



December 21, 2023

Steven Gomez
Senior Engineer – Traffic
City of Aurora
15151 E. Alameda Parkway
Aurora, CO 80012

Re: Revolve at Windler Traffic Impact Study Cover Letter
SEC 56th Avenue and Denali Street
Aurora, Colorado

Dear Mr. Gomez:

The purpose of this cover letter is to inform City of Aurora staff that the Revolve at Windler Traffic Impact Study has been updated to be consistent with the recent changes to the lane configurations at the 56th Avenue and Denali Street intersection from the Windler Homestead Traffic Impact Study Supplemental Letter dated October 3, 2023. These changes consist of converting the northbound approach of the 56th Avenue and Denali Street intersection from one left turn lane, a shared left/through lane, and a continuous right to lane to dual left turn lanes, one through lane, and a right turn lane.

Thank you for the continued coordination with the Revolve at Windler project. If you have any questions or require anything further, please feel free to call me at (720) 943-9962

Sincerely,

KIMLEY-HORN AND ASSOCIATES, INC.

A handwritten signature in blue ink that reads "Jeffrey R. Planck". The signature is fluid and cursive, with the first name "Jeffrey" being more prominent.

Jeffrey R. Planck, P.E.
Project Traffic Engineer

Traffic Impact Study

Revolve at Windler

Aurora, Colorado

Prepared for:

Sub4 Development Co.

Kimley»Horn

T R A F F I C I M P A C T S T U D Y

Revolve at Windler

Aurora, Colorado

Prepared for
Sub4 Development Co.
7150 East Camelback Road
Suite 444
Scottsdale, Arizona 85251

Prepared by
Kimley-Horn and Associates, Inc.
4582 South Ulster Street
Suite 1500
Denver, Colorado 80237
(303) 228-2300



December 2023

This document, together with the concepts and designs presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Reuse of and improper reliance on this document without written authorization and adaptation by Kimley-Horn and Associates, Inc. shall be without liability to Kimley-Horn and Associates, Inc.

TABLE OF CONTENTS

TABLE OF CONTENTS	i
LIST OF TABLES	ii
LIST OF FIGURES	ii
1.0 EXECUTIVE SUMMARY	1
2.0 INTRODUCTION	6
3.0 EXISTING AND FUTURE CONDITIONS	8
3.1 Existing Study Area and Future Access	8
3.2 Existing and Future Roadway Network	8
3.3 Existing Traffic Volumes	9
3.4 Unspecified Development Traffic Growth	10
4.0 PROJECT TRAFFIC CHARACTERISTICS	11
4.1 Trip Generation	11
4.2 Trip Distribution	12
4.3 Traffic Assignment	12
4.4 Total (Background Plus Project) Traffic	12
5.0 TRAFFIC OPERATIONS ANALYSIS	19
5.1 Analysis Methodology	19
5.2 Key Intersection Operational Analysis	20
5.3 Turn Bay Length Analysis	28
5.4 Vehicle Queueing Analysis	29
5.5 Bicycle, Pedestrian, Transit Access, and Traffic Calming Evaluation	31
5.6 Improvement Summary	33
6.0 CONCLUSIONS AND RECOMMENDATIONS	36

APPENDICES

- Appendix A – Intersection Count Sheets
- Appendix B – NEATS Data & Master Traffic Study
- Appendix C – Trip Generation Worksheets
- Appendix D – Intersection Analysis Worksheets
- Appendix E – Signal Warrant Analysis Worksheets
- Appendix F – Queue Analysis Worksheets
- Appendix G – Conceptual Site Plan

LIST OF TABLES

Table 1 – Trip Generation Comparison	12
Table 2 – Level of Service Definitions	19
Table 3 – 56 th Avenue & Denali Street (#1) LOS Results	21
Table 4 – 56 th Avenue & Fultondale Street (#2) LOS Results	22
Table 5 – 56 th Avenue & Harvest Road (#3) LOS Results.....	23
Table 6 – 56 th Avenue & Denali Street (#4) LOS Results.....	24
Table 7 – 55 th Avenue & Fultondale Street (#5) LOS Results	25
Table 8 – 55 th Avenue & Harvest Road (#6) LOS Results.....	26
Table 9 – Project Accesses Level of Service Results.....	27
Table 10 – Turn Lane Warrant and Length Summary.....	28
Table 11 – Turn Lane Queueing Analysis Results.....	30

LIST OF FIGURES

Figure 1 – Vicinity Map.....	7
Figure 2 – 2025 Project Trip Distribution	13
Figure 3 – 2040 Project Trip Distribution	14
Figure 4 – 2025 Project Traffic Assignment.....	15
Figure 5 – 2040 Project Traffic Assignment.....	16
Figure 6 – 2025 Total Traffic Volumes	17
Figure 7 – 2040 Total Traffic Volumes	18
Figure 8 – 2025 Recommended Geometry and Control.....	34
Figure 9 – 2040 Recommended Geometry and Control.....	35

1.0 EXECUTIVE SUMMARY

This report has been prepared to document the results of a Traffic Impact Study for Revolve at Windler proposed to be located on the southeast corner of the future 56th Avenue and Denali Street intersection in Aurora, Colorado. Revolve at Windler is proposed to include 201 multifamily housing units.

This study includes a 2025 horizon for project buildout as well as full buildout of the overall Windler development area in the 2040 horizon. It is noted that only the Revolve at Windler is being considered for the 2025 horizon in this submittal, however, the full buildout of the overall Windler development area with the addition of this project is included in the 2040 horizon to provide a comprehensive analysis for this area. It is expected that Revolve at Windler will be completed in the next several years with the remaining Windler Development to be completed after Revolve at Windler. Therefore, analysis was conducted for the 2025 Revolve at Windler buildout horizon and the 2040 full area buildout horizon. The Windler Homestead Master Traffic Study completed in May 2023 was used as a basis for the 2040 project horizon.

The purpose of this traffic study is to identify project traffic generation characteristics to determine potential project traffic related impacts on the local street system and to develop the necessary mitigation measures required for the identified traffic impacts. The following intersections were incorporated into this traffic study based on the City of Aurora requested scope:

- 56th Avenue & Denali Street (#1)
- 56th Avenue & Fultondale Street (#2)
- 56th Avenue & Harvest Street (#3)
- 55th Avenue & Denali Street (#4)
- 55th Avenue & Fultondale Street (#5)
- 55th Avenue & Harvest Road (#6)

In addition, the two proposed full movement accesses along the north side of 55th Avenue (#7 and #8) were evaluated.

Regional access to Revolve at Windler will be provided by E-470, I-70, and Peña Boulevard. Primary access will be provided by 56th Avenue, while direct access into the project site will be

provided by two access intersections along the north side of 55th Avenue approximately 350 feet and 685 feet east of Denali Street for the West Access (#7) and East Access (#8), respectively (measured center to center).

Revolve at Windler is expected to generate approximately 1,356 weekday daily trips, with 80 of these trips occurring during the morning peak hour and 103 of these trips occurring during the afternoon peak hour.

Based on the analysis presented in this report, Kimley-Horn believes Revolve at Windler will be successfully incorporated into the existing and future roadway network. Analysis of the existing and future street network, the proposed project development, and expected traffic volumes resulted in the following conclusions and recommendations:

2025 Recommendations

For purposes of this analysis, it was assumed that the Revolve at Windler development would be the first in place for the overall Windler development area. Therefore, the following roadway configurations are based upon this assumption:

- The intersection of 56th Avenue and Denali Street (#1) is planned to be constructed with development of the project. It is recommended that the eastbound and westbound 56th Avenue approaches consist of one left turn lane, one through lane, and one right turn lane. The northbound and southbound Denali Street approaches should operate with stop control with the installation of R1-1 “STOP” signs and one shared lane for all movements. The eastbound left turn lane, eastbound right turn lane, and westbound right turn lane lengths are recommended based upon CDOT standards as these meet turn lane warrants; it is recommended that these lanes be constructed to a length of 275 feet plus a 160-foot taper. Additionally, the westbound left turn lane, which is not anticipated to meet CDOT turn lane warrants in 2025, is recommended to be designated in the shadow of the eastbound left turn lane to a length of 100 feet.
- The ‘T’-intersection of 56th Avenue and Fultondale Street (#2) is planned to be constructed with development of the project. It is recommended that all three approaches consist of one

shared lane for all movements in this horizon. The northbound Fultondale Street approach should operate well with stop control with the installation of an R1-1 “STOP” sign.

- With completion of the Revolve at Windler project, two accesses (#7 and #8) are proposed along the north side of 55th Avenue on the south side of the development. It is recommended that an R1-1 “STOP” sign be installed on the exiting southbound approaches. Both access intersections should operate well with one shared lane for all movements at each intersection.

2040 Recommendations

- For purposes of this analysis, it was assumed that the overall Windler development area would be completed by 2040. Therefore, the intersection configuration at the intersections included in the Windler Homestead Master Traffic Study are consistent with that study, while the intersection configuration for intersections that were not studied in the master study are based on the operational analysis performed in this study. Additionally, the turn lane lengths at each intersection are generally aligned with the Windler Homestead Master study with a minimum of 100 feet in length.
- It is anticipated that a signal will be warranted at the intersection of 56th Avenue and Denali Street (#1). Therefore, if future volumes are realized, this intersection should be signalized by 2040. Additionally, it is recommended that the eastbound 56th Avenue approach consist of a left turn lane with 100 feet in length, three through lanes, and a right turn lane with 275 feet in length. The 56th Avenue westbound approach is recommended to consist of 200-foot dual left turn lanes and three through lanes with the outside lane being a shared through/right turn lane. The northbound Denali Street approach is recommended to consist of dual left turn lanes, one through lane, and a right turn lane. It is recommended that the inside northbound left turn lane be 225 feet of length, the outside left turn lane be a continuous lane, and the northbound right turn lane provide a length of 175 feet. The Denali Street southbound approach is recommended to consist of one 100-foot left turn lane, one through lane, and a 100-foot right turn lane.
- It is recommended that the eastbound approach at the intersection of 56th Avenue and Fultondale Street (#2) consist of three through lanes with the outside lane being a shared through/right turn lane. The 56th Avenue westbound approach is recommended to consist of

a 100-foot left turn lane and three through lanes. The northbound Fultondale Street approach is recommended to be designated with one left turn lane and one 100-foot right turn lane. This configuration aligns with the Windler Homestead Master study.

- The intersection of 56th Avenue and Harvest Road (#3) is planned to be constructed with completion of the overall Windler development. By 2040, it is anticipated that a signal will be warranted at this intersection. Therefore, this intersection should be signalized if future volumes are realized. It is recommended the eastbound 56th Avenue approach consist of 350-foot dual left turn lanes and three through lanes with the outside lane being a shared through/right turn lane. The 56th Avenue westbound approach should consist of one 350-foot left turn lane and three through lanes with the outside lane being a shared through/right turn lane. The northbound Harvest Road approach should consist of one 275-foot left turn lane, two through lanes, and a 100-foot right turn lane. The southbound Harvest Road approach is recommended to consist of one 300-foot left turn lane, two through lanes, and a 550-foot right turn lane.
- With full buildout of the Windler Development, it is anticipated that 55th Avenue will be extended to the west and Denali Street will be extended to the south, creating the four-leg intersection of 55th Avenue and Denali Street (#4). It is recommended that the eastbound and westbound 55th Avenue approaches operate with stop control with the installation of R1-1 “STOP” signs and consist of one shared lane for all movements. The northbound and southbound Denali Street approaches are recommended to consist of one 100-foot left turn lane and two through lanes with the outside lane being a shared through/right turn lane.
- With full buildout of the Windler Development, it is anticipated that 55th Avenue will be extended to the east and Fultondale Street will be extended to the south, creating the four-leg intersection of 55th Avenue and Fultondale Street (#5). It is recommended that the eastbound and westbound 55th Avenue approaches operate with stop-control with the installation of R1-1 “STOP” signs. All four approaches are recommended to consist of one shared lane for all movements.
- The intersection of 55th Avenue and Harvest Road (#6) is planned to be constructed with completion of the overall Windler development. It is recommended the eastbound and

westbound approaches consist of a shared left turn/through lane and one 100-foot right turn lane. The northbound and southbound approaches should consist of one 100-foot left turn lane, two through lanes, and one 100-foot right turn lane.

- With full construction of the Windler development, a south leg is anticipated to be constructed at the 55th Avenue West Access (#7). It is recommended that this south leg operate with stop control with installation of a R1-1 “STOP” sign.

General Recommendations

- Any onsite or offsite improvements should be incorporated into the Civil Drawings and conform to standards of the City of Aurora and the Manual on Uniform Traffic Control Devices (MUTCD) – 2009 Edition.

2.0 INTRODUCTION

Kimley-Horn and Associates, Inc. has prepared this report to document the results of a Traffic Impact Study for Revolve at Windler proposed to be located on the southeast corner of the future 56th Avenue and Denali Street intersection in Aurora, Colorado. A vicinity map illustrating the Revolve at Windler development location is shown in **Figure 1**. Revolve at Windler is proposed to include 201 multifamily housing units. A conceptual site plan is attached in **Appendix G**.

This study includes a 2025 horizon for project buildout as well as full buildout of the overall Windler development area in the 2040 horizon. It is noted that only the Revolve at Windler is being considered for the 2025 horizon in this submittal, however, the full buildout of the overall Windler development area with the addition of this project is included in the 2040 horizon to provide a comprehensive analysis for this area. It is expected that Revolve at Windler will be completed in the next several years with the remaining Windler Development to be completed after Revolve at Windler. Therefore, analysis was conducted for the 2025 Revolve at Windler buildout horizon and the 2040 full area buildout horizon. The Windler Homestead Master Traffic Study completed in May 2023 was used as a basis for the 2040 project horizon.

The purpose of this traffic study is to identify project traffic generation characteristics to determine potential project traffic related impacts on the local street system and to develop the necessary mitigation measures required for the identified traffic impacts. The following intersections were incorporated into this traffic study based on the City of Aurora requested scope:

- 56th Avenue & Denali Street (#1)
- 56th Avenue & Fultondale Street (#2)
- 56th Avenue & Harvest Street (#3)
- 55th Avenue & Denali Street (#4)
- 55th Avenue & Fultondale Street (#5)
- 55th Avenue & Harvest Road (#6)

In addition, the two proposed full movement accesses along the north side of 55th Avenue (#7 and #8) were evaluated.

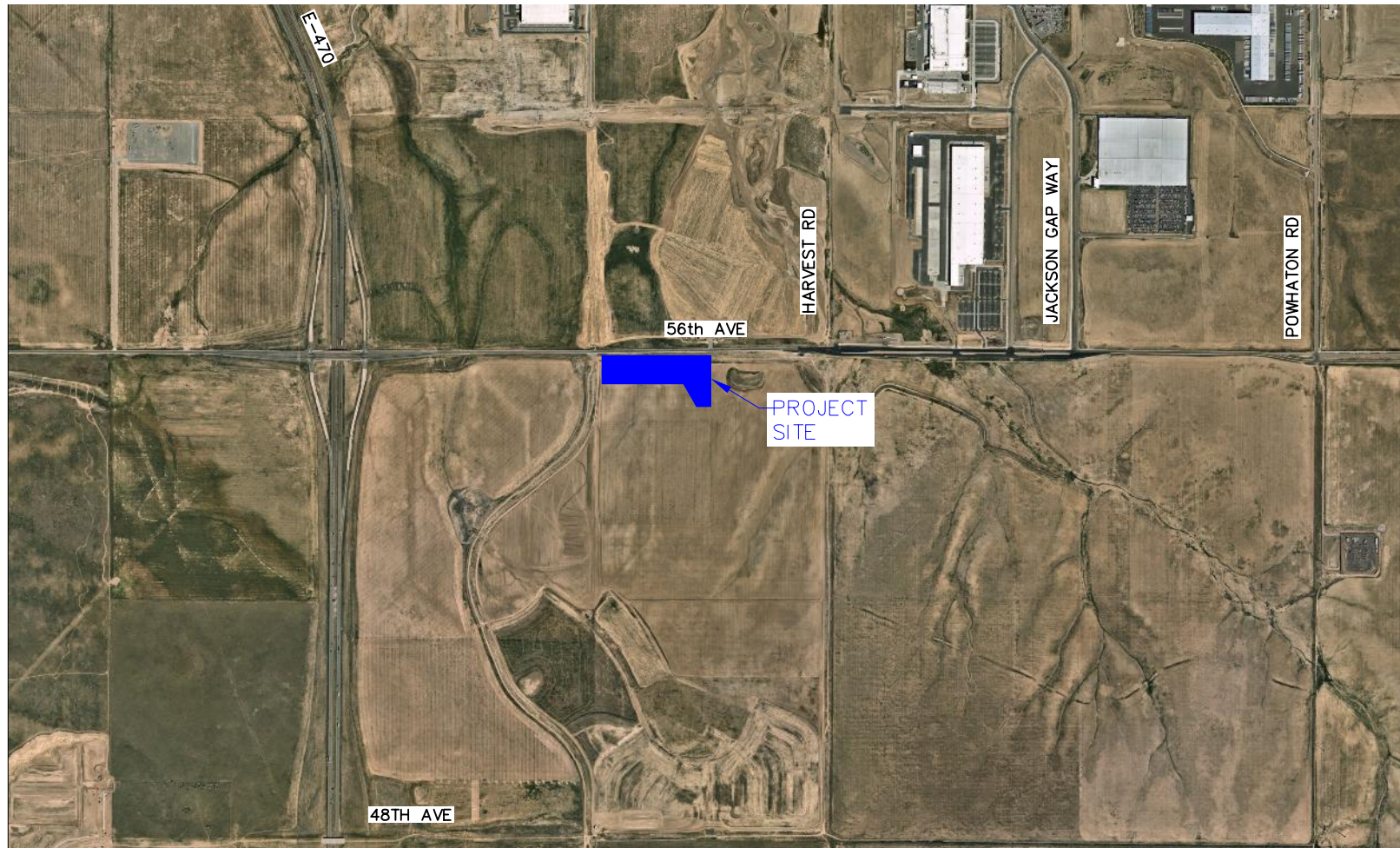


FIGURE 1
REVOLVE AT WINDLER
AURORA, CO
VICINITY MAP

3.0 EXISTING AND FUTURE CONDITIONS

3.1 Existing Study Area and Future Access

The existing site and surrounding vicinity are comprised of vacant land, with most of the nearest existing development located to the west, which are mainly single-family homes to the west of Picadilly Road. There is additional development currently occurring in the vicinity, with some industrial uses and Denver International Airport (DEN) related uses to the northeast of the project site.

Regional access to Revolve at Windler will be provided by E-470, I-70, and Peña Boulevard. Primary access will be provided by 56th Avenue, while direct access into the project site will be provided by two access intersections along the north side of 55th Avenue approximately 350 feet and 685 feet east of Denali Street for the West Access (#7) and East Access (#8), respectively (measured center to center).

3.2 Existing and Future Roadway Network

As most of the area is currently undeveloped in this area, the street network surrounding the project site is not yet constructed. With development continuing to occur in the study area, several new roadways and intersections will be created in the next several years.

56th Avenue

56th Avenue provides one lane of travel in each direction eastbound and westbound with a posted speed limit of 45 miles per hour. Based on the Northeast Aurora Transportation Study (NEATS) 2030 proposed roadway network, 56th Avenue is anticipated to provide two through lanes in each direction to the west of Jackson Gap Street and one through lane to the east of Jackson Gap Street. According to NEATS and the Windler Homestead Master Traffic Study, 56th Avenue will provide three through lanes in each direction eastbound and westbound by the 2040 horizon within the study area.

55th Avenue

55th Avenue is proposed to include one through lane in each direction eastbound and westbound. With construction of the Revolve at Windler development 55th Avenue is proposed to extend along the project frontage between Denali Street and Fultondale Street. By 2040 and according to the

Windler Homestead Master Traffic Study, 55th Avenue will be extended from the west of Denali Street through Harvest Street to the east.

Denali Street

With project construction, Denali Street is proposed to include one through lane in each direction northbound and southbound. With construction of the Revolve at Windler development, Denali Street is proposed to extend along the project frontage from 56th Avenue to the north and to 55th Avenue on the south. According to NEATS and the Windler Homestead Master Traffic Study, by 2040 Denali Street is planned to be extended south beyond 48th Avenue and is anticipated to provide two through lanes in each direction northbound and southbound.

Fultondale Street

Fultondale Street is proposed to include one through lane in each direction northbound and southbound. With construction of the Revolve at Windler development, Fultondale Street is proposed to extend along the project frontage between 55th Avenue and 56th Avenue. By 2040 and according to the Windler Homestead Master Traffic Study, Fultondale Street will be extended south beyond 48th Avenue and continue to provide one through lane in each direction northbound and southbound.

Harvest Road

Harvest Road within the study area is not anticipated to be constructed by 2025. However, according to the Windler Homestead Master Traffic Study, Harvest Road will be extended south to 48th Avenue and north beyond 56th Avenue and provide two through lanes in each direction northbound and southbound.

3.3 Existing Traffic Volumes

Existing turning movement counts were conducted at the intersection of 56th Avenue and E-470 Northbound Ramps on Tuesday, January 10, 2023, during the weekday morning and afternoon peak hours to provide a basis of existing eastbound and westbound through traffic along 56th Avenue adjacent to the project site. The counts were conducted during the morning and afternoon peak hours of adjacent street traffic in 15-minute intervals from 7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM on this count date. Count sheets are provided in **Appendix A**.

3.4 Unspecified Development Traffic Growth

None of the study area key intersections analyzed in this study are constructed today. However, it is believed that the Revolve at Windler development will be the first development constructed as part of the overall Windler Homestead development. Therefore, traffic traveling along the proposed roadways of Denali Street, Fultondale Street, and 55th Avenue in the study area will only be project-generated trips during the 2025 short-term horizon. To conform to City of Aurora Traffic Impact Study Guidelines, a two (2) percent annual growth rate was used to estimate future traffic volume along 56th Avenue for the 2025 horizon. In addition, the Harvest Mile – Fulenwider development traffic volumes were directly added to the 2025 traffic volumes to provide a conservative analysis.

Traffic volumes from the Windler Homestead Master Traffic Study were used to derive 2040 traffic volumes at the key intersections. Traffic volumes from the PA-5 development were subtracted from the 2040 total traffic volumes as the Revolve at Windler development will be constructed in this area. Background traffic volumes at the intersections of 55th Avenue/Fultondale Street (#5) and the 55th Avenue project accesses (#7 and #8) were based on the traffic volumes at adjacent intersections from the Windler Homestead Master Traffic Study, as these intersections were not studied in the master study. Applicable documents from the Windler Homestead Master Traffic Study are attached in **Appendix B**.

4.0 PROJECT TRAFFIC CHARACTERISTICS

4.1 Trip Generation

Site-generated traffic estimates are determined through a process known as trip generation. Rates and equations are applied to the proposed land use to estimate traffic generated by the development during a specific time interval. The acknowledged source for trip generation rates is the *Trip Generation Manual*¹ published by the Institute of Transportation Engineers (ITE). ITE has established trip rates in nationwide studies of similar land uses. For this study, Kimley-Horn used the ITE Trip Generation Report average rate equations that apply to Multifamily Low-Rise Housing (ITE Land Use Code 220) for traffic associated with the development.

Revolve at Windler is expected to generate approximately 1,356 weekday daily trips, with 80 of these trips occurring during the morning peak hour and 103 of these trips occurring during the afternoon peak hour. Calculations were based on the procedure and information provided in the ITE *Trip Generation Manual, 11th Edition – Volume 1: User's Guide and Handbook*, 2021.

The Windler Homestead Master Traffic Study identified this same development area (PA-5) to include 228 multifamily low-rise housing units. This development area was expected to generate approximately 1,537 weekday daily trips, with 94 of these trips occurring during the morning peak hour and 119 of these trips occurring during the afternoon peak hour. Calculations in the original master study were based on the procedure and information provided in the ITE *Trip Generation Manual, 11th Edition*. The following **Table 1** compares the trip generation of the applicable area from the original traffic study to the current proposal. The trip generation worksheets are included in **Appendix C** for the Revolve at Windler development and **Appendix B** for the Windler Homestead Master Traffic Study.

¹ Institute of Transportation Engineers, *Trip Generation Manual*, Eleventh Edition, Washington DC, 2021.

Table 1 – Trip Generation Comparison

Land Use and Size	Weekday Vehicle Trips						
	Daily	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Original Traffic Study (Applicable Area, PA-5 - ITE 10 th Edition)							
Multifamily Low-Rise Housing (ITE 220) – 228 Dwelling Units	1,537	23	71	94	75	44	119
Proposed Development (ITE 11 th Edition)							
Multifamily Low-Rise Housing (ITE 220) – 201 Dwelling Units	1,356	19	61	80	65	38	103
Trip Difference	-181	-4	-10	-14	-10	-6	-16

As summarized in the trip generation table, the proposed Revolve at Windler development generates 181 fewer daily trips, 14 fewer trips during the morning peak hour, and 16 fewer trips during the afternoon peak hour compared to the previously studied development area.

4.2 Trip Distribution

Distribution of site traffic on the street system was based on the area street system characteristics, existing traffic patterns, existing and anticipated surrounding employment, school, and attraction information, and the proposed access system for the project. The directional distribution of traffic is a means to quantify the percentage of site-generated traffic that approaches the site from a given direction and departs the site back to the original source. The project trip distribution for the proposed development is illustrated in **Figure 2** for the 2025 horizon and **Figure 3** for the 2040 horizon.

4.3 Traffic Assignment

Revolve at Windler traffic assignment was obtained by applying the project trip distribution to the estimated traffic generation of the development shown in **Table 1**. Traffic assignment is shown in **Figure 4** for the 2025 horizon and in **Figure 5** for the 2040 horizon.

4.4 Total (Background Plus Project) Traffic

Site traffic volumes were added to the background volumes to represent estimated traffic conditions for the short-term 2025 horizon and long-term 2040 twenty-year planning horizon. These total traffic volumes for the study area are illustrated for the 2025 horizon and 2040 horizon years in **Figures 6** and **7**, respectively.

