38th Avenue Corridor Study
Road Diet Traffic Analysis

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I. INTRODUCTION

The 38th Avenue corridor between Wadsworth Boulevard and Sheridan Boulevard is identified as a "priority area for redevelopment" in the City of Wheat Ridge updated comprehensive plan, *Envision Wheat Ridge* (October 2009). This area is considered a key implementation corridor where steps should be taken to create a place in the community for residents to gather and for businesses to thrive. The future of the diverse 38th Avenue corridor will feature a Main Street area with the distinct character of the City of Wheat Ridge and provide a primary destination for city residents and visitors.

One of the recommendations toward the goal of creating the desired Main Street atmosphere along the corridor is to perform a "road diet" on 38th Avenue between Wadsworth Boulevard and Sheridan Boulevard. A road diet is a technique which reduces the number of lanes on a roadway cross section. The purpose of this study is to assess in detail the potential traffic impacts of the proposed road diet in the vicinity of the 38th Avenue Corridor.

A. Study Area

The study area focuses on 38th Avenue between the intersections of Wadsworth Boulevard (State Highway 121) at the west end and Sheridan Boulevard (State Highway 95) on the east end. Data collection and analysis included several additional locations along adjacent roadways; specifically along 44th Avenue to the north and 32nd Avenue to the south. However, the primary analysis and results for this report are provided for the intersections along 38th Avenue itself. The 38th Avenue study limits are shown on **Figure 1**.

Figure 1 - Vicinity Map

B. Other Studies

Entelechy Design, the prime consultant for the 38th Avenue Corridor Study, reviewed the existing plans and policies which the City of Wheat Ridge has drafted and commissioned over the past 10 years that express the City's desire to redevelop the 38th Avenue Corridor. The Main Street theme with mixed uses and pedestrian-friendly urban design is a common desire expressed within these studies. The Entelechy review of the following documents is provided in **Appendix A**.

- 38th Avenue Corridor Blight Study
  (April 2001, City of Wheat Ridge)
- The 38th Avenue Corridor Redevelopment Plan – An Urban Renewal Plan
  (October 2001, Clarion and HNTB)
- Repositioning Wheat Ridge: Neighborhood Revitalization Strategy
  (July 2005, Winston Associates, et al.)
- Feasibility of On-Street Parking
  (April 2007; Charlier Associates)
- Architectural and Site Design Manual
  (June 2007, City of Wheat Ridge)
- Comprehensive Plan – Envision Wheat Ridge
  (October 2009, City of Wheat Ridge)
- 38th and high Courte Node Market Study – Site and Trade Area
  (Leland)
- W. 38th Avenue Community Revitalization Partnership Report
  (December 2009, Department of Local Affairs and Downtown Colorado, Inc.)
- Zoning Code
  (Adopted February 2001)
- Visual Preference Survey Results
  (May 2009 and April 2010, City of Wheat Ridge)
- Bicycle and Pedestrian Master Plan
  (July 2010, Felsburg Holt and Ullevig)
- Streetscape Design Manual Final Draft
  (February 2011, City of Wheat Ridge)

II. EXISTING CONDITIONS

Existing conditions were evaluated to assess baseline operational characteristics of the corridor, which served as a point of reference for comparison to future traffic conditions and proposed alternatives.

A. Roadway Network

The current roadway geometry along the 38th Avenue corridor varies by location. For the purpose of this analysis the corridor can be separated into four distinct segments:

- **Wadsworth Boulevard to Vance Street** – The cross section of this segment is dominated by the intersection approach laneage at Wadsworth Boulevard. There are 2 through lanes in each direction, two westbound left-turn lanes at Wadsworth Boulevard which are back to back with 1 eastbound left-turn lane at Depew Street. There is a westbound right-turn lane and a wide eastbound right-turn acceleration lane at Wadsworth Boulevard.
- **Vance Street to Pierce Street** – This segment has a 5-lane cross section including 2 through lanes in each direction with a Two-Way Left-Turn Lane (TWLTL) median between intersections. Striped left-turn lanes are provided at the signalized intersections along this segment.
- **Pierce Street to Depew Street** – This segment has a 4-lane cross section including 2 through lanes in each direction with no median. However, left-turn lanes are provided at Harlan and Pierce Streets.
- **Depew Street to Sheridan Boulevard** – This segment has a 5-lane cross section including 2 through lanes in each direction and a TWLTL median. Striped left-turn lanes are provided at several unsignalized intersections along this section. Several other amenities, such as landscaping, specialized crosswalk striping, and detached sidewalks are also provided along this segment.

The roadway network proximate to the 38th Avenue study corridor includes:

- **Wadsworth Boulevard (State Highway 121)** – This is a 4-lane arterial with auxiliary lanes provided at intersections and some access points. Access is provided at both signalized and unsignalized full-movement intersections with median treatment (raised curb or striping) restricting turning movements at mid-block access points.
- **Sheridan Boulevard (State Highway 95)** – This is a 4-lane arterial with a TWLTL median throughout. Left-turn lanes are provided at several mid-block intersections and right-turn lanes are provided at the 38th Avenue intersection.
- **32nd Avenue** – This is a 2-lane residential collector roadway which provides access to the local roadways on either side. Intersections are unsignalized with the exception of the signal at the Pierce Street intersection. Auxiliary left-turn lanes are provided at some intersections; the remainder of the roadway does not have left turn lanes.
- **44th Avenue** – This is a 4-lane arterial roadway with auxiliary lanes provided at some intersections. There are several signalized intersections though most cross street intersections are unsignalized. There is a relatively short section with a TWLTL but there is no median through most of the section.
- **35th Avenue, 41st Avenue** – These are 2-lane local roadways with direct residential access.

B. Data Collection

Traffic Volumes

Turning movement counts were collected in January 2011 (data attached in **Appendix B**) for the AM and PM peak periods at the following signalized intersections within the study corridor:

- 38th Avenue at Vance Street
- 38th Avenue at High Court
- 38th Avenue at Pierce Street
- 38th Avenue at Harlan Street
- 38th Avenue at Depew Street
- Sheridan Boulevard at 32nd Avenue
- Sheridan Boulevard at 38th Avenue
- Sheridan Boulevard at 44th Avenue

The City of Wheat Ridge provided traffic analysis data for Wadsworth Boulevard, including traffic volume data, at the following intersections:

- Wadsworth Boulevard at 32nd Avenue
- Wadsworth Boulevard at 38th Avenue
- Wadsworth Boulevard at 44th Avenue

Daily traffic volumes used in this analysis were provided by the City of Wheat Ridge.

Pedestrian Volumes

In addition to vehicle counts, pedestrian traffic was counted at the signalized intersections along 38th Avenue and Sheridan Boulevard. Pedestrian traffic, however, is typically far more volatile than vehicle traffic due to a variety of factors. For example, the average temperature on the day the counts were taken was 26°F with a chance of snow in the forecast. This may have reduced the number of people who chose to walk that day, yet have little impact on those who commute via bus on a daily basis and must walk to or from the stop regardless of the weather.

The following table presents the total pedestrian counts collected along with the turning movement counts during the 2 hour AM and PM peak periods (**Table 1**).

Table 1 - Peak Period Pedestrian Count

AM / PM Pedestrian Counts[1]	North Approach	East Approach	South Approach	West Approach
Sheridan Boulevard & 38th Avenue	0 / 1	4 / 4	0 / 0	0 / 3
Depew Street & 38th Avenue	0 / 0	0 / 0	0 / 0	0 / 0
Harlan Street & 38th Avenue	0 / 2	1 / 7	2 / 5	2 / 5
Pierce Street & 38th Avenue	5 / 8	0 / 12	8 / 5	6 / 3
High Court & 38th Avenue	1 / 0	0 / 0	0 / 0	0 / 0
Vance Street & 38th Avenue	0 / 0	0 / 0	0 / 0	0 / 0
Sheridan Boulevard & 44th Avenue	0 / 0	0 / 2	0 / 0	1 / 3
Sheridan Boulevard & 32nd Avenue	1 / 3	7 / 8	1 / 1	4 / 1

1. The peak period pedestrian volumes were provided along with the vehicle counts from 6:45AM to 8:45AM and from 4:15PM to 6:15PM.

The lack of pedestrian activity over a total of 4 hours data collection at the Depew Street and Vance Street intersections was contrary to expectations. However, it is possibly due to the aforementioned volatility in pedestrian traffic.

Accident History

The City of Wheat Ridge provided accident history data for the three year period from 2008 through 2010. Over this period there were 144 reported accidents along 38th Avenue between Wadsworth Boulevard and Sheridan Boulevard. A brief review of the accident data indicated that the majority of the accidents along the corridor (102 of 144) occurred at or very near the signalized intersections. This is to be expected along an arterial corridor, including the higher concentrations of accidents at the intersections with Wadsworth Boulevard and Sheridan Boulevard.

The following table (**Table 2**) provides a summary of the accident data at and between the signalized intersections along 38th Avenue, detailed by accident type.

Table 2 - Summary of Accident Data (1/1/2008 to 12/31/2010)

Intersection	Pedestrian	Bicycle Collision	Fixed Objects	Multi-Vehicle	Unknown	Total
WADSWORTH BLVD			3	26	10	39
VANCE ST	1		1	9	3	14
Vance to Pierce				5	4	9
PIERCE ST		1	3	11	1	16
Pierce to Harlan	1	2		12	3	18
HARLAN ST	1	1	1	3		6
Harlan to Depew				5		5
DEPEW ST				4	2	6
Depew to Sheridan				8	2	10
SHERIDAN BLVD	2			14	5	21
Total	5	4	8	97	30	144

This table was developed based on a cursory review of the accident data table provided by the City of Wheat Ridge. The accident locations are approximate, at best, and are only meant to provide a general picture of the traffic accidents along the corridor.

