Crash Review</td>
<td>16</td>
</tr>
<tr>
<td>- Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting</td>
<td>17</td>
</tr>
<tr>
<td>- Observations</td>
<td>17</td>
</tr>
<tr>
<td>- Recommendations</td>
<td>18</td>
</tr>
<tr>
<td>III. Quebec Street &amp; Shopping Center Access</td>
<td>19</td>
</tr>
<tr>
<td>- Background Information</td>
<td>19</td>
</tr>
<tr>
<td>- Crash Review</td>
<td>19</td>
</tr>
<tr>
<td>- Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting</td>
<td>19</td>
</tr>
<tr>
<td>- Observations</td>
<td>19</td>
</tr>
<tr>
<td>- Recommendations</td>
<td>20</td>
</tr>
<tr>
<td>IV. Quebec Street &amp; 29th Avenue</td>
<td>22</td>
</tr>
<tr>
<td>- Background Information</td>
<td>22</td>
</tr>
<tr>
<td>- Crash Review</td>
<td>22</td>
</tr>
<tr>
<td>- Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting</td>
<td>23</td>
</tr>
<tr>
<td>- Observations</td>
<td>23</td>
</tr>
<tr>
<td>- Recommendations</td>
<td>24</td>
</tr>
</tbody>
</table>
V. Quebec Street & 29th Drive ................................................................. 26
   Background Information .................................................................... 26
   Crash Review .................................................................................. 26
   Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting .................................................. 26
   Observations .................................................................................. 26
   Recommendations .......................................................................... 27

VI. Quebec Street & Martin Luther King Jr. Boulevard............................. 28
   Background Information .................................................................... 28
   Crash Review .................................................................................. 28
   Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting .................................................. 30
   Observations .................................................................................. 30
   Recommendations .......................................................................... 32

VII. Quebec Street & 33rd Avenue .......................................................... 35
    Background Information .................................................................... 35
    Crash Review .................................................................................. 35
    Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting .................................................. 36
    Observations .................................................................................. 36
    Recommendations .......................................................................... 37

VIII. Quebec Street & 35th Avenue ......................................................... 39
      Background Information .................................................................... 39
      Crash Review .................................................................................. 40
      Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting .................................................. 40
      Observations .................................................................................. 40
      Recommendations .......................................................................... 42

IX. Quebec Street & 36th Avenue ............................................................ 43
   Background Information .................................................................... 43
   Crash Review .................................................................................. 43
   Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting .................................................. 44
   Observations .................................................................................. 44
   Recommendations .......................................................................... 46

X. Quebec Street & Smith Road .............................................................. 47
   Background Information .................................................................... 47
   Crash Review .................................................................................. 48
   Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting .................................................. 48
   Observations .................................................................................. 48
   Recommendations .......................................................................... 50
Appendices

Appendix A. RSA Recommendations Table
Appendix B. RSA Pre-Audit Meeting Presentation
Appendix C. RSA Intent Memorandum
Appendix D. Preliminary Findings Presentation

List of Figures

Figure 1. Project Location Map .................................................................................................................................................. 1
Figure 2. RSA Team Members .................................................................................................................................................... 2
Figure 3. Project Area Speed Limits and Average Annual Daily Traffic............................................................................ 4
Figure 4. Corridor Crash Map .................................................................................................................................................... 5
Figure 5. Crashes by Location .................................................................................................................................................... 6
Figure 6. Examples of Roadway Users ...................................................................................................................................... 8
Figure 7. Missing Sidewalk north of 36th Avenue .................................................................................................................. 8
Figure 8. Obscured Speed Limit Sign north of Martin Luther King Jr. Boulevard ........................................................ 9
Figure 9. Excessive Westbound Queue Spillback at 36th Avenue ................................................................................... 10
Figure 10. Pedestrian Activity at Martin Luther King Jr. Boulevard Intersection ......................................................... 10
Figure 11. Quebec Street & 26th Avenue ............................................................................................................................. 13
Figure 12. Missing Sidewalk Connection from 26th Avenue to Bus Stop ........................................................................ 14
Figure 13. Quebec Street & 26th Avenue Recommendation Map .................................................................................. 15
Figure 14. Quebec Street & 28th Avenue ............................................................................................................................. 16
Figure 15. Damaged Signposts at 28th Avenue .................................................................................................................... 17
Figure 16. Quebec Street & 28th Avenue Recommendation Map .................................................................................. 18
Figure 17. Quebec Street & Shopping Center Access ........................................................................................................ 19
Figure 18. Over Tracking Damage at Shopping Center Access ....................................................................................... 20
Figure 19. Quebec Street & Shopping Center Access Recommendation Map ............................................................. 21
Figure 20. Quebec Street & 29th Avenue ............................................................................................................................. 22
Figure 21. South Crosswalk at 29th Avenue Intersection ................................................................................................. 23
Figure 22. Quebec Street & 29th Avenue Recommendation Map .................................................................................. 24
Figure 23. Quebec Street & 29th Avenue Concept ............................................................................................................ 25
Figure 24. Quebec Street & 29th Drive ................................................................................................................................. 26
Figure 25. Quebec Street & 29th Drive Recommendation Map ...................................................................................... 27
Figure 26. Quebec Street & Martin Luther King Jr. Boulevard ......................................................................................... 28
Figure 27. Underused Eastbound Through Lane at Martin Luther King Jr. Boulevard ..................................................... 31
Figure 28. Incorrect Southbound Striping at Martin Luther King Jr. Boulevard ........................................................... 31
Figure 29. Quebec Street & Martin Luther King Jr. Boulevard Recommendation Map ............................................. 32
Figure 30. Quebec Street & Martin Luther King Jr. Boulevard Concept .......................................................................... 33
Figure 31. Conceptual Green Up Arrow Indication ............................................................................................................ 34
Figure 32. Quebec Street & 33rd Avenue ............................................................................................................................ 35
Figure 33. Bicyclist Crossing Southbound Quebec Street at 33rd Avenue ................................................................... 36
Figure 34. Quebec Street & 33rd Avenue Recommendation Map ................................................................. 37
Figure 35. Quebec Street & 33rd Avenue Concepts .................................................................................. 38
Figure 36. Quebec Street & 35th Avenue .................................................................................................. 39
Figure 37. Westbound Queue Spillback at 35th Avenue ........................................................................ 41
Figure 38. Left-Turn/Pedestrian Conflict During Permitted Phase at 35th Avenue .................................. 41
Figure 39. Quebec Street & 35th Avenue Recommendation Map ............................................................. 42
Figure 40. Quebec Street & 36th Avenue .................................................................................................. 43
Figure 41. Southbound Left-Turn Restriction at 36th Avenue ................................................................. 45
Figure 42. Overhead Lane Assignment Signs North of 36th Avenue ......................................................... 45
Figure 43. Quebec Street & 36th Avenue Recommendation Map ............................................................. 46
Figure 44. Quebec Street & Smith Road .................................................................................................. 47
Figure 45. Pedestrian Curb Ramp Aligned with Valley Gutter at Smith Road ........................................ 49
Figure 46. Poor Lighting in Channelized Right-Turn at Smith Road ....................................................... 49
Figure 47. Quebec Street & Smith Road Recommendation Map ............................................................. 50

List of Tables

Table 1. Recommended Left Turn Operations .......................................................................................... 12
Table 2. Quebec Street & 26th Avenue Crash Summary ........................................................................ 14
Table 3. Quebec Street & 28th Avenue Crash Summary ....................................................................... 17
Table 4. Quebec Street & 29th Avenue Crash Summary ....................................................................... 23
Table 5. Quebec Street & Martin Luther King Jr. Boulevard Crash Summary ..................................... 29
Table 6. Quebec Street & Martin Luther King Jr. Boulevard Red-Light Running Crashes ................... 29
Table 7. Quebec Street & 33rd Avenue Crash Summary ....................................................................... 36
Table 8. Quebec Street & 35th Avenue Crash Summary ....................................................................... 40
Table 9. Quebec Street & 36th Avenue Crash Summary ....................................................................... 44
Table 10. Quebec Street & Smith Road Crash Summary ..................................................................... 48
City and County of Denver RSA Process

The Denver Vision Zero Action Plan is a five-year plan to achieve zero traffic deaths and serious injuries by 2030. The Denver Vision Zero program provides traffic safety professionals a unique opportunity to work as part of a dedicated traffic safety improvement program by collaborating with law enforcement, first-responders, government officials, and other stakeholders.