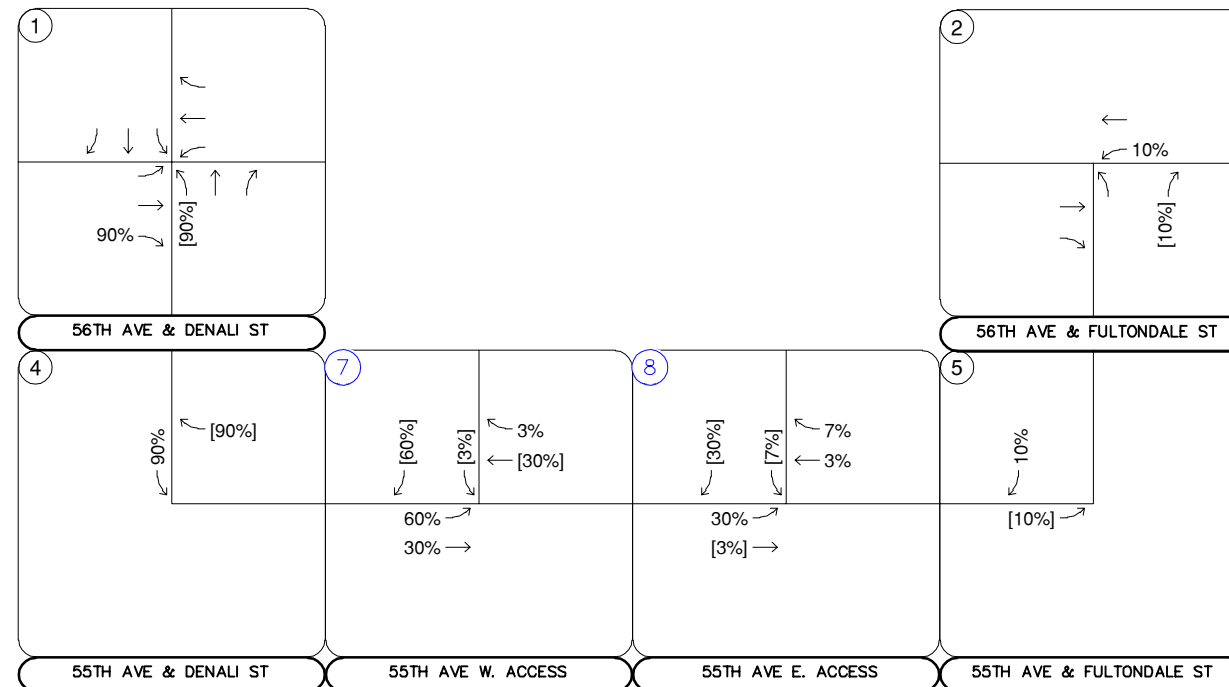
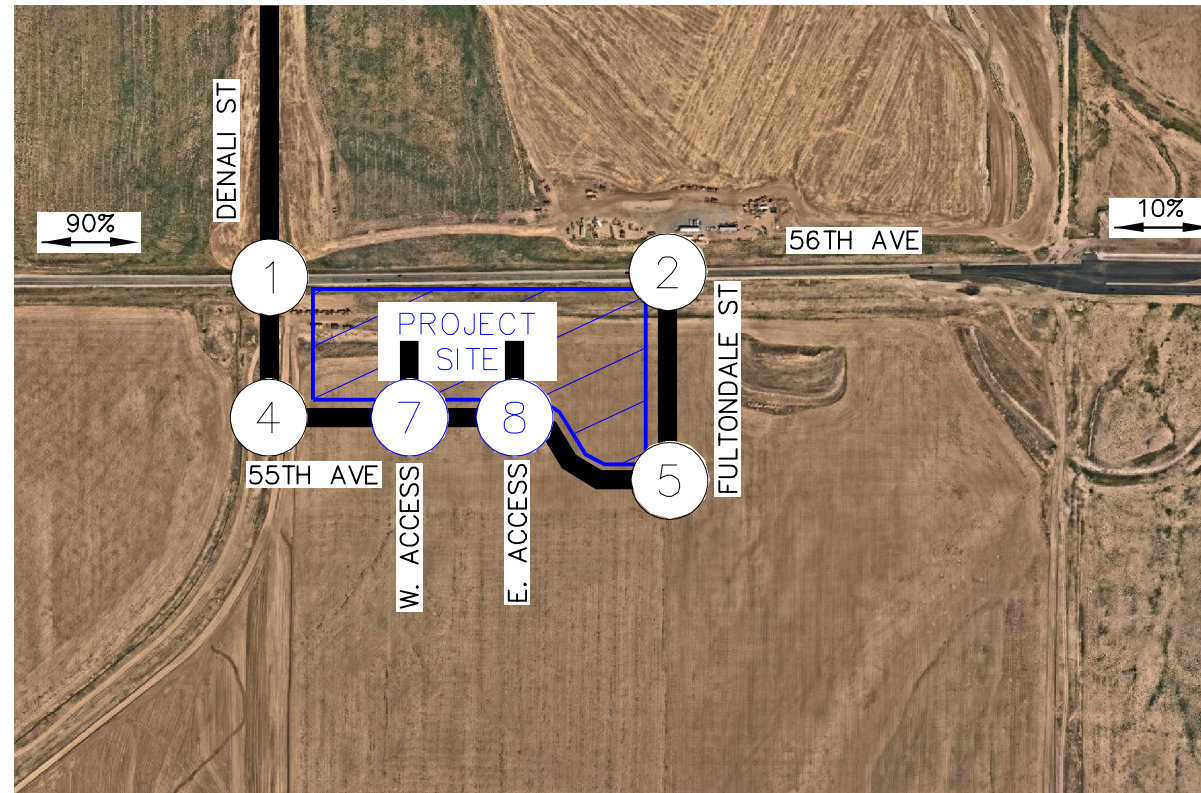
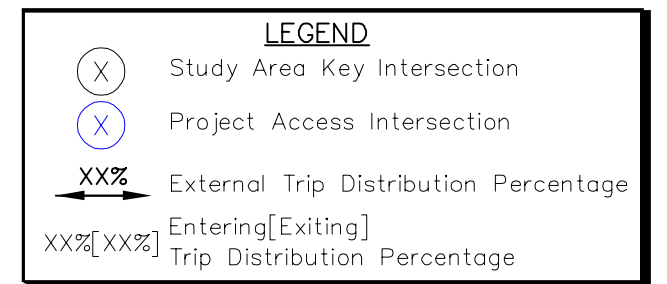


FIGURE 2
REVOLVE AT WINDLER
AURORA, COLORADO
2025 PROJECT TRIP DISTRIBUTION



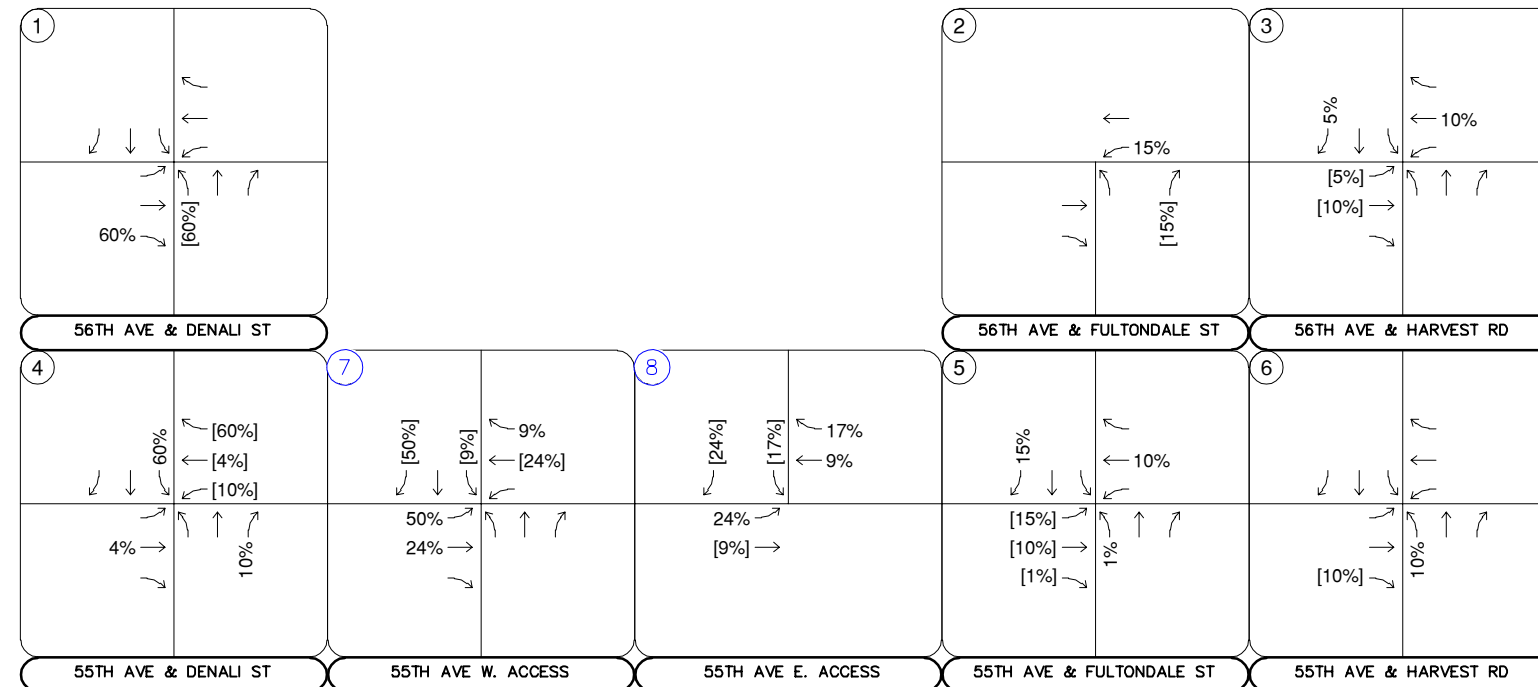
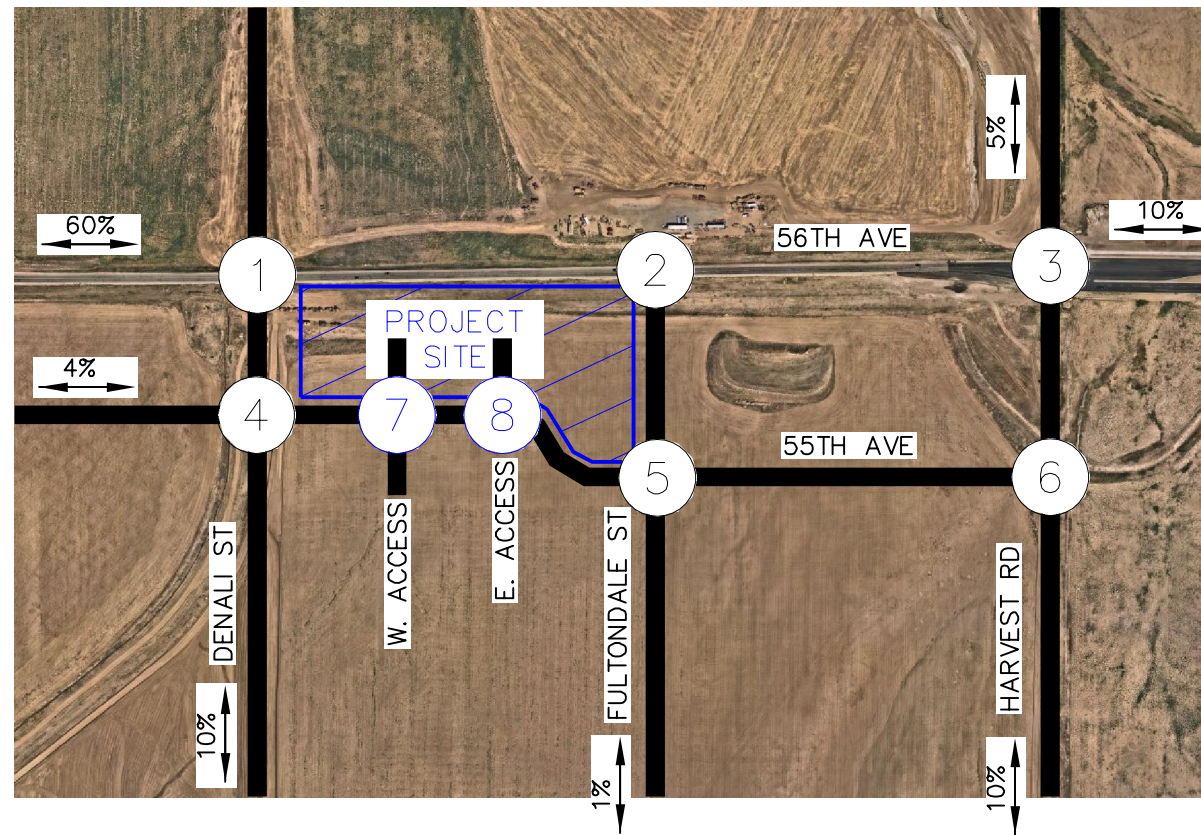
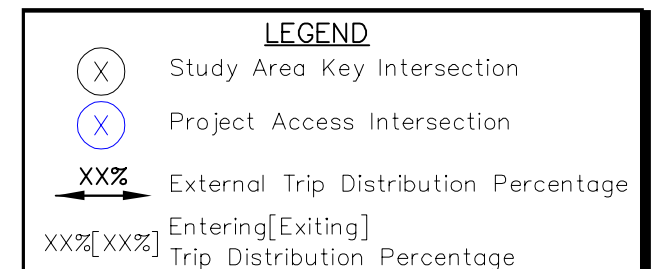
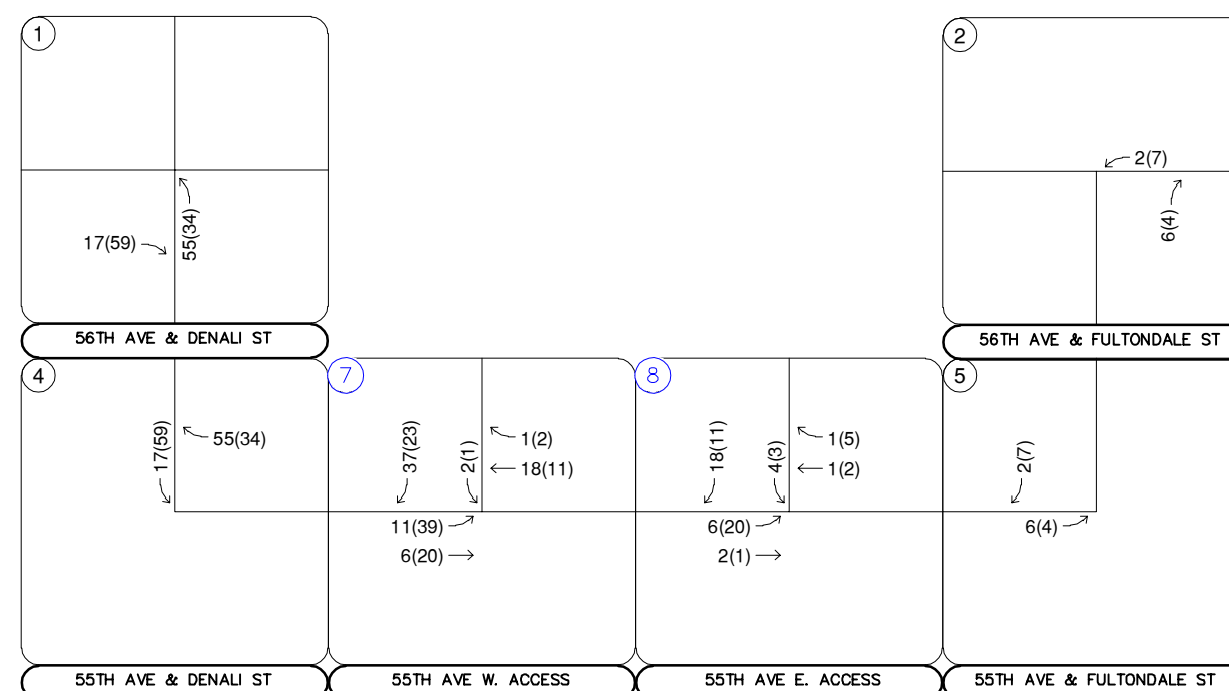





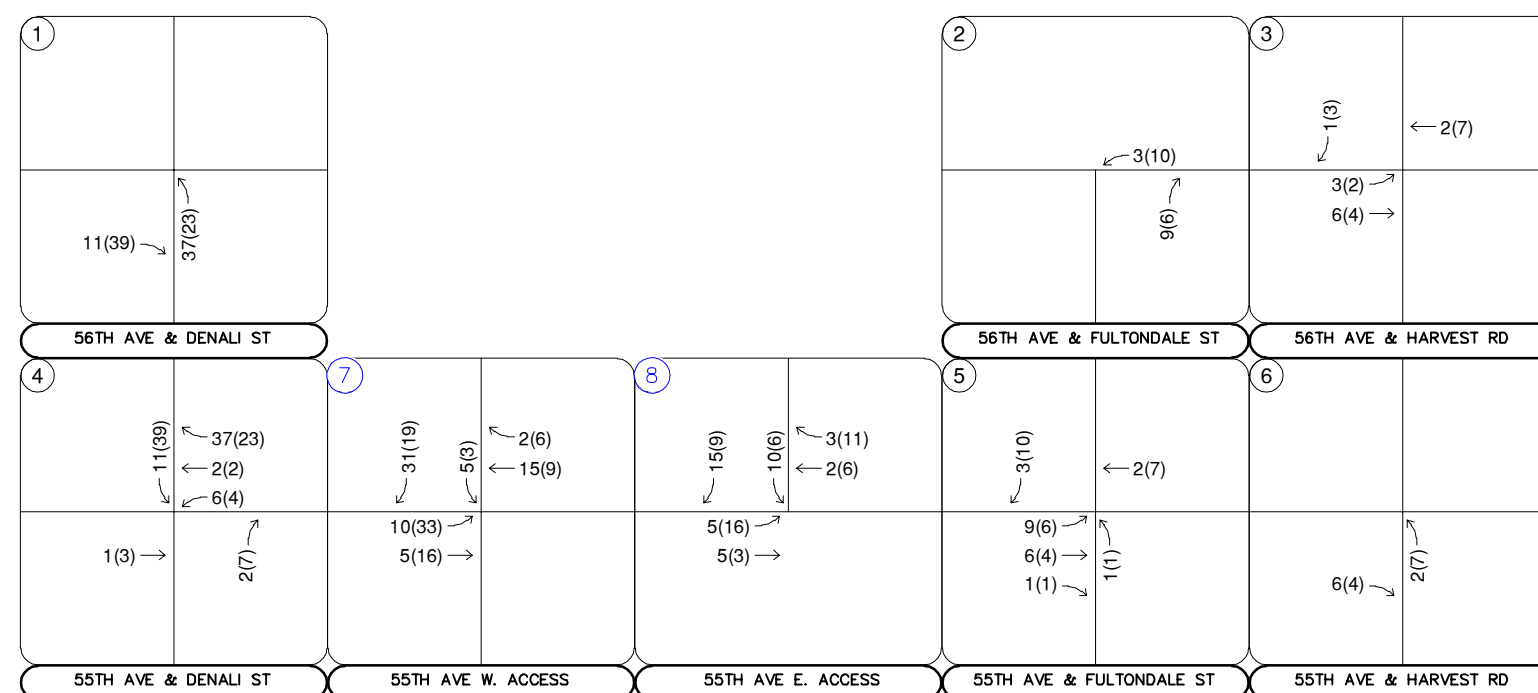
FIGURE 3
REVOLVE AT WINDLER
AURORA, COLORADO
2040 PROJECT TRIP DISTRIBUTION









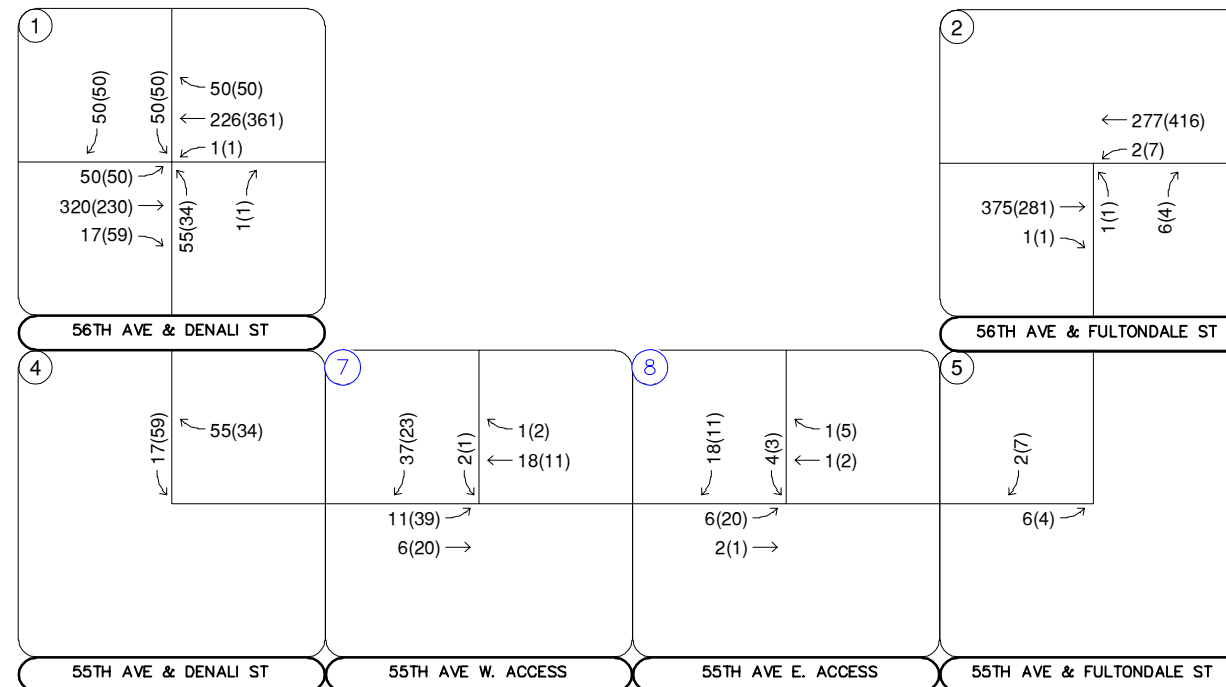
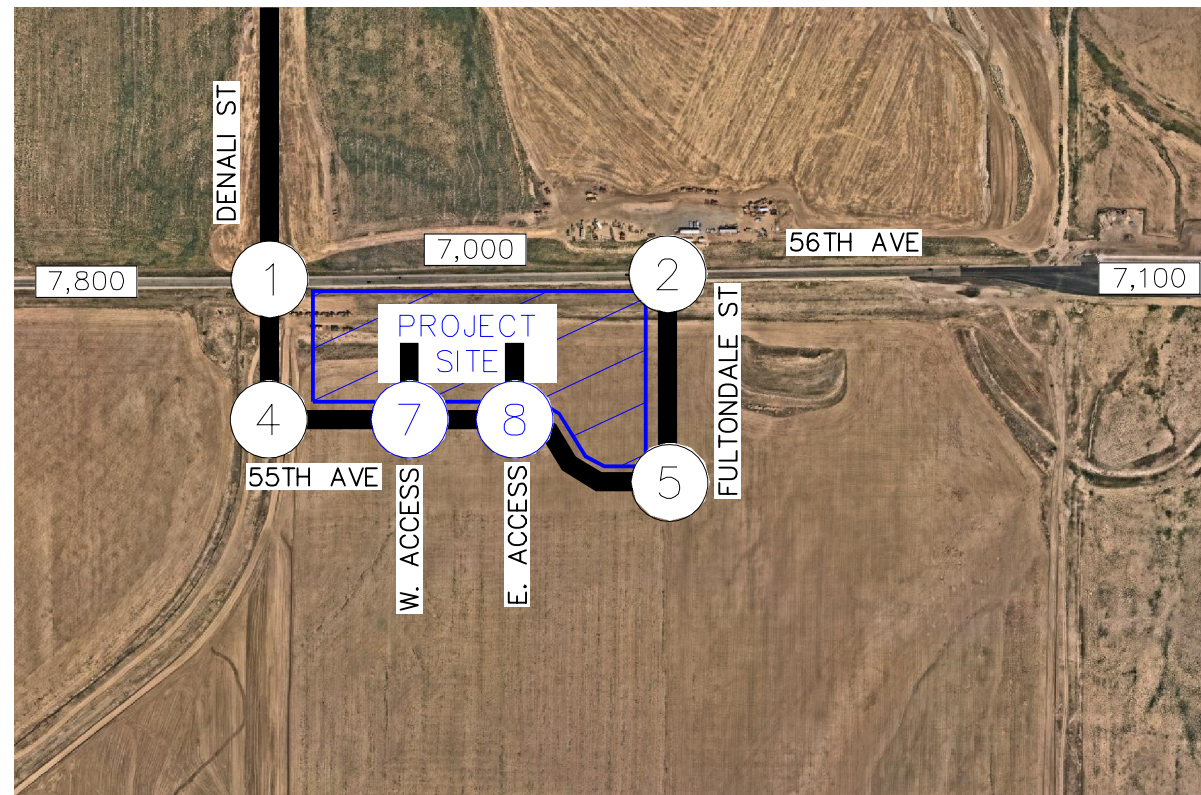
LEGEND

	Study Area Key Intersection
	Project Access Intersection
xxx(XXX)	Weekday AM(PM) Peak Hour Traffic Volumes
	Estimated Daily Traffic Volume



LEGEND

	Study Area Key Intersection
	Project Access Intersection
	Weekday AM(PM) Peak Hour Traffic Volumes
	Estimated Daily Traffic Volume



LEGEND	
(X)	Study Area Key Intersection
(X)	Project Access Intersection
XXX(XXX)	Weekday AM(PM) Peak Hour Traffic Volumes
XX,X00	Estimated Daily Traffic Volume

FIGURE 6
REVOLVE AT WINDLER
AURORA, COLORADO
2025 TOTAL TRAFFIC VOLUMES

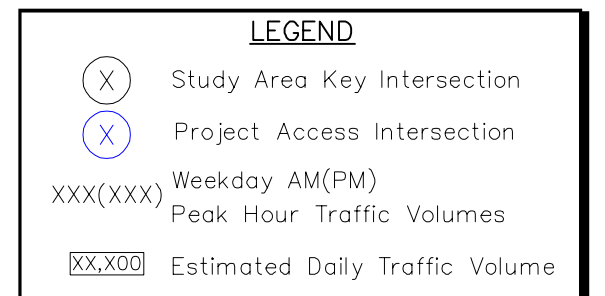
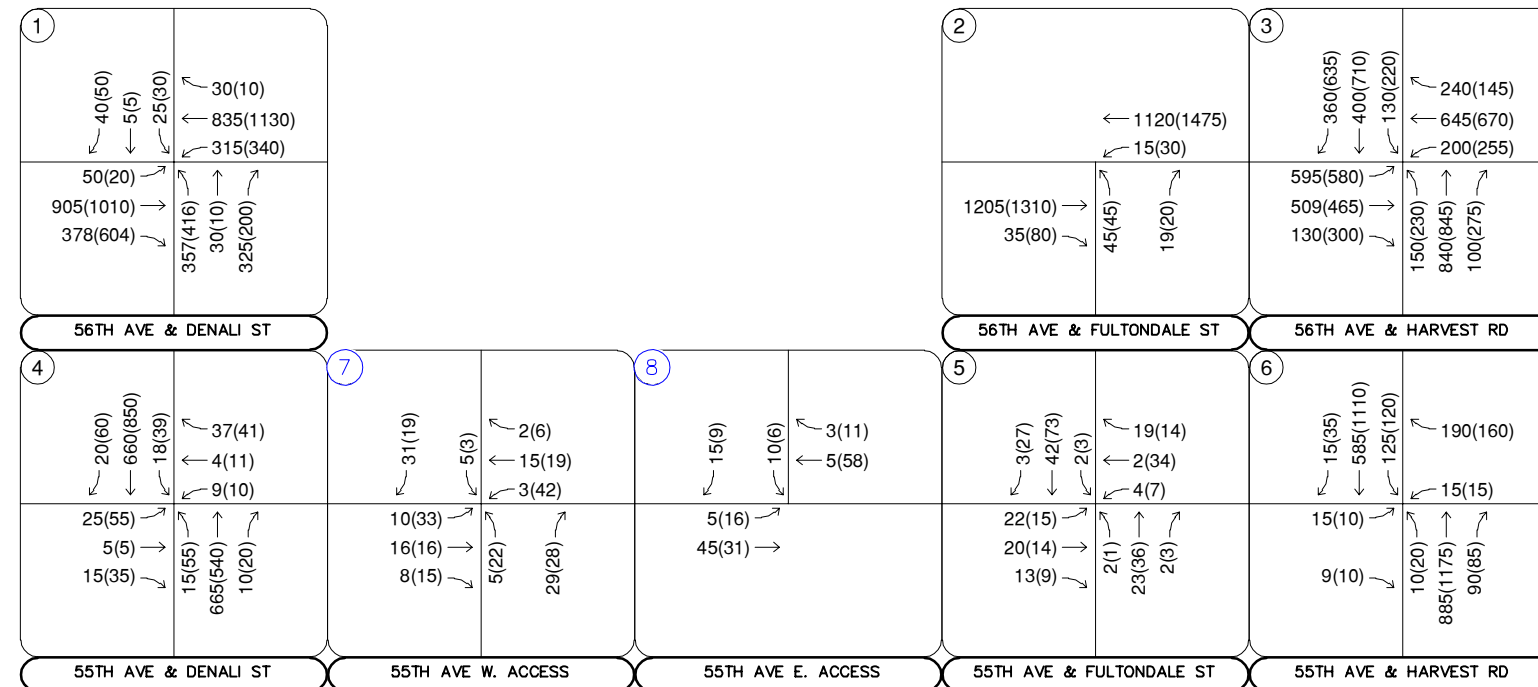
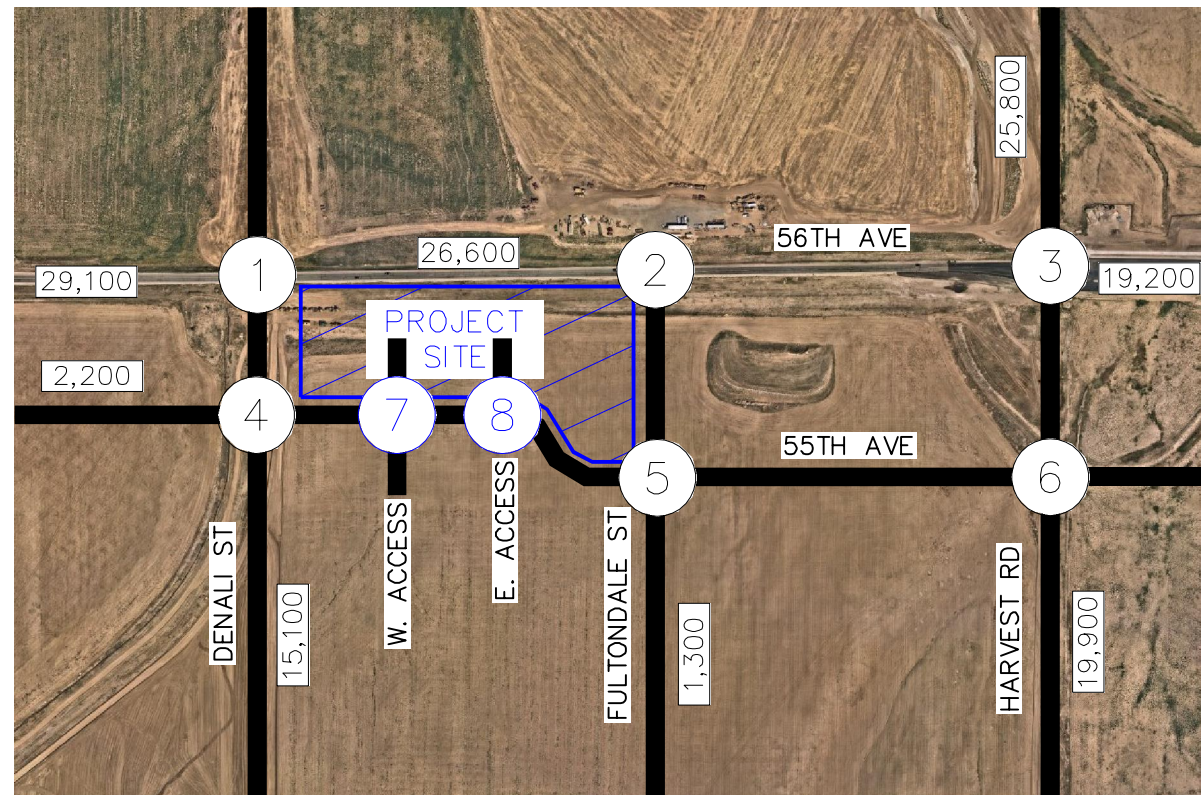


FIGURE 7
REVOLVE AT WINDLER
AURORA, COLORADO
2040 TOTAL TRAFFIC VOLUMES

5.0 TRAFFIC OPERATIONS ANALYSIS

Kimley-Horn's analysis of traffic operations in the site vicinity was conducted to determine potential capacity deficiencies in the 2025 and 2040 development horizons at the identified key intersections. The acknowledged source for determining overall capacity is the *Highway Capacity Manual (HCM)*².