C. Existing Conditions Traffic Analysis

The traffic operational analysis focuses on the signalized intersections along the 38th Avenue study corridor (7 total) for which specific traffic volumes and operational analysis results are reported.

Traffic Volumes

The traffic volume data was obtained from several sources, thus it was necessary to adjust the traffic volumes in order to provide a reasonable balance of traffic between intersections. These adjustments primarily affect the intersection of 38th Avenue and Wadsworth Boulevard, with only minor rounding adjustments made at other locations. The resulting traffic volumes used for the 2011 Existing Conditions scenario are presented graphically on **Figure 2**.

Operational Analysis

Traffic operations were evaluated using the methodology described in the Highway Capacity Manual, by the Transportation Research Board (TRB), 2000. Level of Service (LOS) is a qualitative measure of traffic operational conditions based on capacity and motorist delay.

Each level of service is designated with a letter, from A to F, with LOS A representing the best operating conditions and LOS F representing over capacity or congested conditions. For signalized intersections, LOS is related to the amount of delay per vehicle experienced as a result of signal operations. Volume to capacity (v/c) ratios are another common measure of effectiveness used, where operations decrease as the v/c ratio approaches, or exceeds a value of 1.0 (at which point the volume equals the capacity of the roadway). Traffic signal timing data was provided by the City of Wheat Ridge for Wadsworth Boulevard and 38th Avenue, the Denver Regional Council of Governments (DRCOG) provided data for Sheridan Boulevard.

Figure 3 graphically presents the results of the 2011 Existing Conditions operational analysis along with the associated lane geometry. The corridor's seven signalized intersections operate at LOS D or better during the AM and PM peak hours. There is some congestion at the intersection of 38th Avenue with Wadsworth Boulevard, as indicated by high v/c ratios on certain movements. This is not unexpected due to the high volume of peak hour traffic on Wadsworth Boulevard. The interior intersections along the study corridor (Vance Street through Depew Street) all operate at LOS C or better during the peak periods with individual movement group v/c ratios of 0.7 or less.

Figure 2 - 2011 Existing Conditions: Traffic Volumes

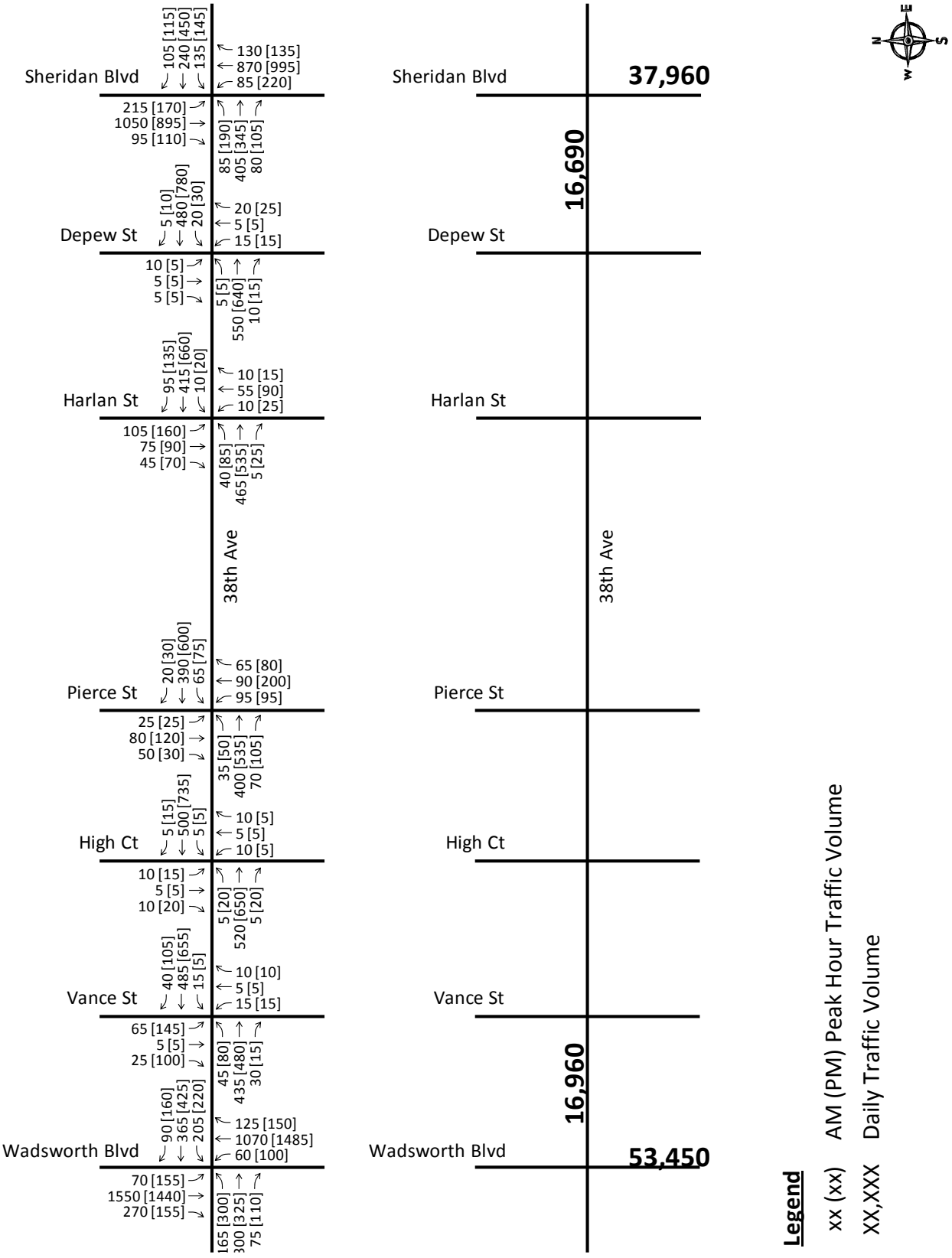
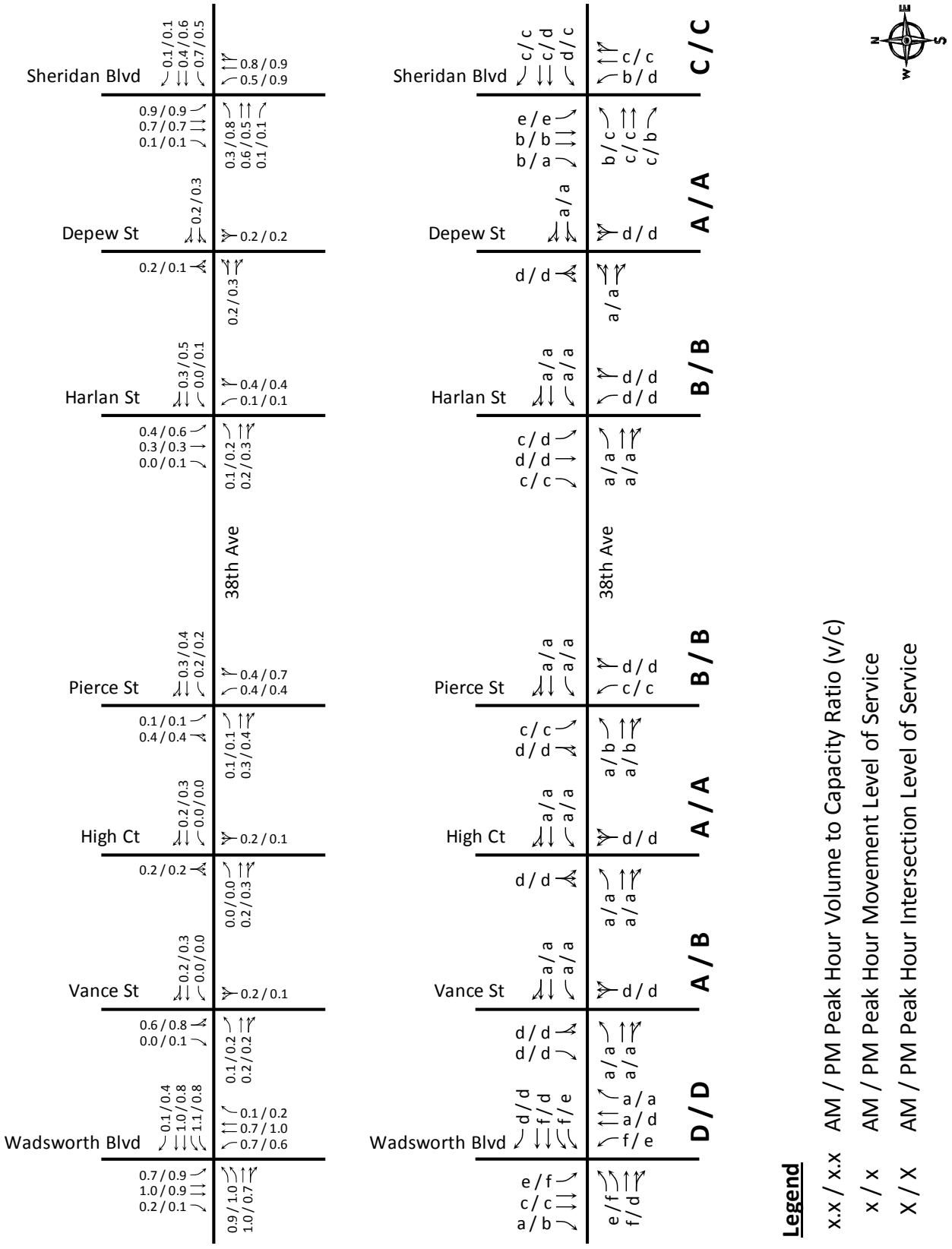


Figure 3 - 2011 Existing Conditions Lane Geometry, Levels of Service and v/c Ratios



III. TRAFFIC PROJECTIONS

A. Traffic Growth

Traffic growth projections along the corridor were reviewed using several methodologies; the final result is a 15% growth rate used throughout the study corridor. Historic growth rates based on several decades of traffic count data, and a review of the land use growth and other planning documents, showed relatively flat growth of between 5% and 15%. However, the DRCOG 2035 regional traffic model showed a large amount of growth with more than double the traffic at several locations.