The Quebec Street corridor is part of Denver’s High Injury Network (HIN). As part of the Vision Zero initiative, the City and County of Denver (CCD) has identified the HIN as the network of corridors with the highest number of fatal and injury crashes for all travel modes. The choice of Road Safety Audit (RSA) corridors is driven by their proximity to the Equity Index Areas, i.e., areas of Denver where more vulnerable populations live. As stated in Denver’s Vision Zero statement, these areas are places with higher speeds, in closer proximity to schools and high school density, elderly populations, people with disabilities, and those without vehicles. Figure 1 shows the project location. The study area includes both directions of Quebec Street between 26th Avenue and Smith Road in northeast Denver.

Figure 1. Project Location Map

RSAs are formal examinations of selected roadway entities from a safety performance viewpoint. All RSAs are performed by an independent multidisciplinary team and are highly benefited by including one or more professionals trained in performing RSAs. An RSA qualitatively estimates and reports on potential road safety issues and identifies opportunities for safety improvements for all road users. RSAs can be used in any phase of project development from planning to preliminary engineering to design to construction. RSAs can also be used on any sized project from a minor intersection and roadway retrofits to long corridors. The RSA team considers the safety of all road users, qualitatively estimates and reports on potential road safety issues, and identifies opportunities for safety improvement. The RSA team reviews police crash reports, reviews local agency crash data, and conducts field observations during different times of the day such as day/night and peak/non-peak hours.
RSA Team

Gaurav Vasisht of Felsburg Holt and Ullevig (FHU) led the independent multidisciplinary RSA team, which included:

- Gaurav Vasisht, PE, PTOE, RSP21, FHU
- Ryan Saline, PE, FHU
- Charles Alexander, PE, AICP, RSP1, Fehr & Peers
- Patrick Picard, AICP, RSP1, Fehr & Peers
- Hilda Ofori-Addo, Fehr & Peers

The following sections provide background information, crash review, comments from the RSA Pre-Audit Meeting, observations from the field review, and recommendations for the Quebec Street corridor and for each study intersection. Appendix A includes a comprehensive list of all recommendations, including location, countermeasures, crash modification factors (i.e., factors used to compute the expected number of crashes
after implementing a countermeasure), return on investment (a subjective low, medium and high rating), and planning-level cost estimate.

**Pre-Audit Meeting**

The RSA team met virtually on Tuesday, January 18, 2022, via Microsoft Teams with CCD staff Mike King (CCD Project Manager), David DiGiacomo, Thomas Shaw and Dana Hoffman to discuss background information and the RSA schedule. Additionally, Council Aide Leya Hartman from Christopher Herndon’s office (Council District #8) was also present. The RSA Pre-Audit Meeting presentations can be found in Appendix B. Information presented and discussed at the Pre-Audit/Kickoff Meeting is included under background information, crash review, and comments provided by City staff and RSA stakeholders.

**Observation Process**

The RSA team began the observation period by driving the Quebec Street corridor in both directions in its entirety, followed by driving every approach to each intersection. Corridor-wide observations are based on general observations made by the RSA team during the windshield review and while conducting the walking field reviews. Observations included road user behavior, traffic signal operations, Americans with Disabilities Act (ADA) facility conditions including ramps and sidewalks, sign visibility, design deficiencies, bicycle infrastructure, spot speed measurements, and windshield review.

Field reviews were conducted on:
- Tuesday, January 18 (RSA Day 1) – 4:00 PM to 9:00 PM
- Wednesday, January 19 (RSA Day 2) – 7:00 AM to 12:00 PM

Further information regarding presentations and site visits can be found in the RSA Intent Memorandum included in Appendix C. Weather was clear and cool on the Tuesday of observations, but cold with rain/snow mix during Wednesday morning observations. The observation periods consisted of driving and walking the road and observing road users. Information provided in this report does not reflect the opinion of any one team member.

**Recommendation Process**

Recommendations reflect the collective suggestions of all team members based on their individual education, training, and experience. The safety and mobility of all road users are considered. The recommendations listed below have been grouped into:

i. Short-term: (Less than 1 year) Denoted by a green circle
ii. Medium-term: (1 to 3 years) Denoted by a blue square

**Appendix A**

i. Low: Operational Improvements
ii. Medium: Up to $100,000
iii. High: Greater than $100,000

The RSA team met virtually on Monday, January 24, 2022, via Microsoft Teams, to present preliminary findings during the Post-Audit presentation to CCD staff Mike King (CCD Project Manager), David DiGiacomo, Thomas Shaw, Dana Hoffman, and Rolf Eisinger. Leya Hartman from Council District #8 was also present. Observations and potential opportunities for improvements were discussed during this meeting. Presentation slides from this meeting are provided in Appendix D.
Quebec Street Corridor

The following section provides background information, observations, and recommendations for the Quebec Street corridor, including intersection geometry, user behavior, signal control, and multimodal infrastructure.

Background Information

Quebec Street is a north-south arterial with varying characteristics throughout the project study limits. From 26th Avenue to 29th Avenue, two travel lanes are provided in each direction, and the posted speed limit is 35 miles per hour (MPH). From 29th Avenue to Martin Luther King Jr. Boulevard, Quebec Street has three travel lanes in each direction. From Martin Luther King Jr. Boulevard to 36th Avenue, Quebec Street has four travel lanes in each direction and the posted speed limit increases to 45 MPH. North of 36th Avenue, three travel lanes are carried under Smith Road in each direction while one lane serves as an access ramp to local businesses and Smith Road.

Sidewalks are provided throughout most of the project area. There are no bike lanes on Quebec Street. Bike lanes are provided on Martin Luther King Jr. Boulevard, but not in the immediate vicinity of the intersection. Bike lanes are also provided on 26th Avenue, and 29th Avenue is a designated bike route. Annual Average Daily Traffic (AADT) along the Quebec Street corridor is estimated to be about 38,600 vehicles per day (vpd).

Several RTD bus routes serve the study corridor. Route 28 primarily serves 29th Avenue but crosses the corridor at Martin Luther King Jr. Boulevard before terminating at the Central Park Station. Route 43 serves Martin Luther King Jr. Boulevard west of the study area to the Central Park Station. Route 65 serves Monaco Parkway but uses Martin Luther King Jr. Boulevard to reach the Central Park Station. Finally, Route 73 serves Quebec Street from south of 26th Avenue to the Central Park Station. Figure 3 displays a summary of the corridor roadway characteristics.

![Figure 3. Project Area Speed Limits and Average Annual Daily Traffic](image-url)
Crash Review

Between March 2017 and March 2020, there were a total of 375 crashes along Quebec Street within the RSA project limits. Figure 4 illustrates the corridor crash map and Figure 5 shows crashes by location.