5.1 Analysis Methodology

Capacity analysis results are listed in terms of Level of Service (LOS). LOS is a qualitative term describing operating conditions a driver will experience while traveling on a particular street or highway during a specific time interval. It ranges from A (very little delay) to F (long delays and congestion). According to City of Aurora guidelines for signalized intersections, individual movements may be allowed to fall to LOS E, but in most cases the overall intersection must operate (or be projected to operate) at a LOS D or better during AM and PM peak periods. If the existing LOS for an intersection is worse than LOS D, potential alternatives to improve the intersection to achieve LOS D should be provided or maintain the existing critical lane volume with the addition of site generated traffic. Minor movements at unsignalized intersections, such as left turns onto a major arterial from a side street, may be allowed to fall below LOS D pending the specific conditions. Movements which have a light traffic demand, and a viable travel alternative may be allowed to fall below LOS D. **Table 2** shows the definition of level of service for signalized and unsignalized intersections.

Table 2 – Level of Service Definitions

Level of Service	Signalized Intersection Average Total Delay (sec/veh)	Unsignalized Intersection Average Total Delay (sec/veh)
A	≤ 10	≤ 10
B	> 10 and ≤ 20	> 10 and ≤ 15
C	> 20 and ≤ 35	> 15 and ≤ 25
D	> 35 and ≤ 55	> 25 and ≤ 35
E	> 55 and ≤ 80	> 35 and ≤ 50
F	> 80	> 50

Definitions provided from the Highway Capacity Manual, Sixth Edition, Transportation Research Board, 2016.

² Transportation Research Board, *Highway Capacity Manual*, Sixth Edition, Washington DC, 2016.

Study area intersections were analyzed based on average total delay analysis for signalized and unsignalized intersections. Under the unsignalized analysis, the LOS for a two-way stop-controlled intersection is determined by the computed or measured control delay and is defined for each minor movement. LOS for a two-way stop-controlled intersection is not defined for the intersection as a whole. LOS for signalized, roundabout, and all-way stop controlled intersections are defined for each approach and for the overall intersection.

5.2 Key Intersection Operational Analysis

Calculations for the operational level of service at the key intersections for the study area are provided in **Appendix D**. The HCM urban standard of 0.92 was used for the 2025 and 2040 horizon analysis years. The signalized intersection analysis generally assumes a 120-second cycle length with optimized phasing and timing at each signalized intersection. Synchro traffic analysis software was used to analyze the signalized and unsignalized key intersections for HCM level of service.

56th Avenue and Denali Street (#1)

The intersection of 56th Avenue and Denali Street (#1) is planned to be constructed with development of the project. It is conservatively assumed that the north leg of this intersection will be constructed in association with the Harvest Mile – Fulenwider project by the 2025 horizon. In the 2025 horizon, it is recommended that the eastbound and westbound 56th Avenue approaches consist of one left turn lane, one through lane, and one right turn lane. The northbound and southbound Denali Street approaches should operate well with one shared lane for all movements at each approach to the intersection in this horizon with stop control through the installation of R1-1 “STOP” signs. With this configuration, the movements at this intersection are anticipated to operate acceptably during the 2025 horizon with the addition of project traffic.

By 2040, it is anticipated that a signal will be warranted at this intersection. Therefore, if future volumes are realized, this intersection should be signalized by 2040. Signal warrant analysis worksheets are included in **Appendix E**. By 2040, and consistent with the recent 56th Street & Denali Boulevard Laneage Memo (supplement to Windler Homestead Master Traffic Impact Study) completed in October 2023, it is recommended that the eastbound 56th Avenue approach consist of one left turn lane, three through lanes, and one right turn lane while the 56th Avenue westbound approach is recommended to consist of dual left turn lanes and three through lanes

with the outside lane being a shared through/right turn lane. The northbound Denali Street approach is recommended to be designated with dual left turn lanes, one through lane, and a right turn lane while the Denali Street southbound approach is recommended to consist of one left turn lane, one through lane, and a right turn lane. With this recommended geometry and control, this intersection is anticipated to operate acceptably with LOS C during both peak hours in 2040. Roundabout analysis was not conducted at this intersection as three through lanes are not conducive to roundabout operations. **Table 3** provides the results of the LOS analysis conducted at this intersection.

Table 3 – 56th Avenue & Denali Street (#1) LOS Results

Scenario	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
2025 Total #				
Northbound Approach	19.9	C	20.7	C
Eastbound Left	8.0	A	8.4	A
Westbound Left	8.0	A	7.9	A
Southbound Approach	15.0	C	17.1	C
2040 Total ##	23.3	C	26.4	C
Eastbound Approach	19.5	B	30.8	C
Eastbound Left	15.6	B	22.4	C
Eastbound Through	21.8	C	31.4	C
Eastbound Right	14.5	B	30.0	C
Westbound Approach	13.5	B	14.7	B
Westbound Left	49.1	D	53.7	D
Westbound Through/Right	0.5	A	2.7	A
Northbound Approach	43.5	D	40.1	D
Northbound Left	56.4	E	52.7	D
Northbound Through	40.4	D	31.8	C
Northbound Right	29.6	C	14.3	B
Southbound Approach	55.0	E	46.8	D
Southbound Left	58.3	E	52.8	D
Southbound Through	50.8	D	43.8	D
Southbound Right	53.4	D	43.3	D

= Eastbound and westbound approaches: one left turn lane, one through lane, and one right turn lane; northbound and southbound approaches: stop-controlled with one shared lane for all movements

= Signalized; eastbound approach: one left turn lane, three through lanes, and one right turn lane; westbound approach: dual left turn lanes and three through lanes with the outside lane being a shared through/right turn lane; northbound approach: dual left turn lanes, one through lane, and one right turn lane; southbound approach: one left turn lane, one through lane, and one right turn lane

56th Avenue and Fultondale Street (#2)

The 'T'-intersection of 56th Avenue and Fultondale Street (#2) is planned to be constructed with development of the project. In the 2025 short-term horizon, it is recommended that all three approaches consist of one shared lane for all movements. In this horizon, the northbound Fultondale Street approach should operate with stop control with the installation of an R1-1 "STOP" sign. With this configuration, the movements at this intersection are anticipated to operate acceptably during the 2025 horizon with project traffic.

By 2040, it is recommended that the eastbound 56th Avenue approach consist of three through lanes with the outside lane being a shared through/right turn lane. The 56th Avenue westbound approach is recommended to consist of one left turn lane and three through lanes. The northbound Fultondale Street approach is recommended to be designated with one left turn lane and one right turn lane. Of note, this lane configuration and control is consistent with the Windler Homestead Master Traffic Study. With the recommended geometry and control, the movements at this intersection are anticipated to operate acceptably with LOS C or better during both peak hours through the 2040 horizon. **Table 4** provides the results of the LOS analysis conducted at this intersection.

Table 4 – 56th Avenue & Fultondale Street (#2) LOS Results

Scenario	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
2025 Total #				
Northbound Approach	12.4	B	11.0	B
Westbound Left	8.1	A	7.9	A
2040 Total ##				
Northbound Left	13.2	B	15.4	C
Northbound Right	10.8	B	11.2	B
Westbound Left	9.6	A	10.0	A

= One shared lane for all movements on all three approaches with a stop-controlled northbound approach

= Eastbound approach: three through lanes with the outside lane being a shared through/right turn lane; westbound approach: one left turn lane and three through lanes; northbound approach: stop-controlled with one left turn lane and one right turn lane

56th Avenue and Harvest Road (#3)

The intersection of 56th Avenue and Harvest Road (#3) is not anticipated to be constructed by the 2025 horizon but is planned to be constructed with completion of the overall Windler development area. Therefore, this intersection was analyzed for the 2040 horizon only. By 2040, it is anticipated that a signal will be warranted at this intersection. Therefore, this intersection should be signalized if future volumes are realized. Signal warrant analysis worksheets are included in **Appendix E**. It is recommended the eastbound 56th Avenue approach consist of dual left turn lanes and three through lanes with the outside lane being a shared through/right turn lane. The 56th Avenue westbound approach should consist of one left turn lane and three through lanes with the outside lane being a shared through/right turn lane. The northbound Harvest Road approach should consist of one left turn lane, two through lanes, and a right turn lane. The southbound Harvest Road approach is recommended to consist of one left turn lane, two through lanes, and a right turn lane. Of note, this lane configuration and control is consistent with the Windler Homestead Master Traffic Study. With the recommended geometry and control, this intersection is anticipated to operate with LOS D during both peak hours in 2040. Roundabout analysis was not conducted at this intersection as three through lanes are not conducive to roundabout operations. **Table 5** provides the results of the LOS analysis conducted at this intersection.

Table 5 – 56th Avenue & Harvest Road (#3) LOS Results

Scenario	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
2040 Total #	50.7	D	54.7	D
Eastbound Approach	59.1	E	64.5	E
Eastbound Left	62.0	E	69.9	E
Eastbound Through/Right	57.2	E	63.0	E
Westbound Approach	60.0	E	59.4	E
Westbound Left	37.5	D	42.4	D
Westbound Through/Right	73.7	E	72.2	E
Northbound Approach	40.2	D	44.0	D
Northbound Left	40.9	D	50.9	D
Northbound Through	41.8	D	54.0	D
Northbound Right	4.2	A	7.7	A
Southbound Approach	40.1	D	53.2	D
Southbound Left	44.8	D	53.9	D
Southbound Through	37.8	D	48.9	D
Southbound Right	41.8	D	61.9	E

= Signalized; eastbound approach: dual left turn lanes and three through lanes with the outside lane being a shared through/right turn lane; westbound approach: one left turn lane and three through lanes with the outside lane being a shared through/right turn lane; northbound approach: one left turn lane, two through lanes, and a right turn lane; southbound approach: one left turn lane, two through lanes, and one right turn lane

55th Avenue and Denali Street (#4)

The intersection of 55th Avenue and Denali Street (#4) is planned to be constructed with development of the project. In 2025, this intersection will consist of a north and east leg as only the roadways that border the project are anticipated to be constructed. Therefore, there will be no conflicting movements at this intersection with project construction which results in no delays at this intersection in this horizon.

With full buildout of the Windler Development, it is anticipated that 55th Avenue will be extended to the west and Denali Street will be extended to the south creating a four-leg intersection. By 2040, it is recommended that the eastbound and westbound 55th Avenue approaches operate with stop control with the installation of R1-1 “STOP” signs and consist of one shared lane for all movements. The northbound and southbound Denali Street approaches are recommended to consist of one left turn lane and two through lanes with a shared through/right turn lane. Of note, this lane configuration and control is consistent with the Windler Homestead Master Traffic Study. With the recommended geometry and control, the movements at this intersection are anticipated to operate acceptably with LOS C or better during both peak hours in 2040. **Table 6** provides the results of the LOS analysis conducted at this intersection.

Table 6 – 56th Avenue & Denali Street (#4) LOS Results

Scenario	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
2040 Total #				
Northbound Left	8.0	A	8.6	A
Eastbound Approach	13.8	B	17.8	C
Westbound Approach	13.1	B	14.3	B
Southbound Left	9.2	A	8.9	A

= Eastbound and westbound approaches: stop-controlled, one shared lane for all movements; northbound and southbound approaches: one left turn lane and two through lanes with the outside lane being a shared through/right turn lane

55th Avenue and Fultondale Street (#5)

The intersection of 55th Avenue and Fultondale Street (#5) is planned to be constructed with development of the project. In 2025, this intersection will consist of a north and west leg as only the roadways that front the project are anticipated to be constructed. Therefore, there will be no conflicting movements at this intersection with project construction which results in no delays at this intersection in this horizon.

With full buildout of the Windler Development, it is anticipated that 55th Avenue will be extended to the east and Fultondale Street will be extended to the south creating a four-leg intersection. By 2040, it is recommended that the eastbound and westbound 55th Avenue approaches operate with stop-control with the installation of R1-1 “STOP” signs. All four approaches are recommended to consist of one shared lane for all movements. With the recommended geometry and control, the movements at this intersection are anticipated to operate acceptably with LOS A during both peak hours in 2040. **Table 7** provides the results of the LOS analysis conducted at this intersection.

Table 7 – 55th Avenue & Fultondale Street (#5) LOS Results

Scenario	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
2040 Total #				
Northbound Left	7.3	A	7.4	A
Eastbound Approach	9.4	A	9.8	A
Westbound Approach	8.7	A	9.9	A
Southbound Left	7.3	A	7.3	A

= Stop-controlled eastbound and westbound approaches and one shared lane for all movements on all approaches

55th Avenue and Harvest Road (#6)

The intersection of 55th Avenue and Harvest Road (#6) is planned to be constructed with completion of the overall Windler development area. Therefore, this intersection was analyzed for the 2040 horizon only. It is recommended the eastbound and westbound approaches consist of a shared left turn/through lane and a right turn lane. The northbound and southbound approaches should consist of one left turn lane, two through lanes, and a right turn lane. Of note, this lane configuration and control is consistent with the Windler Homestead Master Traffic Study. With the recommended geometry and control, the movements at this intersection are anticipated to operate acceptably with LOS E or better during both peak hours in 2040 when the minor approaches are designed to allow two-stage left turn movements. **Table 8** provides the results of the LOS analysis conducted at this intersection.

Table 8 – 55th Avenue & Harvest Road (#6) LOS Results

Scenario	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
2040 Total #				
Northbound Left	7.9	A	9.1	A
Eastbound Left/Through	29.0	D	48.8	E
Eastbound Right	9.3	A	11.0	B
Westbound Left/Through	21.2	C	33.4	D
Westbound Right	16.0	C	19.6	C
Southbound Left	12.0	B	14.8	B

= Eastbound and westbound approaches: shared left turn/through lane and one right turn lane; northbound and southbound approaches: one left turn lane, two through lanes, and a right turn lane

Project Accesses

With completion of the Revolve at Windler project, two accesses (#7 and #8) are proposed along the north side of 55th Avenue on the south side of the development. It is recommended that an R1-1 “STOP” sign be installed on the exiting southbound approaches. Both accesses should operate with one shared lane for all movements. With full construction of the Windler development, it is anticipated that a south leg will be constructed that will align with the West Access (#7). It is recommended that this south leg operate with stop control with installation of an R1-1 “STOP” sign. **Table 9** provides the results of the level of service for these accesses. As shown in the table, the project street access intersections along 55th Avenue are anticipated to have all movements operating with acceptable LOS A during the peak hours in both the 2025 and the 2040 horizons.

Table 9 – Project Accesses Level of Service Results

Intersection	2025 Total				2040 Total			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
55th Ave West Access (#7)								
Eastbound Left	7.3	A	7.3	A	-	-	-	-
Southbound Approach	8.6	A	8.5	A	-	-	-	-
55th Ave West Access (#7) #								
Northbound Approach	-	-	-	-	8.7	A	9.5	A
Eastbound Left	-	-	-	-	7.3	A	7.3	A
Westbound Left	-	-	-	-	7.3	A	7.3	A
Southbound Approach	-	-	-	-	8.6	A	8.8	A
55th Ave East Access (#8)								
Eastbound Left	7.2	A	7.3	A	7.2	A	7.4	A
Southbound Approach	8.5	A	8.5	A	8.6	A	8.9	A

= South leg constructed to align with the West Access (#7)

5.3 Turn Bay Length Analysis

The City of Aurora defaults to the Colorado Department of Transportation (CDOT) State Highway Access Code (SHAC) guidelines to determine if turn lanes are warranted at key intersections and accesses. CDOT classifies their state highways based on roadway types. The Non-Rural Arterial Category NR-B (moderate travel speed and moderate traffic volumes) was assigned to 56th Avenue based on matching the characteristics of the CDOT roadways. The speed limit along 56th Avenue is currently 45 miles per hour.

According to the State Highway Access Code for category NR-B roadways, the following thresholds apply for an auxiliary lane:

- A left turn lane with storage length plus taper is required for any access with a projected peak hour left ingress turning volume greater than 25 vph. If the posted speed is greater than 40 mph, a deceleration lane and taper is required for any access with a projected peak hour left ingress turning volume greater than 10 vph. The taper length will be included within the deceleration length.
- A right turn lane with storage length plus taper is required for any access with a projected peak hour right ingress turning volume greater than 50 vph. If the posted speed is greater than 40 mph, a right turn deceleration lane and taper is required for any access with a projected peak hour right ingress turning volume greater than 25 vph. The taper length will be included within the deceleration length.

Table 10 provides a summary of whether auxiliary turn lane warrants are met based on 2025 total traffic volumes. If warranted, the required turn lane lengths are provided based on CDOT State Highway Access Code guidelines:

Table 10 – Turn Lane Warrant and Length Summary

Intersection	2025 Total Traffic		
	Volume	Met?	Turn Lane Length
56th Ave & Denali St (#1)			
Eastbound Left	50	Y	275'+160'T
Eastbound Right	59	Y	275'+160'T
Westbound Left	5	N	-
Westbound Right	50	Y	275'+160'T

As shown in the table above an eastbound left turn lane, eastbound right turn lane, and westbound right turn lane are warranted at the intersection of 56th Avenue and Denali Street (#1) by 2025 with project traffic. It is recommended that these turn lanes be designated to a length of 275 feet plus a 160-foot taper. It should be noted that project traffic only contributes to the eastbound right turn movements.

5.4 Vehicle Queueing Analysis

A vehicle queueing analysis was conducted for the study area intersections. The queueing analysis was performed using Synchro presenting the results of the 95th percentile queue lengths. Results are shown in the following **Table 11** with calculations provided within the level of service operational sheets of **Appendix D** for unsignalized intersections and **Appendix F** for signalized intersections. The recommended turn lane lengths shown in the 2025 horizon are based on the queues seen at the study area intersections while also meeting the CDOT State Highway Access Code (SHAC) guidelines for each turn lane where applicable, as was shown in **Table 10**.

Table 11 – Turn Lane Queueing Analysis Results

Intersection Turn Lane	2025 Calculated Queue (feet)	2025 Recommended Length (feet)	2040 Calculated Queue (feet)	2040 Recommended Length (feet)
56th Ave & Denali St (#1)				
Eastbound Left	25'	275'+160'T	34'	100'
Eastbound Right	25'	275'+160'T	268'	275'
Westbound Left	25'	100'	116'	200' DL
Westbound Right	25'	275'+160'T	-	-
Northbound Left	DNE	DNE	211' DL	225' DL
Northbound Right	DNE	DNE	178'	175'
Southbound Left	DNE	DNE	65'	100'
Southbound Right	DNE	DNE	25'	100'
56th Ave & Fultondale St (#2)				
Westbound Left	DNE	DNE	25'	100'
Northbound Right	DNE	DNE	25'	100'
56th Ave & Harvest Rd (#3)				
Eastbound Left	DNE	DNE	350'	350' DL
Westbound Left	DNE	DNE	268'	350'
Northbound Left	DNE	DNE	269'	275'
Northbound Right	DNE	DNE	85'	100'
Southbound Left	DNE	DNE	253'	300'
Southbound Right	DNE	DNE	480'	550'
55th Ave & Denali St (#4)				
Northbound Left	DNE	DNE	25'	100'
Southbound Left	DNE	DNE	25'	100'
55th Ave & Harvest Road (#6)				
Eastbound Right	DNE	DNE	25'	100'
Westbound Right	DNE	DNE	50'	100'
Northbound Left	DNE	DNE	25'	100'
Northbound Right	DNE	DNE	25'	100'
Southbound Left	DNE	DNE	25'	100'
Southbound Right	DNE	DNE	25'	100'

T = Taper Length (Feet); DL = Dual Left Turn Lanes; DNE = Does Not Exist; C = Continuous Turn Lane;
Blue Text = Recommendation; **Red** Text = Recommendation from Windler Homestead Master Traffic Study

As shown in **Table 11**, the vehicle queues are all anticipated to remain within the recommended turn lane lengths through the 2040 full project buildout horizon. For purposes of this analysis, the recommended turn lane lengths provided in this study are generally based on meeting CDOT State Highway Access Code where applicable for the 2025 horizon, whereas the original Windler Homestead Master Traffic study recommended turn lane lengths were recommended for the 2040 horizon with a minimum turn lane length of 100 feet. The recommended turn lane lengths are provided in **Table 11**.

In 2025, at the intersection of 56th Avenue and Denali Street (#1) the eastbound left, eastbound right, and westbound right turn lanes are recommended to be installed to a length of 275 feet with a 160-foot taper to meet CDOT State Highway Access Code standards, while the westbound left turn lane, which is not warranted per CDOT standards, should be constructed in the shadow of the eastbound left turn lane with a minimum standard length of 100 feet. By 2040, the eastbound left turn lane is recommended to be 100 feet. Additionally, in 2040 northbound dual left turn lanes are recommended with 225 feet of length and the northbound right turn lane is recommended with 175 feet of length at 56th Avenue and Denali Street intersection. The southbound left and right turn lanes are recommended to be 100 feet. The eastbound right turn lane, westbound dual left turn lanes, and northbound right turn lane lengths each align with the Windler Homestead Master study with 125 feet, 200 feet, and continuous in length, respectively.

The 56th Avenue and Fultondale Street (#2) intersection is not anticipated to provide turn lanes in 2025, but by 2040 it is recommended the westbound left turn lane and northbound right turn lane be constructed to 100 feet in length.

At the intersection of 56th Avenue and Harvest Road (#3), the dual eastbound left turn lanes are recommended to provide 350 feet in length. The westbound direction should provide a 350-foot left turn lane. The northbound direction should provide a 275-foot left turn lane and a 100-foot right turn lane. The southbound direction should also provide a 300-foot left turn lane and a 550-foot right turn lane.

With construction of the 55th Avenue and Denali Street (#4) intersection, it is recommended that the northbound and southbound left turn lanes be designated to a length of 100 feet.

With construction of the 55th Avenue and Harvest Road (#6) intersection, it is recommended that the eastbound right, westbound right, northbound left, northbound right, southbound left, and southbound right turn lanes be designated to a length of 100 feet.

5.5 Bicycle, Pedestrian, Transit Access, and Traffic Calming Evaluation

Since the roadways included in this study do not currently exist, with the exception of 56th Avenue, there is no bicycle, pedestrian, or transit infrastructure established within the study area. As such, these multimodal evaluations will be conducted based on the planned future bicycle, pedestrian,

and transit infrastructure proposed in the City of Aurora NEATS report and the transit network that is proposed in the Windler Homestead Master study with applicable documents attached in **Appendix B**. These proposed bicycle, pedestrian, and transit routes are subject to change based on traffic and design analysis over the next several years.

According to the City of Aurora NEATS report and the Windler Homestead Master study, the envisioned service plan for transit routes in the area would include 1- to 2-mile route spacing along major arterials, all routes connecting to a park-n-ride, FasTracks, and/or mobility hub, most routes meeting RTD's "Suburban Local" classification with at least 20 riders boarding on average per hour, all routes having 15-minute peak hour services and at least 60-minute off-peak service, and ridership for each route ranging from 170 to 2,400 rides per day based on comparable existing service ridership. Nearby and within the study area, future high frequency transit routes identified in NEATS would be located along 56th Avenue, 48th Avenue to the south of the site, E-470, Picadilly Road to the west of the site, and Harvest Road to the southeast of the site. A Type 1 mobility hub is planned at 48th Avenue/Harvest Road and 56th Avenue/Picadilly Road which would include enhanced bus stops with real-time information, designated bus lanes and priority signals, secure bike parking, car sharing, off-street bike paths, and a transit/community information kiosk.

56th Avenue is anticipated to be a primary bike route, which could include separated bike lanes and trails; with Denali Street as a secondary bike route, which could include buffered or separated bike lanes; and there is also a proposed High Plains Trail to travel along the western perimeter of E-470 to the west of the project site. It would be anticipated that there could be grade-separated or enhanced at-grade crossings for pedestrian and bicycle routes within the area. It is also anticipated that sidewalks will be provided along each side of 56th Avenue, Denali Street, and other applicable roadways with crosswalks as appropriate at intersections within the study area to provide sufficient multimodal access to all developments as this area continues to grow. To identify possible traffic calming measures that could be employed in the area, speed cushions, chicanes, lane narrowing, and other traffic calming measures could be employed, however, these measures are not expected to be needed within or surrounding the project site. As mentioned, these recommendations may change over the next several years as needed based on the additional development occurring in the area.

5.6 Improvement Summary

Based on the results of the intersection operational and vehicle queueing analysis, the key intersection recommended improvements and control are shown in **Figure 8** for the 2025 horizon and **Figure 9** for the 2040 horizon.