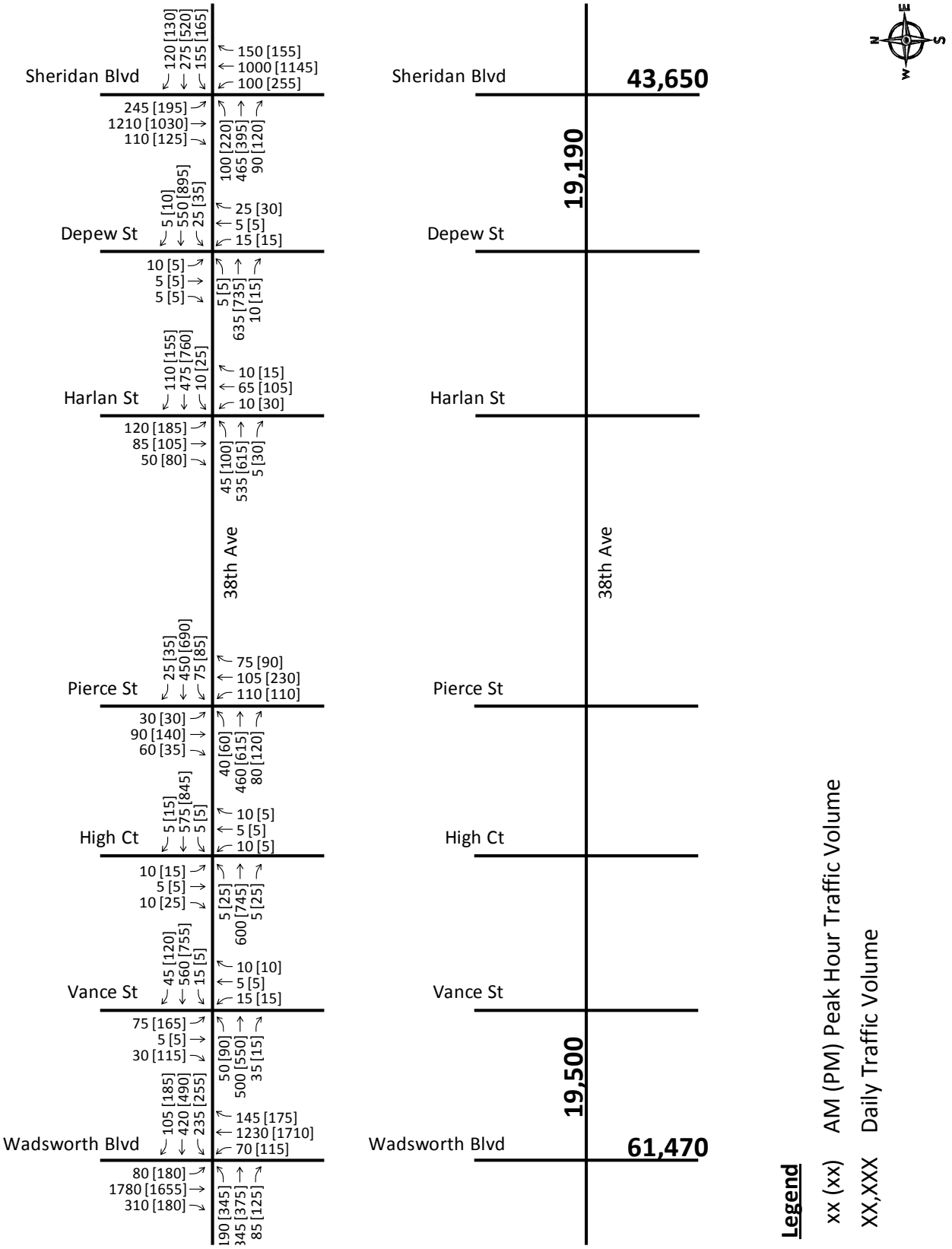
It was concluded that the unexpected growth on 38th Avenue was at least in part due to the roadway's location and designation as a principal arterial in the DRCOG model, allowing the model to use 38th Avenue as an outlet for excess I-70 traffic. DRCOG staff agreed that a growth rate in the 10% to 15% range would be more appropriate given the nature and purpose of 38th Avenue.

The traffic growth rate findings and recommendations were summarized in an earlier Technical Memorandum dated March 1, 2011 (attached as **Appendix C**).

Traffic Volumes

The 2035 projected traffic volumes were calculated by applying the flat 15% growth throughout the corridor, with minor adjustments made as necessary. **Figure 4** shows the resulting traffic volumes used for all 2035 Projected Conditions scenarios.

Figure 4 - 2035 Projected Conditions, Traffic Volumes



IV. ALTERNATIVES ANALYSIS

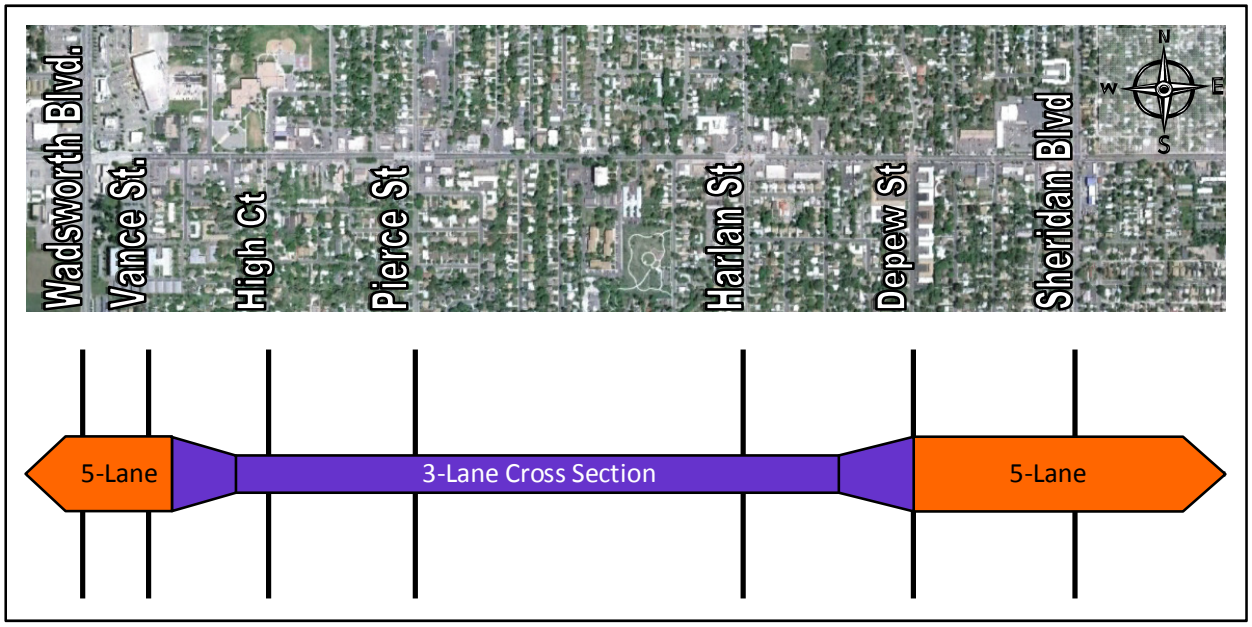
There were 4 alternatives reviewed in this analysis: the no action alternative and three "road diet" alternatives. The no action alternative maintains the existing lane geometry and is used as the baseline for comparative analyses.

A. Road Diet Geometry

The primary changes made in the road diet alternatives are the removal of one through lane in each direction and the addition (where applicable) of a Two-Way Left-Turn Lane (TWLTL) median. Thus the road diet cross sections are best described as 3-lane roadways; one thru lane in each direction and a TWLTL median. Striped left-turn bays will be provided at signalized intersection approaches and unsignalized intersections where proper.

On the west side of the corridor, the existing 5-lane cross section on 38th Avenue will be maintained through Vance Street to North Upham Street. The transition is expected to occur in the vicinity of North Upham Street, with auxiliary lanes provided as necessary to accommodate the Fire Station located north of 38th Avenue on North Upham Street. On the east side of the corridor the transition is expected to occur at Depew Street with the 3-lane cross section on the west approach and the existing 5-lane cross section on the east approach. As shown on **Figure 5**, the road diet will extend approximately 1 mile in length (not including the transition area).

Figure 5 - Road Diet Transition



The proposed road diet roadway geometry can be summarized by segment as follows:

- **Wadsworth Boulevard to North Upham Street** – This segment will retain the current 5-lane cross section with auxiliary lanes at the Wadsworth Boulevard intersection with 38th Avenue.
- **North Upham Street Transition** – The transition from 5-lane cross section to the 3-lane cross section is expected to occur in the vicinity of North Upham Street. The outside (right) through lane in the eastbound direction should taper down to one lane such that the transition does not interfere with either the South or North Upham Street intersections. The outside through lane in the westbound direction is expected to be added at the North Upham Street intersection opposite a right-turn only lane such that emergency vehicles have an eastbound acceleration lane.
- **North Upham Street to Depew Street** – This segment will have a consistent 3-lane cross section; one through lane in each direction and a TWLTL median.
- **Depew Street Transition** – The transition from 3-lane to 5-lane cross sections is expected to take place at the Depew Street/38th Avenue intersection. The outside (right) through lane in the eastbound direction will begin on the east side of the intersection. The outside through lane in the westbound direction will be converted to a right-turn only lane and not continue beyond the intersection.
- **Depew to Sheridan** – This segment will retain the current 5-lane cross section.