- 6 killed/serious injury (KSI) crashes were recorded during the study period
  - 1 fatal crash was reported
- 10 crashes involved pedestrians/cyclists
- 46 percent of total crashes were between 12 PM and 6 PM; 67 percent of KSI crashes were between 6 PM and 9 PM
- Total crashes: 34 percent broadside, 29 percent rear end, and 22 percent sideswipe
- KSI crashes: 50 percent pedestrian, 33 percent broadside, and 17 percent head on
- 4 additional KSI crashes were recorded since March 2020

![Figure 4. Corridor Crash Map](image-url)
Crash Data Summary

The following summarize the corridor-wide crash data and present common trends at intersections and along midblock segments:

- Broadside crashes were the most common types observed at intersections within the study area. This is heavily influenced by the frequency of red-light running, especially at the Martin Luther King Jr. Boulevard intersection.
- Rear end and sideswipe crashes were the next most common crash types within the study area. This may be influenced by the frequency of traffic signals and unexpected lane configuration changes, especially in the southbound direction.
- Pedestrian crashes were most common at signalized intersections and involved motorists turning left from a side street and failing to yield to pedestrians in the crosswalk.
- Total crash frequency along the study corridor was substantially elevated from 12 PM to 6 PM. This is likely associated with generally higher traffic volumes.
- KSI crash frequency was generally even between 6 AM and 9 PM, which was influenced by elevated vehicle and pedestrian activity along the corridor.
- The highest crash frequencies were observed at the Martin Luther King Jr. Boulevard and 36th Avenue intersections.

Pre-Audit Comments

City staff and RSA stakeholders provided several comments during the Pre-Audit Meeting, including:

- AADT variation is expected throughout the corridor but could not be confirmed by counts. The RSA team and Department of Transportation and Infrastructure (DOTI) staff will look for additional counts from other studies to help examine AADT.
- DOTI noted that no major projects are planned in the RSA study area, but multiple are planned on the north and south sides.
  - New bridge construction is planned for Quebec Street over Airlawn Road. The project will also provide missing sidewalk and trail connections to Quebec Street between I-70 and Smith Road.
  - Multimodal improvements are planned for Quebec Street between 12th Avenue and Montview Avenue. The project will provide sidewalk connections, build new bus pads, and reconstruct the 17th Avenue intersection and traffic signals.

![Figure 5. Crashes by Location](image-url)
- KSI crashes were most frequently observed between 6PM and 9PM, but no trends were found with respect to lighting conditions.

- Several lane-drops along southbound Quebec Street come from different sides of the street and may be a source of driver confusion and sideswipe crashes (i.e., Martin Luther King Jr. Boulevard, 29th Avenue, 17th Avenue).

- Red-light running is common at the Martin Luther King Jr. Boulevard intersections. DOTI requested the RSA team investigate time-of-day influence on crash history.
  - The RSA team should try to observe the intersection during dusk and midday to assess if sun glare is a contributing factor for red-light running.
  - The RSA team should observe operations at the Martin Luther King Jr. Boulevard intersection to assess the function traffic controllers, which use multiple cabinets.
  - The RSA team should observe the visibility of downstream programmable signal indications and assess their influence on red-light running.

- Red-light enforcement cameras are in place for northbound Quebec Street at the 36th Avenue intersection.
  - Council District #8 has received complaints about this camera, but no other comments were provided about the corridor.

- DOTI is collecting turning movement counts at 35th Avenue and 36th Avenue intersections to determine the feasibility of split-phasing for east-west movements. The counts will not be available before the RSA is complete, but the RSA team should consider the safety impacts of these operations.

- The RSA team should also attempt to observe A-Line railroad crossings if possible. Multiple bike/ped fatal crashes have been recorded, and DOTI would like to ensure that crossing arms are functioning properly.
  - Significant delay is caused by these gates being down for several minutes before the crossing occurs due to the assumed speed of trains and may contribute to impatient road users.

- Driver familiarity is likely lower along this corridor due to the presence of commercial and industrial land uses nearby. This may be a contributing factor for many crashes. The RSA team noted multiple crash reports where drivers say they were following directions on their cell phones.

- The wide median on Quebec Street between Smith Road and Martin Luther King Jr. Boulevard is not a designated parkway and should not require coordination with Parks & Recreation if changes are proposed.

- A speed study was conducted in 2019 and identified that 85th percentile speeds on Quebec Street were 5 to 10 MPH above the posted speed limit. Recommended contextual speed limit changes were also discussed in this study.

- DOTI often receives complaints of wrong-way driving along parkway corridors but does not have many from Quebec Street. This may be due to the presence of commercial/industrial land uses versus residential land uses along other parkways.

**Corridor-Wide Observations**

The following section summarizes general observations that apply to the project corridor.

**Road Users**

The following road users were observed along the corridor (**Figure 6**):

- Vehicles
- Tractor trailers
- Motorcycles
- Bicyclists/shared scooters
- Pedestrians
- RTD buses
Observations and Issues

Pedestrian Infrastructure

- Most curb ramps lacked truncated domes.
- Several locations had curb ramp grades and landing areas that are not ADA compliant.
- Use of pedestrian countdown signals was inconsistent at intersections along the corridor.
- The sidewalk on the west side of Quebec Street south of Martin Luther King Jr. Boulevard was very narrow (about 2.5 feet).
- Segments of sidewalk that would provide connections to transit stops were missing.
Signing and Striping

- Many signs along the corridor are too small for the operating speed of Quebec Street.
- Several signs are placed at inappropriate locations.
- Signing is generally inconsistent within the corridor.
- There are several instances of incorrect striping along the corridor.

Traffic Operations

- Speeding was consistently observed along the corridor, with vehicle speeds frequently measured at 5 to 10 MPH above the posted speed limit.
- Several aggressive lane changes associated with the auxiliary through lanes at the Martin Luther King Jr. Boulevard intersections were observed.
- Late/unsafe lane changes were also observed along southbound Quebec Street where lane drops occur.
- Traffic volumes during the PM peak hour resulted in more substantial queueing than during the AM peak hour.
- Excessive queueing and spillbacks were observed along eastbound and westbound 35th Avenue and 36th Avenue during the PM peak hour.
- Long side street queues were observed at the Quebec Street & Martin Luther King Jr. Boulevard intersection (eastbound during the PM peak hour, westbound during the AM peak hour).
Adjacent Land Uses

- Surrounding land uses along the corridor include residential (single- and multi-family), hotels, and commercial retail.
- Land uses and transit services generate high pedestrian activity across Quebec Street.
- High shuttle activity associated with the hotels was observed along the corridor.
- The United Airlines Flight Training Center (FTC) is located on the east side of Quebec Street between Martin Luther King Jr. Boulevard and 35th Avenue.
  - United Airlines trainees frequently cross Quebec Street to travel between hotels and the FTC. Several large groups of pedestrians were observed during the PM peak hour.
Corridor-Wide Recommendations

The following recommendations are based on the collaborative effort of the RSA multidisciplinary team and stakeholder interviews, as well as on the team’s experience driving and walking the corridor:

1. Replace signs to provide appropriate size, retroreflectivity, and placement.
   a. Sign placement should be in visible and appropriate locations (as opposed to where convenient).
   b. Larger sign sizes should be used consistently throughout the corridor.
   c. Add one-way signs (R6-1) consistently on the far side of cross street intersections.
   d. Provide advance street name signs throughout the corridor. Where appropriate, supplement advance street name signs with directional arrows.

2. Improve traffic signal infrastructure.
   a. Ensure that all pedestrian push buttons are operating correctly.
   b. Implement countdown signals at all pedestrian crossings.
   c. Provide Leading Pedestrian Intervals (LPI) for additional intersections.
   d. Provide retroreflective backplate tape on all backplates at signalized intersections.

3. Improve pavement striping.
   a. Correct striping in locations where striping does not match the intent of lane use or does not provide enough warning for motorists to make safe lane changes.
   b. Add yellow edge lines throughout the corridor to reinforce one-way movements on couplet roadways.
   c. Provide positive guidance striping at intersections throughout the corridor.

4. Improve lighting conditions.
   a. Provide more consistency in brightness and color of lighting along Quebec Street.
   b. Increase lighting at channelized right-turn lanes to illuminate pedestrian crossings.

5. Conduct corridor-wide signal phasing/timing review to accommodate intersection-specific changes to phasing and capacity.