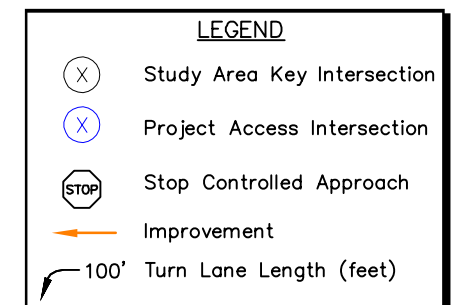
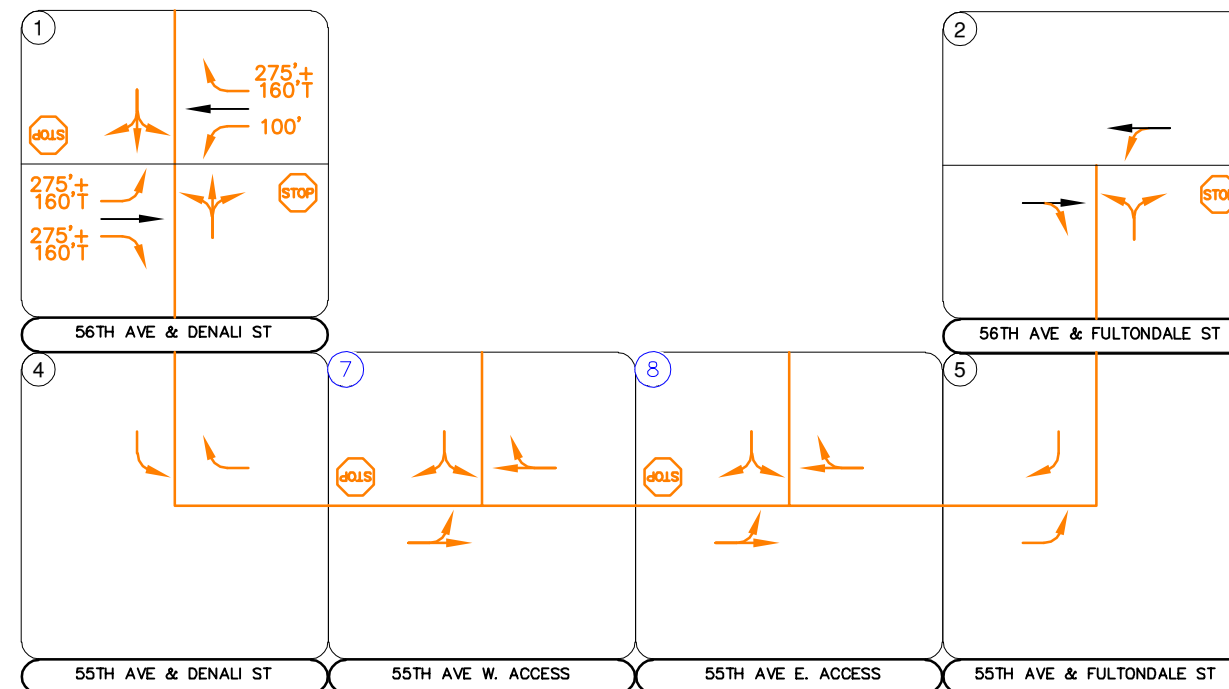
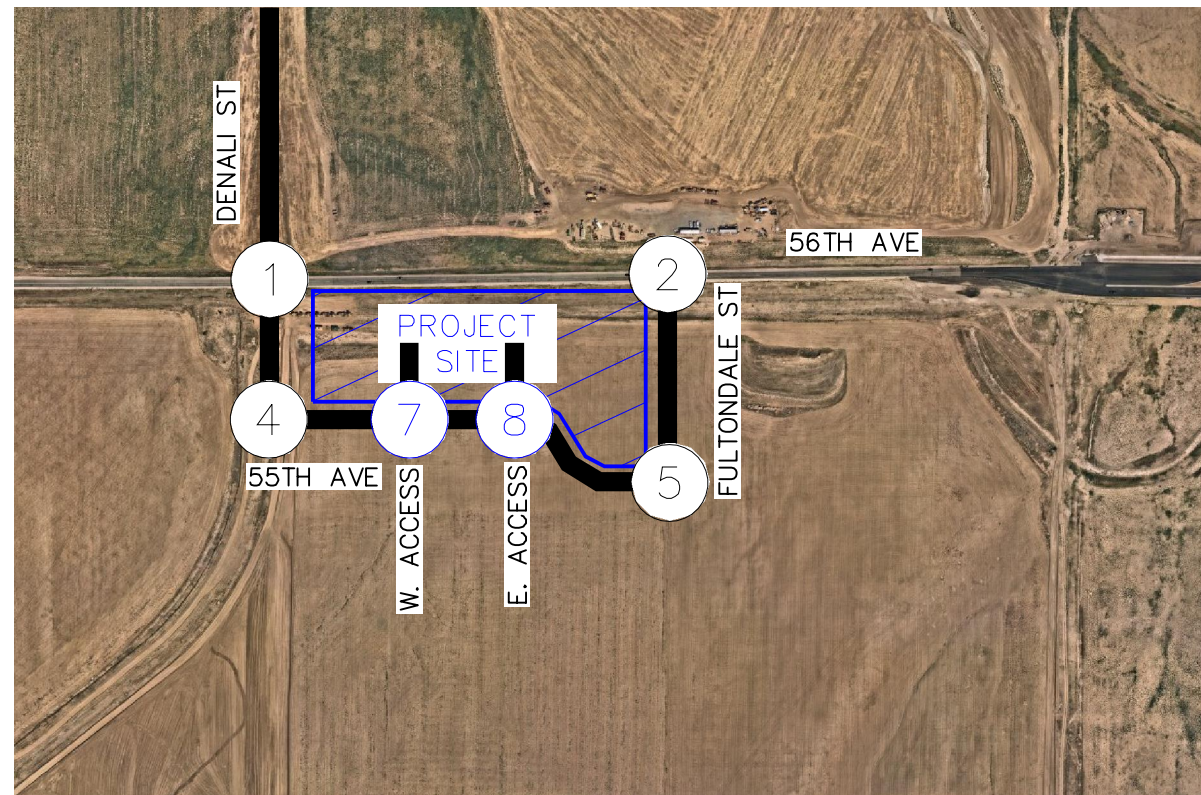


FIGURE 8
REVOLVE AT WINDLER
AURORA, COLORADO
2025 RECOMMENDED GEOMETRY AND CONTROL

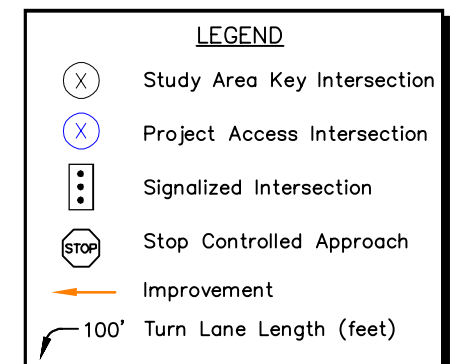
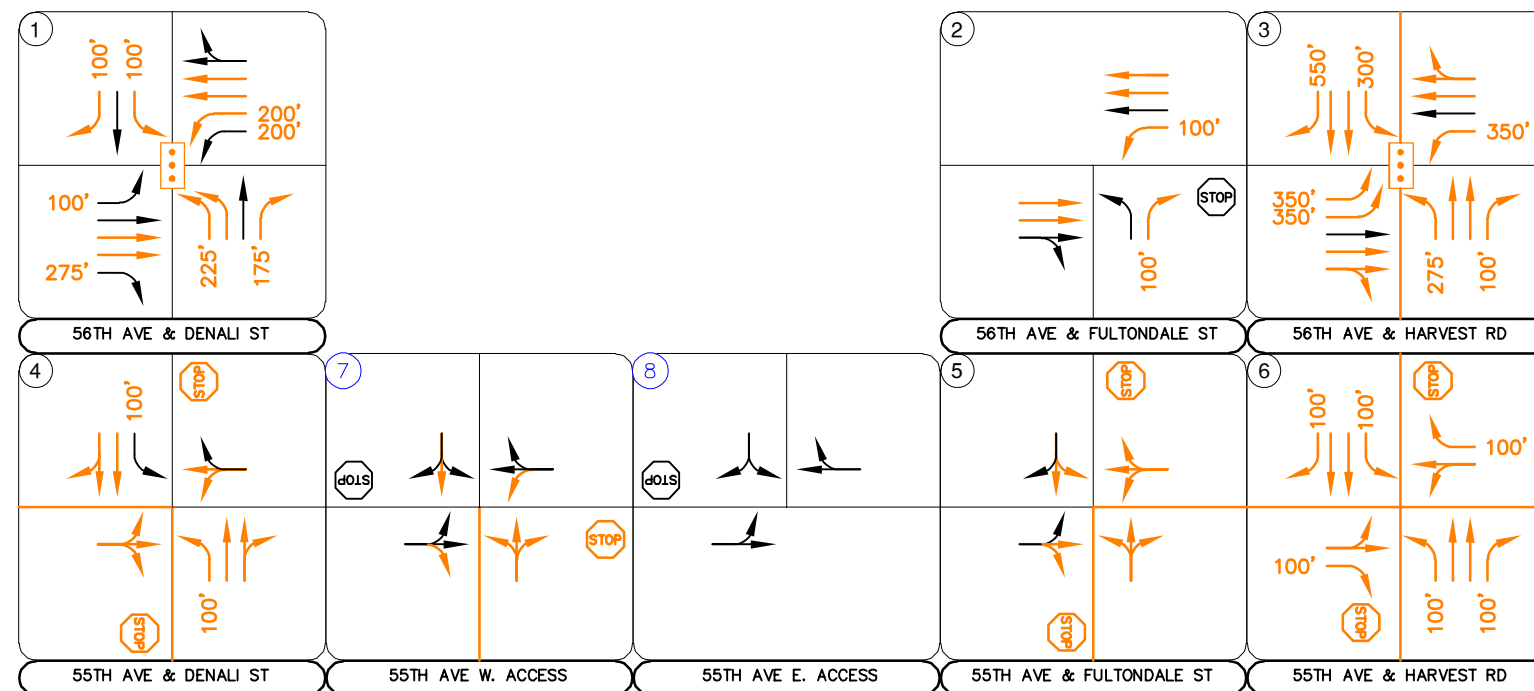
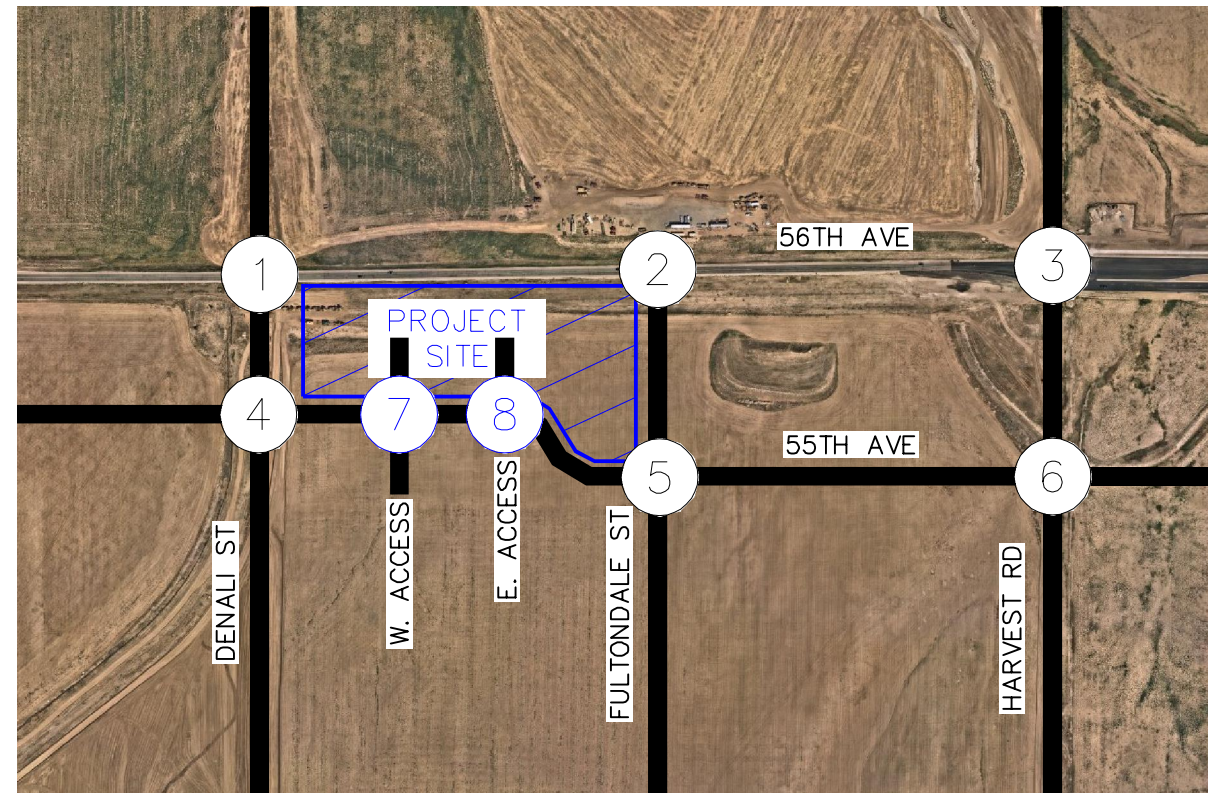


FIGURE 9
REVOLVE AT WINDLER
AURORA, COLORADO
2040 RECOMMENDED GEOMETRY AND CONTROL

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the analysis presented in this report, Kimley-Horn believes Revolve at Windler will be successfully incorporated into the existing and future roadway network. Analysis of the existing and future street network, the proposed project development, and expected traffic volumes resulted in the following conclusions and recommendations:

2025 Recommendations

For purposes of this analysis, it was assumed that the Revolve at Windler development would be the first in place for the overall Windler development area. Therefore, the following roadway configurations are based upon this assumption:

- The intersection of 56th Avenue and Denali Street (#1) is planned to be constructed with development of the project. It is recommended that the eastbound and westbound 56th Avenue approaches consist of one left turn lane, one through lane, and one right turn lane. The northbound and southbound Denali Street approaches should operate with stop control with the installation of R1-1 “STOP” signs and one shared lane for all movements. The eastbound left turn lane, eastbound right turn lane, and westbound right turn lane lengths are recommended based upon CDOT standards as these meet turn lane warrants; it is recommended that these lanes be constructed to a length of 275 feet plus a 160-foot taper. Additionally, the westbound left turn lane, which is not anticipated to meet CDOT turn lane warrants in 2025, is recommended to be designated in the shadow of the eastbound left turn lane to a length of 100 feet.
- The ‘T’-intersection of 56th Avenue and Fultondale Street (#2) is planned to be constructed with development of the project. It is recommended that all three approaches consist of one shared lane for all movements in this horizon. The northbound Fultondale Street approach should operate well with stop control with the installation of an R1-1 “STOP” sign.
- With completion of the Revolve at Windler project, two accesses (#7 and #8) are proposed along the north side of 55th Avenue on the south side of the development. It is recommended that an R1-1 “STOP” sign be installed on the exiting southbound approaches. Both access intersections should operate well with one shared lane for all movements at each intersection.

2040 Recommendations

- For purposes of this analysis, it was assumed that the overall Windler development area would be completed by 2040. Therefore, the intersection configuration at the intersections included in the Windler Homestead Master Traffic Study are consistent with that study, while the intersection configuration for intersections that were not studied in the master study are based on the operational analysis performed in this study. Additionally, the turn lane lengths at each intersection are generally aligned with the Windler Homestead Master study with a minimum of 100 feet in length.
- It is anticipated that a signal will be warranted at the intersection of 56th Avenue and Denali Street (#1). Therefore, if future volumes are realized, this intersection should be signalized by 2040. Additionally, it is recommended that the eastbound 56th Avenue approach consist of a left turn lane with 100 feet in length, three through lanes, and a right turn lane with 275 feet in length. The 56th Avenue westbound approach is recommended to consist of 200-foot dual left turn lanes and three through lanes with the outside lane being a shared through/right turn lane. The northbound Denali Street approach is recommended to consist of dual left turn lanes, one through lane, and a right turn lane. It is recommended that the inside northbound left turn lane be 225 feet of length, the outside left turn lane be a continuous lane, and the northbound right turn lane provide a length of 175 feet. The Denali Street southbound approach is recommended to consist of one 100-foot left turn lane, one through lane, and a 100-foot right turn lane.
- It is recommended that the eastbound approach at the intersection of 56th Avenue and Fultondale Street (#2) consist of three through lanes with the outside lane being a shared through/right turn lane. The 56th Avenue westbound approach is recommended to consist of a 100-foot left turn lane and three through lanes. The northbound Fultondale Street approach is recommended to be designated with one left turn lane and one 100-foot right turn lane. This configuration aligns with the Windler Homestead Master study.
- The intersection of 56th Avenue and Harvest Road (#3) is planned to be constructed with completion of the overall Windler development. By 2040, it is anticipated that a signal will be warranted at this intersection. Therefore, this intersection should be signalized if future volumes are realized. It is recommended the eastbound 56th Avenue approach consist of

350-foot dual left turn lanes and three through lanes with the outside lane being a shared through/right turn lane. The 56th Avenue westbound approach should consist of one 350-foot left turn lane and three through lanes with the outside lane being a shared through/right turn lane. The northbound Harvest Road approach should consist of one 275-foot left turn lane, two through lanes, and a 100-foot right turn lane. The southbound Harvest Road approach is recommended to consist of one 300-foot left turn lane, two through lanes, and a 550-foot right turn lane.

- With full buildout of the Windler Development, it is anticipated that 55th Avenue will be extended to the west and Denali Street will be extended to the south, creating the four-leg intersection of 55th Avenue and Denali Street (#4). It is recommended that the eastbound and westbound 55th Avenue approaches operate with stop control with the installation of R1-1 “STOP” signs and consist of one shared lane for all movements. The northbound and southbound Denali Street approaches are recommended to consist of one 100-foot left turn lane and two through lanes with the outside lane being a shared through/right turn lane.
- With full buildout of the Windler Development, it is anticipated that 55th Avenue will be extended to the east and Fultondale Street will be extended to the south, creating the four-leg intersection of 55th Avenue and Fultondale Street (#5). It is recommended that the eastbound and westbound 55th Avenue approaches operate with stop-control with the installation of R1-1 “STOP” signs. All four approaches are recommended to consist of one shared lane for all movements.
- The intersection of 55th Avenue and Harvest Road (#6) is planned to be constructed with completion of the overall Windler development. It is recommended the eastbound and westbound approaches consist of a shared left turn/through lane and one 100-foot right turn lane. The northbound and southbound approaches should consist of one 100-foot left turn lane, two through lanes, and one 100-foot right turn lane.
- With full construction of the Windler development, a south leg is anticipated to be constructed at the 55th Avenue West Access (#7). It is recommended that this south leg operate with stop control with installation of a R1-1 “STOP” sign.

General Recommendations

- Any onsite or offsite improvements should be incorporated into the Civil Drawings and conform to standards of the City of Aurora and the Manual on Uniform Traffic Control Devices (MUTCD) – 2009 Edition.

APPENDICES

APPENDIX A

Intersection Count Sheets



ALL TRAFFIC DATA SERVICES

(303) 216-2439

www.alltrafficdata.net

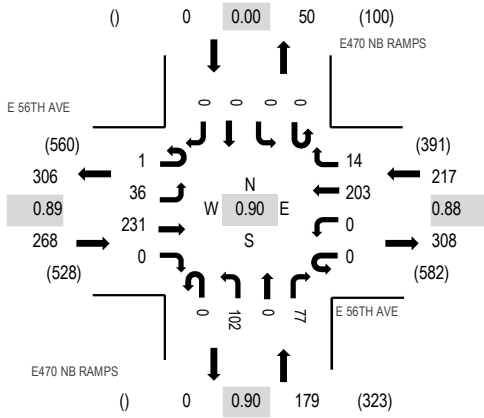
Location: 1 E470 NB RAMPS & E 56TH AVE AM

Date: Tuesday, January 10, 2023

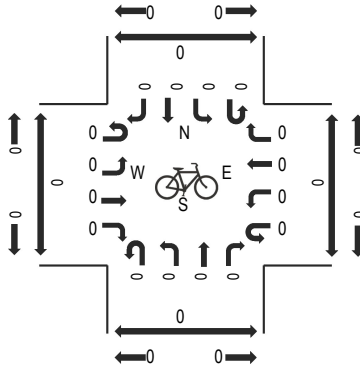
Peak Hour: 07:45 AM - 08:45 AM

Peak 15-Minutes: 08:00 AM - 08:15 AM

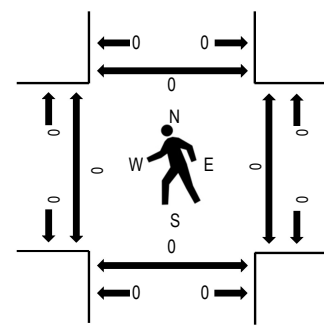
Peak Hour - Motorized Vehicles



Peak Hour - Bicycles



Peak Hour - Pedestrians



Note: Total study counts contained in parentheses.

Traffic Counts - Motorized Vehicles

Interval Start Time	E 56TH AVE Eastbound				E 56TH AVE Westbound				E470 NB RAMPS Northbound				E470 NB RAMPS Southbound				Total	Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right			West	East	South	North
7:00 AM	0	13	58	0	0	0	33	4	0	16	0	14	0	0	0	0	138	591	0	0	0	0
7:15 AM	0	12	67	0	0	0	34	2	0	20	0	11	0	0	0	0	146	638	0	0	0	0
7:30 AM	0	9	49	0	0	0	42	3	0	24	0	20	0	0	0	0	147	650	0	0	0	0
7:45 AM	0	5	63	0	0	0	43	7	0	19	0	23	0	0	0	0	160	664	0	0	0	0
8:00 AM	0	8	68	0	0	0	57	6	0	27	0	19	0	0	0	0	185	651	0	0	0	0
8:15 AM	0	15	42	0	0	0	49	1	0	34	0	17	0	0	0	0	158		0	0	0	0
8:30 AM	1	8	58	0	0	0	54	0	0	22	0	18	0	0	0	0	161		0	0	0	0
8:45 AM	0	5	47	0	0	0	54	2	0	31	0	8	0	0	0	0	147		0	0	0	0
Count Total	1	75	452	0	0	0	366	25	0	193	0	130	0	0	0	0	1,242		0	0	0	0
Peak Hour	1	36	231	0	0	0	203	14	0	102	0	77	0	0	0	0	664		0	0	0	0



ALL TRAFFIC DATA SERVICES

(303) 216-2439

www.alltrafficdata.net

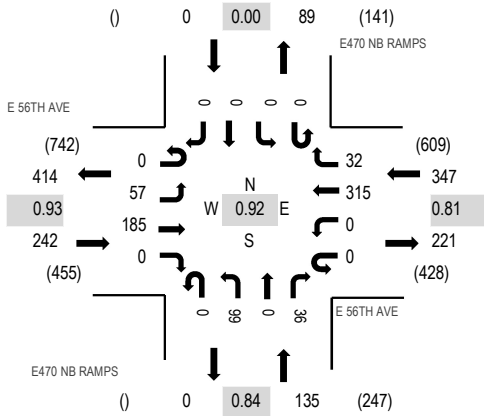
Location: 1 E470 NB RAMPS & E 56TH AVE PM

Date: Tuesday, January 10, 2023

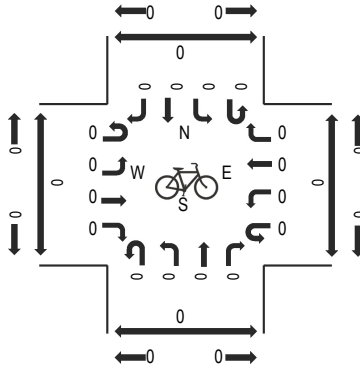
Peak Hour: 04:30 PM - 05:30 PM

Peak 15-Minutes: 05:00 PM - 05:15 PM

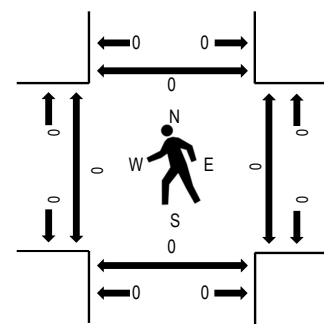
Peak Hour - Motorized Vehicles



Peak Hour - Bicycles



Peak Hour - Pedestrians



Note: Total study counts contained in parentheses.

Traffic Counts - Motorized Vehicles

Interval Start Time	E 56TH AVE Eastbound				E 56TH AVE Westbound				E470 NB RAMPS Northbound				E470 NB RAMPS Southbound				Total	Rolling Hour	Pedestrian Crossings			
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right			West	East	South	North
4:00 PM	0	7	31	0	0	0	83	4	0	16	0	10	0	0	0	0	151	639	0	0	0	0
4:15 PM	0	17	28	0	0	0	64	5	0	24	0	5	0	0	0	0	143	684	0	0	0	0
4:30 PM	0	17	38	0	0	0	77	6	0	21	0	12	0	0	0	0	171	724	0	0	0	0
4:45 PM	0	12	49	0	0	0	72	11	0	24	0	6	0	0	0	0	174	711	0	0	0	0
5:00 PM	0	15	42	0	0	0	102	5	0	23	0	9	0	0	0	0	196	672	0	0	0	0
5:15 PM	0	13	56	0	0	0	64	10	0	31	0	9	0	0	0	0	183		0	0	0	0
5:30 PM	0	6	59	0	0	0	66	4	0	17	1	5	0	0	0	0	158		0	0	0	0
5:45 PM	0	7	58	0	0	0	35	1	0	23	0	11	0	0	0	0	135		0	0	0	0
Count Total	0	94	361	0	0	0	563	46	0	179	1	67	0	0	0	0	1,311		0	0	0	0
Peak Hour	0	57	185	0	0	0	315	32	0	99	0	36	0	0	0	0	724		0	0	0	0

APPENDIX B

NEATS Data & Master Traffic Study



Figure ES-4.
Future Transit Routes

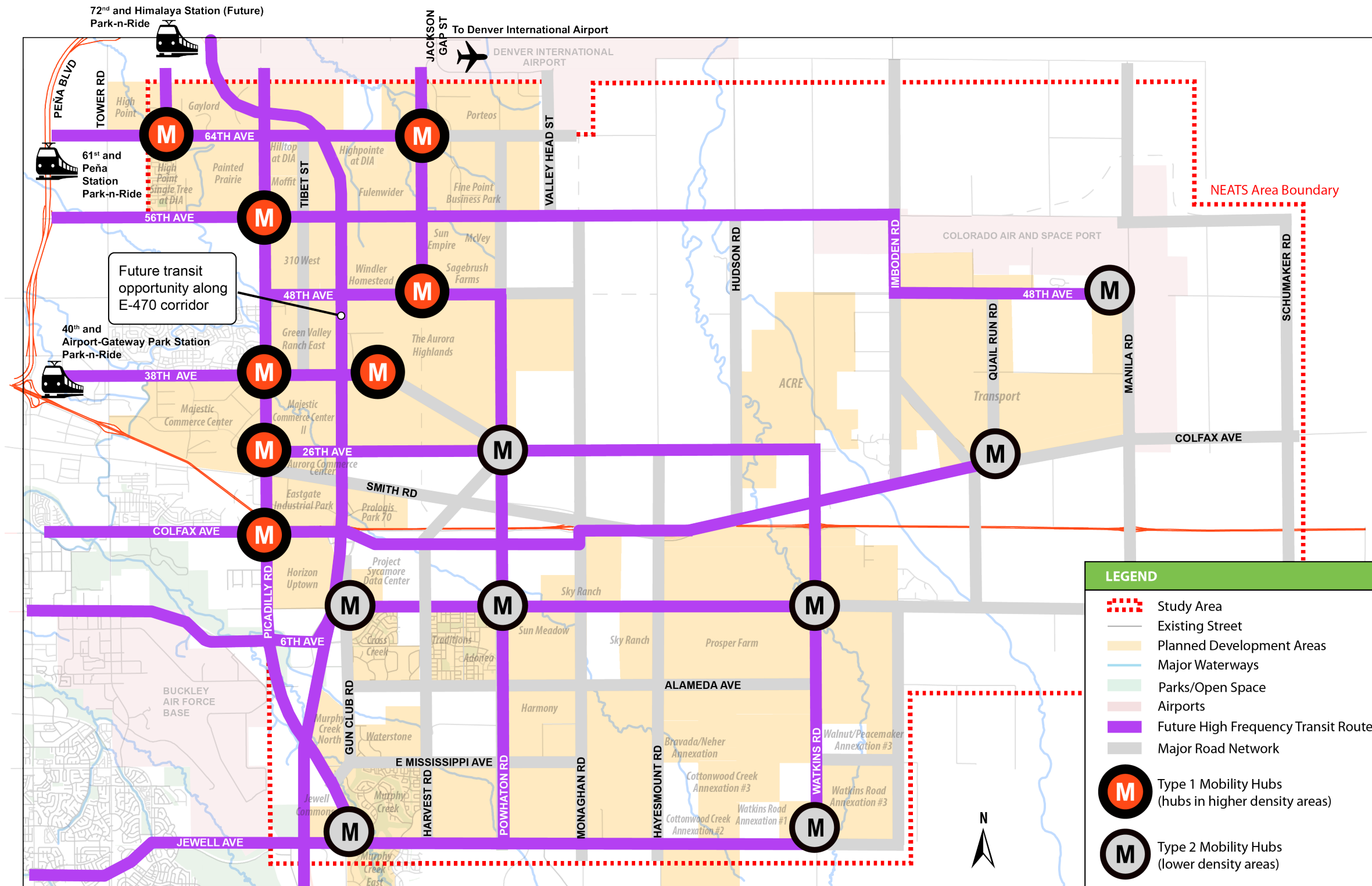
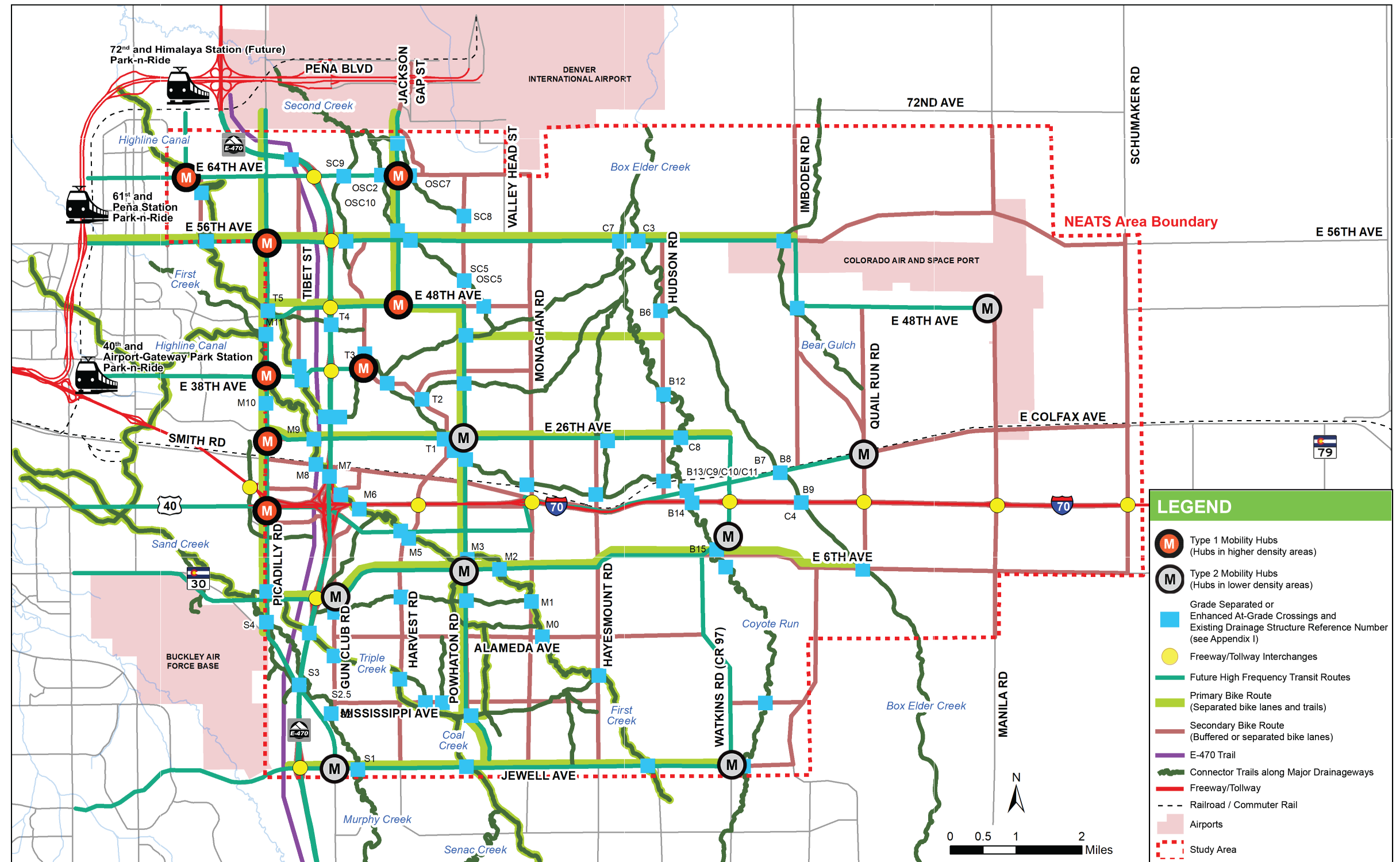




Figure ES-5.
Pedestrian/Bicycle Network and Transit Hub Interface



Note

Pedestrian/bicycle facilities are subject to change based on traffic and design analysis for development construction. Trail alignments shown are conceptual; specific alignments will be determined with detailed site plans.