Wadsworth Boulevard Lane Configuration

Special consideration was given to the intersection of Wadsworth Boulevard and 38th Avenue regarding the lane geometry on the eastbound approach. Currently there are two left-turn lanes, one through lane and a shared through/right-turn lane on the eastbound approach. Between 20% and 25% of the traffic in the through and through/right-turn lane are projected to turn right, which indicates that a higher proportion of the through traffic may use the inside through lane. This condition, called *lane utilization*, may be exacerbated by the road diet alternative where the outside through lane will drop as the road transitions to the 3-lane cross section. Placing the transition east of the Vance Street intersection, providing an additional 1,000 feet beyond the stop-bar, should help mitigate this issue.

The addition of a separate eastbound right-turn lane would also help improve the operation on this approach. City of Wheat Ridge long term plans for the Wadsworth Boulevard/38th Avenue intersection include the eastbound right-turn lane in addition to other improvements at this intersection. For the purpose of this analysis, the eastbound right-turn lane is included for all future traffic conditions. *(Note: In addition, the lane utilization factor for the eastbound approach at Wadsworth was reduced to from 0.95 to 0.81 to account for the imbalanced lane utilization)*.

Parking

The potential for on-street parking was also considered as an element in the road diet alternatives. On-street parking can negatively impact traffic flow depending on the location and frequency of parking maneuvers. Parking maneuvers near signalized intersections can decrease the capacity of adjacent travel lanes by 10-20%. For the alternatives that included on-street parking, it was assumed that 10 maneuvers would occur per hour/per block, which is slightly higher (more conservative) than the HCM's recommended default rate of 8 maneuvers per hour for 2-hour parking zones.

Bus Stops

Bus stop locations along 38th Avenue were also evaluated for their potential impact on the road diet alternatives. Currently, the Regional Transportation District's (RTD) bus stops are located such that buses stop in the outside (right) travel lane, which requires through traffic to bypass stopped buses by using the left travel lane. Under road diet alternatives, buses could potentially block through traffic at each bus stop because there is only one through lane in each direction.

To assess this potential impact and to also determine where bus turnouts may be required, bus stop ridership data was collected for RTD's #38 bus route. The #38 bus route is the only route on 38th Avenue through Wheat Ridge. The #38 bus operates on the following headways:

- Eastbound #38: AM Peak – 15 minute headways, PM Peak – 30 minute headways.
- Westbound #38: AM Peak – 30 minute headways, PM Peak – 12 minute headways.

Figure 6 and **Table 3** show the locations of the bus stops and the boarding and alighting activity for those stops within the proposed road diet segment.

Figure 6 – Bus Stop Locations

Table 3 - RTD Route #38 Ridership Data

Location	Bus Boarding and Alighting (combined)					
	Eastbound			Westbound		
	AM[1] 9 Buses	PM[2] 6 Buses	All Day 40 Buses	AM[1] 6 Buses	PM[2] 9 Buses	All Day 40 Buses
High Court	4	4	18	5	4	21
Reed Street (EB Only)	5	2	16	-	-	-
Pierce Street	8	5	26	6	8	33
Newland Street / Marshall Street	2	1	8	1	2	8
Kendall Street	4	6	25	4	4	24
Harlan Street	6	4	28	3	7	27
Fenton Street / Eaton Street	1	2	7	0	1	6
Depew Street	5	3	19	4	5	17

[1] RTD AM peak data compiled from 6:00 AM to 8:59 AM (3 hours)
[2] RTD PM peak data compiled from 3:00 PM to 5:59 PM (3 hours)

The bus stops at Pierce and Harlan Streets have the highest amount of activity and also have the greatest potential of disrupting traffic operations. The Kendall Street stop also has a moderate amount of activity; however, bus stop usage is not as pronounced during peak traffic hours as the Harlan or Pierce Street stops. This is likely due to the proximity of the Kendall stop to the senior housing building, where patrons are more likely to use the bus during off-peak hours than during peak hours. The remaining stops at High Court, Reed Street, Newland/Marshall Street, Fenton/Eaton Street and Depew Street all have relatively low activity and the impact of buses on through traffic flow would be very minor due to infrequent stops and the distance of these stops away from any major intersections.

To mitigate the impact of bus blockage at the Harlan, Kendall and Pierce Street intersections, bus turnouts were considered. The turnouts allow buses to pull out of the through lane and not impede through vehicle traffic. The Transit Cooperative Research Program (TCRP) Report 19 provides guidelines for where bus pullouts may be needed:

Bus turnouts should be considered at a location when the following factors are present:

1. *Traffic in the curb lane exceeds 250 vehicles during the peak hour,*
2. *Traffic speed is greater than 40 mph,*
3. *Bus volumes are 10 or more per peak hour on the roadway,*
4. *Passenger volumes exceed 20 to 40 boardings an hour,*
5. *Average peak-period dwell time exceeds 30 seconds per bus,*
6. *Buses are expected to layover at the end of a trip,*
7. *Potential for auto/bus conflicts warrants separation of transit and passenger vehicles,*
8. *History of repeated traffic and/or pedestrian accidents at stop location,*
9. *Right-of-way width is adequate to construct the bay without adversely affecting sidewalk pedestrian movement,*
10. *Sight distances (i.e., hills, curves) prevent traffic from stopping safely behind a stopped bus,*
11. *A right-turn lane is used by buses as a queue jumper lane,*

12. *Appropriate bus signal priority treatment exists at an intersection,*
13. *Bus parking in the curb lane is prohibited, and*
14. *Improvements, such as widening, are planned for a major roadway. (This provides the opportunity to include the bus bay as part of the reconstruction, resulting in a better-designed and less-costly bus bay.)*

Source: TCRP Report 19 Guidelines for the Location and Design of Bus Stops, 1996

A review of these guidelines indicates that only the first guideline and possibly the seventh guideline are applicable. Given the low bus stop activity at the Kendall stop during peak traffic periods, a bus turnout is not recommended at this location. Bus turnouts are recommended at Harlan and Pierce Streets, primarily to reduce the impact of stopped buses on the operation of the traffic signals. All other locations should maintain the stops at their present location (at the far side of the intersection).

Bus stop activity was not explicitly included in the traffic operational analyses due to the recommended bus turnouts (which remove buses from the traffic flow) and the relatively low activity at the mid-block and secondary intersection locations.

B. Road Diet Alternatives

For the purpose of this analysis, no significant improvements to the existing roadway geometry are expected in absence of the road diet project for the 2035 Projected Conditions scenarios.

No Action Alternative

No changes are made to the existing roadway network with the exception of the additional eastbound right-turn lane at the Wadsworth Boulevard / 38th Avenue intersection (consistent in all alternatives).

Alternative 1 – 3-Lane Section: No On-Street Parking, No Right-Turn Lanes

This alternative represents the basic road diet geometry which would provide a consistent 3-lane cross section (with TWLTL) between North Upham Street and Depew Street. On-street parking is not included in this scenario, and separate right-turn lanes are not provided.

Alternative 2 – 3-lane section: On-Street Parking Included, No Right-Turn Lanes

This alternative includes the basic road diet geometry (3-lane cross section with TWLTL) between North Upham Street and Depew Street. On-street parking has been included throughout the 3-lane section of the roadway. In the analysis, the presence of on-street parking is reflected as a reduction in the capacity of the roadway.

Alternative 3 – 3-lane section: On-Street Parking Included, Right-Turn Lanes at Pierce and Harlan

This alternative includes the basic road diet geometry (3-lane cross section with TWLTL) between North Upham Street and Depew Street. Separate right-turn lanes are provided for the Pierce Street and Harlan Street intersection. On-street parking is still included through most of the 3-lane section of the roadway except in the vicinity of the Pierce and Harlan intersections.

C. Road Diet Operational Analysis

Roadway operations were reviewed in detail for the signalized intersections along 38th Avenue using HCM methodologies. The traffic signal timings provided by the City of Wheat Ridge and DRCOG were used as a base starting point in each scenario, but were modified as needed to reflect expected changes to traffic flows and geometric conditions. **Table 4** provides a summary of the LOS results and associated intersection delay for all scenarios.

Table 4 - Intersection Level of Service and Delay Summary

Description	Wadsworth Boulevard	Vance Street	High Court	Pierce Street	Harlan Street	Depew Street	Sheridan Boulevard
2010 Existing	D / D 38.5 / 45.6	A / B 6.3 / 10.0	A / A 3.9 / 2.8	B / B 16.9 / 20.0	B / B 12.8 / 12.8	A / A 3.3 / 3.2	C / C 26.1 / 28.6
2035 Projection, No Action	E / E 61.3 / 77.2	A / B 6.6 / 10.5	A / A 3.8 / 2.8	B / C 17.5 / 22.0	B / B 12.7 / 13.6	A / A 3.2 / 3.3	C / D 32.5 / 46.9
2035 Projection, Alt 1 2-Lane – with Two Way Left Turn Lane (TWLTL)	E / E 64.0 / 77.4	A / B 7.1 / 11.4	A / A 5.4 / 4.2	B / C 19.8 / 29.7	B / C 12.9 / 26.5	A / A 4.9 / 6.5	C / D 32.6 / 48.1
2035 Projection, Alt 2 2-Lane – w/TWLTL: On-Street Parking (OSP)	E / E 64.2 / 77.4	A / B 7.4 / 10.8	A / A 6.7 / 5.4	C / D 23.3 / 43.5	B / D 15.5 / 49.5	A / A 5.6 / 7.5	C / D 32.8 / 48.2
2035 Projection, Alt 3 2-Lane – w/TWLTL: Some OSP: RT Lanes[1]	E / E 64.7 / 77.4	A / B 7.4 / 10.9	A / A 6.9 / 5.9	C / C 20.1 / 25.8	B / B 14.2 / 18.4	A / A 6.2 / 7.3	C / D 32.8 / 48.0

Note: delay values measured as the average seconds of delay per vehicle for the intersection as a whole.
[1] RT Lanes refer to providing eastbound and westbound right-turn lanes at the Pierce and Harlan intersections with 38th.