6. Implement geometric improvements to create consistency along the corridor.
   a. Improve consistency of lane assignments and lane drops to meet driver expectations.
   b. Determine the basic number of lanes needed along Quebec Street.
   c. Add sidewalk closer to the curb along the east side of Quebec Street between 26th Avenue and 29th Drive. Alternatively, provide curb ramps and appropriate crossings aligned with existing sidewalks.
   d. Widen sidewalk along the west side of Quebec Street between 26th Avenue and Martin Luther King Jr. Boulevard.
   e. Construct directional curb ramps consistently at all intersections.
   f. Replace valley gutters on cross streets to improve ADA compliance.

7. Review and adjust left-turn operations. Table 1 summarizes the RSA team’s proposals for left-turn operation at traffic signals along the corridor.
## Table 1. Recommended Left Turn Operations

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<thead>
<tr>
<th>Intersection</th>
<th>Movement</th>
<th>Existing Operation</th>
<th>Recommended Operation</th>
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**Notes:** Turning movement counts need to be collected at each intersection to finalize phase change decisions.

<sup>1</sup>Operate as a protected left when pedestrian calls are made, permissive all other times.

<sup>2</sup>Split-phasing would also achieve protection at this intersection.
I. Quebec Street & 26th Avenue

Background Information

The Quebec Street & 26th Avenue intersection is signalized and represents the southern boundary of the project study area (Figure 11). Quebec Street consists of two through lanes in each direction, plus dedicated left-turn lanes. Northbound and southbound right-turns must be made from the shared through lane. The west leg of 26th Avenue includes a dedicated eastbound left-turn lane and a shared through/right-turn lane, as well as one westbound receiving lane. The east leg of 26th Avenue includes dedicated westbound left-turn, through, and right-turn lanes, as well as one eastbound receiving lane. The right-turn lane is channelized with yield-control. On-street parking is permitted on both sides of 26th Avenue just east of Quebec Street.

Bike lanes are provided for both directions of 26th Avenue west of Quebec Street, but the eastbound bike lane combines ends just after Poplar Street. The bicycle route is diverted to a multiuse path through Fred Thomas Park on the east side of Quebec Street. All left-turns operate with permitted-only phasing. Quebec Street has a posted speed limit of 35 MPH, and 26th Avenue has a posted speed limit of 30 MPH.

Figure 11. Quebec Street & 26th Avenue

Crash Review

Between March 2017 and March 2020, there were a total of 6 crashes at the Quebec Street & 26th Avenue intersection. Table 2 displays a summary of crash history for the intersection.

- 3 broadside/head on crashes constitute 50 percent of crashes.
- Failure to yield right-of-way was cited in 50 percent of crashes.
- 1 KSI crash occurred involving a pedestrian in the north crosswalk and an eastbound left-turning vehicle that failed to yield right-of-way.
- An additional KSI crash occurred after the crash review period involving a pedestrian walking southbound after parking on-street who was struck by a southbound bus.
- Crashes were most common in the northbound direction (50 percent).

**Table 2. Quebec Street & 26th Avenue Crash Summary**

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>KSI</th>
<th>Fatal</th>
<th>EB</th>
<th>WB</th>
<th>NB</th>
<th>SB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Crashes</strong></td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>17%</td>
<td>17%</td>
<td>17%</td>
<td>50%</td>
</tr>
<tr>
<td><strong>Most Harmful Event</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broadside/head on</td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrian</td>
<td>17%</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Driver Action</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failed to yield right-of-way</td>
<td>50%</td>
<td>100%</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failed to stop at signal</td>
<td>33%</td>
<td>50%</td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Movement</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making left-turn</td>
<td>33%</td>
<td>100%</td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making right-turn</td>
<td>33%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50%</td>
<td>50%</td>
</tr>
</tbody>
</table>

**Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting**

No comments regarding this intersection were provided during the Pre-Audit meeting.

**Observations**

The RSA team made the following observations during the morning, afternoon, and evening field reviews:

- No directional curb ramps are provided.
- Pedestrian countdown signals are not provided for the south crosswalk.
- Sidewalk connection to the bus stop on the northeast side of Quebec Street is missing.
- A valley gutter constructed across the east leg of 26th Avenue does not meet ADA guidance for the crosswalk.
Recommendations

The following improvements are recommended for the intersection.

8. Implement LPIs for eastbound and westbound crossings.

9. Adjust left-turn operations.
   - **Northbound:** Refer to Boulder Guidelines for phasing changes.
   - **Southbound:** Refer to Boulder Guidelines for phasing changes.
   - **Eastbound:** Consider protected phasing when a pedestrian call is made.
   - **Westbound:** Consider protected phasing when a pedestrian call is made.

10. Construct sidewalk connecting the intersection to the northbound bus stop.

![Figure 13. Quebec Street & 26th Avenue Recommendation Map](image)
II. Quebec Street & 28th Avenue

Background Information

The Quebec Street & 28th Avenue intersection is a three-quarter movement intersection; westbound left-turns are prohibited (Figure 14). Quebec Street consists of two through lanes in each direction. A dedicated southbound left-turn lane is provided. The westbound approach of 28th Avenue is stop-controlled and channelized into a right-turn lane with a raised pedestrian refuge island. Quebec Street has a posted speed limit of 35 MPH.

Figure 14. Quebec Street & 28th Avenue

Crash Review

Between March 2017 and March 2020, there were a total of 5 crashes at the Quebec Street & 28th Avenue intersection. Table 3 displays a summary of crash history for the intersection.

- 3 rear end crashes constitute 60 percent of crashes.
- 2 broadside crashes constitute 40 percent of crashes.
- No KSI crashes occurred during the study period.
- Most crashes occurred in the westbound direction (60 percent)
Table 3. Quebec Street & 28th Avenue Crash Summary

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>KSI</th>
<th>Fatal</th>
<th>EB</th>
<th>WB</th>
<th>NB</th>
<th>SB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Crashes</strong></td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0%</td>
<td>60%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Most Harmful Event</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rear end</td>
<td>60%</td>
<td></td>
<td></td>
<td>33%</td>
<td>33%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Broadside</td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td><strong>Driver Action</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Followed too closely</td>
<td>40%</td>
<td></td>
<td></td>
<td>50%</td>
<td>50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failed to yield right-of-way</td>
<td>20%</td>
<td></td>
<td></td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Movement</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making right-turn</td>
<td>60%</td>
<td></td>
<td></td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting

No comments regarding this intersection were provided during the Pre-Audit meeting.

Observations

The RSA team made the following observations during the morning, afternoon, and evening field reviews:

- The radius of the southeast corner is very large, likely to accommodate larger design vehicles. This creates a longer pedestrian crossing.
- Pedestrian curb ramps for the east crosswalk are misaligned, resulting in a longer crossing distance.
- The median opening for southbound left-turns from Quebec Street is misaligned with the eastbound receiving lane on 28th Avenue.
- Signposts in the median show evidence of collision(s).

Figure 15. Damaged Signposts at 28th Avenue
Recommendations

The following improvements are recommended for the intersection.

11. Redesign intersection turning radii to reduce speeds and to create a safer pedestrian crossing based on the appropriate design vehicle.

12. Modify the median opening for southbound left-turns from Quebec Street to align with 28th Avenue based on the appropriate design vehicle.

13. Consider adding sidewalk closer to the curb along the east side of Quebec Street. Alternatively, consider providing curb ramps and appropriate crossings aligned with existing sidewalks.
III. Quebec Street & Shopping Center Access

Background Information
The Quebec Street & Shopping Center Access intersection is right-in/right-out intersection (Figure 17). Quebec Street consists of two lanes in each direction divided by a raised median. The westbound Shopping Center Access approach is stop-controlled. Quebec Street has a posted speed limit of 35 MPH through the intersection.

![Figure 17. Quebec Street & Shopping Center Access](image)

Crash Review
No crashes were recorded at the Quebec Street & Shopping Center Access intersection between March 2017 and March 2020.

Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting
No comments regarding this intersection were provided during the Pre-Audit meeting.

Observations
The RSA team made the following observations during the morning, afternoon, and evening field reviews:

- Evidence of over tracking from westbound right-turns is present in the form of compacted soil and tire tracks in the tree lawn.
- Existing curb ramps require pedestrians to travel a substantial distance out of direction to cross the Shopping Center Access closer to Quebec Street. Social trails indicate that many pedestrians cross in line with the sidewalk instead.
Recommendations

The following improvements are recommended for the intersection.