WINDLER HOMESTEAD

TRAFFIC IMPACT STUDY

Prepared for:

GVP Windler LLC
5750 DTC Parkway, Suite 210
Greenwood Village, CO 80111

Prepared by:

Felsburg Holt & Ullevig
6400 S Fiddlers Green Circle, Suite 1500
Greenwood Village, CO 80111
303.721.1440

Project Manager: Philip Dunham, PE, PTOE
Project Engineer(s): Kornel Gwiazdowski, EI, Tom Loseke, EI



FHU Reference No. 123657-01

May 2023

III. PROPOSED CONDITIONS

III.A. Trip Generation

The *Institute of Transportation Engineers (ITE) Trip Generation Manual, 11th Edition, 2021* was used to estimate trip generation. The development would consist of 3,310 units of single-family housing, 2,185 multifamily units, 648,900 square feet of retail space, 290,000 square feet of office space, 2.2 million square feet of industrial/warehousing space, and a 300-student elementary school. This analysis used a mix of regression equations and average rates for the corresponding ITE code based on the methodology outlined in *ITE Trip Generation Handbook, 3rd Edition, 2017* for selecting the proper rates. **Table I** shows the trip generation rates and equations for each land use code.

Table I. ITE Trip Generation Rates and Equations

Land Use	ITE Code	Unit	Daily	Peak	Equations & Rates	Distributions	
						In	Out
General Light Industrial	110	KSF	$T=3.76*X+50.47$	AM	$T=0.68*X+3.81$	88%	12%
				PM	$\ln(T)=0.72*\ln(X)+0.38$	14%	86%
High-Cube Transload & Short-Term Storage Warehouse	154	KSF	$T=6.41*X+75.31$	AM	$T=0.31*X+22.85$	24%	76%
				PM	$T=0.43*X+20.55$	63%	37%
Single-family Detached	210	DU	$\ln(T)=0.92*\ln(X)+2.68$	AM	$\ln(T)=0.91*\ln(T)+0.12$	26%	74%
				PM	$\ln(T)=0.94*\ln(X)+0.27$	63%	37%
Multifamily (Low-Rise)	220	DU	$T=6.41*X+75.31$	AM	$T=0.31*X+22.85$	24%	76%
				PM	$T=0.43*X+20.55$	63%	37%
Elementary School	520	Students	$T=2.27*X$	AM	$T=0.74*X$	54%	46%
				PM	$T=0.16*X$	46%	54%
General Office	710	KSF	$T=10.84*X$	AM	$T=1.52*X$	88%	12%
				PM	$T=1.44*X$	17%	83%
Shopping Center (> 150 KSF)	820	KSF	$T=10.84*X$	AM	$T=1.52*X$	88%	12%
				PM	$T=1.44*X$	17%	83%
Shopping Plaza (40-150 KSF)	821	KSF	$T=67.52*X$	AM	$T=1.73*X$	62%	38%
				PM	$T=5.19*X$	49%	51%
Strip Retail Plaza (<40KSF)	822	KSF	$T=42.2*X+229.68$	AM	$T=2.36*X$	60%	40%
				PM	$T=6.59*X$	50%	50%

DU = Dwelling Units KSF = 1,000 SF

Table 2 outlines the estimated vehicle-trip generation for the proposed development. The Windler development is anticipated to generate a total of 88,699 vehicle trips per day and approximately 5,454 and 8,226 trips during the AM and PM peak hours, respectively.

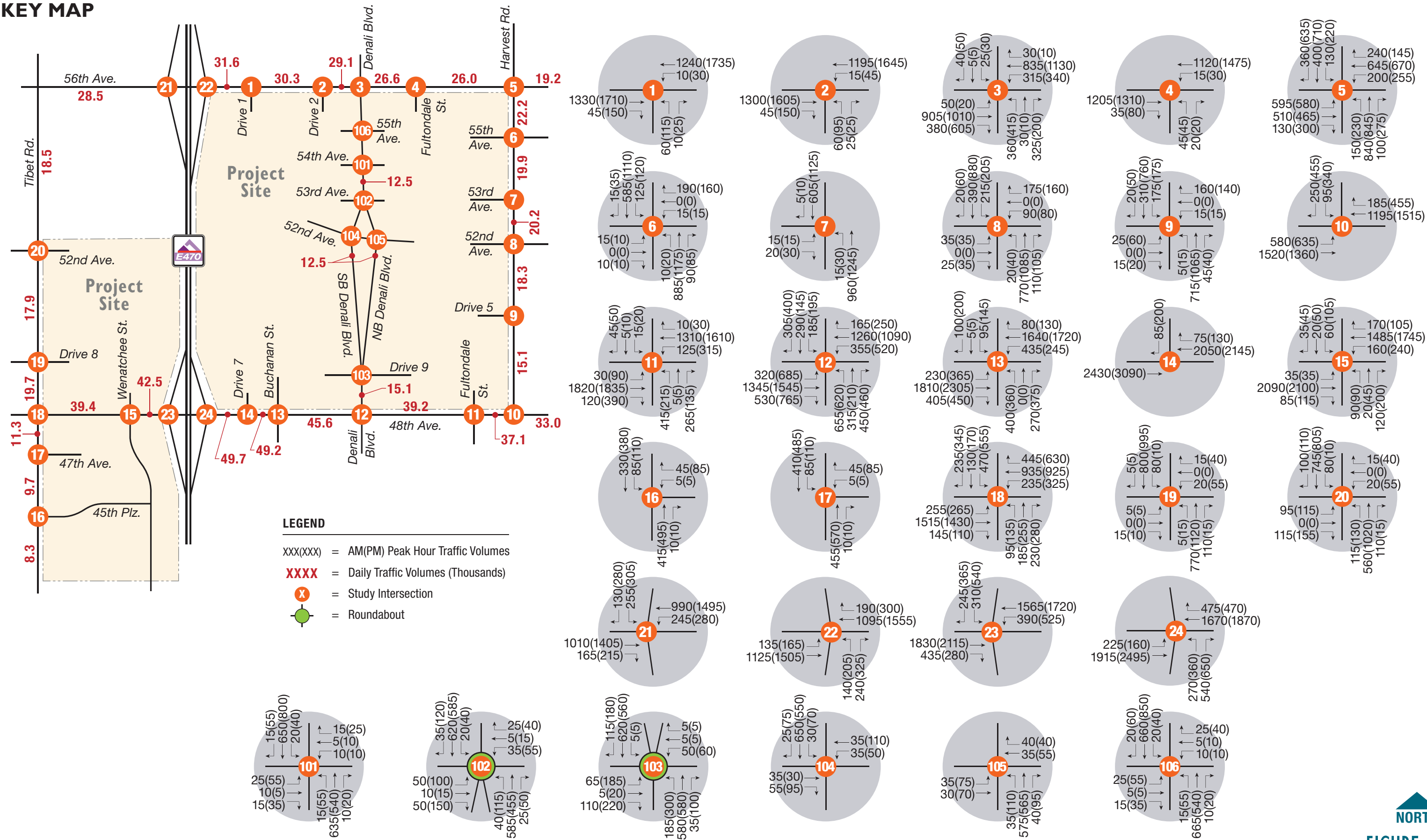
Internal trip capture was determined using the National Cooperative Highway Research Program (NCHRP) 684 spreadsheet. Given the NCHRP 684 internal capture calculation methods, approximately 11 percent of the total generated trips were found to be internal, and 16 percent of the PM trips were determined to be internal. This equates to an estimated internal trip capture of 614 vehicle-trips during the AM peak hour and 1,232 vehicle-trips during the PM peak hour.

Additionally, A pass-by trip deduction was applied to traffic on the adjacent roadway. Pass-by trips consist of existing trips on the adjacent roadway that choose to make an interim stop on the way to their destination. Pass-by trip percentages from the *ITE Trip Generation Handbook* were used for the appropriate uses. **Appendix C** shows the NCHRP 684 internal capture summary sheets.

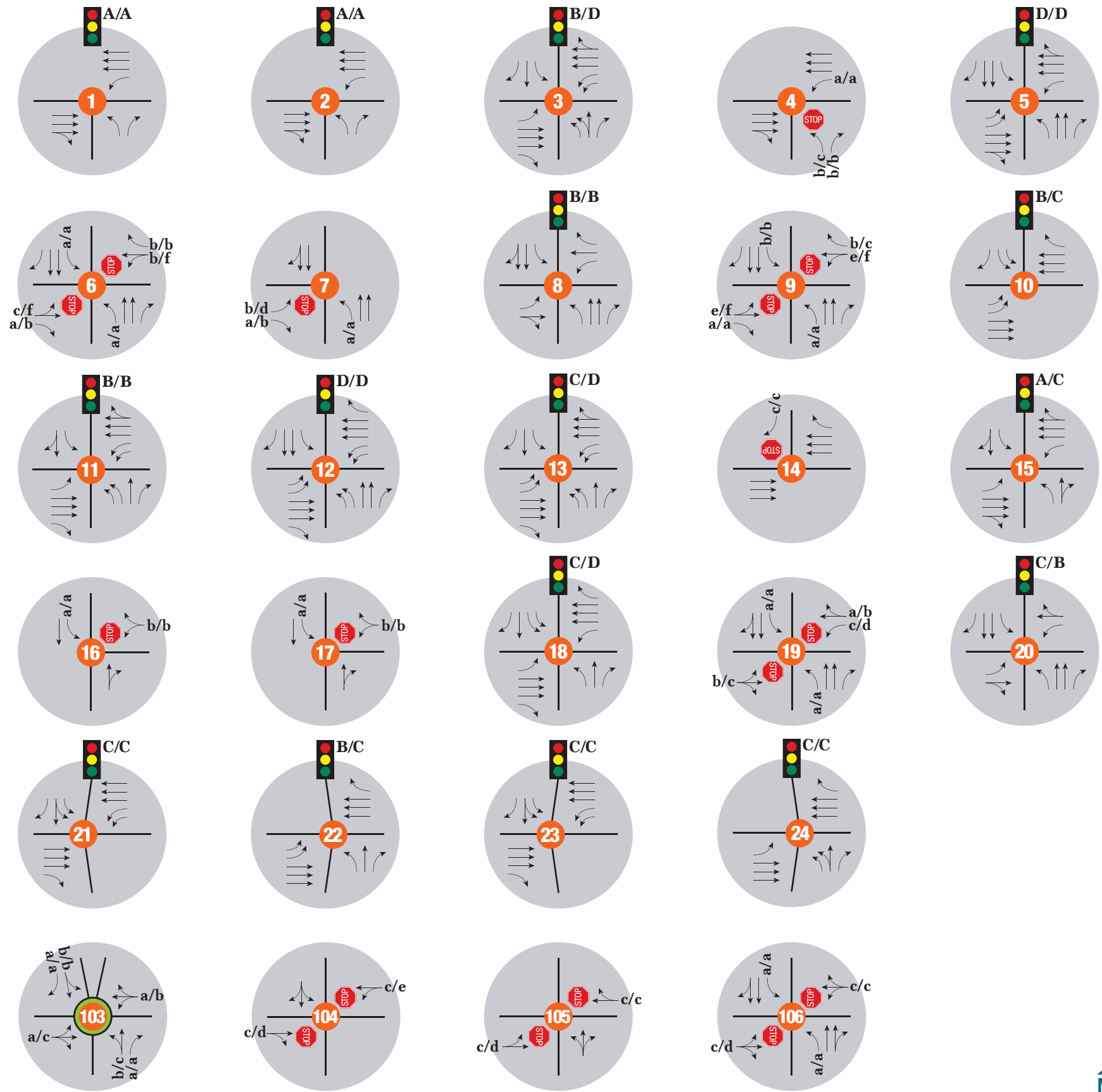
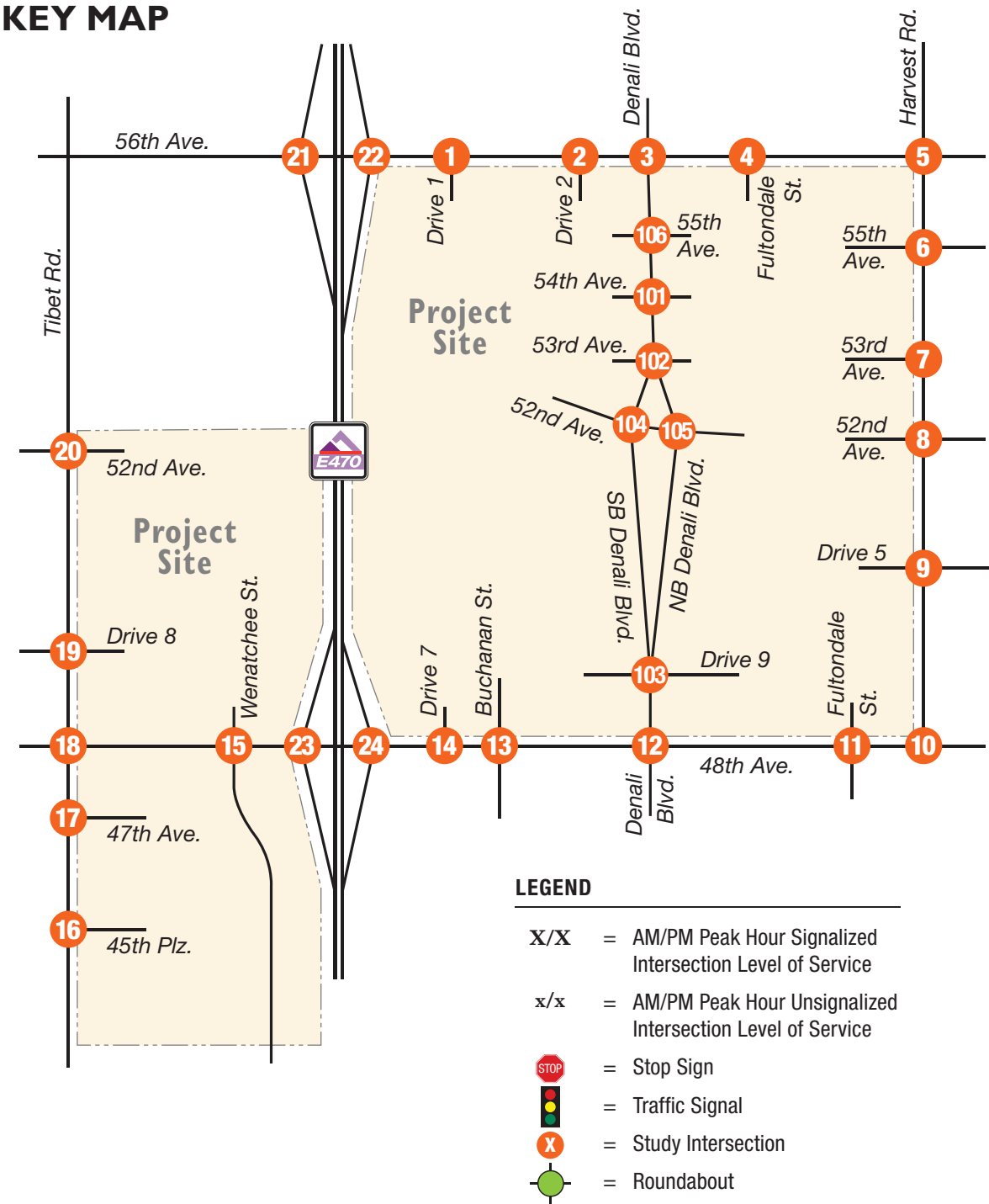
Table 2. Site Trip Generation

Map Code	ITE Code	Land Use Description	Size	Unit	Daily	AM Peak Hour Total Trip Generation			AM Peak Hour Internal Capture Trips					AM Peak Hour External Trips			PM Peak Hour Total Trip Generation			PM Peak Hour Internal Capture Trips					PM Peak Hour External Trips			PM Pass-By %	PM Pass-By Trips
						Total	In	Out	Total	In %	Out %	In	Out	Total	In	Out	Total	In	Out	Total	In %	Out %	In	Out	Total	In	Out	Total	
PA-1	820	Shopping Center	338.0	KSF	14,689	206	127	333	29%	25%	61	31	92	145	96	241	651	705	1,356	16%	20%	104	141	245	547	564	1,111	34%	186
PA-2	220	Multifamily Housing (Low-Rise)	711	DU	4,633	58	185	243	3%	6%	2	11	13	56	174	230	205	121	326	11%	16%	23	20	43	182	101	283	-	-
PA-3.1	210	Single Family Detached Housing	76	DU	784	15	43	58	3%	6%	1	3	4	14	40	54	49	28	77	11%	16%	5	5	10	44	23	67	-	-
PA-3.2	822	Strip Retail Plaza	10.0	KSF	652	14	10	24	29%	25%	4	3	7	10	7	17	39	39	78	16%	20%	6	8	14	33	31	64	34%	11
PA-4	210	Single Family Detached Housing	316	DU	2,908	53	159	212	3%	6%	2	9	11	51	150	201	185	108	293	11%	16%	20	18	38	165	90	255	-	-
PA-5	220	Multifamily Housing (Low-Rise)	228	DU	1,537	23	71	94	3%	6%	1	4	5	22	67	89	75	44	119	11%	16%	8	7	15	67	37	104	-	-
PA-6	220	Multifamily Housing (Low-Rise)	322	DU	2,139	30	93	123	3%	6%	1	6	7	29	87	116	100	59	159	11%	16%	11	10	21	89	49	138	-	-
PA-7.1	210	Single Family Detached Housing	269	DU	2,508	46	137	183	3%	6%	2	8	10	44	129	173	159	93	252	11%	16%	18	15	33	141	78	219	-	-
PA-7.2	822	Strip Retail Plaza	5.0	KSF	441	7	5	12	29%	25%	2	1	3	5	4	9	24	24	48	16%	20%	4	5	9	20	19	39	34%	7
PA-8	210	Single Family Detached Housing	160	DU	1,555	29	43	114	3%	6%	1	3	4	28	40	110	98	57	155	11%	16%	11	9	20	87	48	135	-	-
PA-9	520	Elementary School	300	Students	681	120	102	222	33%	42%	40	42	82	80	60	140	22	26	48	68%	62%	15	16	31	7	10	17	-	-
PA-10	210	Single Family Detached Housing	185	DU	1,777	33	98	130	3%	6%	1	6	7	32	92	123	112	65	177	11%	16%	12	10	22	100	55	155	-	-
PA-11	210	Single Family Detached Housing	206	DU	1,962	36	108	144	3%	6%	1	7	8	35	101	136	123	73	196	11%	16%	14	12	26	109	61	170	-	-
PA-12	210	Single Family Detached Housing	205	DU	1,953	36	107	143	3%	6%	1	6	7	35	101	136	123	72	195	11%	16%	14	12	26	109	60	169	-	-
PA-13.1	210	Single Family Detached Housing	160	DU	1,555	29	86	114	3%	6%	1	5	6	28	81	108	98	57	155	11%	16%	11	9	20	87	48	135	-	-
PA-13.2	220	Multifamily Housing (Low-Rise)	338	DU	2,242	31	97	128	3%	6%	1	6	7	30	91	121	105	61	166	11%	16%	12	10	22	93	51	144	-	-
PA-14.1	210	Single Family Detached Housing	195	DU	1,865	34	103	137	3%	6%	1	6	7	33	97	130	117	69	186	11%	16%	13	11	24	104	58	162	-	-
PA-14.2	220	Multifamily Housing (Low-Rise)	320	DU	2,127	29	93	122	3%	6%	1	5	6	28	88	116	100	58	158	11%	16%	11	9	20	89	49	138	-	-
PA-14.3	710	General Office Building	130	KSF	1,458	185	25	210	21%	91%	40	23	63	145	2	147	35	171	206	88%	6%	31	11	42	4	160	164	-	-
PA-15	210	Single Family Detached Housing	313	DU	2,883	53	158	210	3%	6%	2	9	11	51	149	199	183	107	290	11%	16%	20	17	37	163	90	253	-	-
PA-16	210	Single Family Detached Housing	59	DU	621	12	35	46	3%	6%	1	2	3	11	33	43	38	23	61	11%	16%	4	4	8	34	19	53	-	-
PA-17.1	210	Single Family Detached Housing	152	DU	1,483	27	82	109	3%	6%	1	5	6	26	77	103	93	54	147	11%	16%	10	9	19	83	45	128	-	-
PA-17.2	822	Strip Retail Plaza	10.9	KSF	690	15	11	26	29%	25%	5	3	8	10	8	18	41	42	83	16%	20%	7	9	16	34	33	67	34%	12
PA-18	210	Single Family Detached Housing	142	DU	1,393	26	77	102	3%	6%	1	4	5	25	73	97	87	51	138	11%	16%	10	8	18	77	43	120	-	-
PA-19	210	Single Family Detached Housing	161	DU	1,564	29	86	115	3%	6%	1	5	6	28	81	109	98	57	155	11%	16%	11	10	21	87	47	134	-	-
PA-20	710	General Office Building	160	KSF	1,747	221	30	251	21%	91%	47	27	74	174	3	177	42	203	245	88%	6%	37	13	50	5	190	195	-	-
PA-21.1	220	Multifamily Housing (Low-Rise)	320	DU	2,127	29	93	122	3%	6%	1	6	7	28	87	115	100	58	158	11%	16%	11	10	21	89	48	137	-	-
PA-21.2	821	Shopping Plaza	45	KSF	4,252	98	61	159	29%	25%	29	15	44	69	46	115	223	241	464	16%	20%	36	49	85	187	192	379	34%	64
PA-22.1	820	Shopping Center	240.0	KSF	12,130	171	105	275	29%	25%	50	26	76	121	79	199	509	551	1,060	16%	20%	82	110	192	427	441	868	34%	145
PA-22.2	220	Multifamily Housing (Low-Rise)	103	DU	736	13	42	55	3%	6%	1	2	3	12	40	52	41	24	65	11%	16%	5	4	9	36	20	56	-	-
PA-23	210	Single Family Detached Housing	209	DU	1,988	37	110	146	3%	6%	1	6	7	36	104	139	125	74	199	11%	16%	14	12	26	111	62	173	-	-
PA-24	210	Single Family Detached Housing	118	DU	1,175	22	65	87	3%	6%	1	4	5	21	61	82	73	43	116	11%	16%	8	7	15	65	36	101	-	-
PA-25	210	Single Family Detached Housing	276	DU	2,568	47	141	188	3%	6%	2	8	10	45	133	178	163	95	258	11%	16%	18	16	34	145	79	224	-	-
PA-26.1	154	High-Cube Transload and Short-Term Storage Warehouse	250	KSF	350	15	5	20	0%	0%	0	0	0	15	5	20	7	18	25	0%	0%	0	0	0	7	18	25	-	-
PA-26.2	110	General Light Industrial	250	KSF	990	153	21	174	0%	0%	0	0	0	153	21	174	11	67	78	0%	0%	0	0	0	11	67	78	-	-
PA-27.1	154	High-Cube Transload and Short-Term Storage Warehouse	100	KSF	140	6	2	8	0%	0%	0	0	0	6	2	8	3	7	10	0%	0%	0	0	0	3	7	10	-	-
PA-21.2	110	General Light Industrial	100	KSF	426	63	9	72	0%	0%	0	0	0	63	9	72	6	34	40	0%	0%	0	0	0	6	34	40	-	-
PA-28.1	154	High-Cube Transload and Short-Term Storage Warehouse	375	KSF	525	23	7	30	0%	0%	0	0	0	23	7	30	11	27	38	0%	0%	0	0	0	11	27	38	-	-
PA-28.2	110	General Light Industrial	375	KSF	1,460	228	31	259	0%	0%	0	0	0	228	31	259	15	89	104	0%	0%	0	0	0	15	89	104	-	-
PA-29.1	154	High-Cube Transload and Short-Term Storage Warehouse	375	KSF	525	23	7	30	0%	0%	0	0	0	23	7	30	11	27	38	0%	0%	0	0	0	11	27	38	-	-
PA-29.2	110	General Light Industrial	375	KSF	1,460	228	31	259	0%	0%	0	0	0	228	31	259	15	89	104	0%	0%	0	0	0	15	89	104	-	-
Total Vehicles					88,699	2,553	2,901	5,454	-	-	307	307	614	2,246	2,594	4,840	4,315	3,911	8,226	-	-	616	616	1,232	3,699	3,295	6,994	-	425
DU = Dwelling Units KSF = 1,000 SF																													

KEY MAP



KEY MAP



V.D. Queuing and Auxiliary Lane Requirements

Recommendations for vehicle storage lengths at each of the external study area intersections are included in **Table 3** for use in identifying construction needs for the Windler site. These dimensions represent the storage space necessary to meet the 95th percentile maximum queue during either the AM or PM peak hour.

Output from the traffic analysis effort was used to recommend these storage lengths, using the following methodology:

- **Left turn lane storage lengths.** At signalized intersections, the greater of the HCM 6th Edition or Synchro methodology queue calculations were reported. For unsignalized intersections, the HCM 6th Edition calculation was reported.
- **Through movements.** For signalized intersections, Synchro calculation results were reported. No through movement queues are reported for unsignalized intersections as the through movements are free.
- **Right turn movements.** The Synchro queue length was used. HCM 6th Edition information was not used because HCM's signalized intersection methodology does not account for right turns on red.

Deceleration lane and taper lengths should be added to these dimensions per the City of Aurora standards to identify the total length of each auxiliary lane. Upon the development of site plans, more detailed traffic impact studies should be prepared to confirm/refine the above queue lengths as well as all the study area intersection operations.