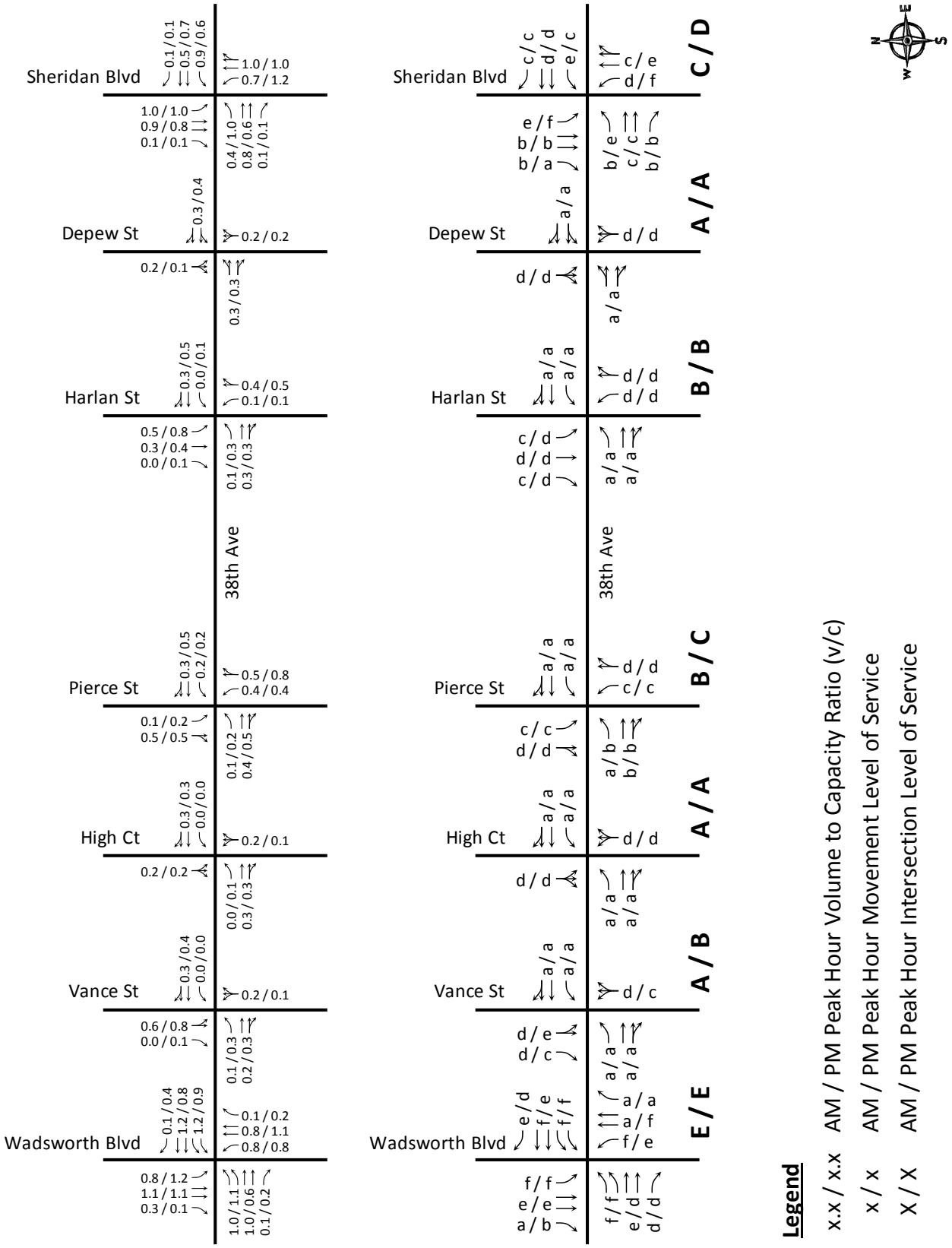
The capacity analysis worksheets for all scenarios are attached in **Appendix D**. The following sections detail the LOS results for each scenario.

No Action Alternative

Figure 7 provides the lane geometry, levels of service and v/c ratios for the No Action alternative. The intersection of 38th Avenue / Wadsworth Boulevard operates at LOS E during the peak hours, with several movements operating at- or over-capacity. This is not unexpected at this location due to the high volumes along Wadsworth Boulevard. Sheridan Boulevard operates at LOS D or better, though some movements are at- or over-capacity.

At the internal intersections, which are the focus of the study, all signals operate at LOS C or better during the peak hours with very good LOS for 38th Avenue movements. Side street movement delays are higher, but generally acceptable for day to day operations.

Figure 7 - 2035 Projected Conditions: No Action Lane Geometry, LOS and v/c Ratios



Alternative 1 – 3-Lane Section: No On-Street Parking, No Right-Turn Lanes

Figure 8 provides the lane geometry, levels of service and v/c ratios for Alternative 1. The Wadsworth Boulevard and Sheridan Boulevard intersections are unchanged other than minor variations which exist due to differences such as corridor progression factors. At the internal intersections, traffic continues to operate at LOS C or better, although there are some at- or near-capacity movements in the PM peak hour, specifically for westbound 38th Avenue.

Alternative 2 – 3-lane section: On-Street Parking Included, No Right-Turn Lanes

Figure 9 provides the lane geometry, levels of service and v/c ratios. The Wadsworth Boulevard and Sheridan Boulevard intersections are again unchanged other than minor, predictable, variations. In this scenario, the LOS suffers at the Pierce Street and Harlan Street intersections, especially during the PM peak hour where they are LOS D. This is primarily due to the capacity reduction that comes from the presence of on-street parking adjacent to the single through/right-turn lanes at these intersections. The at- or over-capacity movements can be seen in the eastbound direction at Pierce Street and the westbound direction at Harlan Street.

Alternative 3 – 3-lane section: On-Street Parking Included, Right-Turn Lanes at Pierce and Harlan

Figure 10 provides the lane geometry, levels of service and v/c ratios. The Wadsworth Boulevard and Sheridan Boulevard intersections remain relatively unchanged compared to the No Action alternative. The addition of right-turn lanes at the Pierce Street and Harlan Street intersections, along with the removal of the parking maneuvers adjacent to these approaches, results in improved levels of service over the Alternative 2 scenario. The levels of service along 38th Avenue with the road diet geometry are LOS C or better during both the AM and PM peak periods. The on-street parking continues to have minor impacts at other intersections.

Figure 8 - 2035 Projected Conditions: Alternative 1 Lane Geometry, LOS and v/c Ratios