**14.** Redesign intersection turning radii to reduce speeds and to create a safer pedestrian crossing based on the appropriate design vehicle.

**15.** Consider adding sidewalk closer to the curb along the east side of Quebec Street. Alternatively, consider providing curb ramps and appropriate crossings aligned with existing sidewalks.
Figure 19. Quebec Street & Shopping Center Access Recommendation Map
IV. Quebec Street & 29th Avenue

Background Information

The Quebec Street & 29th Avenue intersection is a signalized T-intersection with residential access serving as the fourth leg of the intersection (Figure 20). Northbound Quebec Street consists of two through lanes; a third northbound lane is added north of 29th Avenue. Southbound Quebec Street consists of two through lanes and a dedicated left-turn lane. Southbound left-turns operate with protected/permittet phasing. Westbound 29th Avenue consists of a dedicated left-turn and lane right-turn lane. Eastbound 29th Avenue is offset approximately 120 feet north of the westbound approach and is stop-controlled. Quebec Street has a posted speed limit of 35 MPH through the intersection. 29th Avenue has a posted speed limit of 25 MPH.

Crash Review

Between March 2017 and March 2020, there were a total of 10 crashes at the Quebec Street & 29th Avenue intersection. Table 4 displays a summary of crash history for the intersection.

- 3 sideswipe crashes constitute 30 percent of crashes; all occurred along southbound Quebec Street.
- 1 KSI crash occurred during the study period; a pedestrian crossing the south crosswalk was struck by a westbound left-turning motorist that failed to yield right-of-way.
- 70 percent of crashes occurred in the southbound direction.
### Table 4. Quebec Street & 29th Avenue Crash Summary

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>KSI</th>
<th>Fatal</th>
<th>EB</th>
<th>WB</th>
<th>NB</th>
<th>SB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Crashes</strong></td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>70%</td>
</tr>
<tr>
<td><strong>Most Harmful Event</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sideswipe</td>
<td>30%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>Broadside</td>
<td>10%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>10%</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td><strong>Driver Action</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lane violation</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>Failed to yield right-of-way</td>
<td>20%</td>
<td>100%</td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
<td>50%</td>
</tr>
<tr>
<td><strong>Movement</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making left-turn</td>
<td>20%</td>
<td>100%</td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
<td>50%</td>
</tr>
</tbody>
</table>

### Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting

- Southbound Quebec Street drops a through lane at 29th Avenue as it becomes the dedicated left-turn lane. This may be a source of driver confusion and contribute to the frequency of sideswipe crashes at the intersection.

### Observations

The RSA team made the following observations during the morning, afternoon, and evening field reviews:

- Signs are in place prohibiting trucks from using the west leg of 29th Avenue.
- A pedestrian median refuge is provided in the south crosswalk, but no pedestrian countdown signals are present.
- Directional curb ramps with truncated domes are provided at all crosswalks.
- The existing median nose on the south approach allows westbound left-turn movements to occur at higher speeds, resulting in vehicle paths “slicing” across the crosswalk.
- A lagging southbound left-turn phase was observed during the PM peak hour.
- Eastbound 29th Avenue (stop-controlled) is restricted to right-turns only.
  - Signs noting this turn restriction are posted on the streetlight pole, which is not in the immediate line-of-sight for eastbound motorists.

![Figure 21. South Crosswalk at 29th Avenue Intersection](image)
**Recommendations**

The following improvements are recommended for the intersection.

16. Implement LPIs for eastbound and westbound crossings.

17. Increase the length of skip striping noting the transition to the southbound left-turn lane.

18. Improve signage along southbound Quebec Street between Martin Luther King Jr. Boulevard and 29th Avenue noting the left lane use.

19. Relocate turn restriction and one-way signs for eastbound 29th Avenue to appropriate locations directly across from the approach (as opposed to where convenient).

20. Adjust left-turn operations.
   - **Southbound**: Refer to Boulder Guidelines for phasing changes.
   - **Westbound**: Consider protected phasing when a pedestrian call is made.

21. Consider dropping a lane from southbound Quebec Street at Martin Luther King Jr. Boulevard instead of 29th Avenue, carrying only two through lanes through that segment and providing a deceleration lane for southbound left-turns.

22. Evaluate the design vehicle path for westbound left-turns with respect to the existing south median nose. Potentially reconstruct the median to prevent turning vehicles from “slicing” across the crosswalk.

![Figure 22. Quebec Street & 29th Avenue Recommendation Map](image)
Figure 23. Quebec Street & 29th Avenue Concept
Quebec Street – 26th Avenue to Smith Road

V. Quebec Street & 29th Drive

Background Information

The Quebec Street & 29th Drive is a three-quarter movement intersection; westbound left-turns are prohibited (Figure 24). Quebec Street consists of three through lanes in each direction. A dedicated southbound left-turn lane is provided. The westbound approach of 29th Drive is stop-controlled. Quebec Street has a posted speed limit of 35 MPH.

Crash Review

Two crashes were recorded at Quebec Street & 29th Drive between March 2017 and March 2020. Neither crash resulted in a KSI.

Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting

No comments regarding this intersection were provided during the Pre-Audit meeting.

Observations

The RSA team made the following observations during the morning, afternoon, and evening field reviews:

- Signing/striping noting the westbound turning restrictions is not present.
- The intersection is not well lit at night, especially the southbound left-turn lane, which limits visibility for turning vehicles.
Recommendations

The following improvements are recommended for the intersection.

23. Provide signs indicating westbound turn restrictions across from the 29th Drive approach.

24. Increase lighting at the intersection, especially for southbound left-turns.

Figure 25. Quebec Street & 29th Drive Recommendation Map
VI. Quebec Street & Martin Luther King Jr. Boulevard

Background Information

The Quebec Street & Martin Luther King Jr. Boulevard intersection is signalized, and both streets operate as one-way couplets through the intersection area (Figure 26). Northbound Quebec Street includes one left-turn that opens to two lanes inside the intersection, three through lanes, and a dedicated right-turn lane (channelized with yield control). Southbound Quebec Street includes two left-turn lanes, two through lanes, and a shared through/right-turn lane (channelized with yield control). Eastbound Martin Luther King Jr. Boulevard includes two left-turn lanes, two through lanes, and a shared through/right-turn lane. Westbound Martin Luther King Jr. Boulevard includes one left-turn that opens to two lanes inside the intersection, three through lanes, and a dedicated right-turn lane (channelized with an acceleration lane).

Northbound Quebec Street has a posted speed limit of 35 MPH versus 45 MPH for southbound Quebec Street. Martin Luther King Jr. Boulevard has a posted speed limit of 35 MPH.

Bicycle lanes are provided along Martin Luther King Jr. east and west of the intersection, but cyclists are encouraged to use sidewalks within the intersection area.

Crash Review

Between March 2017 and March 2020, there were a total of 109 crashes at the Quebec Street & Martin Luther King Jr. Boulevard intersection. Table 5 displays a summary of crash history for the intersection.

- 61 broadside/head on crashes constitute 56 percent of crashes.
- Nearly all resulted from one driver running a red light.
- 15 sideswipe crashes constitute 14 percent of crashes.
- 3 bicycle/pedestrian crashes occurred at this intersection:
  - 1 fatal crash occurred when a northbound driver ran a red light and struck three pedestrians, killing one and seriously injuring the other two.
  - 1 other KSI crash occurred when a southbound driver ran a red light, striking an eastbound motorist who subsequently struck an eastbound bicyclist.
- 3 additional KSI crashes occurred since 2020: two involving red-light running and another involving a pedestrian who crossed against the signal.