Table 3A. Turn Lane Storage & 95th Percentile Queue Lengths

Location	Movement	95% Queue Length (ft)	Recommended Storage Length (ft)	SHAC Recommendation (ft)
		2040 Future Total (AM Peak/PM Peak)		
Drive 1 & 56 th Avenue	NB Left-turn	93 / 151	175	150
	NB Right-turn	18 / 27	Continuous	Continuous
	EB Through ⁺	48 / 166	Continuous	Continuous
	WB Through	125 / 141	Continuous	Continuous
	WB Left-turn	6 / 46	50	50
Drive 2 & 56 th Avenue	NB Left-turn	93 / 131	Continuous	Continuous
	NB Right-turn	29 / 28	50	125
	EB Through ⁺	117 / 83	Continuous	Continuous
	WB Left-turn	m3 / m51	75	75
	WB Through	39 / 222	Continuous	Continuous
Denali Boulevard & 56 th Avenue	NB Left-turn	192 / 205	225	550
	NB Through ⁺	193 / 206	Continuous	Continuous
	NB Right-turn	140 / 76	Continuous	Continuous
	EB Left-turn	52 / m19	75	75
	EB Through	204 / 281	Continuous	Continuous
	EB Right-turn	89 / 125	125	875
	SB Left-turn	34 / 38	50	50
	SB Through	16 / 17	Continuous	Continuous
	SB Right-turn	0 / 0	50	75
	WB Left-turn**	m176 / m161	200	550
	WB Through ⁺	126 / 212	Continuous	Continuous
Fultondale Street & 56 th Avenue	NB Left-turn	8 / 13	Continuous	Continuous
	NB Right-turn	3 / 3	25	50
	WB Left-turn	3 / 3	25	50

Table 3B. Turn Lane Storage & 95th Percentile Queue Lengths (Continued)

Location	Movement	95% Queue Length (ft)	Recommended Storage Length (ft)	SHAC Recommendation (ft)
		2040 Future Total (AM Peak/PM Peak)		
Harvest Road & 56 th Avenue	NB Left-turn	147 / #270	275	300
	NB Through	453 / #466	Continuous	Continuous
	NB Right-turn	25 / 65	100	375
	EB Left-turn**	#273 / #333	350	775
	EB Through ⁺	168 / 162	Continuous	Continuous
	SB Left-turn	#144 / #276	300	300
	SB Through	190 / 369	Continuous	Continuous
	SB Right-turn	183 / 549	550	850
	WB Left-turn	143 / #325	350	350
	WB Through ⁺	293 / 278	Continuous	Continuous
Harvest Road & 55 th Avenue	NB Left-turn	0 / 3	25	50
	EB Left-turn ⁺	5 / 25	Continuous	Continuous
	EB Right-turn	0 / 3	25	25
	SB Left-turn	13 / 13	25	175
	WB Left-turn ⁺	3 / 18	Continuous	Continuous
	WB Right-turn	30 / 33	50	250
Harvest Road & 53 rd Avenue	NB Left-turn	0 / 3	25	50
	EB Left-turn	3 / 8	Continuous	Continuous
	EB Right-turn	3 / 3	25	50
Harvest Road & 52 nd Avenue	NB Left-turn	m9 / m16	25	75
	NB Through	110 / 178	Continuous	Continuous
	NB Right-turn	m0 / m7	25	150
	EB Left-turn	64 / 64	75	50
	EB Through ⁺	0 / 0	Continuous	Continuous
	SB Left-turn	35 / m66	100	300
	SB Through ⁺	30 / 112	Continuous	Continuous
	WB Left-turn	115 / 106	125	125
	WB Through	0 / 0	Continuous	Continuous
	WB Right-turn	117 / 123	125	250
Harvest Road & Drive 5	NB Left-turn	0 / 0	25	25
	EB Left-turn ⁺	20 / 170	Continuous	Continuous
	EB Right-turn	25 / 3	25	50
	SB Left-turn	23 / 35	50	250
	WB Left-turn ⁺	13 / 38	Continuous	Continuous
	WB Right-turn	30 / 35	50	225
Harvest Road & 48 th Avenue	EB Left-turn**	m319 / 351	375	825
	EB Through	434 / 20	Continuous	Continuous
	SB Left-turn**	63 / 177	200	450
	SB Right-turn	91 / 247	Continuous	Continuous
	WB Through	307 / 468	Continuous	Continuous
	WB Right-turn	41 / 65	75	600

Table 3C. Turn Lane Storage & 95th Percentile Queue Lengths (Continued)

Location	Movement	95% Queue Length (ft)	Recommended Storage Length (ft)	SHAC Recommendation (ft)
		2040 Future Total (AM Peak/PM Peak)		
Fultondale Street & 48 th Avenue	NB Left-turn**	#248 / 127	250	550
	NB Through	13 / 15	Continuous	Continuous
	NB Right-turn	160 / 84	175	350
	EB Left-turn	m8 / m25	50	125
	EB Through	608 / m183	Continuous	Continuous
	EB Right-turn	m1 / m0	25	525
	SB Left-turn	24 / 45	50	25
	SB Through ⁺	41 / 53	Continuous	Continuous
	WB Left-turn**	74 / #202	225	425
	WB Through ⁺	269 / 81	Continuous	Continuous
Denali Boulevard & 48 th Avenue	NB Left-turn**	#385 / #394	400	825
	NB Through	162 / 128	Continuous	Continuous
	NB Right-turn	373 / #383	400	600
	EB Left-turn**	m139 / m#377	400	775
	EB Through	m453 / m#482	Continuous	Continuous
	EB Right-turn	m29 / m95	675	1000
	SB Left-turn	158 / 231	250	375
	SB Through	171 / 92	Continuous	Continuous
	SB Right-turn	124 / 177	200	600
	WB Left-turn**	m#217 / #341	350	700
	WB Through	362 / 328	Continuous	Continuous
	WB Right-turn	m12 / 17	50	400
Buchanan Street & 48 th Avenue	NB Left-turn**	#270 / #253	275	525
	NB Through	14 / 17	Continuous	Continuous
	NB Right-turn	146 / #520	Continuous	Continuous
	EB Left-turn**	m125 / m162	175	475
	EB Through	m#523 / m150	Continuous	Continuous
	EB Right-turn	m42 / m0	50	600
	SB Left-turn	101 / 172	200	200
	SB Through	16 / 17	Continuous	Continuous
	SB Right-turn	27 / 151	Continuous	Continuous
	WB Left-turn**	m#267 / m#148	275	575
	WB Through ⁺	426 / m398	Continuous	Continuous
Drive 7 & 48 th Avenue	SB Right-turn	20 / 68	Continuous	Continuous
Wenatchee Street & 48 th Avenue	NB Left-turn	127 / 109	150	125
	NB Through ⁺	77 / 177	Continuous	Continuous
	EB Left-turn	m4 / m6	25	50
	EB Through ⁺	125 / #269	Continuous	Continuous
	SB Left-turn	95 / #131	150	150
	SB Through ⁺	55 / 104	Continuous	Continuous
	WB Left-turn	m124 / m#271	275	325
	WB Through ⁺	398 / m497	Continuous	Continuous
Tibet Road & 45 th Plaza	SB Left-turn	8 / 10	25	150
	WB Left-turn ⁺	8 / 18	Continuous	Continuous
Tibet Road & 47 th Avenue	SB Left-turn	8 / 10	25	150
	WB Left-turn ⁺	8 / 20	Continuous	Continuous

Table 3D. Turn Lane Storage & 95th Percentile Queue Lengths (Continued)

Location	Movement	95% Queue Length (ft)	Recommended Storage Length (ft)	SHAC Recommendation (ft)
		2040 Future Total (AM Peak/PM Peak)		
Tibet Road & 48 th Avenue	NB Left-turn	94 / 125	125	200
	NB Through	#251 / #380	Continuous	Continuous
	NB Right-turn	136 / 176	200	375
	EB Left-turn	253 / 264	275	350
	EB Through	497 / #501	Continuous	Continuous
	EB Right-turn	35 / 29	50	200
	SB Left-turn**	#280 / #352	375	725
	SB Through	84 / 135	Continuous	Continuous
	SB Right-turn	24 / 99	100	450
	WB Left-turn	#299 / #430	450	425
	WB Through	270 / 212	Continuous	Continuous
	WB Right-turn	158 / 533	550	825
Tibet Road & Drive 8	NB Left-turn	0 / 3	25	25
	EB Left-turn ⁺	3 / 3	Continuous	Continuous
	SB Left-turn	8 / 0	25	125
	WB Left-turn ⁺	5 / 30	Continuous	Continuous
	WB Right-turn	3 / 5	Continuous	Continuous
Tibet Road & 52 nd Avenue	NB Left-turn	m42 / m59	75	175
	NB Through	104 / m303	Continuous	Continuous
	NB Right-turn	m13 / m0	25	150
	EB Left-turn	119 / 120	125	150
	EB Through ⁺	0 / 0	Continuous	Continuous
	SB Left-turn	64 / 17	75	125
	SB Through	228 / 315	Continuous	Continuous
	SB Right-turn	9 / 24	25	150
	WB Left-turn	43 / 85	100	75
SB E-470 & 56 th Avenue	WB Through ⁺	0 / 0	Continuous	Continuous
	EB Through	235 / 396	Continuous	Continuous
	EB Right-turn	37 / 46	50	300
	SB Left-turn	177 / 150	200	400
	SB Through ⁺	178 / 150	Continuous	Continuous
	SB Right-turn	70 / 238	250	375
	WB Left-turn**	118 / 168	175	375
NB E-470 & 56 th Avenue	WB Through	38 / 31	Continuous	Continuous
	NB Left-turn ⁺	50 / 226	Continuous	Continuous
	NB Through ⁺	50 / 226	Continuous	Continuous
	NB Right-turn	34 / 310	325	425
	EB Left-turn**	90 / 111	125	225
	EB Through	116 / 103	Continuous	Continuous
	WB Through	191 / 175	Continuous	Continuous
SB E-470 & 48 th Avenue	WB Right-turn	0 / 7	25	400
	EB Through	226 / #448	Continuous	Continuous
	EB Right-turn	22 / m0	25	575
	SB Left-turn	m161 / m310	325	725
	SB Through ⁺	m161 / m310	Continuous	Continuous
	SB Right-turn	m210 / m#451	475	475
	WB Left-turn**	m151 / m#224	250	700
	WB Through	122 / m100	Continuous	Continuous

Table 3E. Turn Lane Storage & 95th Percentile Queue Lengths (Continued)

Location	Movement	95% Queue Length (ft)	Recommended Storage Length (ft)	SHAC Recommendation (ft)
		2040 Future Total (AM Peak/PM Peak)		
NB E-470 & 48 th Avenue	NB Left-turn	m134 / m167	175	475
	NB Through ⁺	m135 / m168	Continuous	Continuous
	NB Right-turn	#643 / m#748	750	850
	EB Left-turn	m#257 / m#107	275	300
	EB Through	98 / m#878	Continuous	Continuous
	WB Through	m407 / m#652	Continuous	Continuous
	WB Right-turn	m41 / m127	150	625
Denali Boulevard & 54 th Avenue	NB Left-turn	0 / 5	50	50
	EB Left-turn ⁺	15 / 50	Continuous	Continuous
	SB Left-turn	3 / 3	50	45
	WB Left-turn ⁺	10 / 23	Continuous	Continuous
Denali Boulevard & 53 rd Avenue	NB Through ⁺	121 / 118	Continuous	Continuous
	EB Through ⁺	19 / 67	Continuous	Continuous
	SB Through ⁺	101 / 106	Continuous	Continuous
	SB Right-turn ⁺	3 / 12	Continuous	Continuous
	WB Through ⁺	11 / 19	Continuous	Continuous
Denali Boulevard & Drive 9	NB Through ⁺	148 / 686	Continuous	Continuous
	NB Right-turn ⁺	3 / 10	Continuous	Continuous
	EB Through ⁺	34 / 166	Continuous	Continuous
	SB Through ⁺	172 / 227	Continuous	Continuous
	WB Through ⁺	12 / 9	Continuous	Continuous
SB Denali Boulevard & 52 nd Avenue	EB Through ⁺	25 / 35	Continuous	Continuous
	WB Left-turn ⁺	30 / 108	Continuous	Continuous
NB Denali Boulevard & 52 nd Avenue	EB Left-turn ⁺	23 / 58	Continuous	Continuous
	WB Through ⁺	18 / 30	Continuous	Continuous
Denali Boulevard & 55 th Avenue	NB Left-turn	0 / 5	50	50
	EB Left-turn ⁺	13 / 55	Continuous	Continuous
	SB Left-turn	3 / 3	50	45
	WB Left-turn ⁺	10 / 18	Continuous	Continuous

*shared lane **dual turn lane SHAC values based on a HV% of ten percent.
- 95th percentile volume exceeds capacity; queues may be longer
m - volume for 95th percentile queue is metered by upstream signal

V.E. Transit Network

NEATS states that a well-developed transit system, properly related to the development patterns and land uses within the NEATS study area, will provide travelers with an effective alternative to single-occupancy vehicles. The reduction in single-occupancy vehicle use will help reduce congestion and improve air quality within the surrounding region.

NEATS identifies a proposed transit network, including a series of mobility hubs that will anchor transit routes that serve major employment and population areas. The network is designed to allow a systematic transition from traditional fixed route bus services and park-n-rides to a comprehensive transit system, including high frequency fixed transit routes and on-demand transit services linked with mobility hubs.

As identified in NEATS, while RTD is operating traditional fixed route bus service, the envisioned service plan for the transit routes is outlined below:

- 1 to 2-mile route spacing along major arterials.
- All routes connect to a park-n-ride, FasTracks station and/or mobility hub.
- Most routes would meet RTD's "Suburban Local" classification with at least 20 riders boarding on average per hour.
- All routes would have 15-minute peak hour services and at least 60-minute off peak service.
- The possible ridership for each route would range from 170 to 2,400 rides per day based on comparable existing service ridership.

NEATS has identified the following high frequency transit routes surrounding the Windler site:

- Along 56th Avenue from the western NEATS boundary at Tower Road extending east to Imboden Road.
- Along 48th Avenue from Picadilly Road extending east to Powhaton Road.
- Along Harvest Road from 48th Avenue extending north to the northern NEATS boundary at 72nd Avenue.

Additionally, NEATS identifies a Type I Mobility Hub planned for the southeast corner of Windler at the intersection of 48th Avenue and Harvest Road. Features of a Type I Mobility Hubs at intersections include but are not limited to:

- Enhanced bus stops with real time information
- Designated bus lanes and priority signals
- Secure bike parking
- Car sharing
- Off-street bike paths
- Public art
- A transit/community information kiosk

V.F. Bicycle and Pedestrian Network

NEATS states that a safe and connected walking and biking network is the cornerstone of the mobility system. The proposed network of trails along drainageways, bike lanes, and sidewalks will allow people of all ages and abilities to safely travel to and from their destinations. The network includes on and off-street travel ways that people can use for commuting, recreation, exercise, and short personal trips.

The network of bicycle and pedestrian facilities is designed for people who are traveling by foot or using a variety of e-motorized and non-motorized vehicles. This network includes facilities along roadway corridors and along drainageways. The range of facilities includes the following: sidewalks, shared-use paths, off-street trails, on-street bike lanes and buffered bike lanes, and protected or separated bike lanes. This network will provide the flexibility to serve pedestrians, bicycles, small e-vehicles, skateboarders, and other non-motorized vehicles that will emerge in the future. This walk and wheel accessible network will work in conjunction with the roadway and transit networks to provide safe access within neighborhoods and around the study area. In this context, the recommended bicycle and pedestrian network from the NEATS Refresh study creates a “complete street” system of multimodal facilities along the arterial and collector roadway grid in the study area.

Pedestrian and bicycle facilities identified in the NEATS Refresh study surrounding the Windler site include:

Primary Bike Routes (Separated bike lanes and Trials):

- Along 56th Avenue from the western NEATS boundary at Tower Road extending east to Imboden Road
- Along 48th Avenue from Picadilly Road extending east to Powhaton Road
- Along Harvest Road from 48th Avenue extending north to the northern NEATS boundary at 72nd Avenue

Secondary Bike Routes (Buffered or Separated bike lanes):

- Along Denali Boulevard from 38th Avenue extending north to 56th Avenue
- Along Tibet Street from 38th Avenue extending north to 64th Avenue

Trails

- The E-470 along the westside of E470 along the east side of E-470 through the entire NEATS study area from Jewell Avenue extending north to 72nd Avenue.
- A Connector Trail branching off of the secondary bike route along Denali Boulevard within the Windler site extending north to the Second Creek drainage near the northern NEATS boundary at 72nd Avenue, including an Enhanced At-Grade Crossing at 56th Avenue.



October 3, 2023

MEMORANDUM

TO: Mr. Carl Harline, PE
Principal Engineer – Traffic
City of Aurora

FROM: Philip Dunham, PE, PTOE
Kornel Gwiazdowski, EI
Felsburg Holt & Ullevig

SUBJECT: 56th Street & Denali Boulevard Laneage Updated Memo
FHU Reference No. 123657-01

Felsburg Holt & Ullevig (FHU) has completed an analysis of the proposed changes to the intersection of 56th Street with Denali Boulevard as part of the Windler Homestead development located in Aurora, CO.

As part of the *Windler Homestead Traffic Impact Study (TIS), July 2023*, by FHU, the recommended lane assignment for the northbound approach was a dedicated left-turn lane, a shared through/left-turn lane, and a dedicated right-turn lane at the intersection of 56th Street with Denali Boulevard. This laneage was proposed to reduce creating significant offset of the northbound through movement with the southbound left-turn movement, which is proposed to be a single-lane. The proposed change would provide exclusive dual left-turns lanes, a through lane, and right-turn lane on the northbound approach. This memo summarizes anticipated traffic operations with the proposed change in lane geometry on the northbound approach and resulting adjustment to signal phasing.

Proposed Changes & Analysis

The design team at Westwood has proposed shifting the left-turn lane into the proposed median in order to provide exclusive dual left-turns lanes, a through lane, and right-turn lane based upon a comment received from City of Aurora staff on a recent ISP submittal. With the proposed lane configuration, operational benefits are expected, due to the north-south movements not requiring the traffic signal to run split phasing as required with the previous lane assignment.

The proposed lane geometry and change in signal phasing was analyzed using Synchro traffic analysis software. Under Future Total (2040) traffic conditions with proposed lane geometry and phasing changes, the intersection of 56th Street with Denali Boulevard is anticipated to operate at LOS C during the AM and LOS D during the PM peak periods. With the proposed changes, the intersection LOS would be unchanged to the previous lane geometry and phasing. However, the anticipated delay and LOS is expected to improve for several of the intersection movements. **Table 1** provides a summary and comparison of the anticipated delay and LOS for each movement between the previous lane geometry and the recommended lane geometry under Future (2040) traffic conditions.

The 95th percentile queue lengths were also reviewed at the intersection for the proposed lane geometry and compared with the previous recommendation for Future Total (2040) traffic conditions. **Table 2** summarizes the findings propose lane changes. These dimensions represent the storage space necessary to meet the 95th percentile maximum queue during either the AM or PM peak hour. Methodologies noted in the *Windler Homestead TIS* for storage length recommendations were used for this analysis.

Table 1. Delay & LOS Movement Summary and Comparison

Location	Critical Movements	Previous Lane Geometry		Recommended Lane Geometry	
		Delay (sec) (AM / PM)	Level of Service (AM / PM)	Delay (sec) (AM / PM)	Level of Service (AM / PM)
56 th Street & Denali Boulevard (#3)	NB Left-turn	51.1 / 53.3	D / D	49.8 / 50.8	D / D
	NB Through	50.4 / 53.4	D / D	35.3 / 45.5	D / D
	NB Right-turn	3.5 / 3.6	A / A	3.2 / 4.9	A / A
	EB Left-turn	28.7 / 24.5	C / C	25.1 / 18.8	C / B
	EB Through	28.5 / 25.8	C / C	25.7 / 19.9	C / B
	EB Right-turn	1.3 / 2.7	A / A	1.3 / 2.6	A / A
	WB Left-turn	42.6 / 51.6	D / D	42.6 / 51.6	D / D
	WB Through ⁺	16.1 / 15.8	B / B	14.5 / 11.3	B / B
	SB Left-turn	58.7 / 59.3	E / E	32.3 / 38.1	C / D
	SB Through	52.6 / 52.0	D / D	55.2 / 55.2	E / E
	SB Right-turn	1.1 / 3.2	A / A	1.6 / 2.2	A / A
Total		28.0 / 37.5	C / D	26.3 / 35.8	C / D

Table 2. Turn Lane Storage & 95th Percentile Queue Lengths

Location	Critical Movements	95% Queue Length (ft) (AM/PM Peak)		Recommended Storage Length	SHAC Recommended
		Previous Lane Geometry	Recommended Lane Geometry		
56 th Street & Denali Boulevard (#3)	NB Left-turn	311 / 255	257 / 211	275 feet	550 feet
	NB Through	307 / 256	46 / 23	Continuous	Continuous
	NB Right-turn	54 / 44	42 / 36	Continuous	Continuous
	EB Left-turn	61 / 29	56 / 28	75 feet	75 feet
	EB Through	300 / 312	277 / 296	Continuous	Continuous
	EB Right-turn	20 / 46	20 / 46	150 feet	875 feet
	WB Left-turn	m151 / m193	m151 / m193	200 feet	550 feet
	WB Through ⁺	169 / 317	162 / 260	Continuous	Continuous
	SB Left-turn	51 / 58	34 / 41	50 feet	50 feet
	SB Through	17 / 17	7 / 17	Continuous	Continuous
	SB Right-turn	0 / 8	0 / 0	50 feet	75 feet
⁺ shared lane # - 95 th percentile volume exceeds capacity; queues may be longer m – volume for 95 th percentile queue is metered by upstream signal					

Based on the queue analysis conducted, the change in lane geometry and phasing is anticipated to reduce the queuing at the intersection. Specifically, the northbound left-turn movement is expected to decrease from 311-feet to 257-feet and the northbound through queue would reduce from 307-feet to 46-feet during the AM peak hour.

Summary and Recommendations

A change to the lane geometry for the northbound approach was proposed at the intersection of 56th Street with Denali Boulevard from the previously recommended left-turn lane, shared left-turn/through lane, and right-turn lane assignments. The proposed change would shift the left-turn lane into the proposed median in order to provide exclusive dual left-turns lanes, a through lane, and right-turn lane. The change in lane assignment and geometry was analyzed under the Future (2040) traffic conditions. Based on the analysis conducted, it was determined that the change would improve traffic operations by reducing queuing and allow for non-split signal phasing to be used for the north-south movements. Additionally, the anticipated LOS at the intersection would not be affected with the lane change, however delay is expected to reduce for several movements at the intersection.

Appendix

- A. Previous Geometry Synchro LOS Worksheets
- B. Proposed Geometry Synchro LOS Worksheets

APPENDIX C

Trip Generation Worksheets

Project Revolve at Windler
 Subject Trip Generation for Multifamily Housing (Low-Rise)
 Designed by TES Date January 05, 2023 Job No. 196140008
 Checked by _____ Date _____ Sheet No. _____ of _____

TRIP GENERATION MANUAL TECHNIQUES

ITE Trip Generation Manual 11th Edition, Average Rate Equations

Land Use Code - Multifamily Housing (Low-Rise) (220)

Independent Variable - Dwelling Units (X)

$$X = 201$$

T = Average Vehicle Trip Ends

Peak Hour of Adjacent Street Traffic, One Hour Between 7 and 9 a.m. (200 Series Page 255)

Average Weekday	Directional Distribution:	24% ent.	76% exit.
(T) = 0.40 (X)	T = 80	Average Vehicle Trip Ends	
(T) = 0.40 * (201.0)	19 entering	61 exiting	
	19 + 61 = 80		

Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m. (200 Series Page 256)









Average Weekday	Directional Distribution:	63% ent.	37% exit.
(T) = 0.51 (X)	T = 103	Average Vehicle Trip Ends	
(T) = 0.51 * (201.0)	65 entering	38 exiting	
	65 + 38 = 103		

Weekday (200 Series Page 254)

Average Weekday	Directional Distribution:	50% entering, 50% exiting
(T) = 6.74 (X)	T = 1356	Average Vehicle Trip Ends
(T) = 6.74 * (201.0)	678 entering	678 exiting
	678 + 678 = 1356	

APPENDIX D









Intersection Analysis Worksheets

Intersection												
Int Delay, s/veh	3.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	50	320	17	1	226	50	55	0	5	50	0	50
Future Vol, veh/h	50	320	17	1	226	50	55	0	5	50	0	50
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	150	-	150	150	-	150	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	54	348	18	1	246	54	60	0	5	54	0	54

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	300	0	0	366	0	0	758	758	348	716	722	246
Stage 1	-	-	-	-	-	-	456	456	-	248	248	-
Stage 2	-	-	-	-	-	-	302	302	-	468	474	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1261	-	-	1193	-	-	324	336	695	345	353	793
Stage 1	-	-	-	-	-	-	584	568	-	756	701	-
Stage 2	-	-	-	-	-	-	707	664	-	575	558	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1261	-	-	1193	-	-	292	321	695	331	337	793
Mov Cap-2 Maneuver	-	-	-	-	-	-	292	321	-	331	337	-
Stage 1	-	-	-	-	-	-	559	544	-	723	700	-
Stage 2	-	-	-	-	-	-	658	663	-	546	534	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	1			0			19.9			15		
HCM LOS							C			C		

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	307	1261	-	-	1193	-	-	467
HCM Lane V/C Ratio	0.212	0.043	-	-	0.001	-	-	0.233
HCM Control Delay (s)	19.9	8	-	-	8	-	-	15
HCM Lane LOS	C	A	-	-	A	-	-	C
HCM 95th %tile Q(veh)	0.8	0.1	-	-	0	-	-	0.9

Intersection												
Int Delay, s/veh	3.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	50	230	59	5	361	50	34	0	1	50	0	50
Future Vol, veh/h	50	230	59	5	361	50	34	0	1	50	0	50
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	150	-	150	150	-	150	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	54	250	64	5	392	54	37	0	1	54	0	54























Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	446	0	0	314	0	0	814	814	250	793	824	392
Stage 1	-	-	-	-	-	-	358	358	-	402	402	-
Stage 2	-	-	-	-	-	-	456	456	-	391	422	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1114	-	-	1246	-	-	297	312	789	306	308	657
Stage 1	-	-	-	-	-	-	660	628	-	625	600	-
Stage 2	-	-	-	-	-	-	584	568	-	633	588	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1114	-	-	1246	-	-	262	296	789	293	292	657
Mov Cap-2 Maneuver	-	-	-	-	-	-	262	296	-	293	292	-
Stage 1	-	-	-	-	-	-	628	598	-	595	598	-
Stage 2	-	-	-	-	-	-	534	566	-	601	560	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s	1.2			0.1			20.7			17.1		
HCM LOS							C			C		

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	267	1114	-	-	1246	-	-	405
HCM Lane V/C Ratio	0.142	0.049	-	-	0.004	-	-	0.268
HCM Control Delay (s)	20.7	8.4	-	-	7.9	-	-	17.1
HCM Lane LOS	C	A	-	-	A	-	-	C
HCM 95th %tile Q(veh)	0.5	0.2	-	-	0	-	-	1.1

Timings
1: Denali St & 56th Ave

2040 Total AM
12/21/2023

											
Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											
Traffic Volume (vph)	50	905	378	315	835	357	30	325	25	5	40
Future Volume (vph)	50	905	378	315	835	357	30	325	25	5	40
Turn Type	pm+pt	NA	pm+ov	Prot	NA	Prot	NA	pm+ov	pm+pt	NA	Perm
Protected Phases	7	4	5	3	8	5	2	3	1	6	
Permitted Phases	4		4					2	6		6
Detector Phase	7	4	5	3	8	5	2	3	1	6	6
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	11.0	11.0	11.0	11.0	27.2	11.0	11.0	11.0	11.0
Total Split (s)	13.0	47.0	30.0	31.0	65.0	30.0	29.0	31.0	13.0	12.0	12.0
Total Split (%)	10.8%	39.2%	25.0%	25.8%	54.2%	25.0%	24.2%	25.8%	10.8%	10.0%	10.0%
Yellow Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lead	Lag	Lead	Lead	Lead	Lag	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Max	None	None	C-Max	None	Max	None	None	None	None
Act Effect Green (s)	59.1	52.6	79.6	17.5	65.9	21.0	24.1	44.0	8.6	7.2	7.2
Actuated g/C Ratio	0.49	0.44	0.66	0.15	0.55	0.18	0.20	0.37	0.07	0.06	0.06
v/c Ratio	0.16	0.44	0.35	0.68	0.34	0.65	0.09	0.55	0.21	0.05	0.16
Control Delay	12.5	25.7	3.2	52.1	14.8	51.5	40.4	18.9	56.7	54.2	1.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.5	25.7	3.2	52.1	14.8	51.5	40.4	18.9	56.7	54.2	1.2
LOS	B	C	A	D	B	D	D	B	E	D	A
Approach Delay		18.8			24.7		36.2			24.7	
Approach LOS		B			C		D			C	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBT, Start of Green

Natural Cycle: 75

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.68

Intersection Signal Delay: 24.8

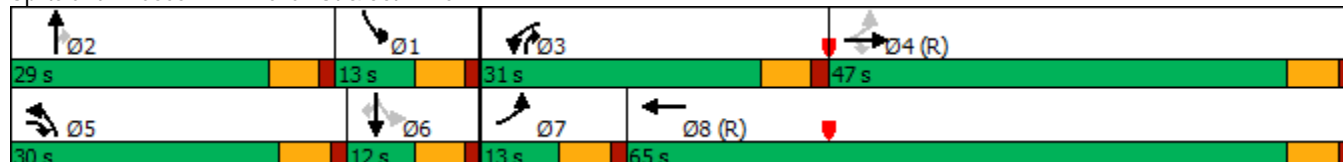
Intersection LOS: C

Intersection Capacity Utilization 58.3%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 1: Denali St & 56th Ave

