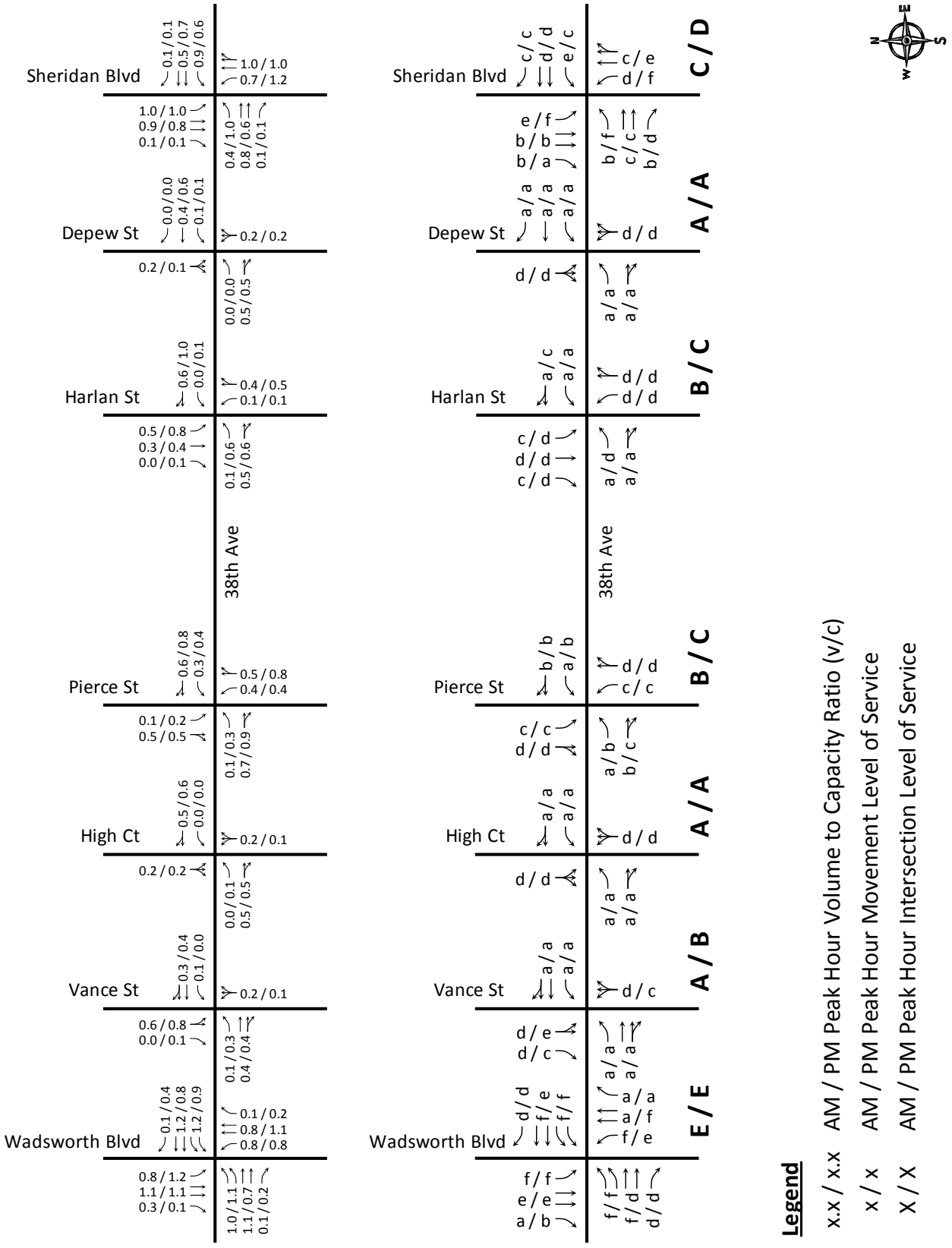


Figure 9 – 2035 Projected Conditions: Alternative 2 Lane Geometry, LOS and v/c Ratios

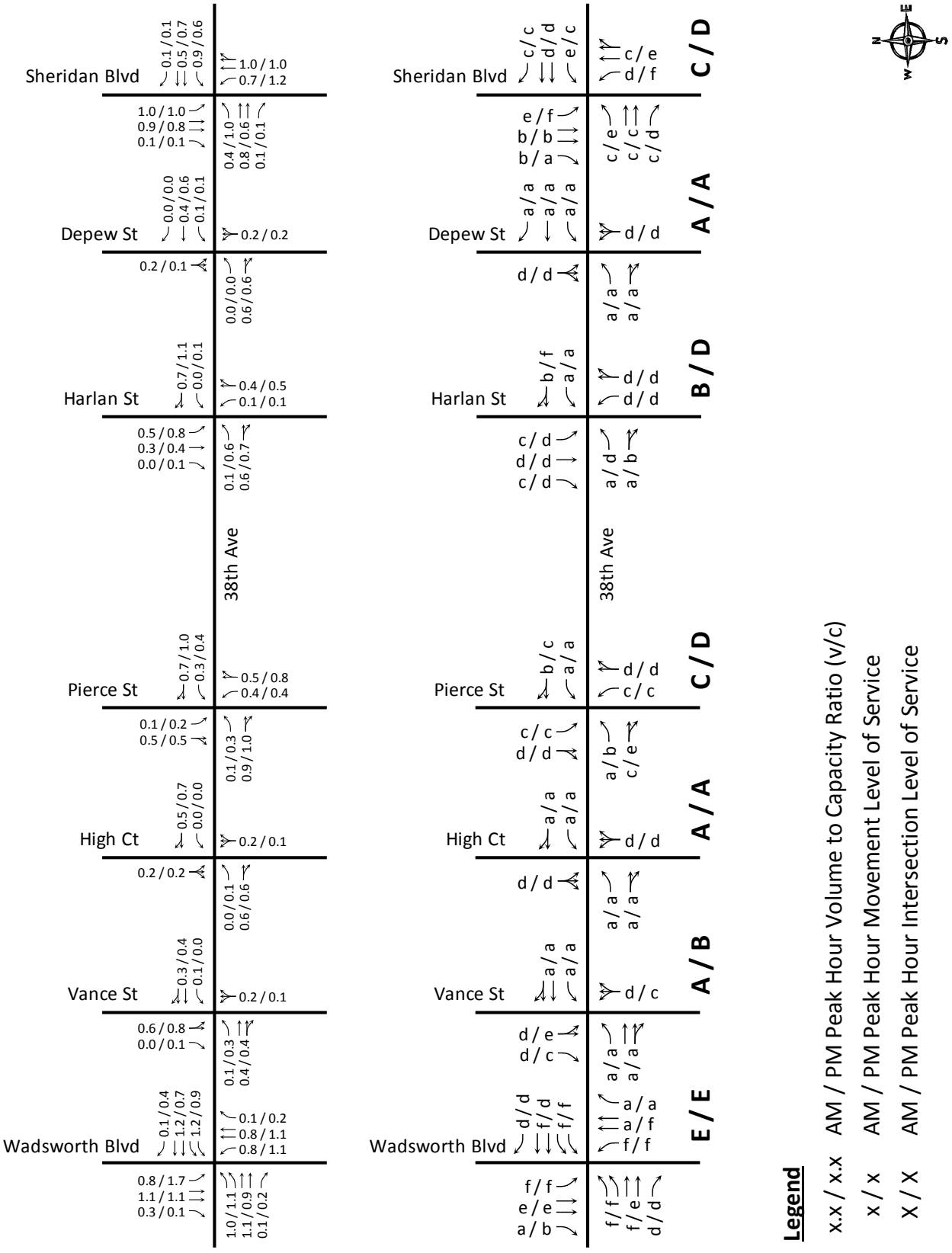
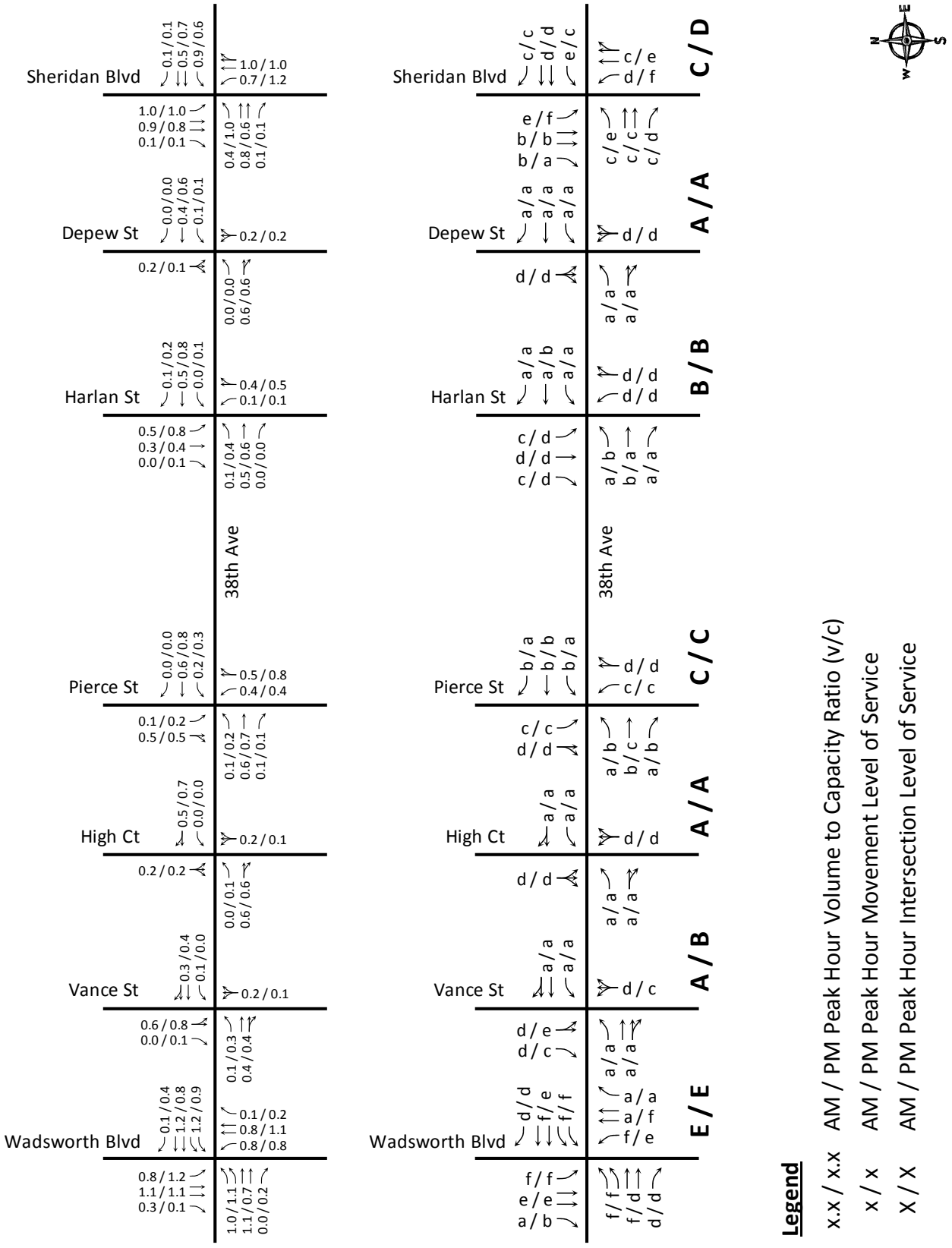


Figure 10 – 2035 Projected Conditions: Alternative 3 Lane Geometry, LOS and v/c Ratios