### Table 5. Quebec Street & Martin Luther King Jr. Boulevard Crash Summary

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>KSI</th>
<th>Fatal</th>
<th>EB</th>
<th>WB</th>
<th>NB</th>
<th>SB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Crashes</strong></td>
<td>109</td>
<td>3</td>
<td>1</td>
<td>20%</td>
<td>20%</td>
<td>22%</td>
<td>38%</td>
</tr>
<tr>
<td><strong>Most Harmful Event</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broadside/head on</td>
<td>56%</td>
<td>33%</td>
<td>23%</td>
<td>31%</td>
<td>21%</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>Sideswipe</td>
<td>14%</td>
<td></td>
<td>40%</td>
<td>13%</td>
<td>7%</td>
<td>40%</td>
<td></td>
</tr>
<tr>
<td>Bicycle</td>
<td>2%</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>1%</td>
<td>67%</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Driver Action</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failed to stop at signal</td>
<td>50%</td>
<td></td>
<td>24%</td>
<td>36%</td>
<td>13%</td>
<td>27%</td>
<td></td>
</tr>
<tr>
<td>Lane violation/improper turn</td>
<td>12%</td>
<td></td>
<td>46%</td>
<td></td>
<td></td>
<td></td>
<td>54%</td>
</tr>
<tr>
<td><strong>Movement</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making left-turn</td>
<td>7%</td>
<td></td>
<td>38%</td>
<td>13%</td>
<td>50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making right-turn</td>
<td>8%</td>
<td></td>
<td>11%</td>
<td>33%</td>
<td>56%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Red-light running was a causal factor in 50 percent of crashes and was common in all approach directions of the intersection. **Table 6** displays a summary of crashes involving red-light running by signalized intersection, at-fault driver, and time of day.

### Table 6. Quebec Street & Martin Luther King Jr. Boulevard Red-Light Running Crashes

<table>
<thead>
<tr>
<th>Intersection</th>
<th>At-Fault Direction</th>
<th>AM Peak 6-10 AM</th>
<th>PM Peak 2-7 PM</th>
<th>Off-Peak</th>
<th>Total</th>
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<tbody>
<tr>
<td>Northwest</td>
<td>Southbound</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>3</td>
<td>7</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Northeast</td>
<td>Northbound</td>
<td>1</td>
<td></td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Southwest</td>
<td>Southbound</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Eastbound</td>
<td>3</td>
<td>3</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Southeast</td>
<td>Northbound</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Eastbound</td>
<td>4</td>
<td>1</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>1</td>
<td>3</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>17</strong></td>
<td><strong>11</strong></td>
<td><strong>25</strong></td>
<td><strong>53</strong></td>
</tr>
</tbody>
</table>
Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting

- Southbound Quebec Street drops a through lane at Martin Luther King Jr. Boulevard as it becomes the dedicated left-turn lane. This may be a source of driver confusion and contribute to the frequency of sideswipe crashes at the intersection.

- Red-light running is common at the Martin Luther King Jr. Boulevard intersections. The RSA team should investigate time-of-day influence on crash history.
  - The RSA team should try to observe the intersection during dusk and midday to assess if sun glare is a contributing factor for red-light running.
  - The RSA team should observe operations at the Martin Luther King Jr. Boulevard intersection to assess the function traffic controllers, which use multiple cabinets.
  - The RSA team should observe the visibility of downstream programmable signal indications and assess their influence on red-light running.

- The wide median on Quebec Street between Smith Road and Martin Luther King Jr. Boulevard is not a designated parkway and should not require coordination with Parks & Recreation if alignment changes are proposed.

Observations

The RSA team made the following observations during the morning, afternoon, and evening field reviews:

- Signalized intersections for the one-way couplets are very closely spaced.
- Multiple instances of red-light running were observed, especially when downstream signals remained green longer than upstream intersections.
- Many motorists made left- and right-turns at high speeds.
- Several instances of driver confusion were noted by abrupt lane changes and turning onto the wrong one-way segment.
- The southwest curb radius is very large and underused by vehicles but promotes high-speed right-turns and increases the pedestrian crossing distance.
- Each intersection approach is very wide. The excess capacity is likely a holdover from the intersection’s previous use as an airport entrance.
- Auxiliary through lanes on Martin Luther King Jr. Boulevard were underused. Aggressive merging behavior was noted when lanes were used. This excess capacity is likely a holdover from the intersection’s previous use as an airport entrance.
- Northbound and westbound double left-turn lanes were underused. This excess capacity is likely a holdover from the intersection’s previous use as an airport entrance.
- A solid channelizing stripe is used for the rightmost southbound through lane instead of lane line striping.
Figure 27. Underused Eastbound Through Lane at Martin Luther King Jr. Boulevard

Figure 28. Incorrect Southbound Striping at Martin Luther King Jr. Boulevard
**Recommendations**

The following improvements are recommended for the intersection.

25. Restripe southbound Quebec Street with correct lane lines.
26. Rephase signals to implement simultaneous red phases in the same through direction.
27. Convert signal indications for straight movements from green balls to up arrows (where permitted).
28. Remove auxiliary lanes on eastbound and westbound Martin Luther King Jr. Boulevard. Potentially replace with dedicated bicycle infrastructure.
29. Increase lighting in the northbound channelized right-turn lanes to illuminate pedestrian crossings.
30. Reduce the intersection footprint by removing dual left-turn lanes on northbound Quebec Street and westbound Martin Luther King Jr. Boulevard.
31. Consider changing southbound Quebec Street to provide two left-turn lanes, two through lanes, and a dedicated right-turn lane. This would eliminate the left-hand lane drop at 29th Avenue.
32. Reduce the inside curb radius for eastbound right-turns.
33. Reconfigure the intersection to reduce or eliminate closely spaced traffic signals. Possibly consider displaced left-turns to provide additional intersection capacity given available footprint.

*Figure 29. Quebec Street & Martin Luther King Jr. Boulevard Recommendation Map*
Figure 30. Quebec Street & Martin Luther King Jr. Boulevard Concept
Figure 31. Conceptual Green Up Arrow Indication
VII. Quebec Street & 33rd Avenue

Background Information

The Quebec Street & 33rd Avenue intersection is an unsignalized T-intersection with Quebec Street, including a two-way segment across the wide median. Stop signs control eastbound and westbound movements from 33rd Avenue (Figure 32). Quebec Street consists of four northbound lanes and five southbound lanes. Two southbound lanes are striped with solid lane lines and become left-turn lanes at the Martin Luther King Jr. Boulevard intersection. Quebec Street has a posted speed limit of 45 MPH. 33rd Avenue west of the intersection is a residential street with a speed limit of 25 MPH.

![Figure 32. Quebec Street & 33rd Avenue](image)

Crash Review

Between March 2017 and March 2020, there were a total of 13 crashes at the Quebec Street & 33rd Avenue intersection. Table 7 displays a summary of crash history for the intersection.

- 10 broadside/head on crashes constitute 77 percent of crashes.
  - 8 involved eastbound motorists who failed to yield right-of-way to southbound traffic.
  - 2 involved southbound left-turning motorists who turned from the wrong lane.
- No KSI crashes occurred during the study period.
Table 7. Quebec Street & 33rd Avenue Crash Summary

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>KSI</th>
<th>Fatal</th>
<th>EB</th>
<th>WB</th>
<th>NB</th>
<th>SB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Crashes</td>
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<td>0</td>
<td>0</td>
<td>77%</td>
<td>0%</td>
<td>0%</td>
<td>23%</td>
</tr>
<tr>
<td>Most Harmful Event</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broadside</td>
<td>69%</td>
<td>78%</td>
<td>22%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rear end</td>
<td>23%</td>
<td>67%</td>
<td>33%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head on</td>
<td>8%</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driver Action</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failed to yield right-of-way</td>
<td>54%</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improper turn</td>
<td>15%</td>
<td></td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Movement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making left-turn</td>
<td>23%</td>
<td></td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting

No comments regarding this intersection were provided during the Pre-Audit meeting.