HCM 6th Signalized Intersection Summary

2040 Total AM

1: Denali St & 56th Ave





























12/21/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  		 	  		 				 	
Traffic Volume (veh/h)	50	905	378	315	835	30	357	30	325	25	5	40
Future Volume (veh/h)	50	905	378	315	835	30	357	30	325	25	5	40
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	54	984	411	342	908	33	388	33	353	27	5	43
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	399	2374	950	410	2776	101	464	358	492	105	154	130
Arrive On Green	0.03	0.46	0.46	0.24	1.00	1.00	0.13	0.19	0.19	0.02	0.08	0.08
Sat Flow, veh/h	1781	5106	1585	3456	5058	184	3456	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	54	984	411	342	611	330	388	33	353	27	5	43
Grp Sat Flow(s),veh/h/ln	1781	1702	1585	1728	1702	1837	1728	1870	1585	1781	1870	1585
Q Serve(g_s), s	1.9	15.3	16.8	11.3	0.0	0.0	13.1	1.7	17.7	0.0	0.3	3.1
Cycle Q Clear(g_c), s	1.9	15.3	16.8	11.3	0.0	0.0	13.1	1.7	17.7	0.0	0.3	3.1
Prop In Lane	1.00		1.00	1.00		0.10	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	399	2374	950	410	1868	1008	464	358	492	105	154	130
V/C Ratio(X)	0.14	0.41	0.43	0.83	0.33	0.33	0.84	0.09	0.72	0.26	0.03	0.33
Avail Cap(c_a), veh/h	441	2374	950	720	1868	1008	691	358	492	165	154	130
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	15.5	21.3	13.0	44.6	0.0	0.0	50.7	39.9	20.9	57.1	50.7	51.9
Incr Delay (d2), s/veh	0.2	0.5	1.4	4.5	0.5	0.9	5.8	0.5	8.7	1.3	0.1	1.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.8	6.2	6.2	4.5	0.1	0.2	6.1	0.9	7.7	0.8	0.1	1.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	15.6	21.8	14.5	49.1	0.5	0.9	56.4	40.4	29.6	58.3	50.8	53.4
LnGrp LOS	B	C	B	D	A	A	E	D	C	E	D	D
Approach Vol, veh/h		1449			1283			774			75	
Approach Delay, s/veh		19.5			13.5			43.5			55.0	
Approach LOS		B			B			D			E	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	9.0	29.0	20.2	61.8	22.1	15.9	10.2	71.9				
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0				
Max Green Setting (Gmax), s	7.0	23.0	25.0	41.0	24.0	6.0	7.0	59.0				
Max Q Clear Time (g_c+I1), s	2.0	19.7	13.3	18.8	15.1	5.1	3.9	2.0				
Green Ext Time (p_c), s	0.0	0.5	0.9	9.2	1.0	0.0	0.0	7.8				
Intersection Summary												
HCM 6th Ctrl Delay				23.3								
HCM 6th LOS				C								

Timings
1: Denali St & 56th Ave

2040 Total PM

12/21/2023

											
Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  		 	  	 					
Traffic Volume (vph)	20	1010	604	340	1130	416	10	200	30	5	50
Future Volume (vph)	20	1010	604	340	1130	416	10	200	30	5	50
Turn Type	pm+pt	NA	pm+ov	Prot	NA	Prot	NA	pm+ov	pm+pt	NA	pm+ov
Protected Phases	7	4	5	3	8	5	2	3	1	6	7
Permitted Phases	4		4					2	6		6
Detector Phase	7	4	5	3	8	5	2	3	1	6	7
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	11.0	11.0	11.0	11.0	11.0	27.2	11.0	11.0	11.0	11.0
Total Split (s)	11.0	44.0	39.0	26.0	59.0	39.0	39.0	26.0	11.0	11.0	11.0
Total Split (%)	9.2%	36.7%	32.5%	21.7%	49.2%	32.5%	32.5%	21.7%	9.2%	9.2%	9.2%
Yellow Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lead	Lag	Lead	Lead	Lead	Lag	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	C-Max	None	None	C-Max	None	Max	None	None	None	None
Act Effect Green (s)	50.1	44.9	87.5	17.5	59.5	36.7	33.0	52.9	5.0	6.3	8.2
Actuated g/C Ratio	0.42	0.37	0.73	0.15	0.50	0.31	0.28	0.44	0.04	0.05	0.07
v/c Ratio	0.10	0.58	0.53	0.74	0.49	0.43	0.02	0.29	0.45	0.05	0.23
Control Delay	15.9	32.8	6.3	48.3	23.8	35.1	32.0	10.0	75.7	54.2	2.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.9	32.8	6.3	48.3	23.8	35.1	32.0	10.0	75.7	54.2	2.3
LOS	B	C	A	D	C	D	C	B	E	D	A
Approach Delay		22.8			29.4		27.0			31.4	
Approach LOS		C			C		C			C	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 4:EBTL and 8:WBT, Start of Green

Natural Cycle: 80

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.74

Intersection Signal Delay: 26.2

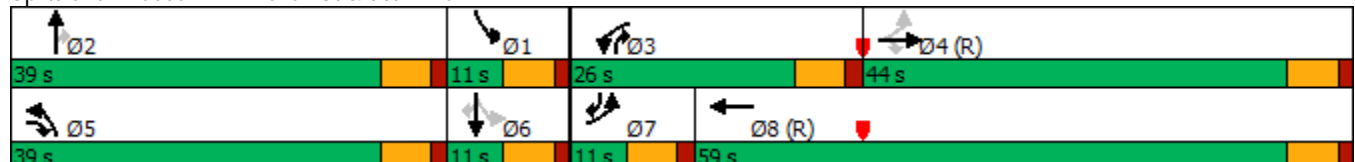
Intersection LOS: C

Intersection Capacity Utilization 66.3%

ICU Level of Service C

Analysis Period (min) 15

Splits and Phases: 1: Denali St & 56th Ave



































HCM 6th Signalized Intersection Summary




2040 Total PM

1: Denali St & 56th Ave

12/21/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		  		 	  		 					
Traffic Volume (veh/h)	20	1010	604	340	1130	10	416	10	200	30	5	50
Future Volume (veh/h)	20	1010	604	340	1130	10	416	10	200	30	5	50
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	22	1098	657	370	1228	11	452	11	217	33	5	54
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	266	1902	838	431	2482	22	539	514	633	170	275	267
Arrive On Green	0.02	0.37	0.37	0.25	0.95	0.95	0.16	0.28	0.28	0.03	0.15	0.15
Sat Flow, veh/h	1781	5106	1585	3456	5219	47	3456	1870	1585	1781	1870	1585
Grp Volume(v), veh/h	22	1098	657	370	801	438	452	11	217	33	5	54
Grp Sat Flow(s),veh/h/ln	1781	1702	1585	1728	1702	1862	1728	1870	1585	1781	1870	1585
Q Serve(g_s), s	0.9	20.6	40.0	12.3	2.6	2.6	15.2	0.5	8.0	0.0	0.3	3.5
Cycle Q Clear(g_c), s	0.9	20.6	40.0	12.3	2.6	2.6	15.2	0.5	8.0	0.0	0.3	3.5
Prop In Lane	1.00		1.00	1.00		0.03	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	266	1902	838	431	1619	885	539	514	633	170	275	267
V/C Ratio(X)	0.08	0.58	0.78	0.86	0.49	0.49	0.84	0.02	0.34	0.19	0.02	0.20
Avail Cap(c_a), veh/h	302	1902	838	576	1619	885	950	514	633	195	275	267
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	22.3	30.1	22.8	44.0	1.6	1.6	49.2	31.7	12.8	52.3	43.8	43.0
Incr Delay (d2), s/veh	0.1	1.3	7.3	9.7	1.1	2.0	3.6	0.1	1.5	0.6	0.0	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.4	8.6	16.1	5.2	0.8	1.1	6.8	0.2	3.1	1.0	0.1	1.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	22.4	31.4	30.0	53.7	2.7	3.6	52.7	31.8	14.3	52.8	43.8	43.3
LnGrp LOS	C	C	C	D	A	A	D	C	B	D	D	D
Approach Vol, veh/h		1777			1609			680			92	
Approach Delay, s/veh		30.8			14.7			40.1			46.8	
Approach LOS		C			B			D			D	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	9.3	39.0	21.0	50.7	24.7	23.6	8.6	63.1				
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0				
Max Green Setting (Gmax), s	5.0	33.0	20.0	38.0	33.0	5.0	5.0	53.0				
Max Q Clear Time (g_c+I1), s	2.0	10.0	14.3	42.0	17.2	5.5	2.9	4.6				
Green Ext Time (p_c), s	0.0	0.7	0.7	0.0	1.5	0.0	0.0	11.5				
Intersection Summary												
HCM 6th Ctrl Delay			26.4									
HCM 6th LOS			C									
Notes												
User approved volume balancing among the lanes for turning movement.												

Intersection						
Int Delay, s/veh	0.2					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	375	1	2	277	5	6
Future Vol, veh/h	375	1	2	277	5	6
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	408	1	2	301	5	7
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	409	0	714	409
Stage 1	-	-	-	-	409	-
Stage 2	-	-	-	-	305	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1150	-	398	642
Stage 1	-	-	-	-	671	-
Stage 2	-	-	-	-	748	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1150	-	397	642
Mov Cap-2 Maneuver	-	-	-	-	397	-
Stage 1	-	-	-	-	671	-
Stage 2	-	-	-	-	747	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0.1		12.4	
HCM LOS					B	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	501	-	-	1150	-	
HCM Lane V/C Ratio	0.024	-	-	0.002	-	
HCM Control Delay (s)	12.4	-	-	8.1	0	
HCM Lane LOS	B	-	-	A	A	
HCM 95th %tile Q(veh)	0.1	-	-	0	-	

Intersection						
Int Delay, s/veh	0.1					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	281	5	7	416	1	4
Future Vol, veh/h	281	5	7	416	1	4
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	305	5	8	452	1	4
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	310	0	776	308
Stage 1	-	-	-	-	308	-
Stage 2	-	-	-	-	468	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1250	-	366	732
Stage 1	-	-	-	-	745	-
Stage 2	-	-	-	-	630	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1250	-	363	732
Mov Cap-2 Maneuver	-	-	-	-	363	-
Stage 1	-	-	-	-	745	-
Stage 2	-	-	-	-	624	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0.1		11	
HCM LOS					B	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	608	-	-	1250	-	
HCM Lane V/C Ratio	0.009	-	-	0.006	-	
HCM Control Delay (s)	11	-	-	7.9	0	
HCM Lane LOS	B	-	-	A	A	
HCM 95th %tile Q(veh)	0	-	-	0	-	

Intersection						
Int Delay, s/veh	0.4					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑		↱	↑↑↑	↱	↱
Traffic Vol, veh/h	1205	35	15	1120	45	19
Future Vol, veh/h	1205	35	15	1120	45	19
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	100
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1310	38	16	1217	49	21
Major/Minor	Major1	Major2		Minor1		
Conflicting Flow All	0	0	1348	0	1848	674
Stage 1	-	-	-	-	1329	-
Stage 2	-	-	-	-	519	-
Critical Hdwy	-	-	5.34	-	5.74	7.14
Critical Hdwy Stg 1	-	-	-	-	6.64	-
Critical Hdwy Stg 2	-	-	-	-	6.04	-
Follow-up Hdwy	-	-	3.12	-	3.82	3.92
Pot Cap-1 Maneuver	-	-	792	-	*407	*646
Stage 1	-	-	-	-	*663	-
Stage 2	-	-	-	-	*685	-
Platoon blocked, %	-	-	1	-	1	1
Mov Cap-1 Maneuver	-	-	792	-	*399	*646
Mov Cap-2 Maneuver	-	-	-	-	*487	-
Stage 1	-	-	-	-	*663	-
Stage 2	-	-	-	-	*672	-
Approach	EB	WB		NB		
HCM Control Delay, s	0	0.1		12.5		
HCM LOS	B					
Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	487	646	-	-	792	-
HCM Lane V/C Ratio	0.1	0.032	-	-	0.021	-
HCM Control Delay (s)	13.2	10.8	-	-	9.6	-
HCM Lane LOS	B	B	-	-	A	-
HCM 95th %tile Q(veh)	0.3	0.1	-	-	0.1	-
Notes						
~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon						

Intersection

Int Delay, s/veh 0.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑↑		↖	↑↑↑	↖	↖
Traffic Vol, veh/h	1310	80	30	1475	45	20
Future Vol, veh/h	1310	80	30	1475	45	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	150	-	0	100
Veh in Median Storage, #	0	-	-	0	1	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1424	87	33	1603	49	22

Major/Minor	Major1	Major2	Minor1
Conflicting Flow All	0	0	1511
Stage 1	-	-	-
Stage 2	-	-	-
Critical Hdwy	-	-	5.34
Critical Hdwy Stg 1	-	-	-
Critical Hdwy Stg 2	-	-	-
Follow-up Hdwy	-	-	3.12
Pot Cap-1 Maneuver	-	-	*757
Stage 1	-	-	-
Stage 2	-	-	-
Platoon blocked, %	-	-	1
Mov Cap-1 Maneuver	-	-	*757
Mov Cap-2 Maneuver	-	-	-
Stage 1	-	-	-
Stage 2	-	-	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	14.1
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	396	602	-	-	* 757	-
HCM Lane V/C Ratio	0.124	0.036	-	-	0.043	-
HCM Control Delay (s)	15.4	11.2	-	-	10	-
HCM Lane LOS	C	B	-	-	A	-
HCM 95th %tile Q(veh)	0.4	0.1	-	-	0.1	-

Notes


























~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Timings

3: Harvest Rd & 56th Ave

2040 Total AM

05/17/2023

										
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	 		 		 			 	
Traffic Volume (vph)	595	509	200	645	150	840	100	130	400	360
Future Volume (vph)	595	509	200	645	150	840	100	130	400	360
Turn Type	Prot	NA	pm+pt	NA	pm+pt	NA	pm+ov	pm+pt	NA	Perm
Protected Phases	7	4	3	8	5	2	3	1	6	
Permitted Phases			8		2		2	6		6
Detector Phase	7	4	3	8	5	2	3	1	6	6
Switch Phase										
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	37.4	11.0	37.4	11.0	37.4	11.0	11.0	37.4	37.4
Total Split (s)	37.4	40.0	25.0	27.6	16.4	36.0	25.0	19.0	38.6	38.6
Total Split (%)	31.2%	33.3%	20.8%	23.0%	13.7%	30.0%	20.8%	15.8%	32.2%	32.2%
Yellow Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lead	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	C-Max	None	None	C-Max	C-Max
Act Effect Green (s)	27.4	22.6	48.0	21.6	35.4	35.4	61.8	36.6	36.6	36.6
Actuated g/C Ratio	0.23	0.19	0.40	0.18	0.30	0.30	0.52	0.30	0.30	0.30
v/c Ratio	0.83	0.71	0.48	1.03	0.47	0.88	0.12	0.61	0.40	0.52
Control Delay	65.9	37.9	37.0	82.5	43.8	51.7	1.1	44.3	35.2	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	65.9	37.9	37.0	82.5	43.8	51.7	1.1	44.3	35.2	6.1
LOS	E	D	D	F	D	D	A	D	D	A
Approach Delay		51.4		74.1		46.0			24.7	
Approach LOS		D		E		D			C	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 110

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 1.03

Intersection Signal Delay: 50.2

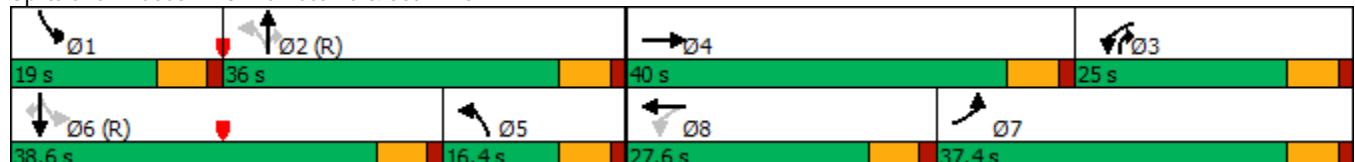
Intersection LOS: D

Intersection Capacity Utilization 85.2%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 3: Harvest Rd & 56th Ave
































HCM 6th Signalized Intersection Summary

2040 Total AM

3: Harvest Rd & 56th Ave

05/17/2023




























												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  			  			 			 	
Traffic Volume (veh/h)	595	509	130	200	645	240	150	840	100	130	400	360
Future Volume (veh/h)	595	509	130	200	645	240	150	840	100	130	400	360
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	647	553	76	217	701	98	163	913	44	141	435	228
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	743	773	105	491	793	110	401	1165	868	206	965	431
Arrive On Green	0.07	0.06	0.06	0.22	0.17	0.17	0.14	0.33	0.33	0.08	0.27	0.27
Sat Flow, veh/h	3456	4548	616	1781	4533	628	1781	3554	1585	1781	3554	1585
Grp Volume(v), veh/h	647	412	217	217	525	274	163	913	44	141	435	228
Grp Sat Flow(s),veh/h/ln	1728	1702	1759	1781	1702	1757	1781	1777	1585	1781	1777	1585
Q Serve(g_s), s	22.2	14.3	14.6	5.4	18.0	18.3	0.0	27.9	0.5	7.9	12.2	14.7
Cycle Q Clear(g_c), s	22.2	14.3	14.6	5.4	18.0	18.3	0.0	27.9	0.5	7.9	12.2	14.7
Prop In Lane	1.00		0.35	1.00		0.36	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	743	579	299	491	595	307	401	1165	868	206	965	431
V/C Ratio(X)	0.87	0.71	0.73	0.44	0.88	0.89	0.41	0.78	0.05	0.68	0.45	0.53
Avail Cap(c_a), veh/h	904	964	499	491	613	316	401	1165	868	253	965	431
HCM Platoon Ratio	0.33	0.33	0.33	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	54.1	53.7	53.9	36.9	48.3	48.4	40.3	36.5	4.1	39.3	36.3	37.2
Incr Delay (d2), s/veh	7.9	1.6	3.3	0.6	13.8	25.3	0.7	5.3	0.1	5.5	1.5	4.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	11.2	6.7	7.2	5.3	8.8	10.2	4.3	12.9	0.2	3.8	5.5	6.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	62.0	55.4	57.2	37.5	62.1	73.7	40.9	41.8	4.2	44.8	37.8	41.8
LnGrp LOS	E	E	E	D	E	E	D	D	A	D	D	D
Approach Vol, veh/h		1276			1016			1120			804	
Approach Delay, s/veh		59.1			60.0			40.2			40.1	
Approach LOS		E			E			D			D	
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	15.9	45.3	32.4	26.4	22.6	38.6	31.8	27.0				
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0				
Max Green Setting (Gmax), s	13.0	30.0	19.0	34.0	10.4	32.6	31.4	21.6				
Max Q Clear Time (g_c+I1), s	9.9	29.9	7.4	16.6	2.0	16.7	24.2	20.3				
Green Ext Time (p_c), s	0.1	0.1	0.5	3.8	0.3	3.3	1.6	0.7				
Intersection Summary												
HCM 6th Ctrl Delay				50.7								
HCM 6th LOS				D								

Timings

3: Harvest Rd & 56th Ave

2040 Total PM

05/17/2023

										
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  		  		 			 	
Traffic Volume (vph)	580	465	255	670	230	845	275	220	710	635
Future Volume (vph)	580	465	255	670	230	845	275	220	710	635
Turn Type	Prot	NA	pm+pt	NA	pm+pt	NA	pm+ov	pm+pt	NA	Perm
Protected Phases	7	4	3	8	5	2	3	1	6	
Permitted Phases			8		2		2	6		6
Detector Phase	7	4	3	8	5	2	3	1	6	6
Switch Phase										
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Minimum Split (s)	11.0	19.0	11.0	19.0	11.0	37.4	11.0	11.0	37.4	37.4
Total Split (s)	31.0	32.0	27.0	28.0	23.0	38.0	27.0	23.0	38.0	38.0
Total Split (%)	25.8%	26.7%	22.5%	23.3%	19.2%	31.7%	22.5%	19.2%	31.7%	31.7%
Yellow Time (s)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
All-Red Time (s)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lead	Lead	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	None	None	None	None	C-Max	None	None	C-Max	C-Max
Act Effect Green (s)	24.4	24.0	44.4	22.0	33.5	33.5	55.9	32.6	32.6	32.6
Actuated g/C Ratio	0.20	0.20	0.37	0.18	0.28	0.28	0.47	0.27	0.27	0.27
v/c Ratio	0.90	0.79	0.71	0.95	0.73	0.93	0.38	0.80	0.80	0.92
Control Delay	76.6	38.8	50.8	65.9	57.4	59.0	8.4	57.5	48.4	34.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	76.6	38.8	50.8	65.9	57.4	59.0	8.4	57.5	48.4	34.6
LOS	E	D	D	E	E	E	A	E	D	C
Approach Delay		55.1		62.3		48.5			44.0	
Approach LOS		E		E		D			D	

Intersection Summary

Cycle Length: 120

Actuated Cycle Length: 120

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:SBTL, Start of Green

Natural Cycle: 100

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.95

Intersection Signal Delay: 51.6

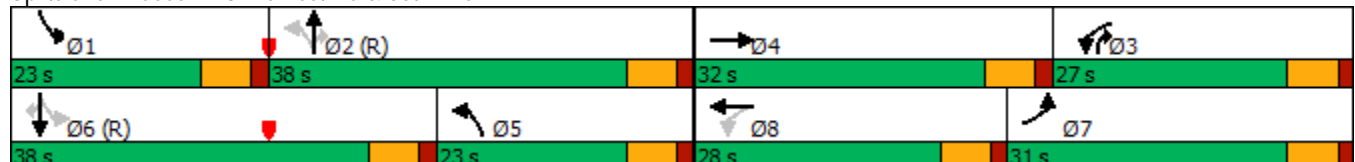
Intersection LOS: D

Intersection Capacity Utilization 88.3%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 3: Harvest Rd & 56th Ave
































HCM 6th Signalized Intersection Summary

3: Harvest Rd & 56th Ave

2040 Total PM

05/17/2023

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  			  			 			 	
Traffic Volume (veh/h)	580	465	300	255	670	145	230	845	275	220	710	635
Future Volume (veh/h)	580	465	300	255	670	145	230	845	275	220	710	635
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No			No			No		
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	630	505	163	277	728	82	250	918	299	239	772	364
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	694	665	208	456	826	92	360	1016	779	302	948	423
Arrive On Green	0.07	0.06	0.06	0.21	0.18	0.18	0.16	0.29	0.29	0.14	0.27	0.27
Sat Flow, veh/h	3456	3852	1206	1781	4660	521	1781	3554	1585	1781	3554	1585
Grp Volume(v), veh/h	630	444	224	277	530	280	250	918	299	239	772	364
Grp Sat Flow(s),veh/h/ln	1728	1702	1653	1781	1702	1777	1781	1777	1585	1781	1777	1585
Q Serve(g_s), s	21.7	15.4	16.0	10.4	18.2	18.4	10.0	29.8	5.2	14.3	24.4	26.2
Cycle Q Clear(g_c), s	21.7	15.4	16.0	10.4	18.2	18.4	10.0	29.8	5.2	14.3	24.4	26.2
Prop In Lane	1.00		0.73	1.00		0.29	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	694	588	285	456	603	315	360	1016	779	302	948	423
V/C Ratio(X)	0.91	0.76	0.78	0.61	0.88	0.89	0.70	0.90	0.38	0.79	0.81	0.86
Avail Cap(c_a), veh/h	720	738	358	456	624	326	360	1016	779	312	948	423
HCM Platoon Ratio	0.33	0.33	0.33	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	54.9	54.1	54.4	40.1	48.1	48.2	45.1	41.2	6.2	41.3	41.2	41.9
Incr Delay (d2), s/veh	15.0	3.5	8.6	2.3	13.4	24.0	5.7	12.8	1.4	12.6	7.6	20.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	11.6	7.4	7.8	7.5	8.8	10.2	7.5	14.7	2.5	7.3	11.6	12.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	69.9	57.6	63.0	42.4	61.5	72.2	50.9	54.0	7.7	53.9	48.9	61.9
LnGrp LOS	E	E	E	D	E	E	D	D	A	D	D	E
Approach Vol, veh/h	1298			1087			1467			1375		
Approach Delay, s/veh	64.5			59.4			44.0			53.2		
Approach LOS	E			E			D			D		
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	22.3	40.3	30.7	26.7	24.6	38.0	30.1	27.3				
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0				
Max Green Setting (Gmax), s	17.0	32.0	21.0	26.0	17.0	32.0	25.0	22.0				
Max Q Clear Time (g_c+l1), s	16.3	31.8	12.4	18.0	12.0	28.2	23.7	20.4				
Green Ext Time (p_c), s	0.1	0.1	0.5	2.7	0.3	2.2	0.4	0.8				
Intersection Summary												
HCM 6th Ctrl Delay	54.7											
HCM 6th LOS	D											

Intersection												
Int Delay, s/veh	1											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↕	↕		↕	↕	
Traffic Vol, veh/h	25	5	15	9	4	37	15	665	10	18	660	20
Future Vol, veh/h	25	5	15	9	4	37	15	665	10	18	660	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	27	5	16	10	4	40	16	723	11	20	717	22

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	1164	1534	370	1162	1540	367	739	0	0	734	0	0
Stage 1	768	768	-	761	761	-	-	-	-	-	-	-
Stage 2	396	766	-	401	779	-	-	-	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-	2.22	-	-
Pot Cap-1 Maneuver	309	169	*815	*311	168	630	*1219	-	-	867	-	-
Stage 1	736	652	-	*364	412	-	-	-	-	-	-	-
Stage 2	601	410	-	*768	643	-	-	-	-	-	-	-
Platoon blocked, %	1	1	1	1	1	1	-	-	-	-	-	-
Mov Cap-1 Maneuver	278	163	*815	*292	162	630	*1219	-	-	867	-	-
Mov Cap-2 Maneuver	401	287	-	*319	293	-	-	-	-	-	-	-
Stage 1	726	637	-	*359	407	-	-	-	-	-	-	-
Stage 2	549	405	-	*729	628	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	13.8		13.1		0.2		0.2	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	* 1219	-	-	458	497	867	-
HCM Lane V/C Ratio	0.013	-	-	0.107	0.109	0.023	-
HCM Control Delay (s)	8	-	-	13.8	13.1	9.2	-
HCM Lane LOS	A	-	-	B	B	A	-
HCM 95th %tile Q(veh)	0	-	-	0.4	0.4	0.1	-

Notes												
-: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon												

Intersection												
Int Delay, s/veh	2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↙	↑↕		↙	↑↕	
Traffic Vol, veh/h	55	5	35	10	11	41	55	540	20	39	850	60
Future Vol, veh/h	55	5	35	10	11	41	55	540	20	39	850	60
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	150	-	-	150	-	-
Veh in Median Storage, #	-	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	60	5	38	11	12	45	60	587	22	42	924	65
Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	1461	1770	495	1267	1791	305	989	0	0	609	0	0
Stage 1	1041	1041	-	718	718	-	-	-	-	-	-	-
Stage 2	420	729	-	549	1073	-	-	-	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-	2.22	-	-
Pot Cap-1 Maneuver	208	127	*737	*333	121	691	1063	-	-	966	-	-
Stage 1	593	541	-	*386	431	-	-	-	-	-	-	-
Stage 2	581	426	-	*695	516	-	-	-	-	-	-	-
Platoon blocked, %	1	1	1	1	1	1	-	-	-	-	-	-
Mov Cap-1 Maneuver	173	114	*737	*288	109	691	1063	-	-	966	-	-
Mov Cap-2 Maneuver	307	244	-	*317	241	-	-	-	-	-	-	-
Stage 1	559	518	-	*364	407	-	-	-	-	-	-	-
Stage 2	498	402	-	*624	494	-	-	-	-	-	-	-
Approach	EB		WB		NB		SB					
HCM Control Delay, s	17.8		14.3		0.8		0.4					
HCM LOS	C		B									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR					
Capacity (veh/h)	1063	-	-	384	454	966	-	-				
HCM Lane V/C Ratio	0.056	-	-	0.269	0.148	0.044	-	-				
HCM Control Delay (s)	8.6	-	-	17.8	14.3	8.9	-	-				
HCM Lane LOS	A	-	-	C	B	A	-	-				
HCM 95th %tile Q(veh)	0.2	-	-	1.1	0.5	0.1	-	-				
Notes												
~: Volume exceeds capacity		\$: Delay exceeds 300s		+: Computation Not Defined					*: All major volume in platoon			