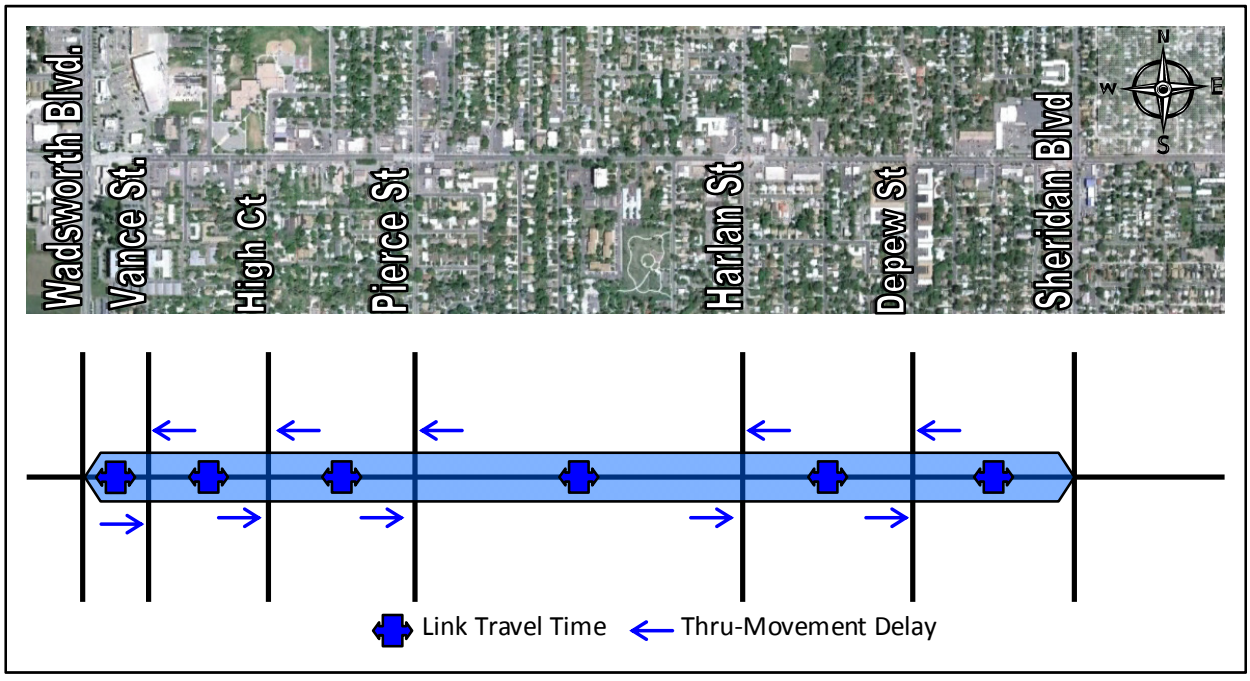
V. TRAVEL TIME / DIVERSION ANALYSIS

The travel time and diversion analyses are two distinct methods used to determine the impacts of the road diet alternatives on 38th Avenue traffic. The travel time analysis looks at the travel time on 38th Avenue between Wadsworth Boulevard and Sheridan Boulevard for all scenarios: Existing Conditions and the four Projected Conditions scenarios. The diversion analysis selects one specific alternative (Alternative 3) and looks at the travel time on both 38th Avenue and on several parallel routes. The travel time analysis provides a comparison of the alternatives specific to 38th Avenue, while the diversion analysis provides a comparison of the 38th Avenue travel times versus routing alternatives.

A. Travel Time Analysis on 38th Avenue

The travel time analysis looks at the amount of time it would take a vehicle to travel from a point just east of Wadsworth Avenue to a point just west of Sheridan Boulevard, as shown on **Figure 11**. The travel time information is a combination of the link travel times and the thru-movement delays on 38th Avenue between Wadsworth Boulevard and Sheridan Boulevard.

Figure 11 - Travel Time Detail



Results

Table 5 provides a summary of the eastbound and westbound travel time analysis for 38th Avenue. The first part of the table shows the estimated travel time (in seconds) with the existing lane geometry. The second part of the table provides the calculated increase in travel time on 38th Avenue as a result of the road diet for each of the 3 alternatives. Again, the Wadsworth Boulevard and Sheridan Boulevard intersection delays were not included in this analysis.

Table 5 - 38th Avenue Travel Time Summary

Description	Eastbound Travel Time in seconds AM / PM	Westbound Travel Time in seconds AM / PM
Travel Time with Existing Lane Geometry (4-lane cross section typical)		
2011 Existing	206 / 223	209 / 205
2035 Projection, No Action	208 / 225	210 / 208
Additional Travel Time after Road Diet (3-Lane cross section typical)		
2035 Projection, Alternative 1 2-Lane – with Two Way Left Turn Lane (TWLTL)	+15 / +15	+15 / +40
2035 Projection, Alternative 2 2-Lane – w/TWLTL: On-Street Parking (OSP)	+27 / +50	+27 / +99
2035 Projection, Alternative 3 2-Lane – w/TWLTL: Some OSP: Intersection Improvements	+19 / +34	+23 / +39

Alternatives 1 and 3 have the least impact to travel time with both options causing only 40 seconds or less of added delay in the corridor. This amount of added delay would typically be within the day-to-day travel time variation that motorists experience, and would likely not be perceptible to the average driver. Alternative 2, however, would increase travel time by as much as 99 seconds in the PM peak hour, which would be more perceptible to the average driver and may result in undesirable congestion. The primary advantage of Alternative 3 over Alternative 1 is that it allows for on-street parking (except in the immediate vicinity of the Harlan and Pierce Street intersections) while creating only a minor increase in overall travel time.

B. Diversion Analysis

The diversion analysis addresses the possibility that drivers will chose to avoid 38th Avenue (their established route) and instead divert to parallel routes such as 32nd Avenue to the south, 44th Avenue to the north or other local streets. This type of diversion will likely occur only if the alternative route would offer an appreciable benefit such as reduced travel time, avoid congestion, or other tangible aspects.

This is especially true during the peak periods in this type of environment, where commuters make up the majority of the vehicle traffic. In general, commuters will stick to an established route which minimizes travel time, ideally with the fewest number of turns and higher travel speeds. Arterial roadways are generally favored by commuter traffic, as opposed to collector roadways which tend to have lower speed limits and signals timed to favor the higher volume roadway.

In order to illustrate the relative efficiency of alternative routes versus the road diet laneage on 38th Avenue, a diversion analysis was conducted using the 2035 Projected Conditions, PM peak hour traffic volumes and the Alternative 3 road diet scenario. The analysis focuses on the primary eastbound and westbound through movements within the corridor which carry the majority of the traffic volumes. The

parallel routes represent paths a typical motorist might try in lieu of continuing eastbound or westbound on 38th Avenue.

It is important to note that the travel times included in this diversion analysis *include all relevant signal approach delays*. In the travel time analysis the approach delays at Wadsworth Boulevard and Sheridan Boulevard were specifically excluded. The diversion analysis includes all turning movements at these bounding intersections as there can be a significant difference in the amount of delay at Wadsworth Boulevard or Sheridan Boulevard when choosing to turn left or right as opposed to continuing through the intersection.

Major Roads (32nd Avenue, 44th Avenue)

The data collected at the Wadsworth Boulevard and Sheridan Boulevard intersections with 32nd Avenue and 44th Avenue were used as a base to estimate the amount of traffic on the major parallel routes. The signalized turning movement delays could then be estimated and combined with the free flow travel times between intersections to calculate the overall travel time for vehicles diverting to 32nd Avenue or 44th Avenue.

Minor Roads (35th Avenue, 41st Avenue)

Travel time was estimated along the minor street diversion routes by assuming vehicles would travel in a free flow manner with the exception of delays incurred at traffic signals, stop signs, dips and turning movements. Standard acceleration and deceleration rates were used to calculate the added delay that would be incurred at such locations.

Results

The results of the eastbound and westbound diversion analysis are provided in **Table 6** and **Table 7**, respectively. The diversion route for each path is described as a sequence of links from a specific location to a common destination on 38th Avenue.

Table 6 - Eastbound Diversion Analysis (Alternative 3, PM Peak Hour)

Route ID	Brief Route Description[1]	Travel Time (in seconds)		
		Diversion Route	Base Route[2] (38th Ave Only)	Difference
1E	38th – Wads – 44th – Sheridan – 38th	615	330	285
2E	38th – Wads – 32nd – Sheridan – 38th	500	330	170
3E	44th – Sheridan – 38th	455	330	125
4E	32nd – Sheridan – 38th	400	330	70
5E	38th – Teller – 35th – Benton – 38th	265	205	60
6E	38th – Jay – 35th – Benton – 38th	175	75	100

[1] Route shown graphically below.
[2] Travel time along 38th Avenue running parallel to the diverted route.