Observations

The RSA team made the following observations during the morning, afternoon, and evening field reviews:

- Lighting in this segment of the corridor is poor, especially for northbound Quebec Street.
- 33rd Avenue through the median is narrow and has small corner radii that require slow turning maneuvers.
- The east-west crossing of southbound Quebec Street is very long and may contribute to the frequency of eastbound broadside crashes.
- Southbound queues were observed to spillback nearly to 33rd Avenue in the PM peak hour.

Figure 33. Bicyclist Crossing Southbound Quebec Street at 33rd Avenue
Recommendations

The following improvements are recommended for the intersection.

34. Move the start of the second southbound left-turn lane for the Martin Luther King Jr. Boulevard intersection south of 33rd Avenue.

35. Increase the length of skip striping noting the transition to the southbound Martin Luther King Jr. Boulevard left-turn lane.

36. Improve lighting near the intersection.

37. Close 33rd Avenue across Quebec Street (create right-in/right-out intersection).

38. Permanently move taper location for second southbound left-turn lane for the Martin Luther King Jr. Boulevard intersection south of 33rd Avenue.

Figure 34. Quebec Street & 33rd Avenue Recommendation Map
Figure 35. Quebec Street & 33rd Avenue Concepts
VIII. Quebec Street & 35th Avenue

Background Information

The Quebec Street & 35th Avenue intersections are signalized (Figure 36). Each direction of Quebec Street operates as a couplet roadway.

At the northbound intersection, Quebec Street includes a shared left-turn/through lane, three dedicated through lanes, and a channelized right-turn lane (controlled with yield signs). Eastbound 35th Avenue includes a dedicated left-turn lane and two through lanes. Westbound 35th Avenue includes two through lanes and a dedicated right-turn lane.

At the southbound intersection, Quebec Street includes a dedicated left-turn lane, three dedicated through lanes, and a shared through/right-turn lane. Eastbound 35th Avenue includes one lane for all movements. Westbound 35th Avenue includes one dedicated left-turn lane and one shared left-turn/through lane.

All left-turn movements operate with permitted-only phasing. Quebec Street has a posted speed limit of 45 MPH through the intersection. West of Quebec Street, 35th Avenue has a posted speed limit of 25 MPH. East of Quebec Street, 35th Avenue has a posted speed limit of 30 MPH.
Crash Review

Between March 2017 and March 2020, there were a total of 21 crashes at the Quebec Street & 35th Avenue intersection. Table 8 displays a summary of crash history for the intersection.

- 11 broadside/head on crashes constitute 52 percent of crashes.
- 1 KSI crash occurred during the study period involving an eastbound left-turning motorist who turned from the wrong lane.
- 24 percent of crashes were caused by a driver running the red light.

Table 8. Quebec Street & 35th Avenue Crash Summary

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>KSI</th>
<th>Fatal</th>
<th>EB</th>
<th>WB</th>
<th>NB</th>
<th>SB</th>
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</thead>
<tbody>
<tr>
<td>Total Crashes</td>
<td>21</td>
<td>1</td>
<td>0</td>
<td>38%</td>
<td>14%</td>
<td>19%</td>
<td>29%</td>
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<tr>
<td>Most Harmful Event</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broadside/head on</td>
<td>52%</td>
<td>100%</td>
<td></td>
<td>36%</td>
<td>18%</td>
<td>25%</td>
<td>38%</td>
</tr>
<tr>
<td>Rear end</td>
<td>24%</td>
<td>20%</td>
<td></td>
<td>40%</td>
<td>40%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sideswipe</td>
<td>24%</td>
<td></td>
<td>60%</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driver Action</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failed to stop at signal</td>
<td>24%</td>
<td></td>
<td>50%</td>
<td>25%</td>
<td>25%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failed to yield right-of-way</td>
<td>14%</td>
<td>100%</td>
<td>67%</td>
<td>33%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Movement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making left-turn</td>
<td>33%</td>
<td>100%</td>
<td></td>
<td>43%</td>
<td>29%</td>
<td>14%</td>
<td>14%</td>
</tr>
</tbody>
</table>

Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting

- DOTI is collecting turning movement counts at 35th Avenue and 36th Avenue intersections to determine the feasibility of split-phasing for east-west movements. The counts will not be available before the RSA is complete, but the RSA team should consider the safety impacts of these operations.

Observations

The RSA team made the following observations during the morning, afternoon, and evening field reviews:

- Pedestrian push buttons and LPIs are not functioning at the southbound Quebec Street intersection.
- Queues within the median segment of 35th Avenue (eastbound and westbound) routinely spillback through the upstream Quebec Street intersection due to high volume of left-turning vehicles yielding to opposing through movements.
- In some instances, through vehicles would yield to left-turning vehicles due to queue spillback from the median segment.
- A driveway access to an office building in the southwest corner of the southbound Quebec Street intersection. A pedestrian crash was noted here in the crash review.
Figure 37. Westbound Queue Spillback at 35th Avenue

Figure 38. Left-Turn/Pedestrian Conflict During Permitted Phase at 35th Avenue
Recommendations

The following improvements are recommended for the intersection.

39. Fix and implement LPIs for all eastbound and westbound crossings.

40. Adjust left-turn operations.
   - **Northbound**: Retain existing phasing.
   - **Southbound**: Retain existing phasing.
   - **Eastbound**: Consider split-phasing or protected phasing.
   - **Westbound**: Consider split-phasing or protected phasing.

41. Close driveway access near the southwest corner of the southbound Quebec Street intersection.

42. Consider widening the median portion of 35th Avenue between the northbound and southbound Quebec Street couplet to provide additional capacity.

Figure 39. Quebec Street & 35th Avenue Recommendation Map
IX. Quebec Street & 36th Avenue

Background Information

The Quebec Street & 36th Avenue intersections are signalized (Figure 40). Each direction of Quebec Street operates as a couplet roadway.

At the northbound intersection, Quebec Street includes a shared left-turn/through lane, three dedicated through lanes, and a dedicated right-turn lane. Eastbound 36th Avenue includes a dedicated left-turn lane and two through lanes. Westbound 36th Avenue includes one through lane and a shared through/right-turn lane.

At the southbound intersection, Quebec Street includes a dedicated left-turn lane, three dedicated through lanes, and a shared through/right-turn lane. Eastbound 36th Avenue includes one lane for all movements. Westbound 36th Avenue includes one dedicated left-turn lane and one shared left-turn/through lane.

All left-turn movements operate with permitted-only phasing. Quebec Street has a posted speed limit of 45 MPH through the intersection. West of Quebec Street, 36th Avenue has a posted speed limit of 25 MPH. East of Quebec Street, 36th Avenue has a posted speed limit of 30 MPH.

Crash Review

Between March 2017 and March 2020, there were a total of 83 crashes at the Quebec Street & 36th Avenue intersection. Table 9 displays a summary of crash history for the intersection.

- 35 broadside/head on crashes constitute 42 percent of crashes.
- Over 50 percent involved one vehicle running the red light (mostly northbound and westbound).
- 25 percent involved eastbound left-turning motorists failing to yield right-of-way to westbound motorists.
▪ 1 KSI crash occurred during the study period involving a westbound motorist who ran the red light.
▪ 24 percent of crashes were caused by a driver making an improper left-turn (mostly southbound and westbound).
▪ 1 pedestrian crash occurred when a westbound left-turning motorist failed to yield to a pedestrian in the south crosswalk.
▪ 1 additional KSI crash occurred after the analysis period involving a southbound motorist who turned left from the wrong lane.