Intersection												
Int Delay, s/veh	4.9											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	22	20	13	4	2	19	2	23	2	2	42	3
Future Vol, veh/h	22	20	13	4	2	19	2	23	2	2	42	3
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	24	22	14	4	2	21	2	25	2	2	46	3
Major/Minor	Minor2		Minor1			Major1			Major2			
Conflicting Flow All	94	83	48	100	83	26	49	0	0	27	0	0
Stage 1	52	52	-	30	30	-	-	-	-	-	-	-
Stage 2	42	31	-	70	53	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	889	807	1021	881	807	1050	1558	-	-	1587	-	-
Stage 1	961	852	-	987	870	-	-	-	-	-	-	-
Stage 2	972	869	-	940	851	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	869	805	1021	849	805	1050	1558	-	-	1587	-	-
Mov Cap-2 Maneuver	869	805	-	849	805	-	-	-	-	-	-	-
Stage 1	960	851	-	986	869	-	-	-	-	-	-	-
Stage 2	950	868	-	902	850	-	-	-	-	-	-	-
Approach	EB		WB			NB			SB			
HCM Control Delay, s	9.4		8.7			0.5			0.3			
HCM LOS	A		A									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR					
Capacity (veh/h)	1558	-	-	874	988	1587	-	-				
HCM Lane V/C Ratio	0.001	-	-	0.068	0.028	0.001	-	-				
HCM Control Delay (s)	7.3	0	-	9.4	8.7	7.3	0	-				
HCM Lane LOS	A	A	-	A	A	A	A	-				
HCM 95th %tile Q(veh)	0	-	-	0.2	0.1	0	-	-				

Intersection												
Int Delay, s/veh	4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	15	14	9	7	34	14	1	36	3	3	73	27
Future Vol, veh/h	15	14	9	7	34	14	1	36	3	3	73	27
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	16	15	10	8	37	15	1	39	3	3	79	29

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	169	144	94	155	157	41	108	0	0	42	0	0
Stage 1	100	100	-	43	43	-	-	-	-	-	-	-
Stage 2	69	44	-	112	114	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	795	747	963	812	735	1030	1483	-	-	1567	-	-
Stage 1	906	812	-	971	859	-	-	-	-	-	-	-
Stage 2	941	858	-	893	801	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	751	745	963	789	733	1030	1483	-	-	1567	-	-
Mov Cap-2 Maneuver	751	745	-	789	733	-	-	-	-	-	-	-
Stage 1	905	810	-	970	858	-	-	-	-	-	-	-
Stage 2	886	857	-	866	799	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	9.8		9.9		0.2		0.2	
HCM LOS	A		A					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1483	-	-	790	799	1567	-
HCM Lane V/C Ratio	0.001	-	-	0.052	0.075	0.002	-
HCM Control Delay (s)	7.4	0	-	9.8	9.9	7.3	0
HCM Lane LOS	A	A	-	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.2	0.2	0	-

Intersection												
Int Delay, s/veh	2.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱		↰	↱	↰	↰↱	↱	↰	↰↱	↱
Traffic Vol, veh/h	15	0	9	15	0	190	10	885	90	125	585	15
Future Vol, veh/h	15	0	9	15	0	190	10	885	90	125	585	15
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	150	-	-	150	150	-	150	150	-	150
Veh in Median Storage, #	-	2	-	-	2	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	16	0	10	16	0	207	11	962	98	136	636	16

Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	1411	1990	318	1574	1908	481	652	0	0	1060	0	0
Stage 1	908	908	-	984	984	-	-	-	-	-	-	-
Stage 2	503	1082	-	590	924	-	-	-	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-	2.22	-	-
Pot Cap-1 Maneuver	165	71	*841	*116	82	531	*1258	-	-	653	-	-
Stage 1	527	513	-	*267	325	-	-	-	-	-	-	-
Stage 2	519	292	-	*793	502	-	-	-	-	-	-	-
Platoon blocked, %	1	1	1	1	1	1	-	-	-	-	-	-
Mov Cap-1 Maneuver	84	55	*841	*96	65	531	*1258	-	-	653	-	-
Mov Cap-2 Maneuver	166	140	-	*239	242	-	-	-	-	-	-	-
Stage 1	523	406	-	*265	322	-	-	-	-	-	-	-
Stage 2	314	289	-	*620	397	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	21.6		16.4		0.1		2.1	
HCM LOS	C		C					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	* 1258	-	-	166	841	239	531	653	-	-
HCM Lane V/C Ratio	0.009	-	-	0.098	0.012	0.068	0.389	0.208	-	-
HCM Control Delay (s)	7.9	-	-	29	9.3	21.2	16	12	-	-
HCM Lane LOS	A	-	-	D	A	C	C	B	-	-
HCM 95th %tile Q(veh)	0	-	-	0.3	0	0.2	1.8	0.8	-	-

Notes										
-: Volume exceeds capacity		\$: Delay exceeds 300s		+: Computation Not Defined			*: All major volume in platoon			

Intersection												
Int Delay, s/veh	2.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔		↔	↔	↔	↕	↔	↔	↕	↔
Traffic Vol, veh/h	10	0	10	15	0	160	20	1175	85	120	1110	35
Future Vol, veh/h	10	0	10	15	0	160	20	1175	85	120	1110	35
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	150	-	-	150	150	-	150	150	-	150
Veh in Median Storage, #	-	2	-	-	2	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	11	0	11	16	0	174	22	1277	92	130	1207	38

Major/Minor	Minor2		Minor1		Major1		Major2		Major2		Major2	
Conflicting Flow All	2150	2880	604	2185	2826	639	1245	0	0	1369	0	0
Stage 1	1467	1467	-	1321	1321	-	-	-	-	-	-	-
Stage 2	683	1413	-	864	1505	-	-	-	-	-	-	-
Critical Hdwy	7.54	6.54	6.94	7.54	6.54	6.94	4.14	-	-	4.14	-	-
Critical Hdwy Stg 1	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.54	5.54	-	6.54	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.52	4.02	3.32	3.52	4.02	3.32	2.22	-	-	2.22	-	-
Pot Cap-1 Maneuver	49	10	*607	*44	12	419	*907	-	-	497	-	-
Stage 1	403	386	-	*165	224	-	-	-	-	-	-	-
Stage 2	405	202	-	*572	361	-	-	-	-	-	-	-
Platoon blocked, %	1	1	1	1	1	1	-	-	-	-	-	-
Mov Cap-1 Maneuver	22	7	*607	*34	8	419	*907	-	-	497	-	-
Mov Cap-2 Maneuver	93	61	-	*143	148	-	-	-	-	-	-	-
Stage 1	394	285	-	*161	219	-	-	-	-	-	-	-
Stage 2	231	197	-	*415	266	-	-	-	-	-	-	-




Approach	EB	WB	NB	SB
HCM Control Delay, s	29.9	20.8	0.1	1.4
HCM LOS	D	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	* 907	-	-	93	607	143	419	497	-	-
HCM Lane V/C Ratio	0.024	-	-	0.117	0.018	0.114	0.415	0.262	-	-
HCM Control Delay (s)	9.1	-	-	48.8	11	33.4	19.6	14.8	-	-
HCM Lane LOS	A	-	-	E	B	D	C	B	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.4	0.1	0.4	2	1	-	-

Notes										
-: Volume exceeds capacity		\$: Delay exceeds 300s		+: Computation Not Defined		*: All major volume in platoon				

Intersection

Int Delay, s/veh 5.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	11	6	18	1	2	37
Future Vol, veh/h	11	6	18	1	2	37
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	12	7	20	1	2	40




Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	21	0	0 52 21
Stage 1	-	-	- 21 -
Stage 2	-	-	- 31 -
Critical Hdwy	4.12	-	- 6.42 6.22
Critical Hdwy Stg 1	-	-	- 5.42 -
Critical Hdwy Stg 2	-	-	- 5.42 -
Follow-up Hdwy	2.218	-	- 3.518 3.318
Pot Cap-1 Maneuver	1595	-	- 957 1056
Stage 1	-	-	- 1002 -
Stage 2	-	-	- 992 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1595	-	- 949 1056
Mov Cap-2 Maneuver	-	-	- 949 -
Stage 1	-	-	- 994 -
Stage 2	-	-	- 992 -

Approach	EB	WB	SB
HCM Control Delay, s	4.7	0	8.6
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1595	-	-	-	1050
HCM Lane V/C Ratio	0.007	-	-	-	0.04
HCM Control Delay (s)	7.3	0	-	-	8.6
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Intersection

Int Delay, s/veh 5.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	39	20	11	2	1	23
Future Vol, veh/h	39	20	11	2	1	23
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	42	22	12	2	1	25

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	14	0	0 119 13
Stage 1	-	-	- 13 -
Stage 2	-	-	- 106 -
Critical Hdwy	4.12	-	- 6.42 6.22
Critical Hdwy Stg 1	-	-	- 5.42 -
Critical Hdwy Stg 2	-	-	- 5.42 -
Follow-up Hdwy	2.218	-	- 3.518 3.318
Pot Cap-1 Maneuver	1604	-	- 877 1067
Stage 1	-	-	- 1010 -
Stage 2	-	-	- 918 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1604	-	- 853 1067
Mov Cap-2 Maneuver	-	-	- 853 -
Stage 1	-	-	- 983 -
Stage 2	-	-	- 918 -

Approach	EB	WB	SB
HCM Control Delay, s	4.8	0	8.5
HCM LOS			A




Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1604	-	-	-	1056
HCM Lane V/C Ratio	0.026	-	-	-	0.025
HCM Control Delay (s)	7.3	0	-	-	8.5
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0.1	-	-	-	0.1

Intersection												
Int Delay, s/veh	5.6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	10	16	8	3	15	2	5	0	29	5	0	31
Future Vol, veh/h	10	16	8	3	15	2	5	0	29	5	0	31
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	11	17	9	3	16	2	5	0	32	5	0	34
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	18	0	0	26	0	0	84	68	22	83	71	17
Stage 1	-	-	-	-	-	-	44	44	-	23	23	-
Stage 2	-	-	-	-	-	-	40	24	-	60	48	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1599	-	-	1588	-	-	903	823	1055	904	819	1062
Stage 1	-	-	-	-	-	-	970	858	-	995	876	-
Stage 2	-	-	-	-	-	-	975	875	-	951	855	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1599	-	-	1588	-	-	869	816	1055	871	812	1062
Mov Cap-2 Maneuver	-	-	-	-	-	-	869	816	-	871	812	-
Stage 1	-	-	-	-	-	-	963	852	-	988	874	-
Stage 2	-	-	-	-	-	-	942	873	-	916	849	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	2.1			1.1			8.7			8.6		
HCM LOS							A			A		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	1023	1599	-	-	1588	-	-	1031				
HCM Lane V/C Ratio	0.036	0.007	-	-	0.002	-	-	0.038				
HCM Control Delay (s)	8.7	7.3	0	-	7.3	0	-	8.6				
HCM Lane LOS	A	A	A	-	A	A	-	A				
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0.1				

Intersection												
Int Delay, s/veh	6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	33	16	15	42	19	6	22	0	28	3	0	19
Future Vol, veh/h	33	16	15	42	19	6	22	0	28	3	0	19
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	36	17	16	46	21	7	24	0	30	3	0	21
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	28	0	0	33	0	0	224	217	25	229	222	25
Stage 1	-	-	-	-	-	-	97	97	-	117	117	-
Stage 2	-	-	-	-	-	-	127	120	-	112	105	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1585	-	-	1579	-	-	732	681	1051	726	677	1051
Stage 1	-	-	-	-	-	-	910	815	-	888	799	-
Stage 2	-	-	-	-	-	-	877	796	-	893	808	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1585	-	-	1579	-	-	689	646	1051	677	642	1051
Mov Cap-2 Maneuver	-	-	-	-	-	-	689	646	-	677	642	-
Stage 1	-	-	-	-	-	-	889	796	-	868	775	-
Stage 2	-	-	-	-	-	-	834	772	-	847	789	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	3.8			4.6			9.5			8.8		
HCM LOS							A			A		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	854	1585	-	-	1579	-	-	977				
HCM Lane V/C Ratio	0.064	0.023	-	-	0.029	-	-	0.024				
HCM Control Delay (s)	9.5	7.3	0	-	7.3	0	-	8.8				
HCM Lane LOS	A	A	A	-	A	A	-	A				
HCM 95th %tile Q(veh)	0.2	0.1	-	-	0.1	-	-	0.1				

Intersection

Int Delay, s/veh 7.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	6	2	1	1	4	18
Future Vol, veh/h	6	2	1	1	4	18
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	7	2	1	1	4	20




Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	2	0	0 18 2
Stage 1	-	-	- 2 -
Stage 2	-	-	- 16 -
Critical Hdwy	4.12	-	- 6.42 6.22
Critical Hdwy Stg 1	-	-	- 5.42 -
Critical Hdwy Stg 2	-	-	- 5.42 -
Follow-up Hdwy	2.218	-	- 3.518 3.318
Pot Cap-1 Maneuver	1620	-	- 1000 1082
Stage 1	-	-	- 1021 -
Stage 2	-	-	- 1007 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1620	-	- 996 1082
Mov Cap-2 Maneuver	-	-	- 996 -
Stage 1	-	-	- 1017 -
Stage 2	-	-	- 1007 -

Approach	EB	WB	SB
HCM Control Delay, s	5.4	0	8.5
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1620	-	-	-	1065
HCM Lane V/C Ratio	0.004	-	-	-	0.022
HCM Control Delay (s)	7.2	0	-	-	8.5
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Intersection

Int Delay, s/veh 6.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	20	1	2	5	3	11
Future Vol, veh/h	20	1	2	5	3	11
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	22	1	2	5	3	12




Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	7	0	50
Stage 1	-	-	5
Stage 2	-	-	45
Critical Hdwy	4.12	-	6.42
Critical Hdwy Stg 1	-	-	5.42
Critical Hdwy Stg 2	-	-	5.42
Follow-up Hdwy	2.218	-	3.518
Pot Cap-1 Maneuver	1614	-	959
Stage 1	-	-	1018
Stage 2	-	-	977
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1614	-	946
Mov Cap-2 Maneuver	-	-	946
Stage 1	-	-	1004
Stage 2	-	-	977

Approach	EB	WB	SB
HCM Control Delay, s	6.9	0	8.5
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1614	-	-	-	1047
HCM Lane V/C Ratio	0.013	-	-	-	0.015
HCM Control Delay (s)	7.3	0	-	-	8.5
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0

Intersection

Int Delay, s/veh 3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	5	45	5	3	10	15
Future Vol, veh/h	5	45	5	3	10	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	5	49	5	3	11	16




Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	8	0	0 66 7
Stage 1	-	-	- 7 -
Stage 2	-	-	- 59 -
Critical Hdwy	4.12	-	- 6.42 6.22
Critical Hdwy Stg 1	-	-	- 5.42 -
Critical Hdwy Stg 2	-	-	- 5.42 -
Follow-up Hdwy	2.218	-	- 3.518 3.318
Pot Cap-1 Maneuver	1612	-	- 939 1075
Stage 1	-	-	- 1016 -
Stage 2	-	-	- 964 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1612	-	- 936 1075
Mov Cap-2 Maneuver	-	-	- 936 -
Stage 1	-	-	- 1013 -
Stage 2	-	-	- 964 -

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	8.6
HCM LOS			A

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1612	-	-	-	1015
HCM Lane V/C Ratio	0.003	-	-	-	0.027
HCM Control Delay (s)	7.2	0	-	-	8.6
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1

Intersection

Int Delay, s/veh 1.9

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	16	31	58	11	6	9
Future Vol, veh/h	16	31	58	11	6	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	17	34	63	12	7	10

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	75	0	0 137 69
Stage 1	-	-	- 69 -
Stage 2	-	-	- 68 -
Critical Hdwy	4.12	-	- 6.42 6.22
Critical Hdwy Stg 1	-	-	- 5.42 -
Critical Hdwy Stg 2	-	-	- 5.42 -
Follow-up Hdwy	2.218	-	- 3.518 3.318
Pot Cap-1 Maneuver	1524	-	- 856 994
Stage 1	-	-	- 954 -
Stage 2	-	-	- 955 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1524	-	- 847 994
Mov Cap-2 Maneuver	-	-	- 847 -
Stage 1	-	-	- 944 -
Stage 2	-	-	- 955 -

Approach	EB	WB	SB
HCM Control Delay, s	2.5	0	8.9
HCM LOS			A

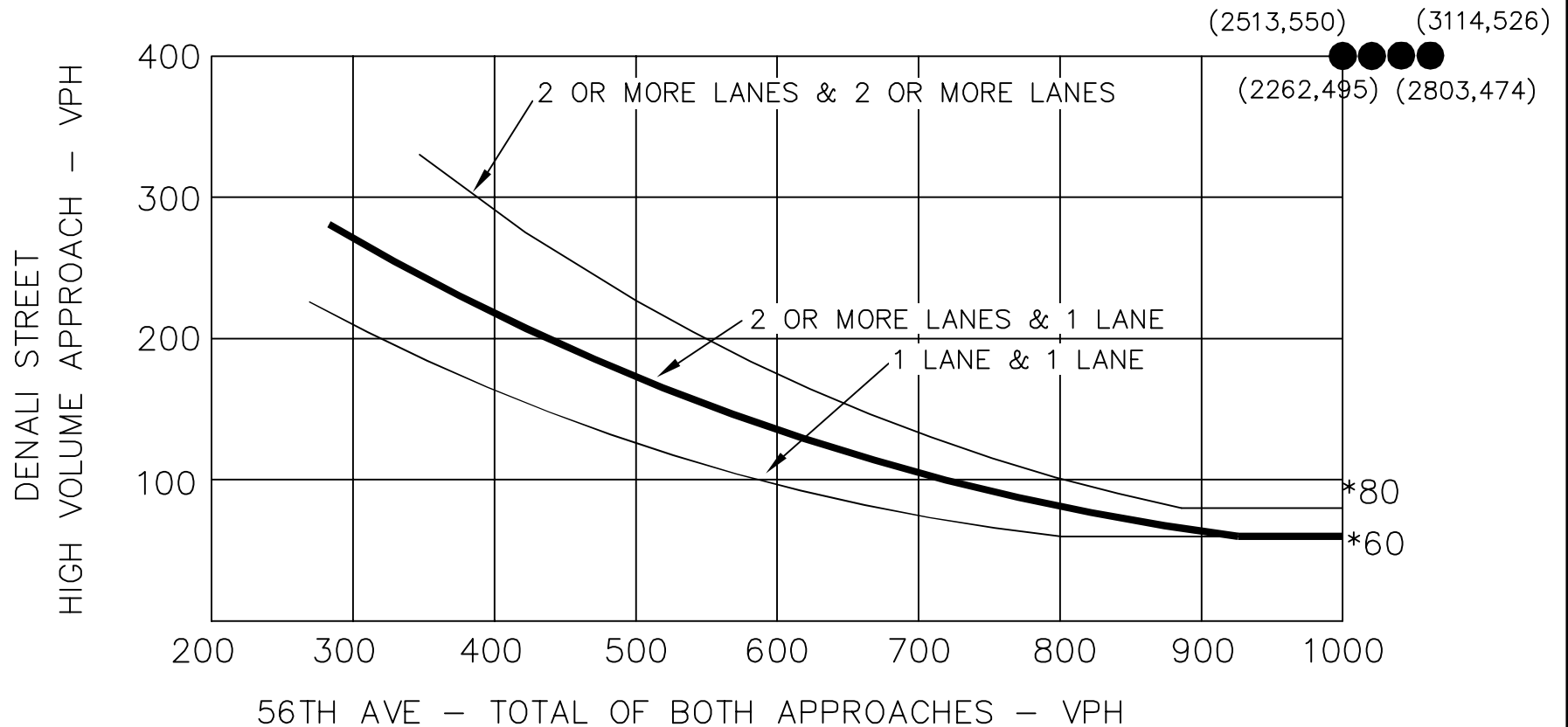
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1524	-	-	-	929
HCM Lane V/C Ratio	0.011	-	-	-	0.018
HCM Control Delay (s)	7.4	0	-	-	8.9
HCM Lane LOS	A	A	-	-	A
HCM 95th %tile Q(veh)	0	-	-	-	0.1

APPENDIX E

Signal Warrant Analysis Worksheets

WARRANT 2 - FOUR HOUR VEHICULAR VOLUME (70% FACTOR)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h (40 mph) ON MAJOR STREET)



* NOTE: 80 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACH WITH TWO OR MORE LANES AND 60 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACHING WITH ONE LANE.

56TH AVE & DENALI ST
SIGNAL WARRANT ANALYSIS
FOUR HOUR VOLUME WARRANT

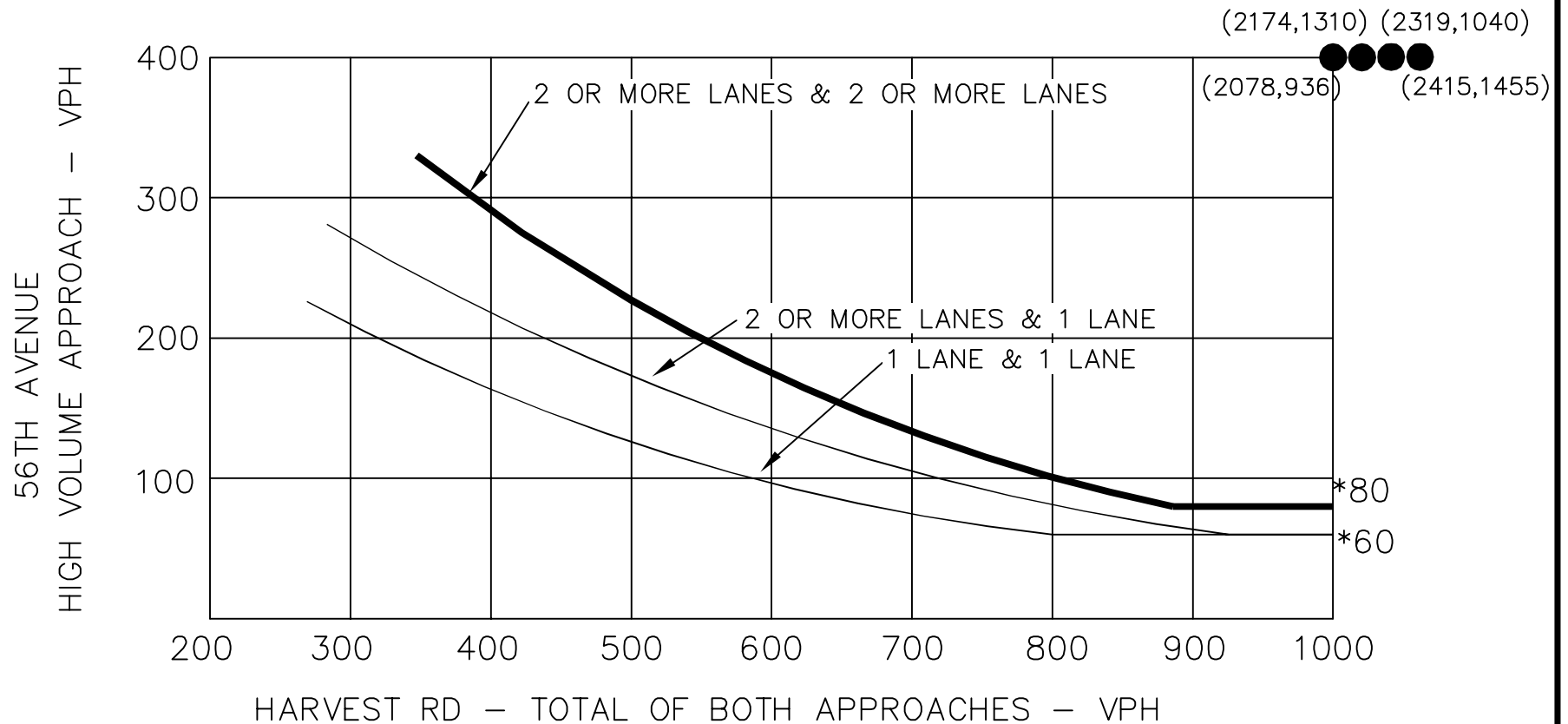
● 2040 TOTAL TRAFFIC DATA POINT WITH PROJECT

FIGURE 1

Source: Manual of Uniform Traffic Control Devices 2009

WARRANT 2 - FOUR HOUR VEHICULAR VOLUME (70% FACTOR)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h (40 mph) ON MAJOR STREET)



* NOTE: 80 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACH WITH TWO OR MORE LANES AND 60 VPH APPLIES AS THE LOWER THRESHOLD VOLUME FOR A MINOR STREET APPROACHING WITH ONE LANE.

56TH AVE & HARVEST RD
SIGNAL WARRANT ANALYSIS
FOUR HOUR VOLUME WARRANT

● 2040 TOTAL TRAFFIC DATA POINT WITH PROJECT

FIGURE 2

Source: Manual of Uniform Traffic Control Devices 2009

APPENDIX F

Queue Analysis Worksheets

Queues

2040 Total AM

1: Denali St & 56th Ave

12/21/2023



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	54	984	411	342	941	388	33	353	27	5	43
v/c Ratio	0.16	0.44	0.35	0.68	0.34	0.65	0.09	0.55	0.21	0.05	0.16
Control Delay	12.5	25.7	3.2	52.1	14.8	51.5	40.4	18.9	56.7	54.2	1.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.5	25.7	3.2	52.1	14.8	51.5	40.4	18.9	56.7	54.2	1.2
Queue Length 50th (ft)	16	202	25	104	213	147	21	121	20	4	0
Queue Length 95th (ft)	34	263	68	m97	m265	192	51	178	52	18	0
Internal Link Dist (ft)		1301			1255		655			300	
Turn Bay Length (ft)	150		650	275		250		100	100		100
Base Capacity (vph)	341	2228	1191	715	2781	686	373	733	138	114	276
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.44	0.35	0.48	0.34	0.57	0.09	0.48	0.20	0.04	0.16

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues
1: Denali St & 56th Ave

2040 Total PM

12/21/2023



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	22	1098	657	370	1239	452	11	217	33	5	54
v/c Ratio	0.10	0.58	0.53	0.74	0.49	0.43	0.02	0.29	0.45	0.05	0.23
Control Delay	15.9	32.8	6.3	48.3	23.8	35.1	32.0	10.0	75.7	54.2	2.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.9	32.8	6.3	48.3	23.8	35.1	32.0	10.0	75.7	54.2	2.3
Queue Length 50th (ft)	8	264	86	107	344	130	6	47	26	4	0
Queue Length 95th (ft)	21	323	268	m116	m377	211	21	85	#65	17	0
Internal Link Dist (ft)		1301			1255		655			300	
Turn Bay Length (ft)	150		650	275		250		100	100		100
Base Capacity (vph)	215	1900	1240	572	2517	1070	512	774	73	97	234
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.58	0.53	0.65	0.49	0.42	0.02	0.28	0.45	0.05	0.23

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues

2040 Total AM

3: Harvest Rd & 56th Ave

05/17/2023



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	647	694	217	962	163	913	109	141	435	391
v/c Ratio	0.83	0.71	0.48	1.03	0.47	0.88	0.12	0.61	0.40	0.52
Control Delay	65.9	37.9	37.0	82.5	43.8	51.7	1.1	44.3	35.2	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	65.9	37.9	37.0	82.5	43.8	51.7	1.1	44.3	35.2	6.1
Queue Length 50th (ft)	269	193	101	~275	100	360	0	83	141	0
Queue Length 95th (ft)	327	235	146	#368	170	#530	12	144	198	77
Internal Link Dist (ft)		1200		568		660			474	
Turn Bay Length (ft)	375		325		375		450	375		600
Base Capacity (vph)	898	1434	456	933	347	1043	880	251	1080	754
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.72	0.48	0.48	1.03	0.47	0.88	0.12	0.56	0.40	0.52

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Queues

2040 Total PM

3: Harvest Rd & 56th Ave

05/17/2023



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	630	831	277	886	250	918	299	239	772	690
v/c Ratio	0.90	0.79	0.71	0.95	0.73	0.93	0.38	0.80	0.80	0.92
Control Delay	76.6	38.8	50.8	65.9	57.4	59.0	8.4	57.5	48.4	34.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	76.6	38.8	50.8	65.9	57.4	59.0	8.4	57.5	48.4	34.6
Queue Length 50th (ft)	263	213	139	242	166	371	49	157	295	222
Queue Length 95th (ft)	#350	260	#268	#329	#269	#508	85	#253	372	#480
Internal Link Dist (ft)		1200		568		660			474	
Turn Bay Length (ft)	375		325		375		450	375		600
Base Capacity (vph)	715	1133	392	935	342	986	793	309	961	749
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.88	0.73	0.71	0.95	0.73	0.93	0.38	0.77	0.80	0.92

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

APPENDIX G

Conceptual Site Plan