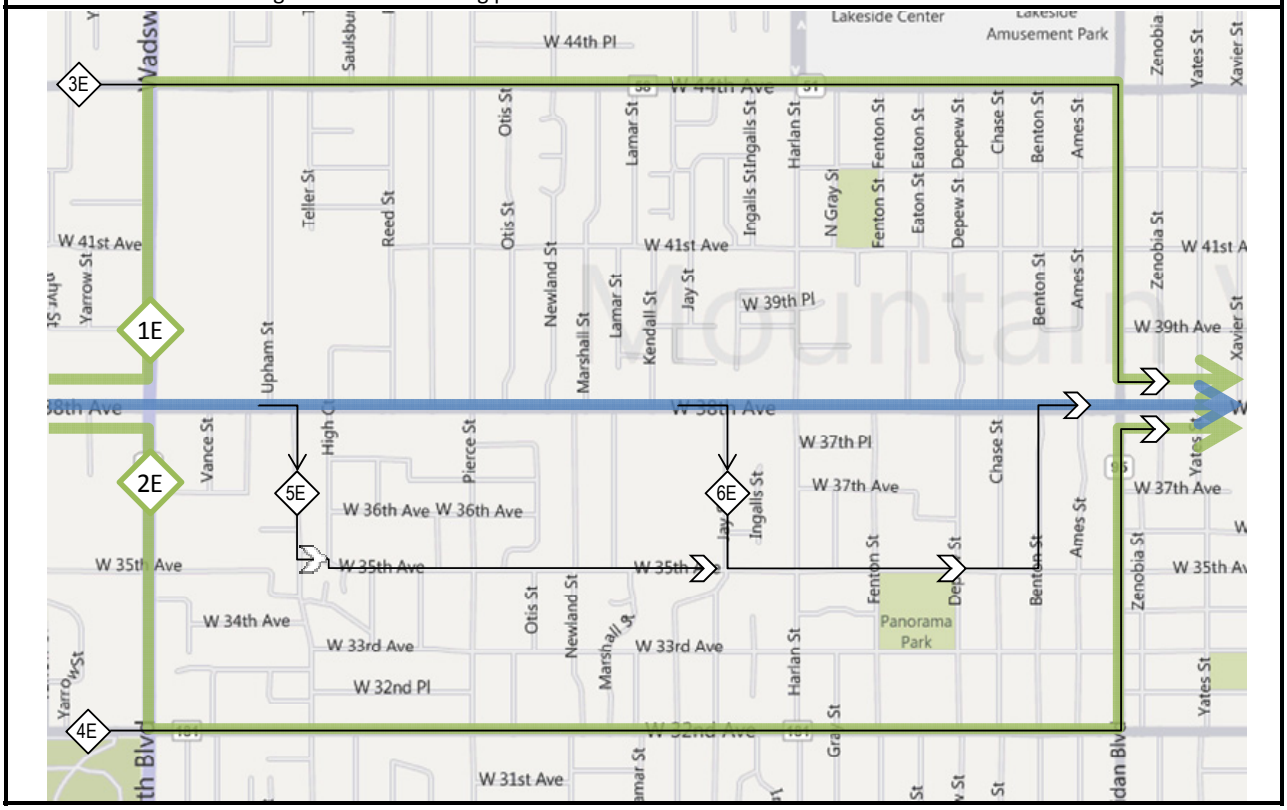
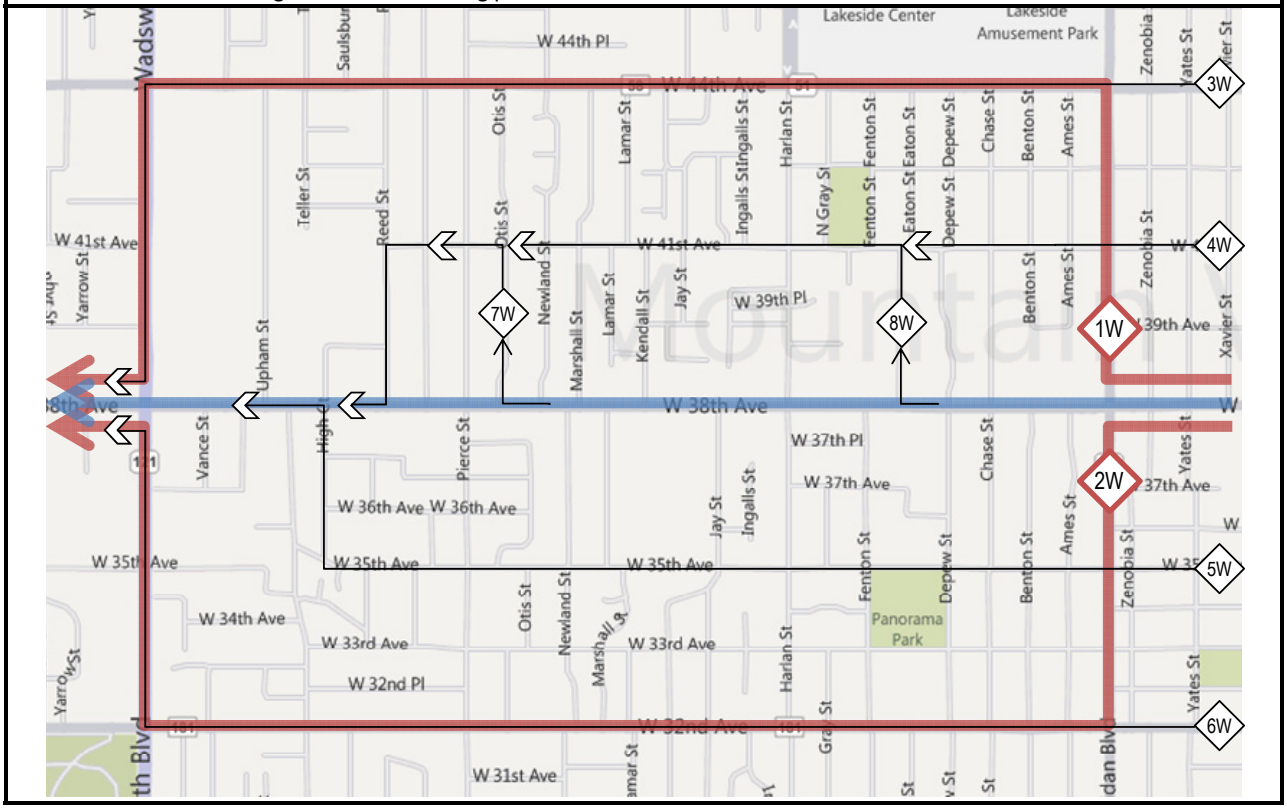


Table 7 - Westbound Diversion Analysis Results (Alternative 3, PM Peak Hour)

Route ID	Brief Route Description[1]	Travel Time (in seconds)		
		Diversion Route	Base Route[2] (38th Ave Only)	Difference
1W	38th – Sheridan – 44th – Wads – 38th	485	345	140
2W	38th – Sheridan – 32nd – Wads – 38th	475	345	130
3W	44th – Wads – 38th	395	345	50
4W	41st – Reed – 38th	305	225	80
5W	35th – High – 38th	285	245	40
6W	32nd – Wads – 38th	430	345	85
7W	38th – Otis – 41st – Reed – 38th	145	35	110
8W	38th – Eaton – 41st – Reed – 38th	245	140	105

1 Route shown graphically below.
2 Travel time along 38th Avenue running parallel to the diverted route.



In each comparison (eastbound and westbound), the diversion routes would result in a longer travel time than continuing along 38th Avenue in the road diet Alternative 3 scenario. Therefore, there is no clear incentive for motorists to divert away from 38th Avenue, and no decrease in traffic flow on 38th Avenue is expected as a result of the road diet.

VI. CONCLUSIONS AND RECOMMENDATIONS

The 38th Avenue corridor between Wadsworth Boulevard and Sheridan Boulevard will feature the Main Street environment for the City of Wheat Ridge. To help this area become a primary destination for city residents and visitors, a road diet has been proposed for this area to allow for various landscaping, atmosphere and character improvements on 38th Avenue.

The proposed road diet would begin east of Vance Street, in the vicinity of North Upham Street, where the road would transition from the current 5-lane cross section to a 3-lane cross section; one through lane in each direction and a Two-Way Left-Turn Lane (TWLTL) median. The 3-lane cross section would continue for approximately 1 mile east to Depew Street where it would transition to the existing 5-lane cross section. At present, 38th Avenue between Pierce Street and Depew Street is a 4-lane road with 2-through lanes in each direction. Left-turn lanes are only provided at Pierce Street and Harlan Streets.

The three road diet alternatives that were evaluated share the same general 3-lane cross section with variations in on-street parking along the corridor and the presence of auxiliary lanes at the intersections of Pierce Street and Harlan Street:

- Alternative 1 – 3-Lane Section: No On-Street Parking, No Right-Turn Lanes.
- Alternative 2 – 3-Lane Section: On-Street Parking Allowed, No Right-Turn Lanes.
- Alternative 3 – 3-Lane Section: Limited On-Street Parking, Right-Turn Lanes at Pierce and Harlan.

Analysis Results

Three types of analysis were conducted on the 38th Avenue study corridor: Level of Service (LOS), Travel Time, and Diversion. The results of the LOS analysis show relatively minor decreases in traffic operations in Alternatives 1 and 3, with LOS C or better at the intersections directly affected by the road diet. Alternative 2 shows a greater impact at the Pierce Street and Harlan Street intersections with LOS D during the PM peak hour. The City of Wheat Ridge has adopted LOS D as the minimum acceptable operation level for City streets.

The travel time analysis shows an increase in travel time along 38th Avenue between approximately 15 seconds and 100 seconds. However, in Alternative 1 and 3 the increase is less than 40 seconds in any one direction during the peak periods. An increase in travel time of less than 1 minute along the 1.5 mile corridor would not likely be noticeable to the average driver, as this falls within the range of typical daily fluctuation in travel times.

The diversion analysis compared travel times along 38th Avenue for Alternative 3 to that of parallel routes that might be selected along 32nd Avenue, 35th Avenue, 41st Avenue or 44th Avenue. The results showed that diverting from 38th Avenue to any of these alternative routes in lieu of continuing eastbound or westbound through the road diet section of 38th Avenue would result in an average increase in travel time of 60% to 70% in the westbound and eastbound directions, respectively. Therefore, traffic is not expected to divert away from 38th Avenue as a result of the road diet.

Recommendations

The traffic analysis results indicate that Alternative 3 would provide the flexibility for on-street parking while mitigating the impact of the road diet conversion by providing auxiliary right-turn lanes at Pierce Street and Harlan Street. On-street parking should be omitted at the Harlan Street and Pierce Street intersections to ensure that these intersections continue to operate at an acceptable level. Similarly, bus turnouts should also be provided at these two intersections to minimize the impact of buses blocking the through traffic lanes. The bus turnouts should be located downstream and within 250-feet of the intersections.