Table 9. Quebec Street & 36th Avenue Crash Summary

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>KSI</th>
<th>Fatal</th>
<th>EB</th>
<th>WB</th>
<th>NB</th>
<th>SB</th>
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</thead>
<tbody>
<tr>
<td>Total Crashes</td>
<td>83</td>
<td>1</td>
<td>0</td>
<td>18%</td>
<td>24%</td>
<td>24%</td>
<td>34%</td>
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<tr>
<td>Most Harmful Event</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broadside/head on</td>
<td>42%</td>
<td>100%</td>
<td></td>
<td>29%</td>
<td>26%</td>
<td>31%</td>
<td>11%</td>
</tr>
<tr>
<td>Sideswipe</td>
<td>27%</td>
<td>10%</td>
<td>29%</td>
<td>62%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrian</td>
<td>2%</td>
<td></td>
<td></td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driver Action</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lane violation / improper turn</td>
<td>24%</td>
<td></td>
<td></td>
<td>40%</td>
<td>5%</td>
<td>55%</td>
<td></td>
</tr>
<tr>
<td>Failed to stop at signal</td>
<td>22%</td>
<td></td>
<td>11%</td>
<td>33%</td>
<td>50%</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Failed to yield right-of-way</td>
<td>11%</td>
<td></td>
<td>89%</td>
<td>11%</td>
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<td>Movement</td>
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<td></td>
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<tr>
<td>Making left-turn</td>
<td>33%</td>
<td></td>
<td>33%</td>
<td>19%</td>
<td>7%</td>
<td>41%</td>
<td></td>
</tr>
</tbody>
</table>

Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting

▪ DOTI is collecting turning movement counts at 35th Avenue and 36th Avenue intersections to determine the feasibility of split-phasing for east-west movements. The counts will not be available before the RSA is complete, but the RSA team should consider the safety impacts of these operations.
▪ Red-light enforcement cameras are in place for northbound Quebec Street at the 36th Avenue intersection.
  ▪ Council District #8 has received complaints about this camera, but no other comments were provided about the corridor.

Observations

The RSA team made the following observations during the morning, afternoon, and evening field reviews:

▪ Queues within the median segment of 36th Avenue (eastbound and westbound) routinely spillback through the upstream Quebec Street intersection due to high volume of left-turning vehicles yielding to opposing through movements.
▪ The northbound right-hand lane has a solid stripe but has no signage for right-turn only restrictions and continues after the intersection.
▪ This is the last traffic signal for northbound Quebec Street and the overhead lane assignment sign is very close to the intersection. This may be a distraction for drivers who are looking for lane guidance but not paying attention to the traffic signal.
▪ GPS navigation systems (i.e., Google Maps, Waze) indicate that it is possible to make a southbound left-turn when merging from the Smith Road on-ramp despite regulatory signing. This was a contributing factor for at least one crash recorded during the analysis period.
Figure 41. Southbound Left-Turn Restriction at 36th Avenue

Figure 42. Overhead Lane Assignment Signs North of 36th Avenue
Recommendations

The following improvements are recommended for the intersection.

43. Implement LPIs for additional eastbound and westbound crossings.

44. Adjust left-turn operations.
   - **Northbound:** Retain existing phasing.
   - **Southbound:** Retain existing phasing.
   - **Eastbound:** Consider split-phasing or protected phasing.
   - **Westbound:** Consider split-phasing or protected phasing.

45. Consider extending the all-red clearance phase for northbound Quebec Street.

46. Install additional advance lane assignment sign(s) along the roadside for northbound Quebec Street.

47. Restripe the northbound right-turn lane to reflect its intended use.

48. Address southbound left-turn movements from the right lane to prevent inappropriate turns.

49. Consider widening the median portion of 36th Avenue between the northbound and southbound Quebec Street couplet to provide additional capacity.

*Figure 43. Quebec Street & 36th Avenue Recommendation Map*
X. Quebec Street & Smith Road

Background Information

The Quebec Street & Smith Road intersections are signalized and represent the northern boundary of the project study area (Figure 44). Each direction of Smith Road operates like a service ramp to/from mainline Quebec Street.

At the northbound intersection, Quebec Street includes a dedicated left-turn lane, two through lanes, and a channelized right-turn lane (with an acceleration lane). Eastbound Smith Road includes a dedicated left-turn lane and two through lanes. Westbound includes two through lanes and a dedicated right-turn lane.

At the southbound intersection, Quebec Street includes a dedicated left-turn lane, a shared through/left-turn lane, a dedicated through lane, and a dedicated right-turn lane. Eastbound Smith Road includes one dedicated through lane and a shared through/right-turn lane. Westbound Smith Road includes one dedicated left-turn lane and one through lane.

Eastbound left-turns operate with protected-only phasing. Northbound and westbound left-turns operate with protected/permitted phasing. Southbound left-turns operate with permitted-only phasing. Quebec Street has a posted speed limit of 40 MPH through the intersection. Smith Road has a posted speed limit of 35 MPH.

Figure 44. Quebec Street & Smith Road
Crash Review

Between March 2017 and March 2020, there were a total of 13 crashes at the Quebec Street & Smith Road intersection. Table 10 displays a summary of crash history for the intersection.

- 6 sideswipe crashes constitute 46 percent of crashes.
- 5 broadside crashes constitute 38 percent of crashes. All occurred when motorists failed to stop at a red light.
- No KSI crashes occurred during the study period.
- 1 pedestrian crash occurred when a minor crossed Smith Road midblock west of the intersection and was struck.

### Table 10. Quebec Street & Smith Road Crash Summary

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>KSI</th>
<th>Fatal</th>
<th>EB</th>
<th>WB</th>
<th>NB</th>
<th>SB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Crashes</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>23%</td>
<td>15%</td>
<td>31%</td>
<td>31%</td>
</tr>
<tr>
<td>Most Harmful Event</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sideswipe</td>
<td></td>
<td></td>
<td></td>
<td>17%</td>
<td>50%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Broadside</td>
<td></td>
<td></td>
<td></td>
<td>40%</td>
<td>40%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Rear end</td>
<td></td>
<td></td>
<td></td>
<td>50%</td>
<td>50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driver Action</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failed to stop at signal</td>
<td></td>
<td></td>
<td></td>
<td>40%</td>
<td>40%</td>
<td>20%</td>
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<tr>
<td>Lane violation</td>
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<td></td>
<td></td>
<td>50%</td>
<td>50%</td>
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<tr>
<td>Movement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making left-turn</td>
<td>15%</td>
<td>50%</td>
<td>50%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments Provided by City Staff and RSA Stakeholders during Pre-Audit Meeting

- New bridge construction is planned for Quebec Street over Airlawn Road. The project will also provide missing sidewalk and trail connections to Quebec Street between I-70 and Smith Road.

Observations

The RSA team made the following observations during the morning, afternoon, and evening field reviews:

- Lighting for the northbound channelized right-turn lane is poor.
- The sidewalk on the south side of Smith Road across the bridge is narrow.
- Several pedestrians curb ramps do not meet ADA criteria (angled approach, narrow, misaligned with crosswalk).
- A valley gutter constructed across the south leg of the northbound Quebec Street intersection does not meet ADA guidance for the crosswalk.
- Southbound receiving lanes at the southbound Quebec Street intersection are very wide and create a long pedestrian crossing.
- The west crosswalk at the southbound Quebec Street intersection is at a considerable skew angle creating a long crossing distance.
- Some pedestrian walk signals are not properly activated by push buttons and result in unusually long wait times.
Figure 45. Pedestrian Curb Ramp Aligned with Valley Gutter at Smith Road

Figure 46. Poor Lighting in Channelized Right-Turn at Smith Road
### Recommendations

The following improvements are recommended for the intersection.

50. Address pedestrian crosswalk timing on the south leg of the northbound Quebec Street intersection to mitigate unnecessary pedestrian delay.

51. Consider extending the all-red clearance phase for the northbound Quebec Street intersection.

52. Improve lighting for the pedestrian crossing of the northbound channelized right-turn.

53. Consider narrowing west and south crosswalks at the southbound Quebec Street intersection.

54. Widen the sidewalk on the south side of Smith Road across the bridge.

55. Construct directional curb ramps and larger pedestrian landing areas at the northbound Quebec Street intersection.

![Figure 47. Quebec Street & Smith Road Recommendation Map](image)
Appendix A. RSA Recommendations Table
Appendix C. RSA Intent Memorandum
Appendix D. Preliminary Findings Presentation